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“The Role of Theory in Development Economics”
June 2–3, 2014 Washington D.C.

Invited Papers
When Should Governments Subsidize Health? The Case of Mass Deworming
Amrita Ahuja, Sarah Baird, Joan Hamory Hicks, Michael Kremer,
Edward Miguel, and Shawn Powers

How Business Community Institutions Can Help Fight Corruption
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Why Haven’t Global Markets Reduced Inequality in Emerging Economies?
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Financial Crises, Development, and Growth: A Long-term Perspective
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Theories of Poverty Traps and Anti-Poverty Policies
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Shorter Papers on: Labor Contracts
The Political Economy of Trade Policy
Health Risks and Insurance
Technology, Incentives, and Firms
Causality and External Validity
Behavioral Economics
Migration

Editors Kaushik Basu and Andrew Foster

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THE WORLD BANK ECONOMIC REVIEW

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Editors’ Introduction

This volume contains the Papers and Proceedings of the 25th Annual Bank Conference on Development Economics (ABCDE) held June 2–3, 2014, at World Bank Headquarters in Washington, DC. The theme of the conference was “The Role of Theory in Development Economics.”

The 2014 ABCDE Organizing Committee was composed of Kaushik Basu (World Bank, Chair), Asli Demirgüç-Kunt and Indermit Gill (World Bank), Andrew Foster (Brown University), Garance Genicot (Georgetown University), and Yaw Nyarko (New York University). The committee chose the topics of the ABCDE sessions and selected the papers to be presented at those sessions. A call for papers appeared in the World Bank’s website and other academic outlets 6 months in advance of the conference. In this volume, a subset of the selected papers are being published, along with the keynote addresses of five well-known academics. Comments and discussions are not being published, but most of the comments, in the form of power point presentations, can be downloaded from the ABCDE website (worldbank.org/abcde2014).

The guidelines for choosing which papers would be published in the World Bank Economic Review (WBER) Papers and Proceedings issue differ from those for the regular issues of the WBER. First, the papers are edited but are not subject to the formal referee process that regular submissions to the WBER must pass, although papers can be rejected if after a thorough reading it is decided that they lack adequate merit. Second, the length of the paper is controlled. Third, papers are more exploratory and looser than formal articles on original research.

Finally, a great deal of teamwork was required to produce a volume of this size as part of the WBER series. The editors wish to thank the authors for their cooperation in meeting deadlines and all the other people who made this volume possible. In addition, we are deeply grateful to Claudia Sepulveda who supervised and organized the conference program.

Kaushik Basu
World Bank

Andrew Foster
Brown University
Development Economics and Method:
A Quarter Century of ABCDE

Kaushik Basu and Andrew Foster†

This, the twenty-fifth anniversary of the Annual Bank Conference on Development Economics (ABCDE) and also of the Washington Consensus, is a good time to take stock of development economics. What have we learned? What do we need to unlearn? What is the right methodology for development economics so that future knowledge is on firmer footing? These are important questions and this year’s ABCDE and this introduction is a stocktaking of where we stand on these questions. Development economics has come a long way from Adam Smith’s towering achievement in putting the discipline on a firm theoretical footing to some great strides in empirical methods in recent times. What we need to focus on now is the blending of analytics, statistics and intuition; and of using theory to integrate disparate empirical research. JEL codes: O1, B4, A11

Introduction

This is the first year of the Papers and Proceedings of the World Bank Economic Review (WBER). In early 2014, Andrew Foster took over as Editor of the WBER. In the same year, Kaushik Basu, as the Bank Chief Economist, presided over the Annual Bank Conference on Development Economics (ABCDE). A decision was taken that a selection of papers from this conference would be published, now on, as a special edition of the WBER, and for this the Chief Economist would join the editor of WBER to serve as joint editors of this special issue.

We are happy to announce on this occasion that from later this year, the WBER will be published in English and in Chinese (translation). Let us also use this opportunity to thank the outgoing editors, Elisabeth Sadoulet and Alain de Janvry, for their effort and persistence in establishing WBER as one of the world’s leading journal of development economics.


1. From 1989 to 1994, the ABCDE Proceedings used to come out as supplement to the World Bank Economic Review and the World Bank Research Observer. Thereafter, it was dissociated from the journals and used to be published as a book.
The year 2014 was special for the World Bank for two reasons. It was the 25th anniversary of the Annual Bank Conference on Development Economics (ABCDE), an initiative that was an unlikely venture when Stanley Fischer and Dennis de Tray (his Director of Research) launched it in 1989. The stated goals at the time were “to improve member country and World Bank policy making by enhancing the knowledge base,” and to “open up the Bank to outside ideas and problems, and if possible, to help shape the research agendas of those outside the Bank who were also thinking about development.” (Fischer 1998). One can read either humility or arrogance from these stated objectives: from the start, the Bank was modest enough to involve outsiders in its thinking, and leverage intellectual resources wherever available, but also keen to influence the global research agenda on development.

That same year (1989), a World Bank Regional Chief Economist, who would later become well known, John Williamson, summarized under the label ‘Washington Consensus’ views that were supposedly held in the policy-making circles of Washington. In an interview in 2000, Joseph Stiglitz pointed out that those were views held not quite in Washington, but in Washington “between 15th Street and 19th Street” (Stiglitz 2000).

It was the end of the 1980s, a difficult decade for developing countries—especially those in Latin America and Sub-Saharan Africa. There had been a debt crisis in Latin America, a decline of GDP per capita in Sub-Saharan Africa, and the Berlin Wall was about to fall. While the East Asian miracle was in full swing, it is understandable that the focus of the dominant themes of policy discussions in Washington was on the need for macroeconomic stabilization and structural reforms. Unfortunately, and contrary to Williamson’s original intent, the Washington Consensus became synonymous with market fundamentalism.

At the 10th anniversary of the ABCDE, held in Washington on April 20–21, 1998, the then World Bank President Jim Wolfensohn noted the general belief that the Washington Consensus needed to be expanded and broadened.

We are pleased that, 25 years on, we have a special ABCDE, and also some serious stock-taking of the Washington Consensus. The world economy has changed dramatically since 1989, and the big issues on the global agenda have evolved too. Over the years, the ABCDE has covered many themes in economics, from transition in socialist economies, the economics of military expenditures, and urbanization, to institutions, geography, and entrepreneurship. This year’s conference, which was organized by Kaushik Basu, was on the role of economic theory in development economics. The idea was to use the occasion to do a stock-taking on the method and the role of analytics in development economics.

The World Bank Economic Review was launched in 1986, three years before the first ABCDE, and has anticipated and accompanied these intellectual changes and pursued investigation into similar topics all along. Its stated goal has always been to encourage and support research in the field of development economics.
It is now one of the world’s most widely read scholarly development economics journals.

Contrary to some other journals supported by development institutions, the WBER accepts submissions from inside and outside the World Bank and they are subject to the same refereeing process and quality standards. And it has been our policy not to interfere with the scientific independence of the published papers. Hence, there may well be views expressed in the pages of the journal that are contrary to the views of the World Bank Group.

**On the Role of Theory in Development Economics**

There are prodigious writings nowadays, in newspaper columns, on web journals, and popular magazines, offering quick solutions to our problems. Reading these it is easy for the professional economist to feel quite inadequate. How come these people have so much to say and such clear solutions to offer when experts find themselves in a dilemma about these matters—how to cut unemployment, how to control exchange rate fluctuations, how to stop inflation? At such times, we have to derive consolation from Thomas Mann’s observation that writing is much harder for the writer than others. We may translate this to mean economics is harder for the serious economist than others.

Economics is what it is today because of the staggering intellectual breakthroughs, starting with Adam Smith in the second half of the 18th century, and all the way till now, with some towering achievements along the way such as Cournot’s seminal work in 1838, Herman Heinrich Gossen’s book in 1854—this would remain undiscovered during his life time, and the magical last decades of the 19th century with major works by Walras, Jevons, Pareto, and Marshall to name just a few. The march continued through the 20th century with seminal research published by Keynes, Samuelson, Hicks, Von Neumann, Myrdal, Arrow, Debreu, and others. Let us leave it at that because to move to more recent times is to make enemies by naming, or more correctly, not naming.

It is a fact of life that the greatest research in history, be it physics, mathematics, or economics, did not happen because of the researcher’s urge to help society. The best research, for good or for bad, came from the innate human desire to discover patterns in the chaos of statistics and data or the passion for deductive reasoning that enabled people to expend huge amounts of energy and concentration to uncover connections between seemingly disparate facts. This pursuit has benefited society greatly, but the benefit occurred as a byproduct of this thirst for aesthetics. We wish the world was different, but it is not. The good policy maker respects this and devises ways to tap into this energy source in order to enhance social welfare and human well-being. The flowing river may not have an interest in generating electricity. But the river’s zest to flow can be tapped to create electricity and well-being.

While all the early pioneers were drawing on facts and knowledge of the world, most of the facts were rudimentary, and impressionistic. The heart of
their work was theory. They tried to deductively explain different parts of the jigsaw puzzle of economic life. This is what has made economics the exciting discipline that it is today.

The excitement of theory was so great that there was a tendency to overdo it, to while away our time on ever-more abstruse mathematical constructions. The need for better statistical work, better data, and more systematic evidence was given short shrift. Fortunately, this has been changing over the past two or three decades; and we have seen a flurry of activity in empirical economics never witnessed before. This has played a transformative role in economics in general, but specifically in development economics. Simple regression analysis, the method of randomization, and the analysis of big data have been transforming development economics (Banerjee and Duflo 2009; Deaton 2010; Ray 2014; Varian 2014). This is truly welcome and has the potential to leave its mark on human well-being, growth, and development.

There is a risk, however, that this euphoria will once again have us carried away. We are seeing, especially in policy circles, these new empirical findings being quickly waved in front of our noses and treated as ground for doing whatever the policy maker wants to do. What is important to realize is that when we say that policy should be evidence-based, both words are important—“evidence” and “based.” We must not fall into the trap of evidence-waved policy. To see this mistake, consider the commonly heard policy refrain: “Recent data show 90% of jobs were created by the private sector. Therefore, we have to rely on the private sector for creating jobs.” The “therefore” is wrong. If it were not wrong, we would also have to go along with the Soviet economist who having studied Russian data in the 1980s wrote: “Recent data show 90% of all jobs were created by the state. Therefore, we have to rely on the state for creating jobs.”

This is why we need the discipline of deductive reasoning, economic theory, and also common sense. Krugman (1995) had explained the marginalization of development economics for many decades by the methodological choice made by many early development economists to reject the drive toward rigor, to ignore the pressures to produce mathematically founded analyses, and adopt instead a loose verbose style in the name of pragmatism.

There are two reasons why we have to avoid the pitfall of only-theory or only-empirics. Since in today’s world the latter is the present and imminent danger, let us concentrate on this. There are many truths that are discovered much more efficiently and convincingly by deductive reasoning, even though we may be able to close in on them empirically as well. We are referring here to logically unfalsifiable claims and tautologies that are so interesting and not obvious that their discovery is well worth the pursuit. Take, for instance, Pythagoras’ theorem on right-angled triangles. If we insisted that all research had to be rooted in data and statistics, we may have forced Pythagoras to collect actual right-angled triangles and do elaborate measurements. He may have inched toward the same conclusion, but there would be many criticisms; there would be the demurrers pointing out that his right-angled triangles were drawn from the
Mediterranean region, that too disproportionately from the island of Samos, and from Croton in Southern Italy, and as such not a random draw from all available triangles in the world. Is there any guarantee, they would argue, that this would hold true of right-angled triangles in the arctic or the Southern hemisphere? What about the right-angled triangles of tomorrow? Those were not part of the population from which his sample was drawn.

The magic of deduction, be it Pythagoras’s theorem or Arrow’s impossibility theorem, is that it cuts through all those criticisms in one fell swoop. In making this statement we are aware that by this method we would not be able to get to truths that cannot be deduced but must be inferred by induction. Knowledge that has to be acquired by induction can never be established beyond any doubt, but it still plays a very important role. That an apple suspended in mid-air will fall down is something that even a child “knows,” but this knowledge is nothing but induction, based on witnessing thousands of objects suspended in mid-air falling, and our intuition, which suggests this will continue to happen.

One of us has recently argued (Basu 2014) that intuition and common sense are not skills that we can dismiss out of hand. They are probably rooted in human evolution. Species that intuited wrongly—believing, for instance, that apples suspended in mid-air will remain there—have perished. And for this reason our intuition must be respected and even treated as an ingredient in scientific inquiry and in the design of policy. What we need is a blend of theory, empirical investigation, and reasoned intuition to get to knowledge and policy.

Theory also plays a critical role in integrating disparate empirical research. For example, in recent years there has a emerged a substantial body of research on the process of learning about new technologies (e.g., Foster and Rosenzweig 2010). Absent theory one has a series of isolated studies on the efficacy of learning on an array of different specific technologies—high yielding variety seeds, contraception, deworming medication, management strategies, clean water, and bed nets—that seem to yield different conclusions. Theory helps us organize these results and understand why the processes of adoption may vary. It points to particular aspects of the technologies and the social structures in which they are embedded and thus permits not only more convincing inference in a particular setting but also provides guidance with respect to untested technologies for which learning subsides may lead to especially high social returns. Moreover, theory allows us a way to provide microfoundations for broader concepts such as the excludability and rivalry of technology that play a role in macrolevel studies of growth and development and in a way provided motivation for this line of microbased work in the first place.

The recent rise in the use of randomization in development economics has greatly enhanced our knowledge. But in that enthusiasm, claims have been made on causality that don’t stand up to scrutiny. This is not the occasion to go into the details of this, but we can demonstrate the serious nature of the problem with an illustration. Suppose researchers come to your village, draw a random sample of inhabitants, and establish that the injection of a green liquid into the arm...
enhances IQ and has no adverse side effect. Will you trust that result and agree to be injected with this? To show the difficulty, let me fill in some details. Suppose this village is actually Eden, populated mainly by snakes and other weird creatures and may be just one more person like you, called Adam. In other words, the random draw on which the experiment was done was mainly snakes. You will have good reason to consider this experiment largely irrelevant for you.

Suppose you hear from a neighboring village, called Washington, where a biased trial was done using the same injection and where half the creatures injected died. But the creatures in Washington all happen to be human. You would be much more likely to trust that result despite its bias and be even more convinced that the proper random experiment done on your own population is less relevant to you than the biased study in a neighboring village. What you just used is intuition and a little bit of deduction based on this intuition.

This is a long and hotly debated subject. Let us leave it here by observing that to get to usable policy, we need to combine good statistical methods with theory and reasoned intuition. None of these three ingredients is dispensable. The two-day colloquium, under the banner of the ABCDE, saw a remarkable blend of papers focused on theory and empirical methods. There were five invited papers and a host of submitted papers from which a small selection was invited for presentation at the conference. This issue of the journal presents a synoptic view of the conference.

Acknowledgements

Before closing, we have to admit that this conference would not have been possible without a huge amount of support. Let us first thank the ABCDE Organizing Committee of this year: Asli Demirgüç-Kunt, Andrew Foster, Garance Genicot, Yaw Nyarko, and Indermit Gill. Indermit, as Director of the Development Policy Department, played an important role beyond this Committee, throughout the process of planning this conference. We are also grateful to Celestin Monga for assisting us in multiple ways.

There has been a lot of help in planning logistics and doing the publicity. For this we would like to specially mention Merrell Tuck-Primdahl, Leita Jones, Roula Yazigi, Swati Mishra, Gytis Kanchas, Nacer Magherbi, Jean-Pierre Djomialieu, Vamsee Kanchi, and DECRG staff. Finally, we want to say a special word for Claudia Sepulveda, who played a critical role, from discussing the intellectual content of the conference to looking into and organizing every detail of the event.

References


INVITED PAPERS
When Should Governments Subsidize Health?
The Case of Mass Deworming

Amrita Ahuja, Sarah Baird, Joan Hamory Hicks, Michael Kremer, Edward Miguel, and Shawn Powers

We discuss how evidence and theory can be combined to provide insight on the appropriate subsidy level for health products, focusing on the specific case of deworming. Although intestinal worm infections can be treated using safe, low-cost drugs, some have challenged the view that mass school-based deworming should be a policy priority. We review well-identified research which both uses experimental or quasi-experimental methods to demonstrate causal relationships and adequately accounts for epidemiological externalities from deworming treatment, including studies of deworming campaigns in the Southern United States, Kenya, and Uganda. The existing evidence shows consistent positive impacts on school participation in the short run and on academic test scores, employment, and income in the long run, while suggesting that most parents will not pay for deworming treatment that is not fully subsidized. There is also evidence for a fiscal externality through higher future tax revenue, which may exceed the cost of the program. Our analysis suggests that the economic benefits of school-based deworming programs are likely to exceed their costs in places where worm infestations are endemic. This would likely be the case even if the benefits were only a fraction of estimates in the existing literature. JEL codes: H2, H51, I1, I12, I15, I2, I20, I25, I3, O1

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I. INTRODUCTION

Moving from empirical evidence to policy judgments requires the implicit or explicit use of theory, both in order to assess the relevance of evidence on existing policy and to make normative judgments. For example, randomized trials have established that take-up of mosquito nets, water treatment products, and deworming pills are very sensitive to price in particular contexts. Theory is needed to make reasonable inferences about price sensitivity of demand for the same goods in other contexts, let alone for other health goods. Kremer and Glennerster (2011), for example, argue that price sensitivity is often the case for goods used to prevent disease or treat nonacute disease. Even if one is willing to make this generalization, however, determining whether subsidies are justified requires a normative analysis.

In this paper, we discuss how evidence and theory might be combined to provide insight on appropriate subsidies for the prevention and treatment of communicable diseases, focusing on the case of deworming. Intestinal worm infections are among the most widespread diseases globally, affecting over a billion people mainly in low income countries (Hotez et al. 2006). School-age children have particularly high infection rates and play an important role in spreading disease (Hotez et al. 2006). Infections can lead to malnutrition, listlessness, organ damage, and internal bleeding (de Silva et al. 2003; Crimmins and Finch 2005). Safe, low-cost drugs are available to treat intestinal worm infections and are the standard of medical care. In fact, because treatment is inexpensive and safe but diagnosis is relatively expensive, the World Health Organization (WHO) recommends periodic mass treatments in areas where worm infections are above certain thresholds. However, some have challenged this WHO policy, accepting that those who are known to be infected should be treated, but questioning whether the existing evidence base is strong enough to support mass treatment (Taylor-Robinson et al. 2012).

What evidence could one gather to shed light on the question of what public policy is appropriate? That may depend in part on one’s normative theoretical perspective, and one could imagine a range of such perspectives. For example:

(1) A strong libertarian view might be that families have different needs and that parents should decide how to spend resources themselves, so that it is inappropriate for the state to take their money in taxes and then decide to subsidize one particular type of expenditure over another.

(2) In a welfare economics/public finance approach, individuals are presumed to make decisions that maximize their own welfare, but government intervention may be justified in cases where individual actions create externalities for others. In particular, subsidies may be appropriate if use of the good creates positive externalities. This could include health externalities from reductions in the transmission of infectious disease, as well as fiscal
externalities if treatment of children increases their long-run earnings and tax payments.

(3) A third approach focuses on cost effectiveness in achieving policymaker goals (and need not assume that the policy maker’s goal is to maximize a weighted sum of household utilities). For example, policy makers may seek to achieve universal primary education (as in the Millennium Development Goals) or to maximize GNP growth subject to constraints, which in turn will lead them to undertake investments with high rates of return. The standard welfare economics/public finance approach assumes that consumers will maximize their own welfare, treats them as rational and informed, and abstracts from conflicts within the household (e.g., between parents and children). This cost effectiveness approach does not do that, but of course it potentially risks efficiently achieving goals that are not those of most citizens.

(4) From a human rights perspective, individuals might be seen as having a right to good health care. Under this approach, one might argue that children have a basic right to treatment for easily and cheaply treated medical conditions.

Note that under the first approach, there may not be any evidence that would make deworming subsidies appropriate, and under a strong enough form of the final perspective, subsidies for mass deworming might be appropriate under any evidence that does not challenge the medical appropriateness of deworming for infected individuals and its safety for those without infections. In this article we will review the evidence on deworming to try to shed light on what might be normatively appropriate under perspectives 2 through 4.

We will argue first that deworming is highly responsive to price. Second, we will review evidence showing that mass school-based deworming is a highly cost-effective educational investment and a high-return economic investment even in the absence of any other health benefits from deworming. We will discuss evidence suggesting that the epidemiological and fiscal externalities associated with deworming are large enough to support the WHO’s position advocating mass presumptive deworming treatment of children in endemic regions, even under a relatively restrictive welfare economics/public finance perspective. Finally, we will compare the costs associated with the two leading policy options in endemic areas, namely, mass treatment versus the screening and treatment of those found to be infected.

The rest of the article is structured as follows. Section 2 provides background information on worm infections, and describes the studies we draw upon to inform our argument. Section 3 summarizes evidence on the impact of price on take-up of deworming treatment. Section 4 reviews evidence on the educational and economic impacts of deworming treatment and discusses fiscal externalities. Section 5 compares the costs of mass treatment to the costs of screening and then treatment of the infected. Section 6 concludes.
II. BACKGROUND ON INTESTINAL WORMS

Roughly one in four people are infected with soil transmitted helminthes (STH) in endemic countries (Pullan et al. 2014), and a further 187 million individuals are infected with schistosomiasis, mostly in Africa (Hotez et al. 2006). These two types of worms follow different modes of disease transmission. STH (which include hookworm, whipworm, and roundworm) are transmitted via eggs deposited in the local environment when individuals defecate in their surroundings or do not practice proper hygiene after defecating, while the schistosomiasis parasite is spread through contact with infected fresh water. Due to their transmission mechanisms, school-aged children are especially vulnerable to these worm infections (Hotez et al. 2006).

The potential health consequences of worm infections are generally agreed to depend on the number of worms in the body, rather than a simple binary indicator of infection status, but there is no scientific consensus on the functional form of this relationship. Some have argued that treating worm infections once or twice per year can improve child appetite, growth, and physical fitness (Stephenson et al. 1993), and reduce anemia (Stoltzfus et al. 1997; Guyatt et al. 2001). Deworming may also strengthen the immunological response to other infections, such as malaria (Kirwan et al. 2010) and human immunodeficiency virus (HIV; Kjetland et al. 2006). Furthermore, chronic parasitic infections in childhood generate inflammatory (immune defense) responses and elevated cortisol levels that lead energy to be diverted from growth, and this may produce adverse health consequences throughout the life course, including organ damage, atherosclerosis, impaired intestinal transport of nutrients, and cardiovascular disease (Crimmins and Finch 2005).

Safe, low-cost drugs are available to treat worm infections and are the standard of medical care (Horton 2000; Keiser and Utzinger 2008; Perez et al. 2012). Because treatment is inexpensive and safe but diagnosis is relatively expensive (requiring lab analysis of a stool sample), the WHO recommends periodic mass school-based treatments in areas where worm infections are above certain thresholds (WHO 2014). Mass school-based deworming involves administering deworming drugs to all children at a school in an area where worms are endemic, without individual diagnosis. The Copenhagen Consensus, the Disease Control Priorities Project, Givewell, and the Abdul Latif Jameel Poverty Action Lab (J-PAL) have reviewed the evidence for, and comparative cost-effectiveness of, a wide range of development interventions and have consistently ranked deworming as a priority for investment.¹

Despite this recommendation, some have challenged the view that mass deworming of school-children should be a policy priority, contending that the evidence on mass treatment programs is of poor quality or inconclusive and is

therefore insufficient to justify these programs (Taylor-Robinson et al. 2012; Hawkes 2013), although they do not dispute that those known to be infected with worms should be treated.

By randomizing at the individual level, most studies on deworming in the public health literature fail to consider the potential for epidemiological externalities from treatment, where treatment can improve outcomes not only for the person treated but also others by reducing the chance of disease transmission (Bundy et al. 2009). The underlying biological mechanisms suggest that treating infected people can prevent them from spreading infection, and existing evidence suggests that such externalities can be substantial.

Bundy et al. (1990) examine a case in which all 2–15 year-olds on the island of Montserrat, West Indies, were treated with single dose albendazole four times over a 16-month period. At the end of the trial, the authors find substantial reductions in infection rates not only for the targeted individuals (where greater than 90% of the target population received treatment) but also for adults aged 16–25 (even though less than 4% received treatment), suggesting large positive epidemiological externalities.

More recently, Miguel and Kremer (2004) study a cluster-randomized school-based deworming program in rural western Kenya during 1998–1999, where students were treated with albendazole twice per year (and some schools were additionally treated with praziquantel once per year). The authors find large reductions in worm infection prevalence among treated individuals, untreated individuals attending treatment schools, and individuals in schools located near treatment schools. In particular, after just one year of treatment the authors estimate an 18 percentage point reduction in the proportion of moderate-to-heavy infections among untreated individuals attending treatment schools, and individuals in schools located near treatment schools. In particular, after just one year of treatment the authors estimate an 18 percentage point reduction in the proportion of moderate-to-heavy infections among untreated individuals attending treatment schools (P-value < .05), and a 22 percentage point reduction among individuals attending a school within 3 kilometers of a treatment school (P-value < .05) (Miguel and Kremer 2004).2

Ozier (2014) studies this same school-based deworming program in Kenya but focuses on children who were 0 to 2 years old when the program was launched and who lived in the catchment areas of the participating schools. These children were not directly treated themselves but could have benefited from the positive within-community externalities generated by mass school-based deworming. Ten years after the program, Ozier (2014) estimates average test score gains of 0.3 standard deviation units (P-value < .01). These children likely benefited primarily through reduced transmission of worm infections, and consistent with this hypothesis, the effects were twice as large among children with an older sibling in one of the schools that received the program.

2. Miguel and Kremer (2014) provide an updated analysis of the data in Miguel and Kremer (2004), correcting some errors in the original analysis. Throughout this paper we still cite Miguel and Kremer (2004), but use the updated numbers where appropriate.
Together, these three studies provide strong evidence for the existence of large, positive, and statistically significant deworming externality benefits within the communities that received mass treatment. Because of this, studies that are randomized at the individual level—rather than the cluster level, which provides geographic separation between treatment and control groups, thereby allowing for a study of treatment externalities—likely greatly underestimate the impacts of treatment.

In what follows, we consider findings from well-identified studies that investigate the effect of deworming on educational and economic outcomes. We consider a study to be well-identified if it both (1) uses experimental or quasi-experimental methods to demonstrate causal relationships and (2) incorporates a cluster design to take into account the potential for infectious disease externalities. In particular, we review evidence from three deworming campaigns in widely different times and contexts—one in the US South in the early 20th century and two in East Africa at the turn of the 21st century.

Bleakley (2007) analyzes the impact of hookworm eradication in the US South, exploiting a program launched by the nongovernmental Rockefeller Sanitary Commission in 1910. After detecting hookworm infection rates of 40% among school-aged children in the region, the Commission sponsored traveling dispensaries that administered treatment to infected individuals in affected areas and educated local physicians and the public about prevention. In their own follow-up analysis, the commission reports a 30 percentage point decrease in infection rates across the infected areas (Bleakley 2007).³ To assess the impact of this intervention on educational and economic outcomes, Bleakley (2007) uses quasi-experimental methods, comparing changes in counties with high baseline worm prevalence to changes in low baseline prevalence counties over the same period.

The second deworming campaign we discuss is an NGO-sponsored school-based treatment program which was phased into 75 schools in a rural district of western Kenya during 1998–2001. This area was characterized by high baseline helminth infection rates, at over 90% among school-children. The program entailed provision of deworming drugs to treat STH (twice per year) and schistosomiasis (once per year), as well as provision of educational materials on worm prevention. Due to administrative constraints of the NGO, schools were phased into the program in three groups, where each school was assigned to a group through list-randomization. The first group began deworming treatment in 1998, the second group in 1999, and the final group in 2001.

Several papers have explored various aspects of this Kenyan program. In what follows, we focus on the Miguel and Kremer (2004) paper mentioned above, which analyzes the short-run impact of the program on education and health outcomes, and Baird et al. (2014), which follows up with participants a decade

³. This measure includes the direct impact on the treated as well as indirect impacts accruing to the untreated population.
later to assess the long-run impact of the program. We also discuss Kremer and Miguel (2007), which studies the behavioral response to a change in the price of deworming treatment in this program.

The third campaign we consider was a program delivered by community-based organizations during 2000–2003 across 48 parishes in five districts in eastern Uganda. This program area was also characterized by high worm prevalence, with an infection rate of over 60% in children aged between five and ten years old (Kabatereine et al. 2001). Treatment was provided during “child health days,” in which parents were offered multiple health and nutrition interventions for children aged 1 to 7. Using a cluster-randomization approach, parishes were randomly assigned to receive either the standard intervention, which included Vitamin A supplementation, vaccines, growth monitoring and feeding demonstrations, or to receive deworming treatment in addition to the standard package (Croke 2014).

Alderman et al. (2006) explore the short-run impacts of this program on child health, and find that mass treatment led to improvements in child weight. Croke (2014) studies the longer term educational impacts on these children 7–8 years after the program. In particular, he exploits data on academic test scores that were collected as part of an unrelated set of national learning assessments by an NGO. These data exist for 22 of the 48 parishes in the original randomized study, of which 12 received the standard treatment and 10 received deworming in addition to the standard package.

III. IMPACT OF PRICING ON TAKE-UP

Before turning to the evidence on the educational and economic impacts of deworming, we first discuss evidence on the impact of pricing on take-up. Under standard welfare economics, the ratio of intramarginal to marginal consumers will be important in determining optimal tax and subsidy policy, since the fiscal costs of increasing subsidies are proportional to the number of inframarginal consumers, while the benefits of any positive epidemiological or fiscal externalities depend on the number of marginal consumers who will be induced to deworm by subsidies. Such considerations will also be important from a cost effectiveness perspective. From a human rights perspective, if parents are not willing to pay for treatment, then the larger society may have an obligation to make treatment free and convenient so children can be treated.

Kremer and Miguel (2007) study the behavioral response to a change in the price of deworming treatment in the context of the Kenyan school-based deworming program. The implementing NGO had a policy of using community cost-recovery in its projects to promote sustainability and confer project ownership on its beneficiaries. Thus, starting in 2001, a random subset of participating schools were allocated to pay user fees for the deworming treatment, with the average cost of deworming per child set at US$0.30 (about one-fifth of the cost of drug purchase and delivery through this program). The authors find that this
cost-sharing reduced take up by 80%, from 75% to 19%. This result is consistent with findings observed for other products for disease prevention and treatment of nonacute conditions such as bednets for malaria and water treatment.4

A more detailed examination of the data on the observed price elasticity of demand suggests that insights from behavioral economics may be important in explaining these results. Cost-sharing came in the form of a per-family fee, so that families with more children effectively faced a lower per-child price. Kremer and Miguel (2007) find no evidence that adoption is sensitive to these variations in positive price, despite the high sensitivity to there being a positive price at all.5 Moreover, the authors find that user fees did not help target treatment to the sickest students: students with moderate to heavy worm infections were not more likely to pay for the drugs in the cost-sharing schools. In standard models of human capital investment, people weigh the opportunity costs of an investment against the discounted value of returns (Becker 1993). Small fees should not make much difference unless people happen to be right at the margin of whether or not to make the investment. In fact, relatively small short-run costs (e.g., $0.30 per deworming pill) appear to generate large movements in adoption, consistent with models of time inconsistent preferences (Laibson 1997). To the extent that people are subject to behavioral biases, there may be a stronger rationale for policymakers basing decisions on deworming programs on their educational and economic cost-effectiveness rather than on conventional public finance criteria.

IV. EDUCATION AND LABOR MARKET IMPACTS OF DEWORMING

In this section we summarize the existing evidence on the impact of deworming on education and labor market outcomes. These direct benefits will help inform the cost-effectiveness perspective, while the fiscal externalities resulting from labor market impacts will be important from a welfare economics perspective. The combination of the findings that many parents will not purchase deworming medication for their children and that deworming affects children’s educational and economic outcomes raises concerns from the perspective of the human rights of the child. To the extent that governments are committed to ensuring that the rights of children are protected, there may be a stronger case for free mass deworming.

School Participation

Early work on the links between deworming and education focuses on simple correlations between worm infection levels and school participation, and finds a significant positive relationship between infection rates and school absenteeism.

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5. Other studies (e.g., Banerjee et al. 2010) also suggest that adoption of health interventions may be particularly sensitive to prices near zero.
(P < .001; Nokes and Bundy 1993). More recently, clustered evaluations have tried to carefully identify the causal effect of deworming on school participation, and avoid issues of confounding that may underlie simple correlations (Bundy, Walson, and Watkins 2013).6

In his difference-in-difference study of the US South, Bleakley (2007) finds that between 1910 and 1920 counties characterized by higher worm prevalence prior to the deworming campaign saw substantial increases in school enrollment, both in absolute terms and relative to areas with lower infection rates. The author estimates that a child infected with hookworm would have been 20 percentage points less likely to be enrolled in school than a noninfected child and was also 13 percentage points less likely to be literate. His estimates suggest that due to the deworming campaign, a county with a 1910 infection rate of 50% would experience an increase in school enrolment of 3–5 percentage points and an increase in attendance of 6–8 percentage points, relative to a county with no infection problem. Because his analysis is performed at the county (and state) level, these results encompass any within-county (state) externality effects but not spillovers across counties (states).

Since Bleakley (2007) is not randomized, one concern is that something other than deworming is driving the difference in outcomes detected for children. However, the finding remains significant when controlling for a number of potentially confounding factors, such as state-level policy changes during that period and the demographic composition of high- and low-worm load areas. In addition, Bleakley (2007) finds no significant differences in adult outcomes, including literacy and labor force participation, across counties with higher and lower prevalence over the period of the deworming campaign. Since adults had much lower infection rates and hence were unlikely to benefit as much from deworming, the lack of a difference in adult outcomes bolsters the case that deworming, and not something else, was driving the enrollment surge in areas that previously had high hookworm prevalence.

Miguel and Kremer (2004) also provide evidence on the impact of deworming on school participation through their cluster-randomized evaluation of the school-based deworming program in Busia, Kenya. The authors find substantially greater school participation in schools that had been assigned to receive deworming than in those that had not yet been phased in to the program.

6. There are also a number of early studies that assessed impacts on school attendance using individually randomized evaluations. For example, Watkins, Cruz, and Pollitt (1996) study deworming treatment of children aged 7–12 years in rural Guatemala and find no impact on school attendance. However, this study is not cluster randomized, thus limiting the ability to interpret the results. Furthermore, attendance in this study is measured through the use of school register data, which excludes any students who have dropped out during the study. Since dropping out is very likely correlated with treatment status, there is a high risk that this gives a biased picture of school participation over time. We might also be concerned about the potential for school officials to overstate attendance due to their awareness of the program and the data collection. Simeon et al. (1995) studies deworming treatment among Jamaican children aged 6–12, and also finds no impact on school attendance. However, this study is also randomized at the individual level.
Participation increased not only among treated children but also among untreated children in the treatment schools (e.g., girls of reproductive age, who at that time were not approved for mass drug administration) and among pupils in schools located near treatment schools. The total increase in school participation, including these externality benefits, was 8.5 percentage points (Miguel and Kremer 2004). As discussed in Dhaliwal et al. (2012), these results imply that deworming is one of the most cost-effective ways of increasing school participation.

**Academic Test Scores**

In their study of the Kenyan deworming program, Miguel and Kremer (2004) do not find effects on cognition or a short-run effect on academic test scores. However, the long-run follow-up evaluation of the same intervention (Baird et al. 2014) finds that among females, deworming increased the rate of passing the national primary school exit exam, by almost 25% (9.6 percentage points on a base of 40%). One hypothesis is that the children receiving treatment were too old for any potential gains in cognitive function but learned more simply through increased school participation.

In the long-run follow-up of the cluster-randomized Uganda deworming program, Croke (2014) analyzes the English, math, and combined test scores comparing treatment and control, as well as looking at whether the impact is greater for those who received multiple deworming treatments as compared those who were dewormed once. The study finds that children in treatment villages have significantly higher scores as compared to those in control villages, with effect sizes ranging from 0.15 to 0.36 standard deviations. Effect sizes also more than double for children who were dewormed more than once, but the difference in coefficients is only significant for math scores.\(^7\)

**Employment and Income**

Bleakley (2007) uses data from the 1940 US census to compare adult outcomes among birth cohorts who entered the labor force before and after the deworming campaign in the US South. Adults who had more “exposure” to deworming as children were significantly more likely to be literate and had higher earnings as adults. He finds a 43% increase in adult wages among those infected as children.

\(^7\) Since the 22 communities included in the Croke (2014) analysis were not randomly selected, although the original assignment was random, there may be concern that the results are driven by long-term differences in these communities as opposed to the deworming treatment. Croke (2014) addresses this issue by showing that the communities are similar on many variables related to adult outcomes (e.g., ownership of phones and televisions, access to water and electricity, and measures of female empowerment). To further support his econometric identification strategy, Croke (2014) also explores the pattern of test scores of all children tested in these parishes. The youngest children would have been too young to receive more than two rounds of deworming, while the oldest children, at age 16, would have never received the program. Thus, one would expect that if effects are truly from the deworming intervention, then the impacts would be lower at the two extremes and higher for children in the middle age group, which is what the study finds.
This effect is large enough to suggest that hookworm infections could have explained as much as 22% of the income gap between the US North and South at the time. Given initial infection rates of 30%–40%, hookworm eradication would therefore imply a long-run income gain of 17% (based on 43% increase in wages and a 40% infection rate) (Bleakley 2010).

Children who were treated for worms in Kenya also had better outcomes later in life. Baird et al. (2014) consider females and males separately, given the different set of family and labor market choices they face in this context (Pitt, Rosenzweig, and Hassan 2012). They find that Kenyan females who received more deworming treatment have higher school enrollment and are more likely to pass the national primary school exit exam. They are also more likely to grow cash crops and reallocate labor time from agriculture to entrepreneurship. Treated males work 3.5 more hours per week, spend more time in entrepreneurial activities, and are more likely to work in higher-wage manufacturing jobs.

The increases in earnings allow Baird et al. (2014) to compute an annualized internal rate of return (IRR) of 32%–52% to deworming, depending on whether health spillovers are included. This is high relative to other investments, implying deworming is cost effective on economic grounds, even without counting any health benefits.

Furthermore, because deworming increases labor supply, it creates a fiscal externality though its impact on tax revenue. In fact, Baird et al. (2014) estimate that the net present value (NPV) of increases in tax revenues greatly exceed the cost of the program. The fiscal externalities are thus sufficiently strong that a government could potentially reduce tax rates by instituting free mass deworming. Deworming thus easily satisfies the weaker conditions required for the benefit to exceed the costs to taxpayers.

V. THE COST OF MASS TREATMENT PROGRAMS VERSUS SCREENED TREATMENT

The WHO recommends mass treatment once or twice a year in regions where worm prevalence is above certain thresholds (WHO 2014). Screening followed by treatment of those testing positive for worms is far less practical and more costly than mass treatment of infected and uninfected children without diagnostic testing. From a practical perspective, screening programs are also logistically difficult, requiring collection of stool samples, and more than 20 minutes of health worker time per sample collected (Speich et al. 2010). For a national program like the current one in Kenya, this would result in the need for approximately 1,200 health workers focused full time on such testing each year.

Turning attention to costs, delivering deworming medicine for soil-transmitted helminths through school-based programs is estimated to cost approximately US$0.35 per child per round of treatment, including delivery costs (Givewell 2014). Diagnosis of worm infections, on the other hand, is far more expensive and complicated, requiring skilled staff. Taylor-Robinson et al. (2012) state that
screening for worm infections is not recommended by the WHO because the cost of screening is 4–10 times that of the treatment itself. Speich et al. (2010) estimate that the cost per child of testing via the Kato-Katz test, the most commonly used method for testing for worms in the field, is US$1.88 in 2013 dollars. Assuming that the test has a specificity of 100% (i.e., identifies 100% of infections) and that all the children who are screened are also present on the day that treatment is provided, the cost per infection treated would be more than six times higher with treatment following screening as compared to mass treatment without screening. Mass treatment is hence clearly preferred on cost-effectiveness and public finance grounds.

The numbers above, however, ultimately underestimate the cost of screening. First, tests for worms do not identify all infections. Estimates of the specificity for the Kato-Katz method range from about 91% to about 52% (Barda et al. 2013; Assefa et al. 2014). With a specificity of 52%, the cost per infection treated would be about 12 times higher for screened treatment as compared to mass treatment. Second, a large number of infections would remain untreated. The fact that screened treatment programs need to reach infected children a second time to treat them, and that it is unlikely they can reach each child who was tested, makes screening even less cost-effective and leaves even more infections untreated.

The vast majority of the 870 million children at risk of worm infections (Uniting to Combat Neglect Tropical Diseases 2014) could be treated each year via mass deworming programs at a cost of approximately 300 million dollars a year, which is feasible given current health budgets. The cost of treating them via screened programs would likely be closer to 2 billion dollars annually, if not higher.

VI. Conclusion

The WHO recommends mass treatment once or twice a year in regions where worm prevalence is above 20% and above 50%, respectively (WHO 2014). Deworming is currently being implemented as policy in many parts of the developing world, with recent estimates suggesting that 280 million children (out of 870 million in need) are treated for worms, many via school-based and community based integrated neglected tropical disease programs (Uniting to Combat Neglect Tropical Diseases 2014).

Our analysis suggests that the WHO recommendations are justified on human rights, welfare economics, and cost-effectiveness grounds. Of course, more evidence would be useful and some uncertainty remains. Although our conclusions

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8. Another screening approach could be to simply ask individuals if they have experienced any of the common side effects of worm infections. While cheaper and potentially useful in environments where stool testing is not practical, this screening method would likely be very imprecise.

9. While we believe that subsidizing deworming is worthwhile given currently available evidence, this should not be taken to imply that we see no role for additional studies generating further evidence to inform future decisions.
are based on evidence from two radically different contexts (East Africa at the turn of the 21st century and the US South at the turn of the 20th century), the impact of deworming will of course vary to some degree with the local context, including circumstances such as type of worm, worm prevalence and intensity, comorbidity, the extent of school participation in the community, and labor market factors.

The most commonly used deworming drugs—albendazole, mebendazole and praziquantel—have all been through clinical trials, have been approved for use by the appropriate regulatory bodies in multiple countries, and have shown to be efficacious against a variety of worm infections and also to have minimal side effects (Horton 2000; Fenwick et al. 2003; Keiser and Utzinger 2008; Perez del Villar et al. 2012). This means that the decision of whether to expend resources on deworming is one that can be made based on comparing expected benefits and costs, given the available evidence.

It is worth noting that deworming would be highly cost effective in many settings on educational and economic grounds alone, even if its benefits were to be only a fraction of those estimated in Kenya, Uganda, and the southern United States. Thus, policy makers would be warranted in moving ahead with deworming even if they thought its benefits were likely to be substantially smaller in their own context, or even if they had some uncertainty about whether benefits would be realized at all. In particular, even if the impact of deworming on school participation is only 1/10th of that estimated in Miguel and Kremer (2004), it would still be among the most highly cost effective ways of boosting school participation. Furthermore, labor market effects half as large as those estimated in Baird et al. (2014) would be sufficient for deworming to generate enough tax revenue to fully cover its costs.\footnote{Note that this estimate is conservative, only taking into account direct deworming benefits, and ignoring positive externality benefits.} A sophisticated welfare analysis would be explicitly Bayesian, taking into account policy makers’ priors and their assessment of their specific context, and we believe that under a Bayesian analysis that placed even modest weight on evidence discussed here, mass school-based deworming would be justified in areas with worm prevalence above the WHO cutoffs.

**Conflict of Interest**

In the interests of transparency around potential conflicts of interest, the authors note that the U.S. Agency for International Development (USAID) and the Douglas B. Marshall, Jr. Family Foundation support deworming. Kremer is the Scientific Director of Development Innovation Ventures at the U.S. Agency for International Development. Also, Ahuja is the chair of the board of Evidence Action, a nonprofit organization which supports governments in scaling mass
school-based deworming programs; this is a voluntary position with no associated remuneration. The content of this article is solely the responsibility of the authors, and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health & Human Development, the U.S. National Institutes of Health, USAID, the Douglas B. Marshall, Jr. Family Foundation, or Evidence Action.

REFERENCES


How Business Community Institutions Can Help Fight Corruption

Avinash K. Dixit

Collective action by the business community to counter corruption in the award of government licenses and contracts is analyzed, by analogy with contract enforcement institutions studied by economic historians and contract law scholars. The suggested anti-corruption institution comprises a no-bribery norm, a system to detect violations, and a multilateral ostracism penalty upon conviction in a tribunal. In combination with formal state law, a business institution of sufficient quality—probability of detection and severity of punishment—can eliminate corruption; a less good institution helps reduce it. The legal and communal institutions together achieve substantially better outcomes than either by itself. JEL Codes: D02, D73, K42, P37, P48

INTRODUCTION

Corruption in dealings between business firms and government officials and politicians is a complex problem that needs to be tackled from multiple angles. Most anti-corruption strategies that have been proposed in policy forums and studied by researchers have two features. First, they are controlled by governments: either the general apparatus of police and courts, or special anti-corruption agencies. Second, their main target is what may be termed the demand side, namely detection and punishment of officials who demand bribes, whether for granting...
some special treatment to those who meet their demand, or as extra extortion payments for taking actions to which the applicant was entitled either without charge or for some nominal fee. Indeed, some researchers have suggested an asymmetric treatment where punishment for the latter kind of bribery should fall entirely on the demand side; suppliers of such bribes should not be punished, or should even be rewarded, for whistle-blowing. See Basu (2011) and formal modeling and extensions in Basu, Basu, Cordella, and Varoudakis (2014).

The government’s formal anti-corruption efforts face a very basic and formidable obstacle. Many officials and politicians, and often even the government in aggregate, stand to gain from corruption. The financial gains are large; political gains from reducing corruption may not be large enough to offset these. Therefore anti-corruption measures and their enforcement are often halfhearted, and any actions by one branch of the government are obstructed by other branches or departments with parallel or independent powers. The incentives of the business community as a whole are better aligned to resist corruption. In some situations business may collude with government officials to increase costs of public projects so both of these parties gain at the expense of the taxpayers. But on the whole the politicians’ and officials’ take is a direct hit to the bottom line of business.

A bribe acts as a tax on business, an uncertain and inefficient tax that reduces the incentive to invest and innovate; Ayyagari, Demirgüç-Kunt and Maksimovic (2014) provide evidence bearing on this. Some may argue that business will simply pass on such a tax to consumers through higher prices, but such recovery will in general be much less than full. If the bribe is for a permit to operate the business per se, that is a fixed cost and does not alter the pricing decision. Any market power would already have been exercised to the same extent and reflected in prices even without the existence of a bribe, so the bribe is a pure subtraction from profit. A payment that affects marginal cost will impact prices. But again, if the original price was optimally chosen to maximize profit, the added cost of the bribe can only lower the net profit.1 There are conditions pertaining to the elasticity of the slope of market demand for an oligopolistic industry, under which a higher marginal cost leads to such a large increase in the equilibrium price that each firm’s profit goes up; see Seade (1983) and Dixit (1986). However, these circumstances are unlikely to be relevant in the present context. If they were, the oligopolists would have many more plausible and legitimate avenues to raise their costs. For example, they could arrange some costly industry-wide regulation that even purports to serve a social purpose such as health promotion or environment

1. If the profit is

$$\Pi = \max_p (p - c) D(p)$$

in obvious notation, then by the envelope theorem

$$\partial \Pi / \partial c = - D(p^*) < 0$$

where $p^*$ is the profit-maximizing price.
protection, instead of relying on bribery. And one never hears businesspeople propose anything resembling bribery as a way of increasing profits for whole industries!

Thus we may conclude that a corrupt system is likely to reduce profitability and growth prospects for the business community as a whole. Of course a firm that wins a government license or contract through bribery will benefit at the expense of other competing firms. Therefore individual firms are tempted to engage in bribery even when the business community as a whole stands to lose from the corrupt system. This is a prisoners’ dilemma: individually rational choices lead to a collectively bad outcome. Like all such dilemmas, collective action is needed to resolve it.

Here I explore the potential of one such nongovernmental institution that operates on the supply side by detecting and punishing givers of bribes, following an initial suggestion in Dixit (2013). If several major and respected firms and businesspeople can become persuaded to take a leadership role in launching and sustaining a collective anti-bribe-giving effort, then they, in alliance with some political and governmental leaders, have a better chance of success than either side on its own.

The concept is similar to the institutions of contract enforcement studied by Greif (1993), Bernstein (1992), and others. Their communities of businesspeople or traders sustain a norm of good behavior in contractual performance using a threat of multilateral punishment. Even though any two given members of the community may not have sufficiently frequent bilateral interaction to support an honest equilibrium outcome in their repeated game, the prospect that if member B cheats in dealing with member A, then C, D, E, . . . will punish B on A’s behalf in their future interactions makes it a repeated game for B in his dealings with the community as a whole.

The mechanism requires the community to have a reliable apparatus for detecting and investigating violations of the norm, and a credible and sufficiently severe punishment for proven contract violations and defiance of any stipulated remedies. The usual punishment is ostracism, which is very drastic since it wipes out the industry-specific capital of the guilty party and essentially takes away his livelihood. The prospect of efficient application of this severe punishment keeps most participants honest; there are few contractual disputes and the punishment has to be inflicted only rarely.

In the case of Greif’s Maghribi traders, the detection apparatus was the system of communication—letters exchanged among the members of this relatively small and closed community. The enforcement of ostracism was credible because it was more costly for a member to enter into a relationship with an ostracized trader than one with a good reputation—the former feared no further punishment and was therefore more likely to cheat. In the case of Bernstein’s diamond merchants, detection is simple because an aggrieved member brings a complaint to the arbitration tribunal, which can investigate it rapidly and efficiently using the members’ experience and detailed inside knowledge of the industry.
In the context of corruption, the norm would be not to give bribes to public officials in order to win licenses or permits or to speed up the process of getting these. The sanction would be that any businessperson who is found to have violated this norm will be ostracized by the rest of the community. Since the winner of a license will need contact with many other members of the community of various essential purposes—supply, subcontracting, marketing, trade credit from other firms, longer-term credit from banks and other financial institutions, accounting services, and so on—a boycott from all or even many of these providers will severely reduce the values of the illicitly won license and of future business opportunities. If this threat is sufficiently severe, winning the license by bribery becomes worthless. The model of The Supply Side with the Business Institution section derives the conditions for this to work. I find that, in combination with the government’s own demand-side enforcement efforts, it can make a significant contribution to reducing the level of corruption.

At first the scheme may seem too idealistic or even naïve to be practical. But there are some closely related precedents of collective action by the business community that have achieved some measure of success. Therefore I believe it deserves further study and even some experiments in implementation.

I should emphasize that I do not expect such a scheme to achieve in real life anywhere near the 100 percent success it can under certain conditions in the theoretical model of this paper. However, the problem is so pervasive and costly for economic development that even a 50 percent or even 25 percent success is worth having. Waiting for 100 percent merely guarantees getting 0 percent.

**Practical Precedents**

Community activists in India have attempted to counter petty bribery by meeting demands with a specially printed zero-rupee note. The idea is partly to shame the official demanding a bribe and, more importantly, to make him aware that the resisting client belongs to an organization, so any reprisal against him will have more serious consequences for the official than if the client were an isolated and unsupported individual. This institution claims to have achieved some success, but hard statistical evidence to support these claims awaits serious research.

Other organized private efforts to increase anti-bribery compliance include TRACE International; see their web site [http://www.traceinternational.org](http://www.traceinternational.org).

Even more remarkable is the Sicilian community organization AddioPizzo, which has attempted, with some success, to resist the Mafia’s extortion. The collective action has made it harder for the Mafia to target retribution that they would have easily inflicted on any individual unorganized resisters. See the account and analysis in Superti (2009).

Business leadership in corporate governance reform has a long and distinguished history. To give just one prominent example, J. Pierpont Morgan and his

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partner Elbert Gary who founded Federal Steel “took the then unusual step of issuing quarterly reports” because “both men believed that corporations issuing publicly traded securities had to account for their financial performance” (Strouse 2000, 398). Only later was the idea picked up by the progressive movement and made into a legislated requirement. Prominent firms in modern sectors of India and some other developing countries are similarly taking leading roles in reforming corporate governance, albeit with limited success so far (Khanna and Palepu, 2004). A similar community effort to fight corruption would be a valuable and welcome extension of these initiatives.

**Literature on Corruption**

The literature on corruption is too huge to survey here. I will only mention the seminal work of Becker and Stigler (1974) and Rose-Ackerman (1978) and the surveys by Aidt (2003) and Rose-Ackerman (2010). In all this work, anti-corruption policies are assumed to be the government’s job, using its formal legal apparatus. The modeling is very detailed and sophisticated. But my focus is on the extra role a nongovernmental business community association can play; therefore I will keep the government side quite simple and in a reduced form.

**A Formal Model**

Suppose a permit or license or contract (henceforth called “license” to avoid constant repetition) lasting one period has value $L$ to a person or firm (henceforth simply “firm” for brevity). I assume $L$ to be exogenous and the same for all potential recipients, like the common value assumption in auction theory; variations and extensions are left for future research. A bureaucracy, which I shall model as a single decision-maker called “the bureaucrat,” decides whether to grant the license. I shall consider both the competitive case where there is only one license and many firms would like to get it and the noncompetitive case where any qualified person or firm can have one. Many other cases can be considered: the license can last more than one period; it may be partially competitive in the sense that its value to one firm depends on how many others have one. These are left for future research.

There will be two key variables in the model: the bribe $B$ relative to the value of the license, denoted by $\beta = B/L$, and the degree of favoritism shown by the bureaucrat to a firm that pays a bribe, which I shall model as a ratio $\pi = p_B/p_0$, where $p_0$ is the probability of getting the license without paying a bribe and $p_B$ the probability of getting it with a bribe. The cases $p_0 = 0$ and $p_B = 1$ are not excluded a priori. Both $\beta$ and $\pi$ are endogenous, to be determined in the various cases under consideration. Other formulations, such as faster service to a bribe-paying firm, are conceivable and should yield qualitatively similar results.

I model the bribe as a kickback, that is, it is to be paid if and only if the firm wins the license. Modeling it as an advance payment without refunds to losers
(like an all-pay auction) changes some of the algebra, but the qualitative results remain the same.

Note also that the model is “partial” or “reduced-form.” I am considering the interaction between just one firm and the bureaucracy. Considering all firms together will enable some of the above parameters to become endogenous variables; for example, if \( n \) identical firms are competing for just one license, in absence of bribery we could have a random allocation mechanism, so \( p_0 = 1/n \) where \( n \) is the number of firms. But the main points can be made without the added considerations, like solution of a general game equilibrium with all firms and the bureaucracy as players, so I will keep everything as simple as possible.

I begin with separate treatments of the bureaucrat’s decision (the “demand side” of corruption) and a firm’s decision (the “supply side”) and then put the two together to characterize the overall equilibrium or outcome of their interaction.

The Demand Side

The bureaucrat would of course like to extract as much of the value of the license as possible. What constrains him is the risk of being detected and punished. Detection need not be the result of monitoring by a formal anti-corruption agency or some other government body. It could come about from investigative journalism, complaints by aggrieved client firms, or internal or external whistle-blowers. I specify all of this monitoring technology in a simple reduced form, writing the probability of detection as a function \( D(\beta, \pi) \). The idea is that, if the fraction of the license fee that is demanded as a bribe is small, it is unlikely to elicit complaints or whistle-blowing, but if the fraction is higher, such activities are more likely. Similarly, if the probability of winning the license with bribery is substantially higher than getting it without bribery, this is more likely to be blatant and visible to anti-corruption inspectors or investigative journalists. I assume a linear form

\[
D(\beta, \pi) = g\beta + h(\pi - 1).
\]

This makes the calculations simpler and yields insights based on plausible numerical values; the qualitative results will persist for more general functional forms. Of course a probability cannot be a linear function over a large domain, but linearity can be a locally valid approximation, and the qualitative results will generalize to plausible nonlinear functions.

Suppose that, when detected, the bureaucrat is punished by having to give up the bribed amount and in addition paying a fine \( F \). Then his expected payoff from the bribe is

\[
EP = D(\beta, \pi)(-F) + [1 - D(\beta, \pi)]\beta L \\
= -[g\beta + h(\pi - 1)]F + [1 - [g\beta + h(\pi - 1)]]\beta L.
\]
Setting this expression equal to a constant \( c \) and solving for \( \pi \), we get the equation of a typical iso-expected-payoff (IEP) contour:

\[
\pi = 1 + \frac{1}{b} \left[ -g \beta + \frac{\beta L - c}{F + \beta L} \right]
\]  

(3)

Then

\[
\frac{\partial \pi}{\partial \beta} = \frac{1}{b} \left[ -g + \frac{(F + c) L}{(F + \beta L)^2} \right]
\]  

(4)

and

\[
\frac{\partial^2 \pi}{\partial \beta^2} = -\frac{2 (F + c) L^2}{(F + \beta L)^3} < 0.
\]

Also

\[
\frac{\partial \pi}{\partial c} = -\frac{1}{b (F + \beta L)} < 0.
\]

Thus the IEP contours are concave, and those lower down correspond to higher expected payoff levels. Figure 1 shows some of these contours. The intuition is that an increase in the favoritism variable \( \pi \) holding the rent extraction ratio \( \beta \) constant (i.e., a vertically upward move in the figure) always makes the bureaucrat worse off by raising the risk of detection, but an increase in \( \beta \) holding \( \pi \) constant (i.e., a horizontal rightward move) creates a tradeoff between bribe revenue and risk of detection, therefore the contours peak in that direction.

Of course the bureaucrat can always act honestly and award the license to any qualified applicant in the noncompetitive case and the best-qualified applicant in the competitive case. This will yield him zero expected payoff in the formula (2).\(^3\) Therefore a corrupt bureaucrat will choose only points in the region in figure 1 below the contour labeled EP0 where \( c = 0 \); this is shown shaded. Note that it starts at the point where \( \beta = 0 \) and \( \pi = 1 \), that is, the “honesty point” with no bribes and no favoritism.

3. That is simply the choice of origin of the expected payoff. It would matter in models that considered government policies of paying efficiency wages or similar bonuses to deter corruption, but that is not my focus here.
An applicant for the license is willing to pay the bribe if \( p_B (L - B) \geq p_0 L \).\(^4\) Using the definitions

\[
\pi = \frac{p_B}{p_0}, \quad \beta = \frac{B}{L},
\]

this becomes

\[
\pi \geq \frac{1}{1 - \beta}.
\] (5)

The boundary of this, defined by an equality in (5), is an increasing convex curve in \((\beta, \pi)\) space, passing through the honesty point \((0,1)\) and asymptotic to the vertical line \(\beta = 1\). Figure 2 shows this curve, and the shaded region above it is the set of points satisfying (5) where the firm is willing to pay the bribe.

\(^4\) In the alternative case of an all-pay bribe, this would change to \( p_B L - B \geq p_0 L \). Readers who prefer that formulation can easily rework the algebra and the figures.
The Outcome without the Business Institution

Figure 3 brings together these curves. On or above the curve labeled $\pi = 1/(1-\beta)$, applicants are willing to pay the bribes demanded. At points on or below the curve labeled $EP_0$, the bureaucracy has positive expected payoff from its corrupt strategy. The intersection of these two regions, shown shaded, is therefore the feasible set. I assume that the bureaucrat states the terms of the bribe demand, to maximize his expected payoff $EP$ subject to feasibility.\(^5\) This occurs at the point B of tangency between the frontier of the feasible set (5) and an IEP contour labeled $EP^*$. Note that at B we have $0 < \beta < 1$ and $\pi > 1$.

The bureaucrat’s choice of $\pi$ may be subject to one other constraint. The firm’s competence or quality may imply that in a bribe-free setting it would get the license with a given probability $p_0$ that is not under the bureaucrat’s control. Since $p_B \leq 1$, the bureaucrat’s choice must satisfy $\pi \leq 1/p_0$, that is, it must be on or below a horizontal line like the one labeled U in figure 3. I have shown a case where this line is above the point B and therefore this constraint is irrelevant, but if $p_0$ is high enough, the constraint may bind; then the solution will be at the corner where the line intersects the firm’s willingness-to-pay frontier.

---

\(^5\) This seems more realistic in the context, but alternative solution concepts, like Nash bargaining or the bribe-giver’s leadership to make the offer, will have qualitatively similar properties.
Both curves have the honesty point in common, and the only way the government’s detection and punishment system can eliminate corruption is if there is a corner solution at this point. For that to happen, the EP₀ contour has to be flatter than the frontier of the feasible set. The slope of the former is given by (4) setting \( c = 0 \) and \( \beta = 0 \), and that of the latter can be found by differentiating its equation \( \pi = 1/(1 - \beta) \). This yields the condition for a corner solution:

\[
\frac{1}{b} \left[ -g + \frac{L}{F} \right] < 1,
\]

or

\[
F/L > 1/(g + b) \quad (6)
\]

Let us consider plausible numerical values. To make the condition (6) easier to satisfy, \( g \) and \( b \) should be as high as possible. The most we can expect for \( g \) is a value like 2 (which means that a bureaucrat who demands half the value of the license for his bribe is sure to be caught). For \( h \), about 0.1 seems as high as we can expect (which means that a bureaucrat who favors bribe-givers by a factor of
10 is sure to be caught). Then the condition becomes $F > 0.476L$: even with the optimistic assumptions about detection probabilities, fines have to be close to half the value of the license. Financial fines of this magnitude seem infeasible in cases of highly valuable licenses or contracts because bureaucrats typically would not have that much wealth to be confiscated. Unless a regime can impose nonmonetary penalties that are equivalently sufficiently harsh—long imprisonments or even death—demand side policies will be insufficient to eliminate corruption. The best that can be done is to increase $F$ as high as possible, lowering and flattening the IEP curves and thereby shifting the bureaucracy’s tangency optimum to the southwest (with lower $\beta$ and $\pi$) along the boundary of the clients’ participation constraint. This is essentially the same solution as we have from Becker (1968) for deterrence of crime in general.

The Supply Side with the Business Institution

Now suppose the business community forms an institution that can detect and punish firms that pay bribes. The punishment consists of ostracism that reduces the values of the current license and of future opportunities. Suppose that when a firm is convicted of bribery by a tribunal of the business community, the value of the license falls from $L$ to $\theta L$, and the continuation value of being in the business falls from $V$ to $\phi V$, where $\theta$ and $\phi$ lie between 0 and 1. A perfect punishment system would have $\theta = \phi = 0$, but I allow for a less than perfect system as is likely to exist in reality. The detection mechanism is not perfect either; let $q$ denote the probability that a firm that is actually guilty of bribery will be convicted by its peers in the association and $r$ the probability that an innocent firm will be wrongly convicted, where $1 > q > r > 0$. Let $\delta$ denote the discount factor.

Note once again the “reduced form” nature of the model: the parameters $q$, $r$, $\theta$, and $\phi$ are taken to be exogenous. A fully rigorous model would specify a detection technology from which $q$ and $r$ emerge endogenously, and a repeated game that endogenizes $\theta$ and $\phi$. Unfortunately, we have little intuitive understanding of the deep structural parameters, so to get some insight into plausible numerical answers, it is better to start with parameters that do have intuitive magnitudes. Also, the reduced form enables me to capture the intuitively appealing idea of partially effective enforcement ($\theta$ and $\phi$ strictly between 0 and 1); in most tractable structural models, enforcement is either perfect ($\theta = \phi = 0$) or totally ineffective ($\theta = \phi = 1$).

Kingston (2008) constructs a structural model where a no-bribe equilibrium is sustained in a repeated relationship by trade links among the bribers but does not consider any interaction with the formal state law and does not obtain numerical magnitudes. Thus his paper and this one offer usefully complementary models.

In reality, $q$ can be an increasing function of $\beta$ and $\pi$ similar to the supply-side detection probability function (1) above; I will omit this algebraic complication.
Consider one firm’s decision whether to pay a bribe. By the standard recursion reasoning, it is willing to comply with the bureaucrat’s demand if

\[ V = (1 - q)[p_B(L - B) + \delta V] + q[p_B(\theta L - B) + \delta \phi V] \geq (1 - r)[p_0 L + \delta V] + r[p_0 \theta L + \delta \phi V] \]

The equality implies

\[ V = p_B \frac{[(1 - q) + \theta q]L - B}{1 - \delta(1 - q + \phi q)} \]

and the inequality implies

\[ p_0 L [1 - r (1 - \theta)] \leq p_B \{L [1 - q (1 - \theta)] - B\} - \delta V (q - r) (1 - \phi). \]

The latter simplifies to

\[ \pi \geq \frac{1 - r (1 - \theta)}{1 - q (1 - \theta) - \beta} \frac{1 - \delta + \delta q (1 - \phi)}{1 - \delta + \delta r (1 - \phi)}, \tag{7} \]

using the same notation \( \pi = p_B / p_0 \) and \( \beta = B / L \) as before.

Introduce the abbreviations

\[ m = [1 - r (1 - \theta)] \frac{1 - \delta + \delta q (1 - \phi)}{1 - \delta + \delta r (1 - \phi)} \tag{8} \]

and

\[ k = 1 - q (1 - \theta). \tag{9} \]

Obviously \( k < 1 \); also \( q > r \) ensures \( m > k \), or \( ml / k > 1 \). Then the condition (7) becomes

\[ \pi \geq \frac{m}{k - \beta} \tag{10} \]

Figure 4 shows the frontier of this, defined by equality in (10), as the thick increasing convex curve that starts at \( \beta = 0 \) and \( \pi = m / k \) and is asymptotic to the vertical line \( \beta = k \). At the points on or above it, the firm is willing to pay the bribes demanded by the bureaucrat, even at the risk of being detected and ostracized by the business community. Compare it with the corresponding curve without the business institution, defined by equality in (5) and shown in figure 4 by the thinner curve. For given \( \beta \), the ratio of \( \pi \) with the business institution to
that without is

\[
m \frac{1 - \beta}{k - \beta} = m \left[ 1 + \frac{1 - k}{k - \beta} \right].
\]

This equals \(m/k > 1\) when \(\beta = 0\), then increases monotonically as \(\beta\) increases, and \(\to \infty\) as \(\beta \to k\). Therefore the frontier of willingness to bribe with the institution lies uniformly above that without the institution, as shown in figure 4. The prospect of the community’s punishment shrinks the region of the firm’s willingness to pay bribes.

Figure 5 brings together the bureaucrat’s IEP curves with the region where a firm is willing to comply. Most importantly, it shows a case of an empty intersection between the set of points where the firm is willing to pay the bribe and the set below the \(EP = 0\) curve where the bureaucracy has positive expected payoff (both these regions are shown shaded). The bureaucracy does best by abandoning its attempts to demand bribes and being content with zero payoff.

We can now consider various ranges of parameters for the business community institution and compare the resulting numbers with the those for the state’s formal system on its own. Table 1 shows a sample of such calculations. For each set of parameter values \(q, r, \theta,\) and \(\phi,\) the fine on the bureaucrat (as a fraction of the value of the license, \(F/L\)) that is needed to achieve a corruption-free outcome...
Table 1. Sample Numerical Calculations for Corruption-Free Equilibrium

<table>
<thead>
<tr>
<th>Institution quality</th>
<th>Detection</th>
<th>Enforcement</th>
<th>Needed fine F/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>q</td>
<td>r</td>
<td>θ</td>
</tr>
<tr>
<td>Good detection</td>
<td>0.75</td>
<td>0.01</td>
<td>0.8</td>
</tr>
<tr>
<td>Good enforcement</td>
<td>0.25</td>
<td>0.10</td>
<td>0.1</td>
</tr>
<tr>
<td>Both medium</td>
<td>0.50</td>
<td>0.05</td>
<td>0.5</td>
</tr>
<tr>
<td>Both good</td>
<td>0.65</td>
<td>0.03</td>
<td>0.25</td>
</tr>
</tbody>
</table>

is shown in the last column. The first row shows an institution that does a good job of detection: the probability of convicting a guilty firm is high \(q = 0.75\) and that of wrongful conviction of an innocent firm is low \(r = 0.01\). But enforcement is poor: a convicted firm loses only 20 percent of its current and future profits \(\theta = \phi = 0.8\). We have \(F/L = 0.145\), much less than the 0.476 that was needed without the business institution. The second row shows the opposite situation: good enforcement \(\theta = \phi = 0.1\) but poor detection \(q = 0.25\), \(r = 0.1\). Here we have \(F/L = 0.207\), not quite as good but still a big improvement over 0.476. In the third row we have case where detection and enforcement are both intermediate; here we have a much better \(F/L = 0.101\). The final row shows an institution where both detection and enforcement are quite good. Then the needed \(F/L\) is very low; the value 0.0046 means that for a license worth a million dollars, a fine on the bureaucrat of only $4600 is needed to get a corruption-free
outcome. This good institution is still not quite as good as a combination of the
best in the first two rows \((q = 0.75, r = 0.01, \theta = \phi = 0.1)\), but when I tried
that, the required \(F/L\) had too many starting zeroes!

Thus we see that the business institution in combination with the state’s im-
perfect legal institutions is much more effective than the latter on its own. Also,
the business institution’s detection and enforcement capabilities appear to be
mutually reinforcing (strategic complements).

To get these numerical results, for each parameter set, I start with a low value
of \(F/L\) and increase it gradually until the two regions in figure 5 separate. For a
fairly wide range of parameters, at the separation point, I find that \(\beta\) is in the
neighborhood of 0.1. This is, in a sense, the range of bribery that is most robust
against punishments, and it is interesting to note that in many countries with
prevalent corruption 10 percent is indeed the “norm” for bribes.

Even if the intersection between the set of points where the firm is willing to
pay the bribe and the set below the EP \(= 0\) curve where the bureaucracy has posi-
tive expected payoff is non-empty, there is a third constraint that may come into
play and rule out deviations from a corruption-free equilibrium.

Suppose there are \(n\) firms, and their competence or quality is such that in a
corruption-free equilibrium their probabilities of winning the license are \(p_i\) for
\(i = 1, 2, \ldots, n\). If the license is exclusive and only one firm will get it, the \(p_i\) must
sum to 1. If it is not exclusive, for example any restaurant that meets the health
and safety standards will qualify for a permit to operate, then there is no such re-
striction. Intermediate cases of congestion-like interactions, where each \(p_i\) depends
on how many and which other firms receive the license, are also possible. Anyway,
I will take the \(p_i\) as exogenous.

Firm \(i\) and the bureaucrat will be able to deviate and upset the candidate
corruption-free equilibrium if they can find a corrupt deal, that is, pair \((\beta, \pi)\), that
leaves both of them better off. For this, the intersection of the firm’s willingness-
to-bribe set, the bureaucrat’s nonnegative EP set, and the constraint \(\pi \leq 1/p_i\) must
have a non-empty intersection. Conversely, a corruption-free equilibrium requires an
empty intersection for all firms. The first two constraints are the same for all firms,
but the third is firm-specific.\(^6\) A non-empty intersection is most likely where that con-
straint is least relevant, that is, for the firm with the smallest \(p_i\). Suppose this is firm
1. Then the corruption-free equilibrium requires an empty intersection of the three
constraints taking the third to be \(\pi \leq 1/p_1\). Figure 6 shows such a case.

As intuition would suggest, the firm least likely to get the license in a
corruption-free situation is the one most likely to accede to a bribe demand.
Conversely, firms that have the best chances in the corruption-free situation are
the best candidates for launching the institution to sustain the clean equilibrium.

\(^6\) It is easy to generalize the analysis to the case where the willingness-to-pay constraint is also
firm-specific, for example if the true and false conviction probabilities \(q\) and \(r\) are different for different
firms. The only added complication is a proliferation of cases and conditions for corruption-proofness.
Thus far we have found conditions for none of the firms to violate the no-bribery norm, given the threat of ostracism. Finally, we need to check that the threat is credible, that is, that other firms are willing to go along with the ostracism imposed on a firm that the community has found guilty of bribery. This is in the context of Nash equilibrium: given that other firms are complying with the ostracism, would it pay any one firm to break away and deal with the miscreant? In emerging countries where our analysis is most relevant, inter-firm dealings are on a relational basis, and the analysis of Greif (1993, Proposition 2, 535) applies. Suppose firm A is already ostracized. It now fears no worse penalty; therefore it is more likely to cheat in inter-firm dealings. To offset this temptation, Firm B contemplating dealing with firm A must give it more of the surplus from the deal. Therefore, it is more costly for B to deal with the ostracized firm A than with others, such as say C, D, . . . that have a clear history. In other words, it is not in any firm’s interest to deviate from the community’s sanctions on the original briber. Once the institution gets going, it will also develop its culture that will reinforce the material incentive to conform with the sanctions.

Partial Reduction in Corruption

Even when the community institution is not good enough (the value of m is not high enough and/or that of k is not low enough), it can make a contribution to reducing corruption in combination with the formal legal apparatus. Consider the case shown in figure 7. (Ignore the dashed curves for the moment.) The set of ($\beta, \pi$) combinations where businesspeople are willing to comply with demands
for bribes has a non-empty intersection with the set that gives positive expected payoff to the bureaucracy; this feasible set is shown shaded. The outcome is at the point C of tangency between the feasible frontier and an IEP contour labeled EP'. As was discussed in connection with figures 3 and 6, if the worst-placed firm’s competence or quality give it a probability \( p_1 \) of getting the license in a bribe-free system, then \( p \) is subject to a further constraint \( p \leq 1/p_1 \), which may bind and further reduce the possibility of corruption. I will omit this possibility to save space and taxonomy.

Let us consider some comparative statics of the partial reduction outcome as various aspects of the formal and the community institutions improve.

Any improvement in the formal institution—an increase in the detection probabilities \( g \) and \( h \) or the fine \( F \)—flatten the IEP contours. To see this, use the implicit function theorem to derive the slope of a typical IEP contour

\[
- [h (\pi - 1) + g \beta] F + \{ 1 - [h (\pi - 1) + g \beta] \} \beta L = c.
\]

This yields

\[
\frac{\partial \pi}{\partial \beta} = \frac{L - L h (\pi - 1) - g (F + 2 \beta L)}{h (F + \beta L)}. \tag{11}
\]
It is easy to see that an increase in $F$ or $g$ reduces this. The effect of $h$ is a bit more complicated. Writing

$$\frac{\partial \pi}{\partial \beta} = \frac{L - g(F + 2\beta L)}{h(F + \beta L)} - \frac{L(\pi - 1)}{F + \beta L},$$

we have

$$\frac{\partial}{\partial h} \left[ \frac{\partial \pi}{\partial \beta} \right] = -\frac{L - g(F + 2\beta L)}{h^2(F + \beta L)}.$$

When $\frac{\partial \pi}{\partial \beta} > 0$, as is the case in the relevant part of the space,

$$L - g(F + 2\beta L) > Lh(\pi - 1) > 0,$$

so

$$\frac{\partial}{\partial h} \left[ \frac{\partial \pi}{\partial \beta} \right] < 0.$$

In figure 7, what happens as the formal enforcement improves is that the IEP contours become flatter and the point of tangency $C$ moves to the southwest along the feasible frontier, resulting in lower $\beta$ and $\pi$, that is, reduced corruption.

Next consider improvements in the business community institution, that is, an increase in the probability $q$ of being convicted when guilty, and/or a decrease in the probability $r$ of being wrongly convicted. When $m$ increases and/or $k$ decreases, the feasible frontier defined by equality in (10) obviously shifts up, but we need to know what happens to its slope. Along it, we have

$$\frac{\partial \pi}{\partial \beta} = \frac{m}{(k - \beta)^2} = \frac{\pi^2}{m}.$$

Therefore the shifted frontier becomes steeper as we move vertically up by increasing $m$ or decreasing $k$ at given $\beta$, but flatter as we move horizontally to the left by increasing $m$, and keeps the same slope when $k$ decreases, at given $\pi$.

The slope of IEP curves changes the opposite way. We see from (11) that moving vertically up at given $\beta$ makes IEP curves flatter, and moving horizontally to the left at given $\beta$ makes them steeper.

Therefore, as the feasible frontier shifts up, in figure 7 the tangency outcome must move somewhere between vertically upward and horizontally leftward to a point like $C$ to the northwest, with lower $\beta$ but higher $\pi$. (The figure shows such a comparison of $C$ and the outcome $B$ with no (or totally ineffective) business institution that was derived in figure 3 and is now shown as the tangency of the
two dashed curves.) Improvement of the business community institution reduces the magnitude of bribes the bureaucrats demand, but the chances of winning the license through bribery improve. Intuitively, as the business community increases its own expected penalties for winning a contract through bribery, the bureaucracy has to make it more attractive for businesspeople to comply with its demands, and it does this by combining smaller bribes and greater probability of success through bribery.

Thus a small improvement in the business community institution has a mixed outcome. However, when the improvement progresses far enough, eventually the feasible set becomes empty and corruption is eliminated.

Practical Considerations Outside the Model

The formal model of the previous section was highly simplified in a reduced form. Moreover, it studied only the equilibrium of the suggested institution, that is, how it would maintain itself once it got going. Therefore the formal analysis must be supplemented by some informal discussion of practical matters of implementation. Here is a brief statement; for a more detailed discussion see Dixit (2013).

Requirements

The work of Ostrom (1990, 2007) and others has clarified some conditions that are necessary for successful operation of self-sustaining communal institutions of collective action. In our context, the following seem the most important ones.

Boundaries. The set of members, and their rights and duties, should be clearly defined. Here the business association imposing the sanctions may have a set of members who have publicly declared themselves to be bound by the norm. That will be valuable in ways mentioned later. These members should also declare themselves to be bound by the sanctioning procedure, agreeing to ostracize any firm that the association finds guilty of bribery, whether or not the guilty firm has itself joined the association. That is, firms should not think themselves immune from sanctions if they stay outside the group that has signed the no-bribery pledge.

Detection and Adjudication. Monitoring and sanctioning is best done by members of the association through their delegated representatives, using their local and insider knowledge, expertise and experience. They can admit and interpret evidence on using broader criteria than can a general court. As in Bernstein (1992) and Greif (1993), this will be conducive to a faster, less costly, and more accurate process. Klitgaard (2012) discusses the comparative advantage of the business community and the role of public-private partnerships for detecting and exposing corruption. The business association can also pursue more pro-active strategies, for example sending its agent-provocateurs to entrap corrupt officials.
and exposing them. However, in the context of corruption, internal adjudication carries the danger that the association becomes an insiders’ clique, using the sanctioning power illegitimately to exclude newcomers and to preserve an oligopoly of incumbents. This is indeed a serious risk because cooperation in the anti-corruption institution can facilitate collusion or cartelization in the business community. To maintain the integrity of the mechanism, it is crucial not only that the procedure is untainted, but that it is seen to be untainted. For this, the adjudication tribunal should have some representation of respected outsiders and of new firms, and its process should have sufficient transparency to allay suspicion. Integrity and objectivity of the tribunal is also important to reduce the risk that a firm is sanctioned because of false accusations by rival firms.

**Graduated Sanctions.** In most game-theoretic models of repeated prisoners’ dilemmas, good behavior is best sustained by the harshest self-enforcing punishment. In practice, however, punishments that are small for a first offense and only gradually become harsh are found to work best. This seems equally valid in the context of corruption, especially because it reduces the risk of wrongful conviction leading to permanent ouster from business. It may also help prevent the morphing of the anti-corruption institution into one that deters new and innovative entry; if a novice firm gains a foothold through bribery, it would not be immediately booted out but be given a warning or a slap-on-the-wrist punishment like a small fine and be given a second chance to stand on its own merit.

As sanctions are ratcheted up against persistent offenders, the business association may strengthen them further by inviting consumers to join the ostracism or boycott against the guilty firm.

**Official Recognition.** We saw that the business institution has to work together with the government’s own anti-corruption efforts, although it does greatly increase the effectiveness of the latter. Conversely, the government’s legal system should accept the business association’s verdicts, much as courts show forbearance for verdicts of recognized private arbitration systems, standing ready to enforce their verdicts and not hearing the cases again. The government can do more. Many private firms and government departments that regularly award contracts have lists of approved bidders. A preliminary scrutiny is carried out to put a firm on this list, and in the competition for any specific contract, only bids from firms on this list are considered. The government can make it a requirement for being on the approved vendors’ list that the firm is not ostracized for previous bribery by the business association. Of course, if such a rule is adopted, that makes it all the more important that the association’s procedure minimizes the risk of false conviction and does not become a means of deterring entry to preserve the insiders’ oligopoly.

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**Launching the Institution**

Shifting an equilibrium is always difficult, and unfortunately, shifting from a good equilibrium to a bad one is easier than shifting from a bad one to a good
one. A rumor or some local difficulty can start a bank run; creating or restoring confidence in the banking system is much harder. Similarly, launching an anti-corruption institution is a difficult task, requiring much effort in reputation-building and creating confidence that the system is going to function sufficiently well. Here are just a few thoughts in this matter; more are sure to occur to others as thinking and experimenting along these lines progresses further.

SELECTING LAUNCH MEMBERS. If the new institution is to get sufficiently rapid recognition and respect, it is essential that several of the most respected leaders of the business community publicly declare their active support and participation by becoming launching members and urging others to join. In countries like India and China, these are most likely to come from the modern sectors of the economy—information and communication technology, web-based businesses, consulting, etc.—who also do business in other countries with higher standards of governance and have some incentive to maintain similar reputation and standards in their own countries. See Khanna and Palepu (2004) for further discussion of such interactions. Once a sufficient mass of respected members exists, others who stay out can be named and shamed into joining; the media can be very helpful here. The government can also help recruitment by requiring that a firm be a member in good standing of the business association as a condition for it to be on the government’s list of approved vendors or bidders for government supply contracts and licenses.

EARNING AND MAINTAINING REPUTATION. The worst thing that can happen to an anti-corruption organization is being tainted by a scandal. The association in its early phases will have to be especially vigilant in its detection and sanctioning, ready to expel and ostracize any members, no matter how important, who are found in violation of the no-bribery norm. It will also have to be especially careful to avoid any suspicion of being seen as a clique of big firms or insiders. To avoid the risk, the community will have to make special efforts to recruit new, small, and innovative firms, not only as members but as active members with representation on the adjudication and decision-making bodies of the association. It should also get some outside experts and respected citizens from outside business to serve as consultants or observers on these bodies.

OVERCOMING OPPOSITION. Businesses with relational capital invested in existing system will resist the new institution; this resistance can take many forms and needs to be countered by all available means, including the use of allies in the press and other media to name and shame the firms that refuse to take the pledge. Resistance will also come from within the government, as many of its politicians and officials stand to lose lucrative bribe incomes. Media campaigns can help; proactive strategies to maintain good relations with the media will help deflect false accusations of improprieties and attempts to create scandals to discredit the institution. More generally, a recent comparative case study (Innovations for
Successful Societies, 2014) of how various governments’ anti-corruption agencies fared in building and maintaining reputations can be useful here.

**Concluding Comments**

Corruption is endemic and entrenched in many countries. The community institution operating on the supply side of bribery that I have proposed here cannot by itself eliminate or even greatly reduce it. But it can significantly strengthen the effectiveness of the government’s formal system of detection and punishment that operates mostly on the demand side.

The analysis applies only to relationships between business firms and officials for awards of government licenses and contracts. But the hope is that, if such an institution becomes established, that will help change the general culture of corruption in the country and thereby also help reduce corruption in other contexts, such as extortion by officials and the police in their dealings with individual citizens.

Therefore I hope the idea will be further scrutinized in research and attempted in some country whose business community is sufficiently well organized and sufficiently adventurous to experiment with novel ideas that have the potential to free it from the yoke of extortionate demands of politicians and officials.

**Conflict of Interest**

None declared.

**References**


Why Haven’t Global Markets Reduced Inequality in Emerging Economies?

E. Maskin

The theory of comparative advantage predicts that globalization should cause inequality in emerging economies to fall. However, this has not been true of the current globalization (even though the prediction held up well for previous such episodes). In this paper, I sketch an alternative theory—developed in collaboration with Michael Kremer—that seems to fit recent history well. JEL codes: D33, E25, F16, F63, O15

The world has witnessed an enormous growth in global markets in the last twenty years or so. Specifically, there has been a sharp upswing in the exchange of goods and services across international borders. There has also been much more production of goods and services across international borders, e.g., design of a product in one country and its assembly in another (and international production will be especially important in my discussion below). The reasons for increased globalization include declines in transport costs and removals of trade barriers (as in the enactment of the North American Free Trade Agreement). But below, I will particularly emphasize falling communication costs as a major driver of the globalization process.

Proponents of globalization have made many promises on its behalf. In particular, they have predicted that it would bring prosperity to emerging economies. And, on that score, they have often delivered on their promise. In China and India, for example, GDP per capita (a crude but common measure of prosperity) has grown dramatically, thanks to global markets. Many other developing economies have also come a long way, if not quite so spectacularly. However, another promise made about globalization was that it would reduce income inequality (specifically, wage inequality) – the gap between the haves and have nots – in poor countries. Yet, in many such countries, wage inequality has actually increased—and, once again, China and India are leading examples.

There has been a great deal in the press and other media about inequality recently. Most of the attention, however, has focused on inequality in rich...
countries, for example, stories about the “1% vs the 99%” in the United States. My concern here, however, is with inequality in poor countries.

One might ask, of course, why we should care about inequality there (although I suspect that most readers of World Bank publications are already persuaded on that point). But there are, I think, at least three good answers. The first is an egalitarian argument: we believe that all people deserve equal treatment, and so huge disparities in wages offend our egalitarian impulses (at least, the impulses of many of us). Second, even if one doesn’t accept this point of view, one might care about eradicating poverty. Yet eliminating poverty is closely connected to inequality, since—in poor countries—antipoverty measures are often anti-inequality measures. Third, even if poverty elimination is not deemed a compelling motive, one might nevertheless care about inequality for a more practical reason: there is a well-established correlation between inequality and social and political instability. So, simply for the state of keeping the social fabric together, reducing inequality may emerge as a serious policy goal.

Next, we should ask whether the rise of inequality in so many poor countries is surprising. But if we accept the theory of comparative advantage, then the answer is clearly yes—because the trend clearly contradicts this venerable theory. Comparative advantage goes back more than two hundred years to David Ricardo. It is, by far, the most important tool for understanding international trade patterns, and historically it has been enormously successful. Indeed, in all previous globalizations (and there have been plenty of previous globalizations), its prediction was right on the money, implying that freeing up trade should reduce inequality in emerging economies. Because of the theory’s importance and success, therefore, let me explain why it draws the implication of declining inequality.

In its formulation by Heckscher and Ohlin, comparative advantage theory asserts that the important difference between countries—from the standpoint of international trade—lies in their relative endowments of the factors of production, that is, the inputs to production. Because my concern is with wage inequality, I shall concentrate on labor factors. Specifically, let’s suppose that there is high-skill labor and low-skill labor.

I will compare a rich economy with a poor country. In the rich country, the ratio of high-skill to low-skill workers is higher—that’s, after all, what makes the rich country richer. This means that the rich country has a comparative advantage in producing goods requiring a high proportion of high-skill workers, for example, computer software. The emerging economy, by contrast, has a comparative advantage in producing goods for which skill doesn’t matter as much. Many agricultural goods fall into this category; let’s take the example of rice.

To see the effect of globalization on production, we will look at production patterns (i) before globalization, that is, before trade between the rich and poor country becomes possible, and (ii) after globalization—after free trade between the two countries is introduced. The difference between (i) and (ii) can be attributed to globalization.
Notice that, before trade is opened, both software and rice must each be produced in both countries—because consumers in both countries demand both goods. But there’s a sense in which producing software in the poor country is inefficient; the country’s labor force—with its relative abundance of low-skill workers—is better suited to rice. Indeed, low-skill workers in the emerging economy are “hurt” by that country’s software production. They are not much needed for software but greatly needed for rice. Thus, to the extent that production is diverted from rice to software, demand for low-skill labor is suppressed and low-skill wages are likely to be especially low. By contrast, high-skill workers in the poor country benefit from the diversion to software and will enjoy especially high wages.

Now let’s see what happens when the door to trade between the rich and poor country is opened. The poor country will shift production from software to rice (which is more efficient for the country to produce) and import its software from the rich country (the rich country will do just the opposite: shift production to software and import rice).

So, the poor country now produces more rice and less software than before. This raises the demand for low-skill workers—since rice uses low-skill workers more intensively than does software—and therefore the low-skill wage. Correspondingly, demand for high-skill labor falls and so do high-skill wages. Thus, inequality in the poor country is reduced as a consequence of globalization.

The foregoing is the standard story for why globalization should abate inequality in emerging economies. Moreover, the story works well empirically when applied to previous globalizations. For example, in the second half of the nineteenth century, Europe had a relative abundance of low-skill labor, whereas the United States was better endowed with high-skill labor. Partly because of a notable decline in trans-Atlantic shipping costs, trade between the United States and Europe rose dramatically in that period. And—just as the theory predicted—inequality fell substantially in Europe.

But as I noted, comparative advantage has been less successful for the recent globalization. One of its predictions is that the greater is the difference in skill ratios between two countries, the more those countries will trade with each other because the greater will be the gains from exchange. But, in reality, the current globalization has engendered little trade between rich industrialized nations (e.g., the US) and the very poorest countries of the world (e.g., Malawi). More importantly, the predicted decline in poor countries’ income inequality has, by and large, not materialized.

Motivated by the predictive failure of comparative advantage, Michael Kremer and I have developed an alternative theory. We posit that what distinguishes the current globalization from its predecessors has been the internationalization of the production process—the fact that, for example, computers are now often designed in the United States, programmed in Europe, and assembled in China. We argue that the reality that a Chinese worker can today be employed by a company on the opposite side of the world—a reality made possible by
dramatically lower communication costs—means the labor market is now truly
global.

To capture a global labor market, we need more than two skill levels. For my
purposes in this expository paper, I will suppose that there are four levels, but
the full model can accommodate many more than that. As with the comparative
advantage model, there are two countries: one rich, one poor. To simplify, I will
suppose that the rich country has workers of skill levels $A$ and $B$ and the poor
country has workers of skill level $C$ and $D$, where $A > B > C > D$ (but the argument still holds if $C > B$).

In the Kremer-Maskin model, wages depend on how workers of different skill
levels are “matched” together to produce output. The production process con-
sists of two tasks: a “managerial” task (which is highly sensitive to skill), and a
“subordinate” task (which is less skill sensitive). Output is produced by matching
a manager with a subordinate, and the quantity yielded depends on the skill
levels of those workers. To be concrete, let us suppose that

$$\text{Output} = M^2S,$$

where $M$ is the skill level of the manager and $S$ the skill level of the subordinate
(the fact that $M$ is squared—this particular value of the exponent is unimpor-
tant—reflects the sensitivity of output to managerial skill). So, for instance, if
$M = 4$ and $S = 3$, output will be $4^2 \times 3 = 48$.

We assume that there are many producers competing to hire managers and
subordinates, in other words, that the labor market is competitive. This ensures
that workers are paid according to their productivity and that matching is effi-
cient (i.e., that it leads to maximum output). In fact, the particular matching
pattern that arises will depend on the distribution of skills.

To see this, assume first that there is a population consisting of two 3-workers
(workers of skill level 3) and two 4-workers. In principle, there are two ways
the workers could be matched: we could either have each 3-worker matched with
a 4-worker (the former would be the subordinate, the latter would be the
manager) resulting in total output of $2 \times (4^2 \times 3) = 96$ (call this “cross-
matching”) or (ii) have the two 3-workers matched together and the two 4-workers
matched together (“own-matching”), for a total output of $4^2 \times 4 + 3^2 \times 3 = 91$.
But since 96 is bigger than 91, competition ensures that cross-matching will occur
in equilibrium. Yet, now suppose instead that there are two 2-workers (instead
of 3-workers) as well as the two 4-workers. Notice that for these revised
numbers, own-matching, leads to higher output—$(4^2 \times 4) + (2^2 \times 2) = 72$ versus
$2 \times (4^2 \times 2) = 64$—and now it becomes the matching pattern in equilibrium.

The two examples illustrate two (conflicting) forces. First, because the two
tasks (managerial and subordinate) are differentially sensitive to skill, there is a
tendency to cross-match: to put a higher-skill worker in the managerial position
and a lower-skill worker in the subordinate position. But, because the two tasks
are complementary, the market gravitates toward *own-matching* if skill levels are *too* different: it would be a waste to match a very high-skill manager with a very low-skill subordinate. The matching pattern that actually arises in equilibrium will strike a balance between these two forces and so will depend on the available distribution of skills.

Let’s apply this logic to our two countries. For concreteness, we’ll suppose that $A = 13$, $B = 8$, $C = 6$, and $D = 4$ with equal numbers of all types, but the same qualitative conclusions will hold for a broad range of other numerical values.

Before globalization—that is, before international production becomes possible—the equilibrium matching pattern entails $A$-workers matching with $B$-workers in the rich country and $C$-workers matching with $D$-workers in the poor country. However, post-globalization—once international production is feasible—$C$-workers will be matched with $B$-workers and $D$-workers (and $A$-workers) will be own-matched.

The important feature here is that although $D$-workers may be matched with $C$-workers pre-globalization, their skill isn’t high enough to match with $B$- or $A$-workers post-globalization. Thus $C$-workers will see their wages rise with globalization, thanks to their new matching opportunity with $B$-workers. But $D$-workers will experience stagnant or perhaps even falling wages. And the overall effect of the internationalization of production will be to amplify the gap between $C$- and $D$-workers, that is, to increase inequality in the poor country. If this theory is right, then there is a clear policy corrective, viz., to raise the skill level of $D$-workers (through job training or education) so that they have international matching opportunities too. The obstacle to such training, however, is that it is costly. And so the question arises: who is going to pay for it?

Clearly, the workers can’t carry the cost themselves—at least not much of it—because these are some of poorest people in the world. Moreover, employers may not have the incentive to fully pay for the training because once a worker’s productivity is enhanced, he will command a higher wage—and so some of his employer’s investment will be lost. Indeed, if he goes to work for his company’s competition (as he is presumably free to do), the investment in him will be lost altogether.

This leaves a significant role for investment by third parties: domestic government, international agencies, NGOs, foreign governments, and even private foundations. Indeed, the message from the theory is not to stop globalization (indeed, even if stopping it were possible, doing so would interfere with the very substantial gains in GDP per capita it has brought). Rather, the most effective remedy for inequality is to give low-skill workers the opportunity to share in globalization’s fruits too.
Observed over long periods, the upward path of the output of most economies occasionally takes jagged steps down. More often than not, these events are associated with a variety of crises, including systemic banking stresses, exchange rate crashes, a burst of inflation, and a restructuring or default on sovereign debt. Using a large panel of countries over a long period, we document that crises are typically associated with lower medium-term growth. That may be a direct causal channel, a reverse channel, or the influence of some other factors on both growth and finance. But they tend to go together. Given that the forces for convergence of income across countries are estimated to be slow, going off track around a crisis will likely have long-lived consequences for relative economic development. JEL codes: G01, N20, O4, O5

INTRODUCTION

Observed over long periods, the upward path of the output of most economies occasionally takes jagged steps down. More often than not, these events are associated with crises, including systemic banking stresses, an exchange rate crash, a burst of inflation, and the restructuring of or default on sovereign debt contracts. The shadow of these events on economic growth also tends to be long, producing the regularity in most time series across the world that the intensity of a variety of crises and GDP growth are negatively related and the effect long lived. This paper is about this association.

The issue resonates now because so many economies (mostly high-income countries) recently went through significant crises and recessions and have struggled with slow growth subsequently. The truth is that the association between crises and economic growth is a feature of the long sweep of history, which is one of the messages of Reinhart and Rogoff (2009). Our update to the dataset underlying that work allows us to document the negative link between elevated crises and economic growth.

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incidence of crises and economic growth across sixty-six countries over the past one and half centuries, which we employ to focus more about the longer-term relationship.

We intend to be careful throughout in not asserting a causal relationship between crises and growth. A crisis might undermine economic prospects by destroying financial wealth and impeding intermediation (as is the first of the possibilities underlying the link discussed in Reinhart and Reinhart, 2010). Or, a significant downward revision to the prospects for economic growth might lead households, firms, or governments to realize they have overborrowed, triggering trauma in finance (as is laid out in Buttiglione, et al., 2014). As another possibility, a haphazard national approach to the rule of law and other inadequacies in the political and regulatory infrastructure might jointly slow growth and raise the probability of crises (as is the message of Acemoglu, et al., 2003).

Ours is a more practical observation. How to spur growth is the first-order mystery of the economic development literature. How to know that growth has been spurred in real time is a daunting challenge for time-series econometrics. But we do know that a variety of crises and slow economic growth go hand-in-hand, implying that a government that attracts financial crises of any sort in a repeated manner invites disappointing economic outcomes. This might be because financial crises are a direct and major menace to economic activity. Even if they are not, they are at least the canary-in-the-coal-mine for signaling a risk to economic growth.

This especially matters for economic development because, as of yet, the other identified forces at work moving an economy along a growth trajectory appear to have only modest effects. Barro (2012) writes about the “iron law” of convergence observed across empirical growth models. Whether assessed conditionally (the association augmented by other variables) or unconditionally (the association taken in isolation), only about 2 percent of the gap between the level of a laggard economy from the advanced norm is worked off each year. Put this in perspective to the result in Reinhart and Reinhart (2010). Ten years after the fifteen worst financial crises of the second half of the 20th century, the median level of GDP per capita was 15 percent below the level predicted from the trend of the ten years prior to the crisis. If convergence is only 2 percent per year of the level difference, this slow force of adjustment implies that output makes up only two-thirds of the gap relative to its previous trend one-half century after the perturbation.

High stakes, indeed, and suggestive that an important focus of governmental attention in the development process should be building the legal and regulatory infrastructure of finance and delivering steady macroeconomic policies in a manner that avoids crisis. Those efforts, as well as avoiding the direct harm of crises, are conducive to growth in the long run.

The next section provides an abbreviated review of the literature and sketches the channels of transmission flowing back and forth between financial crises and medium-term economic growth. This includes work by Fischer (1993) and Bruno and Easterly (1998) highlighting the link between problematic policy choices (especially high inflation) and slower economic growth. Another strand
of work, begun by Ramey and Ramey (1995), delineates deleterious effects of the volatility of real growth to mean growth. The next step is to note that financial crises tend to elevate volatility, forging the link between crises and growth examined for Latin American economies by Edwards (2007) and for Asian ones by Barro (2001) and more broadly by Cerra and Saxena (2008) and Reinhart and Rogoff (2009).

The Varieties of Crises section updates to 2014 the crisis chronology first provided in Reinhart and Rogoff (2009). It reviews the six main varieties of financial dysfunction: banking crises, currency crashes, currency conversions/debasement, default on external debt, default on domestic debt, and high inflation.

This extended dataset is used in the Crises and Convergence section to characterize the relationship between a variety of crises and economic growth at both the individual country level and for regional groupings. We mostly rely on five- and ten-year averages of the data to establish the broad association between the intensity of financial crises and real GDP growth. And, indeed, the two are negatively related across countries and regions and over the broad sweep of time in a manner that seems robust. Another feature of the data is that crises are clustered across countries and persistent over time. Perhaps, then, it should not be a surprise that global economic growth has recently been and is projected to continue to be subpar.

Another aspect of the current conjuncture that is worrisome is examined in the External Risks to Convergence section. Major central banks are providing policy accommodation in unprecedented degrees when measured by the lowness of their policy rates and the scale and scope of their balance sheets (in a manner mapped out by Bernanke and Reinhart, 2004). Low interest rates at financial centers are exactly the mechanism identified in Reinhart and Reinhart (2009) tending to boost capital inflow “bonanzas” around the world. (By their definition, a capital inflow bonanza occurs whenever a country has elevated capital inflows compared to its own history.) Essentially, investors in financial centers are more likely to seek higher returns abroad when those at home are depressed. This matters because Reinhart and Reinhart also show that capital inflow bonanzas are good predictors of subsequent financial distress, including banking and currency crises and sovereign defaults. With major central banks keeping rates pinned to their zero lower bound and ballooning their balance sheets, capital inflows are currently elevated.

The concluding section repeats the advice woven throughout the paper. Avoiding crises is central to successful economic development. The advice for researchers is to try to understand why.

**Channels of Transmission**

Two questions focus our attention in reviewing the literature on various financial crises and economy growth. How might the two be linked? And what evidence has been put forward that they are linked?
As to the first question, economic theory offers many reasons why there would be a complicated back-and-forth connection between crises and economic growth. In principle, observation of an association between two variables invites one of three possibilities. The one causes the other. The other causes the one. Or some other force causes both.

A standard New Keynesian model would predict that a crisis produces an economic slowdown (as discussed in Reinhart and Reinhart, 2010). Most of the financial crises we tally destroy financial wealth, either through stopping payment with default, lowering equity values in the fire sale attendant to a banking crisis, reducing the real value of assets via unexpected inflation, or revaluing upward external liabilities with an exchange rate collapse. Add to this the possibilities that a banking crisis impedes intermediation in the manner discussed by Bernanke (1983) and leads to a “sudden stop” of external funding, as in Calvo (1998). All these influences cumulate to an adverse aggregate demand shock that slows economic activity if there is not sufficient policy offset. Policy offset matters because, in these sorts of models, an aggregate demand shock can always be blunted, abstracting from recognition lags. Monetary policy, however, might be constrained by the zero lower bound to nominal interest rates if little inflation is expected and fiscal policy might be hamstrung if there is a legacy of an outstanding large public debt. The result is economic contraction, followed by slow growth for some time associated with underinvestment in physical and human capital.

As another possibility, current and expected future supply might influence demand and the probability of a financial crisis. In particular, as described in Buttiglione et al. (2014), expectations of future growth determine the slope of the trajectory of future income. The net present value of that path determines the capacity of households, firms, and the government to borrow. If that path rotates down on the realization that growth ambitions were too ambitious, the reaction in financial markets might be jarring. The appreciation that economic performance will be poorer becomes the spark of financial crisis. As for precedent, consider that over-optimism on technological improvements such as the diving bell, the steam engine, the radio, and the Internet gave way to the reality of limits to growth, market correction, and economic contraction.

The third possibility is that this overstates the importance of macroeconomic dynamics. Instead, we might observe poor structural policies jointly impeding growth and raising the chance of financial crisis. Bad policies beget bad outcomes. The most forceful example of this line of argument is Acemoglu et al. (2003). They argue that the colonial past casts a long shadow. In that darkness, those economies have been unable to build the edifice of commerce, finance, and regulation to support growth. They are also more subject to extraction of private resources by those in power. Crises and slow growth are twinned because the government makes it so.

Notice there may be substantial overlap in these forces in any particular economy, indeed to the point of introducing a vicious circle that produces a development trap. An incomplete financial architecture makes it more likely the existing capital markets swing with a wide amplitude to any news on future aggregate...
supply. An adverse swing destroys wealth and sets in motion contraction for all the
conventional Keynesian reasons. But recession and financial crisis brings out the
worst in the elite, leading them to use their influence to get a bigger share of a
shrinking economic pie. The worsening of the rule of law and undercutting of
property rights tilts the growth profile down and further raises its amplitude for
the next mood swing in markets.

Understanding of the association between financial crises and economic growth
evolved over the years. First, there was attention paid to the negative effects of in-
fation and other poor policies on economic expansion. In cross-sectional and
panel regressions, Fischer (1993) found that inflation, large budget deficits, and
distorted foreign exchange markets impaired growth. Moreover, some of his evi-
dence suggested that causation ran from policies to income, not the other way
around. Bruno and Easterly (1998) isolated the investigation to the effect of high
inflation—above 40 percent—on economic growth. They hold that an episode of
high inflation takes a considerable toll on activity but, if reversed, produces an
equally large snapback. Put in our terms, inflation crises and economic growth are
negatively related. As with Fischer, they also find that wide parallel exchange
market premiums have predicted power for ill economic outcomes. This line of
inquiry was ultimately subsumed by work on empirical growth models that signifi-
cantly expanded the search for potential determinants. Summaries of this work
include Easterly and Levine (2001) and more recently Barro (2012).

Ramey and Ramey (1995) approached the issue from another direction.
Rather than look for the effects of policy on the path of national output, they ex-
amined the moments of the GDP process. In a large sample of countries, they
found a negative relationship between mean GDP growth and its volatility. The
core question in interpreting this association, however, is whether volatility is
directly harmful to growth or do countries with little capacity to absorb shocks
have both low and volatile real GDP growth. Hnatkovska and Loayza (2005) ex-
tended Ramey and Ramey’s work to find that, indeed, the effects are more severe
for countries with weak institutions. They also isolate those periods when the
time series of GDP growth volatility of an economy is extreme relative to the
global experience. Over time and across country, extreme volatility is strongly
negatively related to economic growth.

This work is the bridge to the neighborhood this paper inhabits. Identifying
extreme periods of GDP volatility is a selection method to define economic
crises, much in the manner Bruno and Easterly (1998) can be reinterpreted as se-
lecting out inflation crises from their sample. The empirical strategy is to choose
selection criteria for variables such as inflation and the exchange rate, augmented
by the policy narrative on the health of the banking system and sovereign debt re-
payments, to identify crises. Kaminsky and Reinhart (1999) did this for banking
and currency crises to find, among other results, that they are twinned—that
their incidence was highly correlated.¹

¹. Valencia and Laeven (2011) extend the sample of banking crises.
The natural next step was to examine the systematic behavior of macroeconomic variables in and out of these crises episodes. Barro (2001) did so to put the Asian crisis of 1997–98 in perspective, finding a significant negative effect on growth in the five-year window after the crisis but none thereafter. This is similar to Reinhart and Reinhart (2010), who by examining the decade following a crisis, conclude that there was a sizable level lower in GDP per capita after the fifteen worst financial crises of the twentieth century but no growth consequence once far enough passed the crisis. Edwards (2007) considered the behavior of Latin American countries around crises to conclude that weak institutional structures make it likely that the region will fall further down the global league table of GDP per capita.

Reinhart and Rogoff (2009) broadened the search to include more indicators and a much longer history, concluding that the aftermath of a severe financial crisis is considerable on economic activity. Cerra and Saxena (2008), in a shorter but wider sample, find that the output loss appears permanent.

The most explicit linkage between crisis identification and economic modelling is found in the work of Barro (2006), Barro and Ursuà (2008), and Nakamura et al. (2013). On the empirical side, this involved identifying large drops in output, consumption, and equity values over a long and broad sample. On the modelling side, they show that under certain specifications of consumer preferences, even a low probability of very adverse outcomes has profound implications for the equity premium and the risk-free interest rate.2

The central question we ask: Is the effect of a variety of crises on economic growth material enough to matter in the process of economic development? To do so, crises are agglomerated into a single summary statistic, adding across the incidence of chronic high inflation or multi-year default on sovereign debt or a shorter, but more intense, systemic banking crisis or sudden currency crash. This approach lends itself to further inquiry attempting to discriminate according to crisis type, but these distinctions can be blurred by the fact that many types of crises often overlap in the historical country experiences, a point emphasized in Reinhart and Rogoff (2009).

Varieties of Crises

Before we can establish an association between crises and growth, we need an assured definition of crises. In this section we lay out the varieties of crises and update their identification in time series ending in 2014 extending the long time series introduced in Reinhart and Rogoff (2009) in identifying data sources and specifying six types of crises.

Those six crises types are repeated in table 1, along with the criteria for determining that an event has been triggered. Six crises types are dated: banking; high inflation; exchange rate collapses; currency debasement or conversions; sovereign domestic debt restructuring or default; and comparable sovereign credit events for external debt.

2. For an application of this idea to debt dynamics, see Reinhart et al. (2015).
This identification requires judgment, including as to how serious financial distress has to be for a banking crisis. Thresholds on defining an inflation or exchange-rate crisis are similarly subject to debate. The definitions are summarized in table 1 and are taken from Reinhart and Rogoff (2009).

Figure 1 plots the annual average number of crises around the world from 1800 to 2014. A few points of background are required to appreciate this tally. First, as there are six types of crises, the potential range of the chart spans 0 (perfect tranquility) to 6 (all that could go wrong goes wrong). Second, the number of countries varies over time, with colonial empires limiting the count to 16 at the start in 1800. The Latin American independence movement doubled the number by mid-century. Coverage steps up twice more, after the dust clears from World War I and after the African independence movement of the 1960s. Third, the line plotted is unweighted across countries, so emerging market economies have an influence on the average disproportionate to their contribution to global GDP.

Reinhart and Rogoff (2009) run through the movements in this series in some detail. The familiar feature is that crises have always been with us—the events of 2008–09 do not leap off the page. The post-2008 rise in crises is notable higher if

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**Table 1. Six Crises Definitions**

<table>
<thead>
<tr>
<th>Crisis type</th>
<th>Threshold or criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I: Systemic/severe</td>
<td>We mark a banking crisis by two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that marks the start of a string of similar outcomes for other financial institutions</td>
</tr>
<tr>
<td>Type II: Borderline/financial distress/milder</td>
<td></td>
</tr>
<tr>
<td>Currency crashes</td>
<td>An annual depreciation versus the US dollar (or the relevant anchor currency—historically also, the UK pound, the French franc, or the German DM and presently the euro) of 15 percent or more</td>
</tr>
<tr>
<td>Currency conversions are added as a second variety of a currency crash</td>
<td>A currency reform where a new currency replaces a much-depreciated earlier currency in circulation</td>
</tr>
<tr>
<td>Debt crises: External</td>
<td>A sovereign default is defined as the failure to meet a principal or interest payment on the due date (or within the specified grace period). The episodes also include instances where rescheduled debt is ultimately extinguished in terms less favorable than the original obligation</td>
</tr>
<tr>
<td>Debt crises: Domestic</td>
<td>The definition given above for external debt applies. In addition, domestic debt crises have involved the freezing of bank deposits and or forcible conversions of such deposits from dollars to local currency</td>
</tr>
<tr>
<td>Inflation</td>
<td>An annual inflation rate 20 percent or higher by either the year-over-year change or December-to-December (if monthly data is available)</td>
</tr>
</tbody>
</table>

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Reinhart and Reinhart S59
the cries are weighted by the country’s share in world income, as the recent wave of crises fell largely on high income economies. The local peak of about three quarters is an 80th percentile event, not all that common, but the past few years did seem especially turbulent. Part of this is a recency bias because the 1830s, the 1930s, and the 1980s were also turbulent. But this time the banking crises were clustered in advanced economies, and there are more than twice as many emerging market economies in the later part of the sample. The monetary policy response of the central banks in the major financial centers pulled nominal interest rates to near-record lows. This created a relatively mild environment for financial markets and government finance in emerging market economies, suppressing the number of crises there. Also, note that the final chapter on the banking crises of advanced economies has not been written. We provisionally put the duration of banking crises as as long as national GDP had not recovered its prior peak. If GDP is subsequently revised lower or takes a downward turn sometime soon, historians might extend the spell of banking crises beyond what we penciled in here.

The next five charts (figures 2 through 6) track average annual financial crises for five regional subgroups: Africa, Asia, Europe, Latin America, and the “Western Offshoots” of the Old World (Australia, Canada, New Zealand, and the United States). In each, we repeat the track of the world average to give some sense

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3. The four economies of Emerging Europe, which round out the sixty-six-country sample, are not shown separately but are included in the world average.
**Figure 2.** Varieties of Crises, Africa (13 Countries) and World Aggregate (66 Countries), 1800–2014 Average Number of Crises per Country

*Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.*

**Figure 3.** Varieties of Crises, Asia (12 Countries) and World Aggregate (66 Countries), 1800–2014 Average Number of Crises per Country

*Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.*
Figure 4. Varieties of Crises, Western Europe (14 Countries) and World Aggregate (66 Countries), 1800–2014, Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.

Figure 5. Varieties of Crises, Latin America (18 Countries) and World Aggregate (66 Countries), 1800–2014, Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.
of relative performance. Also, as there are the measures we will mostly rely on to compare with GDP growth (which is typically not available as far back in time), the sample starts in 1870.

Two of the main messages of Reinhart and Rogoff (2009) show through here, and another one becomes clearer with the updated data. First, some regions are systematically more volatile than others for long stretches. Africa for most of its history, Asia before World War II, and Latin America since the 1970s regularly ran a rockier road than the rest of the world. Second, all regions have crises (although underneath the overall averages their composition varies). Only for a few decades after World War II were crises not recurrent (and that holds more for advanced economies). And third, graduation to tranquility is hard. Just when it is tempting to say crises are history, as in Asia before 1997 and Europe and the Western Offshoots before 2008, they recur.

Crises and Convergence

Having defined the event, it is incumbent on us to describe how the event matters. To that end, we focus on the growth of real GDP per capita for the sixty-six countries in the sample. Decade averages of the six regional subgroups are provided in table 2. The sources, familiar from Reinhart and Rogoff (2009), are summarized in the note to the table.

As is evident, economic growth does vary substantially from decade to decade. “Lost” decades do appear, witness the outright declines in GDP per
capita in Latin America in the 1980s and Emerging Europe in the 1990s. Rapid economic expansion in Asia is a post–World War II phenomenon, and Africa remains a laggard.

Our goal is to examine if this dispersion of growth outcomes is associated in a systematic fashion with the incidence of crises. The two panels of figures 7 through 11 start the process for the five regions already shown. The upper panels plot the five- and ten-year moving averages of the incidence of crises in the region relative to the world total as, respectively, the solid and dashed lines. The bottom panels do the same for moving averages of regional GDP relative to world growth.

Evident in the broad sweep of data is that Africa and Latin America have delivered subpar growth while still being risky, that Asia ran up several decades of relatively crisis-free expansion, and that advanced economies have become riskier places.

As for relative movements of the upper and lower panels, table 3 provides the simple correlations between the crises and growth differentials, along with the associated t-tests of difference relative to zero. Where available, correlations are provided for the pairwise five- and ten-year moving averages for the periods from 1874 to 2014 and 1955 to 2014. A high relative incidence of crises is associated with slower economic growth at the medium- and longer-term frequency at a

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>Asia</th>
<th>Western Europe</th>
<th>Emerging Europe</th>
<th>Latin America</th>
<th>Western Offshoots</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>1869</td>
<td>.</td>
<td>.</td>
<td>1.2</td>
<td>.</td>
<td>1.9</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>1879</td>
<td>.</td>
<td>.</td>
<td>1.0</td>
<td>.</td>
<td>0.8</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>1889</td>
<td>.</td>
<td>1.2</td>
<td>1.4</td>
<td>.</td>
<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>1899</td>
<td>.</td>
<td>1.8</td>
<td>1.5</td>
<td>.</td>
<td>0.9</td>
<td>0.8</td>
<td>1.3</td>
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<tr>
<td>1909</td>
<td>.</td>
<td>1.4</td>
<td>1.2</td>
<td>.</td>
<td>2.1</td>
<td>2.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1919</td>
<td>.</td>
<td>2.8</td>
<td>0.1</td>
<td>.</td>
<td>0.9</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>1929</td>
<td>.</td>
<td>1.6</td>
<td>3.8</td>
<td>.</td>
<td>3.4</td>
<td>1.5</td>
<td>3.0</td>
</tr>
<tr>
<td>1939</td>
<td>.</td>
<td>0.7</td>
<td>1.2</td>
<td>2.1</td>
<td>0.7</td>
<td>0.8</td>
<td>1.0</td>
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<tr>
<td>1949</td>
<td>.</td>
<td>−0.6</td>
<td>1.0</td>
<td>0.8</td>
<td>1.9</td>
<td>3.0</td>
<td>1.4</td>
</tr>
<tr>
<td>1959</td>
<td>.</td>
<td>3.2</td>
<td>3.9</td>
<td>4.0</td>
<td>1.5</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>1969</td>
<td>2.0</td>
<td>3.6</td>
<td>4.6</td>
<td>3.7</td>
<td>2.4</td>
<td>2.8</td>
<td>3.1</td>
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<tr>
<td>1979</td>
<td>1.9</td>
<td>4.5</td>
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<td>3.2</td>
<td>2.6</td>
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<tr>
<td>1989</td>
<td>0.1</td>
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<td>2.1</td>
<td>0.7</td>
<td>−0.6</td>
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<td>1999</td>
<td>0.4</td>
<td>3.9</td>
<td>1.9</td>
<td>−0.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
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<tr>
<td>2009</td>
<td>2.4</td>
<td>4.5</td>
<td>1.2</td>
<td>3.9</td>
<td>1.9</td>
<td>1.4</td>
<td>2.4</td>
</tr>
<tr>
<td>2010 to 2014</td>
<td>1.7</td>
<td>4.5</td>
<td>0.3</td>
<td>2.7</td>
<td>3.0</td>
<td>1.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Note: Decade averages ending in year listed, percent.

statistically significant level, with the exception of Africa. The negative association is most sizable for Asia, but it is large elsewhere.

This inverse relationship between the growth of GDP per capita and crises incidence also holds in the annual, unsmoothed observations. The inset to figure 12 provides the correlation between real GDP per capita growth and the
incidence of crises across sixty-six countries in the post–World War II era. Across all countries in the sample, the correlation is about $-0.25$, and statistically significantly so. The histogram reports along the vertical axis the frequency observed of the correlation coefficients measures along the horizontal axis. Fully
87 percent of the economies in the sample individually had negative correlation coefficients between growth and crises.

The contemporaneous correlation of about one-quarter belies how tightly growth and crises are knit. The bottom panel shows the correlation from 1955 to 2014 of real GDP growth to the current and lagged readings of the incidence of financial crises. The association is strongly negative long after the event (the
left axis) and statistically significantly so (the right axis). But the result also accords with the finding in Barro (2001) that the link between growth and crises weakens after about five years and Cerra and Saxena (2008) that the level effect is permanent.
Simple correlation coefficients, whether on annual or long-moving averages of the data, do not convey the cumulative relationship over long periods, although the fact that the association is negative over multiple lags offers the possibility that the effect adds up. The two panels of figure 13 below fill this gap by examining the extent that recent economic outcomes are related to a
Table 3. Correlation of Growth and Crisis Differentials for Regional Aggregates Five- and Ten-Year Moving Averages Relative to the World Aggregate

<table>
<thead>
<tr>
<th></th>
<th>Africa*</th>
<th>Asia</th>
<th>Western Europe</th>
<th>Emerging Europe</th>
<th>Latin America</th>
<th>Western Offshoots</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Five-year/five-year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955 to 2014</td>
<td>correlation</td>
<td>-0.03</td>
<td>-0.77</td>
<td>-0.44</td>
<td>-0.49</td>
<td>-0.49</td>
</tr>
<tr>
<td></td>
<td>number of observations</td>
<td>50</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>t-test</td>
<td>-0.20</td>
<td>-9.25</td>
<td>-3.75</td>
<td>-4.32</td>
<td>-4.31</td>
</tr>
<tr>
<td>1874 to 2014</td>
<td>correlation</td>
<td>-0.62</td>
<td>-0.32</td>
<td>-0.31</td>
<td>-0.36</td>
<td>-0.25</td>
</tr>
<tr>
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<td>number of observations</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>t-test</td>
<td>-9.16</td>
<td>-3.98</td>
<td>-3.78</td>
<td>-4.50</td>
<td>-2.99</td>
</tr>
<tr>
<td><strong>Ten-year/ten-year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955 to 2014</td>
<td>correlation</td>
<td>0.17</td>
<td>-0.77</td>
<td>-0.18</td>
<td>-0.45</td>
<td>-0.37</td>
</tr>
<tr>
<td></td>
<td>number of observations</td>
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<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>t-test</td>
<td>1.18</td>
<td>-9.11</td>
<td>-1.37</td>
<td>-3.87</td>
<td>-2.99</td>
</tr>
<tr>
<td>1874 to 2014</td>
<td>correlation</td>
<td>-0.77</td>
<td>-0.27</td>
<td>-0.35</td>
<td>-0.49</td>
<td>-0.21</td>
</tr>
<tr>
<td></td>
<td>number of observations</td>
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<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>t-test</td>
<td>-14.28</td>
<td>-3.36</td>
<td>-4.39</td>
<td>-6.65</td>
<td>-2.56</td>
</tr>
</tbody>
</table>

* 1965 to 2010

Sources: See Reinhart (2010) for varieties of crises. See notes to Table 2 for GDP per capita.
country’s legacy of financial crises. The upper panel looks at (the logarithm of) GDP per capita, measured in US dollars, in 2014, as assessed by the IMF in the *World Economic Outlook* (10/2014). The lower panel looks at annual average inflation from 2010 to 2014, also from the same source. The horizontal axis measures the frequency of crises on average over a country’s existence or from 1800 for nations of longer vintage. As there are six different varieties of crises, the raw count is divided by six times the years of existence. 4

As is evident, countries with a checkered legacy of crises are lower in the ranking of GDP per capita. The inset box reports a regression of GDP on crisis frequency for sixty-five countries (omitting the outlier, Angola). The statistically significant

4. This way, a country that had every type of crisis in every year of its existence would have a crisis frequency of 100 percent.
coefficient of $-0.13$ implies that moving from around the sample average of a 10 percent probability of one of the six crises per year to 20 percent is associated with GDP per capita that is 13 percent lower. A similar doubling of crisis incidence accompanies a 1–3/4 percentage point higher inflation rate in recent years. The former result suggests that the negative correlation between economic growth and crisis incidence over time and across countries and regions cumulates to send an important message about levels. We did not address inflation dynamics in the same manner, but from a development perspective, the occurrence of higher inflation should be taken as a red flag that warns about a higher crisis risk.

Again, we are only dealing with an association, but to quantify that association, one of the variables had to be placed on the right-hand-side of a regression,

**Figure 13.** Predicting Recent Economic Outcomes with Prior Crisis Incidence

GDP per Capita vs. Inflation

just as it was placed along the horizontal axis of a chart. Whatever that arbitrary decision, it may be that crises impede growth or that slower growth breeds crises. Whatever the channel, the frequent appearance of financial crises is paired with a lack of income convergence.

**THE EXTERNAL RISKS TO CONVERGENCE**

If financial crises directly threaten, or even indicate a threat to, economic convergence, then a pattern of late should give anyone pause. Policy interest rates are understandably low in major financial centers, making it important to also understand how that poses risks to economies not as far along in the development process. A repeated pattern in the modern era of global finance is that, when interest rates in major financial centers are low, foreign investors are attracted to emerging markets. Capital flows into small and shallow local markets, leading the exchange rate to appreciate, asset prices to rally, government budgets to improve, and local leaders to congratulate themselves as the rightful recipients of capital. In such an environment, structural weaknesses remain unaddressed, or even worsened, as local institutions stretch to move up a notch among the global competition.

Reinhart and Reinhart (2009) provide a simple identification scheme to assess periods of elevated external risks. Employing a variety of datasets, they select periods when an economy receives elevated capital inflows relative to its own history. Given the paucity of data, they use the mirror to capital account surpluses, current account deficits. Mechanically, any year is identified as having a capital flow bonanza when its current account balance is in deficit and its level relative to nominal GDP is in the lower 20th percentile of experience. The shaded area of figure 14 updates this calculation using the short time series (1980 to 2014) available in the IMF World Economic Outlook (10/2014).

As is evident, there have been four prior peaks in capital inflows in the past 35 years. All came before a pickup in financial crises worldwide. The (largely) Latin American debt crisis came first, early in the sample, as many countries in that region defaulted and suffered attendant financial dysfunction. The Mexican crisis of 1994–95 and the Asian crisis of 1997–98 followed. The most recent peak in capital inflows presaged the subprime crisis of 2008–09. As shown in the inset, across sixty-six countries and thirty-five years of data, the observed unconditional probability of having one of the six possible crises is 13.5 percent in a given year. Limiting the observations to years in which a country is currently having or had in the prior two years a capital inflow bonanza raises the conditional probability of having a financial crisis to 18.4 percent. That difference is statistically significant using the z-test described in Reinhart and Reinhart

5. Of course, large-scale reserve accumulation as practiced by some important economies muddies this relationship.
Indeed, in about two-thirds of the countries, the probability of a crisis around the dates of a capital inflow bonanza is higher than for the entire sample.

The bottom panel shows the unconditional and conditional probabilities of the six possible crises across five regions of the world. In all cases, knowing that a country had at least one of the varieties of crises in a moving three-year window of data sharpens the understanding of a chance of crisis. The largest differences are among emerging market economies, consistent with the view that understanding crisis dynamics is important in the development process.

The likely reason for this link is that a heavy inflow period can persist, potentially lulling policy makers and investors to the view that the bonanza is permanent, rather than temporary. Episodes end, more often than not, in an abrupt reversal. When flows reverse, asset prices give back their gains, often forcing painful adjustments on the economy. A bonanza is not to be confused with a blessing.
CONCLUSION

Policy makers must appreciate that a variety of crises are typically associated with slower economic growth. That may be a direct causal channel, a reverse channel, or the influence of some other factors on both growth and finance. But they go together. The influence of other forces for convergence of income across countries that economists have thus far identified are estimated to be slow, so going off track around a financial crisis will likely have long-lived consequences.

Some of the seeds of crisis are scattered on the financial landscape by official action, including erratic fiscal and monetary policies and a disregard for the rule of law and property rights. But some are beyond the control of policy. The sentiment of investors seems to swing in a wide arc, for instance, and the pace of technological progress is haphazard. Developments on world financial markets, international commodity prices and interest rates at the financial centers, obviously fall into the latter camp. However, when considering alternatives along the development path, policy makers should appreciate “the mixed blessing” of capital inflows.6

The surge in inflows from the early 2000s to 2008 was predominantly directed to advanced economies, most notably in periphery Europe.7 Following the 2008–09 crises, the economic prospects of many emerging markets compared favorably with the bleak performance of the advanced economies, and these discrepancies helped fuel a marked and sustained rise in capital inflows through 2013. Taking at face value the historical patterns described here, as to the connection between inflows and crises and crises and growth, raises concerns that the relatively crisis-scarce decade of 2004–14, which facilitated a faster pace of convergence between emerging markets and advanced economies, may not repeat itself in the years to come.

Policy makers in most open economies cannot stop external waves, but they are not completely powerless as to how much of their force washes ashore. Along with policies in the realms of human capital formation, institution building, and infrastructure development, crisis avoidance supplements the list of policy initiatives to foster long-term growth.

REFERENCES


6. The “mixed blessing” view is not novel, as in the title of Reinhart and Reinhart (1998), who present a menu of policy choices aimed at mitigating the boom-bust cycle of international capital flows.

7. Greece, Iceland, Ireland, Portugal, and Spain posted record or near-record current account deficits, financed by capital inflow bonanzas on the eve of crises.


Theories of Poverty Traps and Anti-Poverty Policies

Maitreesh Ghatak

In this paper we provide a conceptual overview of alternative mechanisms leading to poverty traps at the individual level, making a distinction between those that are due to external frictions (e.g., market failure), and those that are due to behavior under extreme scarcity in the absence of any frictions. We develop a common theoretical framework to examine alternative scenarios, characterizing conditions under which poverty traps (in the sense of multiple stable steady states) arise, as opposed to (possibly, conditional) convergence to a unique steady state. We apply this framework to discuss the relative merits of alternative anti-poverty policies, such as unconditional and conditional cash transfers, and direct interventions aimed at improving market access to the poor or improving public service delivery. JEL codes: D13, D23, O12, O15

INTRODUCTION

There are two distinct strands of thinking on poverty. One view is that the poor are just like the nonpoor in terms of their potential (that includes ability, preferences), and they simply operate in a more adverse environment, in terms of individual characteristics (e.g., factor endowments) or economy-wide characteristics (e.g., prices, infrastructure, various government policies). The best known statement of this view is Schultz’s phrase “poor but rational.” Modern development economics has extended this view to what Duflo (2006) calls “poor but neoclassical” by studying various frictions that impede the smooth functioning of markets as well as technological nonconvexities that make it disadvantageous to be poor or operating at very low scales. We lump these together and call them “external frictions” (along with frictions that arise from poor governance, infrastructure, etc.) that prevent the poor from making the best use of their
endowments through exchanges in the marketplace or through technology. The implicit premise of this view is that poverty is a consequence of individuals operating with an unfavorable external environment. To the extent this can be fixed by placing a poor individual in a more favorable external environment, it will be a transient phenomenon but otherwise the poor may be trapped in poverty. In a sense, in this view the phenomenon of poverty, other than being inequitable, is also inefficient: a combination of individual rationality and market forces should work to utilize any potential gains (e.g., lost income from insufficient investment in human capital) and the question is, what external frictions prevent this from happening.

A very different view of poverty is, even if there were no external frictions, the poor are subject to different pressures and constraints from the nonpoor and that drives them into making choices that are very different, and more importantly, that can reinforce poverty. Having very low incomes means an individual has to engage in a day-to-day struggle for survival for herself and her family, and there may be a self-reinforcing dynamics at work through the choices that are made under extreme scarcity that keep those with poor initial endowments of financial and human capital, poor over time and across generations. It is tempting to call this view “poor but behavioral,” but we are going to argue that this is a broader phenomenon, as even if all individuals are rational in the neoclassical sense, choices under extreme scarcity can reinforce the tendency of the poor to stay poor. For example, at very low income levels, subsistence considerations may rule out the feasibility of saving at a reasonable rate, and investing money in health and education to secure a better for future for themselves and their children. In fact, the relevant scarce resource does not have to be money but can also be time or attention span.\(^1\)

In this paper we develop a conceptual framework and simple unifying model that distinguishes between what we call “friction-driven” and “scarcity-driven” poverty traps corresponding to the two views of poverty discussed above. We start with a standard dynamic model of an individual saving or leaving as bequests a constant fraction of income, and investing over time and study how her income and wealth grows. Then we introduce various external frictions and study conditions under which rather than converging to a unique steady state, there could be multiple stable steady states, and which steady state an individual ends up depends on her initial wealth, that is, a poverty trap exists. We focus on poverty traps at the level of individuals and adopt a partial equilibrium approach (i.e., take prices as given) to examine under what conditions two individuals who are identical in all respects but only differ in their initial wealth may end up with different steady state wealth levels. We do not look at aggregate or macrolevel poverty traps, where interest rates or wages adjust with capital accumulation or

---

\(^1\) See Banerjee and Mullainathan (2008) for a formalization, and also Mullainathan and Shafir (2013) for various examples.
general equilibrium effects. We then extend the model to relax the assumption that people save a constant fraction of their income and allow the choice of saving to depend on income in a nonproportional way (which results from non-homothetic preferences) and characterize conditions for poverty traps to emerge. We consider the role of behavioral biases as well as insufficient intergenerational altruism in this context.

We draw a number of interesting inferences. We show that capital markets frictions play an important role in determining the possibility of poverty traps, but these are neither necessary nor sufficient for poverty traps to arise, even if we restrict attention to friction-driven poverty traps. This suggests being careful in making inferences about whether poverty traps do or do not exist from any piece of evidence suggesting the presence or absence of any single friction. We also show that poverty traps can exist even without any external frictions due to the operation of strong income effects in the behavior of individuals, and this is possible without any behavioral biases.

We then discuss the distinctive policy implications of these two kinds of poverty traps. We will focus on a representative “poor” agent and assume that the policymaker has some resources (which are costly due to taxes being distortionary and there being alternative uses of public funds) and wants to help the poor individual escape poverty, defined in terms of some minimum level of income, consumption, or wealth. For the most part, we assume the policymaker’s objective function is the same as the individual’s preferences, but in some cases there may be grounds for having paternalistic preferences.

We distinguish between policies that are aimed at improving market access to the poor as well as improving productivity in general (e.g., through better public service delivery) by dealing directly with the frictions and those that involve direct transfers to the poor. We show that for both types of poverty traps, lump-sum transfers work (under some conditions). However, if poverty traps are friction-driven, then it is possible to substitute lump-sum transfers with “supply-side” policies that directly tackle the frictions. We also show that to the extent scarcity and frictions coexist, there are strong complementarities between policies that increase the purchasing power of the poor and those that are aimed at removing a friction. We show that to the extent the preferences of the individual differ from that of the policymaker (which can be due to behavioral biases or insufficient intergenerational altruism or gender bias), unconditional lump sum transfers will not be the most efficient form of intervention and there may be a case for “paternalistic” interventions such as conditional cash transfers.

The plan of the paper is as follows. In the next section we develop a benchmark model without any frictions, as well as any scope for the behavior of the poor to be different due to the operation of income effects. In the third section

2. See Azariadis (1996) and Banerjee (2003) for reviews of the literature on poverty traps. See Mookherjee and Ray (2003) for an example of a poverty trap with general equilibrium effects that arise from the equilibrium returns from different occupations adjusting in response to individual choices.
we analyze poverty traps that are driven by frictions (subsection titled External Frictions) and, choice under scarcity (subsection titled Non-Homothetic Preferences). In the fourth section we discuss the policy implications of our theoretical framework. The final section concludes with some observations of interesting issues that are worth exploring further in future research.

THE BENCHMARK MODEL

In this section, we develop a standard model of a representative individual using capital to produce output, with no market friction or any kind of nonconvexity. In addition, we assume preferences are homothetic in income, and therefore, in a proportional sense, there is no difference in the “behavior” or “choices” of the poor from that of the rich, say, in the context of savings.

One-Period Model

Suppose production \( q \) depends on one input \( x \) given by a standard neoclassical production function:

\[
q = Af(x).
\]

\( A \) denotes the productivity parameter which could be driven by skills, ability, infrastructure, institutions. The function \( f(x) \) is assumed to have the standard properties of a neoclassical production function. Whenever convenient, we will use the example of the Cobb-Douglas production function: \( q = Ax^\alpha \) where \( \alpha \in (0, 1) \). We will focus here on physical or financial capital, denoted by \( k \) and so \( x = k \). We will consider the role of other inputs in the next section. Here we can think of a self-employed individual using capital to run a business.

To keep the notation simple, we assume \( k \) is working capital and therefore, fully depreciates after use. Since capital fully depreciates with use, returns to a unit of capital, denoted by \( r \), has to exceed 1: That is, \( r \) is the gross rate of interest. As mentioned earlier, we focus at a representative individual, and take \( r \) as exogenously given all through. An individual has capital endowment \( k \). Her profits are

\[
\pi = \max_k Af(k) - rk.
\]

With perfect capital markets her income is:

\[
y = \pi + rk.
\]

This shows that the endowment of capital or wealth does not matter for productive efficiency although it does matter for final disposable income. Through rental or sales (in a one-period model they are equivalent), they adjust to maximize efficiency, with all production units using the same amount of capital given by \( k^* \) which is a solution to \( Af'(k) = r \). If someone is capital-rich, she can lend
capital, and borrow otherwise. Therefore, with perfect markets and no frictions (e.g., nonconvexities), we have a separation between productive efficiency and individual economic outcomes. To the extent we care about an individual’s income falling below some minimum threshold, that is, poverty, there is a case for redistributive transfers, but they will not have any positive productivity impact on the recipient.

**Infinite Horizon Model** We now introduce dynamics in the one-period model to allow for savings and capital accumulation over time so that the current endowment of the capital stock $k$ (equivalent to wealth in this model) is the result of past choices rather than being exogenously given. We assume preferences are homothetic and people save at a constant rate $s$, as in the Solow model. Alternatively, we can assume that individuals live for one period, pass on a constant fraction $s$ of their wealth as bequests to the next generation. In the next section we will examine the consequences of relaxing the assumption of a constant saving rate.

The constant rate of saving or bequest can be micro-founded in the following way that is standard in the occupational choice literature (see Banerjee 2003). Suppose individuals have preferences over consumption ($c$) and bequests ($b$) and the utility function is given by:

$$U(c, b) = \log c + \beta \log b$$

where $\beta \geq 0$. As is standard, we assume bequests cannot be negative. If we maximize this subject to the budget constraint $c + b \leq y$ then we get the usual result: $b = sy$ where $s = \frac{\beta}{1+\beta}$. This budget constraint implies the presence of intertemporal borrowing constraints. We will discuss the implications of this assumption, as well as that of bequests being non-negative later in this section.

Let $k_t$ denote the capital endowment in time $t$. The bequest of generation $t$ determines capital endowment in period $t+1$: $b_t = k_{t+1}$. With perfect capital markets we get:

$$k_{t+1} = s(\pi + rk_t).$$

Assuming $sr < 1$ we get convergence to a unique steady state as figure 1 shows, using a familiar diagram.

In the figure, the grey line (we will turn to the concave curve in the next section) represents the equation that gives the evolution of the capital stock over time. The unique steady state capital stock $k^*$ is given by

$$k^* = \frac{s\pi}{1 - sr}.$$

3. This is the same as the separation result in the context of Agricultural Household Models, as developed by Singh, Squire, and Strauss (1986).
Since we assume no interpersonal heterogeneity, all individuals will converge to the same steady state $k^*$, that is, we have unconditional convergence. However, as is well known, convergence may take time depending on parameter values, and so as in the one-period model, there may be a case for pro-poor policies on redistributive or equity grounds.

**Departures from Benchmark Model**

Now we proceed to study two sets of departures from this model: first, we introduce external frictions that constrain the choices available to the individual, due to market imperfections, technological nonconvexities; second, we look at the consequences of individuals having non-homothetic preferences, so that the poor behave or make choices that are different from those who are not poor even in the complete absence of external frictions.

**External Frictions**

In this section we discuss relaxing various assumptions of the model outlined in the previous section that allow the possibility that two individuals who are identical in all respects except for their initial endowment of capital (or wealth), $k_0$, can end up with different levels of incomes and capital stocks in steady state, which is a formal way of describing a poverty trap in this framework.
Below we discuss the consequences of relaxing a number of assumptions in the benchmark model.

**Capital Market Imperfections** Suppose capital markets are imperfect. In fact, for expositional simplicity, let us assume that there are no capital markets. This means, on top of intertemporal borrowing constraints, it is not possible to borrow to finance working capital within a given period. In the one-period model the separation result breaks down: output is now $q = Af(\bar{k})$. Turning to the infinite-horizon model, the case of no capital markets is equivalent to the standard Solow model where individuals save a constant fraction of their income to accumulate capital over time. As we assume capital fully depreciates, the modified transition equation is:

$$k_{t+1} = sAf(k_t).$$

This is captured by the concave curve in figure 1. Following a standard argument, there will be convergence to $k^*$, assuming $r$ is given by the marginal product of capital evaluated at the steady state capital stock, namely, $Af'(k^*)$.

$^4$ Initial conditions will not matter in the long-run.

Of course, if $A$ differs across individuals then we get *conditional convergence*. What this diagram shows is, if we introduce capital markets, convergence is speeded up. The capital stock used in production will reach the steady state level right away, while the owned capital stock of the individual will grow along with income, and eventually reach this steady state level.

We could allow intermediate levels of capital market imperfections, where the amount of capital that an individual can use is some multiple of her initial capital stock, i.e., $\sigma k_0$ where $\sigma > 1$ (and not too large so that capital market frictions do have bite), which can be generated by one of the standard channels of credit market frictions, such as *ex ante* or *ex post* moral hazard (see, e.g., Banerjee 2003).

The main lesson of this exercise is that, subject to the same fundamentals, being capital-poor is no handicap in the long run as individuals accumulate and converge to the same steady state even if capital markets are imperfect. Of course, the convergence can take a long time and this might be grounds to have in place policies that facilitate access to capital of the poor. But history does not matter, and one-shot policies cannot have long term effects: two individuals who are identical except for their initial endowments of capital being different will end up in the same steady state. However, if there are additional frictions, then capital market frictions can lead to poverty traps, as we will see below.

$^4$ This is in order to have the same benchmark under these two different scenarios (perfect and no capital markets), and can be justified by the assumption of having many atomistic individuals with the same deep parameters ($A$, $s$ etc), but with different initial values of $k_0$ (and in particular, those with $k_0 \geq k^*$ being able to meet the demand of those with $k_0 < k^*$, on aggregate).
Nonconvexities Suppose the production technology is subject to nonconvexities. In particular, let us introduce set-up costs as an example of nonconvexities in the following form:

\[
q = A_f(k), \quad \text{for } k \geq k^*
\]

\[
= w, \quad \text{otherwise.}
\]

where \(0 \leq w < A_f(k^*)\), is returns from a subsistence activity. It is assumed that the subsistence activity needs no capital and only labor.

It is possible to interpret this nonconvexity as reflecting imperfections in the market for some input other than capital. For example, suppose without a minimum amount of land, production using the modern technology (given by \(A_f(k)\)) cannot take place. Clearly rental markets or time-sharing arrangements could overcome this indivisibility and to the extent those are not possible due to some institutional or contracting friction, the indivisibility will have bite. At the end of this section we will explore the role of inputs other than capital and imperfections in those markets.

First let us assume capital markets are perfect. Then profit maximization yields \(\pi = \max_k A_f(k) - rk\) for all individuals since the subsistence technology is an inferior option. As a result, with perfect capital markets the equation of motion is:

\[
k_{t+1} = s(\pi + rk_t) \quad \text{for all } k \geq 0.
\]

It is depicted by the thin and grey line segment in figure 2.

**Figure 2.** Nonconvergence in the Solow Model
As before, we will have a unique steady state at $k = k^*$. Therefore, with perfect capital markets, an individual can borrow $k$ or more, and so the indivisibility does not bind and there is no poverty trap.

If capital markets are absent then the transition equation is given by:

$$k_{t+1} = sAf(k_t) \text{ for } k \geq k^*$$

$$= s(w + k_t), \text{ otherwise.}$$

Since the subsistence activity needs no capital, any capital that an individual owns is part of total income, but there is no interest earned on it, as capital markets are assumed to be absent. We are assuming that saving is feasible even without capital markets, for example, through some storage technology. Also, we are assuming that all individuals save a fraction $s$ of their income whether they are operating the subsistence technology (for which no capital is needed) or the modern technology. We could alternatively have assumed that for $k \leq k^*$ individuals don’t save at all, that is, $k_{t+1} = 0$ and that would not change our conclusions. We postpone the discussion of the saving rate varying with income to section 3.2.

For $k \geq k^*$, the transition equation is strictly concave and increasing as in the case of no nonconvexities and autarchy. This part is depicted by the concave curve in figure 2. For $k \leq k$, the transition equation is linear, as given by the transition equation above. As there are no capital markets, the transition equation has slope $s$ rather than $sr$. It is depicted by the thick and grey line segment in figure 2. As we can see that there will be multiple steady states: for those whose initial endowment of capital was $k$ or more will converge to $k^*_{I_H}$ while those who started with less than $k$ will converge to $k^*_{I_L} < k^*_{I_H}$. This is an example of a poverty trap: initial conditions matter, even in the very long run. However, having capital market frictions and nonconvexities is not sufficient for poverty traps. If $s$ or $w$ are high enough (as depicted by the dashed line segment), then it is possible to save one’s way out of the poverty trap.5

Even if the production technology is convex, nonconvexities can arise in other ways. For example, suppose $A$ (which captures complementary inputs, such as, infrastructure) depends on $k$ such that wealthy get an advantage, that is, $A = A(k)$ and in addition, this function is subject to nonconvexities. If capital markets are perfect, then individuals should be able to overcome this indivisibility through borrowing. A similar argument applies if in the absence of capital markets that prevent borrowing or saving through external financial institutions, the poor in addition, do not have access to a good savings technology (e.g., storage), due to, say, imperfect property rights while the rich do (because, e.g., it is easier to steal from the poor). To the extent the relationship between wealth and the effective savings rate (as opposed the intended one, which is determined by preferences) is subject to nonconvexities, poverty traps can result.

Non-convexities can take many other forms (e.g., an S-shaped production function that captures increasing returns at low levels of capital, and diminishing returns at higher levels in a more continuous way), but the basic intuition of our analysis goes through.

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5. Non-convexities can take many other forms (e.g., an S-shaped production function that captures increasing returns at low levels of capital, and diminishing returns at higher levels in a more continuous way), but the basic intuition of our analysis goes through.
Alternatively, suppose that if $c \leq \zeta$, people do not survive or are unproductive (similar to the nutrition-based efficiency wage argument as in Dasgupta and Ray 1986). Now the transition equation is

$$k_{t+1} = sAf(k_t) \text{ for } (1-s)f(k_t) \geq \zeta$$

$$= 0, \text{ otherwise.}$$

Again, we will get a threshold $k$ defined by the equation

$$(1-s)f(k_t) = \zeta.$$ 

If capital markets are perfect, individuals can borrow to and invest in their health and therefore, there is no poverty trap. Otherwise, this form of nonconvexity, like those for the production technology, the savings technology, or the productivity parameter $A$, can generate poverty traps when coupled with capital market imperfections.\(^6\)

More broadly, even though we have taken here the example of physical capital, the point about the relationship between capital market frictions and nonconvexities affecting the production technology applies more generally. Instead of a minimum consumption constraint, suppose the productivity of individuals depend on nutrition (as in Dasgupta and Ray 1986) and that relationship involves nonconvexities. If capital markets existed and were perfect (a possibility that Dasgupta and Ray [1986] do not allow), individuals would have borrowed and achieved the efficient level of nutrition. The higher wages that would result from being more productive would help them pay off the loan. To get a poverty trap in this setting, one would need capital markets to be imperfect.

**Other Market Frictions** Let us augment the basic one-period model of section 2 by adding an additional input, $h$, which we will refer to as human capital (but can be interpreted as other inputs such as land in some contexts, as discussed below). Suppose the initial endowment of human capital of the individual is $\bar{h}$ and that $h$ can be obtained from a competitive market at cost $\rho$ per unit. Output is now

$$q = Af(k, h).$$

Profits are $\pi = q - rk - \rho h$. Profit-maximization yields the standard first-order conditions:

$$f_k(k, h) = r$$

$$f_h(k, h) = \rho.$$

\(^6\) An alternative way of treating minimum consumption constraints is discussed in the next section, where people choose to save at a lower rate when they are poor. Here it is modeled similar to an external biological constraint like “maintaining” the (human) capital stock.
The optimal levels of \( \hat{k} \) and \( \hat{h} \) can be solved from these as functions of \( r \) and \( \rho \) and as before, the endowment of the individual will not matter in determining productive efficiency, although it will matter for the income of the individual. A rental or sales market will achieve the efficient allocation and in the absence of specific contracting frictions, these are equivalent. Even if there is a cash-in-advance constraint that applies for inputs other than capital - namely, they must be paid for in advance in cash - our conclusion is unchanged so long as capital markets are perfect.

Now let us assume that there is no market for \( h \) (with or without cash-in-advance) while the market for \( k \) operates just as before. In that case, the individual’s choice of \( k \) will be given by:

\[
f_k(k, \bar{h}) = r
\]

and the optimal choice, which we will denote by \( \hat{k} \), will depend on \( \bar{h} \). For convenience, let us assume the Cobb-Douglas production function: \( q = Ak^a h^\beta \) with \( \alpha, \beta \in (0, 1) \) and \( \alpha + \beta \leq 1 \). In this case, solving the above equation explicitly for \( k \) as a function of \( r \) and \( h \) we get

\[
\hat{k} = \left( \frac{A \alpha}{r h^\beta} \right)^\frac{1}{1-a}
\]

and substituting in the production function, we get

\[
q = A^{\frac{1}{1-a}} \left( \frac{\alpha}{r} \right)^{\frac{a}{1-a}} h^{\frac{\beta}{1-a}}.
\]

Net output (taking into account the cost of \( k \)) is:

\[
q - rk = A^{\frac{1}{1-a}} \left( \frac{\alpha}{r} \right)^{\frac{a}{1-a}} (1 - \alpha) h^{\frac{\beta}{1-a}}.
\]

Let \( \phi(h) = A^{\frac{1}{1-a}} \left( \frac{\alpha}{r} \right)^{\frac{a}{1-a}} (1 - \alpha) h^{\frac{\beta}{1-a}} \) denote net output as a function of \( h \). It is an increasing and strictly concave function of \( h \) for the case of decreasing returns \( (\alpha + \beta < 1) \) or linear in the case of constant returns \( (\alpha + \beta = 1) \). Now the individual’s income \( y \) is net output plus interest earned on owned capital:

\[
y = \phi(h) + rk.
\]

Turning to dynamics, let \( h_t \) and \( k_t \) denote the human and physical capital endowment of the individual at time \( t \). Income at time \( t \) is given by

\[
y_t = \phi(h_t) + rk_t.
\]
The equation of motion for $k_t$ is:

$$k_{t+1} = s(\phi(h_t) + rk_t) \quad \text{for all} \quad k \geq 0.$$ 

Now we turn to the interesting question, namely, how does $h_t$ evolve over time. Suppose income can saved and spent on investing in $h$, similar to how savings is used to accumulate $k$. Even though in a given period, $h$ cannot be rented or bought to be used in production, suppose it can be “produced” for the next period by saving a certain fraction of income (e.g., investing in the education of children). In particular, let

$$h_{t+1} = \gamma y = \gamma(\phi(h_t) + rk_t)$$

where $\gamma \in (0, 1)$ and $s + \gamma < 1$ to ensure that total saving (in $k$ and $h$) as a fraction of income is less than 1. The advantage of this formulation is that the accumulation equation for $h$ is identical to that for $k$, up to a multiplicative constant:

$$h_{t+1} = \frac{\gamma}{s} k_{t+1}.$$ 

The equation of motion of $k$ in this case is:

$$k_{t+1} = s(\phi\left(\frac{\gamma}{s} k_t\right) + rk_t).$$

This allows us to characterize the steady state level of $k^*$ by standard arguments:

$$k^* = \frac{s\phi\left(\frac{\gamma}{s} k^*\right)}{1 - sr}$$

and $h$ too converges to

$$h^* = \frac{\gamma}{s} k^*.$$ 

What is interesting to note is that we do not get poverty traps but unconditional convergence.

Of course, this conclusion changes if there are nonconvexities in the relationship between $h$ and $y$. Suppose the production function is

$$q = \bar{A}k^\alpha \quad \text{for} \quad h \geq \bar{h}$$

$$= \bar{A}k^\alpha, \text{otherwise}$$
where \( \hat{h} > 0 \) and \( \bar{A} > A > 0 \). The only change from above is now net output as a function of \( h \) as captured by \( \varphi(h) \) is no longer a smooth and continuous strictly concave function but has a discrete jump at \( h = \hat{h} \). Income \( y \) is given by:

\[
y_t = (\bar{A})^{\frac{1}{\alpha}} \left( \frac{\alpha}{r} \right)^{\frac{1}{1-\alpha}} (1 - \alpha) + rk_t \quad \text{for} \quad h \leq \hat{h}
\]

\[
y_t = (\bar{A})^{\frac{1}{\alpha}} \left( \frac{\alpha}{r} \right)^{\frac{1}{1-\alpha}} (1 - \alpha) + rk_t \quad \text{otherwise.}
\]

Since \( h_{t+1} = \gamma y_t \) and \( k_{t+1} = s y_t \), both the human and physical capital transition equations will be piecewise linear with discrete jumps at \( h_t = \hat{h} \) and \( k_t = \frac{s}{\gamma} \hat{h} \), respectively. The transition equation for \( h \) is given by:

\[
h_{t+1} = \gamma \left\{ A^{\frac{1}{\alpha}} \left( \frac{\alpha}{r} \right)^{\frac{1}{1-\alpha}} (1 - \alpha) + \frac{sr}{\gamma} h_t \right\}
\]

with \( A \) taking the values \( \bar{A} \) or \( A \), depending on whether \( h_t \geq \hat{h} \) or \( h_t < \hat{h} \). There will be a parallel transition equation for \( k \). By standard arguments, we may have two stable steady states, i.e. a poverty trap may exist as we depict in figure 3 (ignoring the dashed grey line for the moment).

**Figure 3.** Human Capital & Poverty Traps
We have depicted the poverty trap in terms of \( h \), i.e., the long run level of \( y \) and \( h \) depend on the initial level of \( h \). However, since \( k \) depends on income \( y \), the long-run level of \( k \) depends on the initial level of \( h \), although not the initial level of \( k \) unlike in the earlier model with \( k \) being the only input.

As noted in the context of a single input production technology earlier, market frictions and nonconvexities are necessary but not sufficient for poverty traps. That would depend on parameter values. Here too if the values of \( A \) and/or \( \alpha \) are not too low, it is possible that through their saving behavior, individuals escape the poverty trap. If the transition equation for \( h_t < h \) is given by the dashed line instead of the continuous one, then there is a unique steady-state and that involves a high level human capital in steady state.

Let us examine what assumptions drive this kind of a poverty trap. We already saw that when the relationship between \( h \) and \( y \) was given by a smooth strictly concave function we get a unique steady-state, exactly as in the Solow model. Therefore, nonconvexity in the production technology with respect to \( h \) is playing a key role here.

It is interesting to think about what is the role of market frictions here. We are assuming capital markets are perfect as far as \( k \) is concerned. It can be bought, sold, rented and accumulated without any friction (within a period). The market for \( h \) is imperfect however, and that is clearly driving the results. If \( h \) could be bought or rented without any constraints, we would get unconditional convergence as we saw above. When \( h \) can only be autarchically “produced” by saving out of current output, this reflects a market failure that prevents individuals who have a higher endowment of human capital from transmitting it to children of families where parents have a lower endowment of human capital, e.g., through a perfect market for education. Alternatively, if \( h \) is interpreted as land and not human capital, the presumption is, a land-poor individual cannot rent or lease in land due to some institutional failure but it is possible to accumulate it through saving out of current income and buying it. However, capital market frictions implicitly show up, in the form of restrictions on intertemporal transfers since what can be accumulated through savings can presumably be bought by a loan. We now turn to this issue.

Restrictions on Intertemporal Transfers There is a sense in which we are assuming an intertemporal capital market imperfection when discussing technological nonconvexities in physical or human capital. Since saving out of income does help accumulate \( h \) or \( k \), in principle, individuals could be forward looking, and as capital markets are being assumed to be perfect, they should be able to borrow and/or save at temporarily high rates to get over the hump at \( h \). We briefly explore here the consequences of modifying our basic model of choice between consumption and bequests introduced earlier by allowing individuals to be forward-looking and flexible in their savings behavior and given this, examine the role of intertemporal constraints on resource allocation.

Suppose as in our basic model output depends on one nonlabor input \( x \) given by the same production function \( q = A f(x) \). However, now \( x \) is required to be
invested in the previous period to be of productive use in the current period. After use, it depreciates completely. In the current period, individuals are endowed with an exogenous level \( x_0 \) of \( x \) and rental markets are not useful given the lagged nature of the production process. Therefore, current output is \( q_0 = Af(x_0) \), in the next period output is, \( q_1 = Af(x_1) \) where \( x_1 \) is chosen by the individual at time \( t = 0 \), and so on. We can view \( x \) as physical or human capital, although the particular lag structure is more suggestive of human capital.

If we first think of a two-period model, where in the first-period the individual chooses how much to consume in the present period \( (c_0) \) and the next \( (c_1) \), and also how much to invest in \( x \). The individual maximizes

\[
\log c_0 + \beta \log c_1
\]

subject to the intertemporal budget constraint:

\[
c_0 + \frac{c_1}{r} + x_1 \leq q_0 + \frac{Af(x_1)}{r}.
\]

It follows immediately that independent of their preferences over present and future consumption, individuals will choose \( x_1 \) to maximize their lifetime resources. This is an extension of the separation result mentioned in the one-period model at the beginning of this section to a two-period setting—with perfect markets and no constraints on intertemporal transfers, individual preferences should not affect the efficiency of intertemporal resource allocation. The optimality condition for the choice of \( x_1 \) is

\[
Af'(x_1) = r
\]

which is, the marginal return from investment should be equal to the interest rate.

The result holds even if the production technology is nonconvex with respect to \( x \). Suppose investment is a binary decision \( x \in \{0, 1\} \) and the cost of investment is normalized to 1. Without investment, output is \( q \) but with investment, it is \( q + \Delta \). This is similar to the model with human capital in the previous subsection. So long as \( \Delta > r \) individuals would undertake the investment.

However, if there are constraints on intertemporal resource allocation, then this property will no longer hold. In the extreme case, it is not possible to borrow at all, and therefore, the budget constraint facing the individual in the current period is:

\[
c_0 + x_1 \leq q_0
\]

while in the next period it is

\[
c_1 \leq Af(x_1).
\]
The choice of $x$ will now be determined by the condition:

$$\frac{1}{c_0} = \beta \frac{1}{c_1} Af'(x_1)$$

and $x$ will depend on, among other things, $q_0$ which is determined by the initial endowment of $x$.

The basic logic extends to the case of individuals with Barro-Becker altruistic preferences, which by a standard recursive argument becomes equivalent to an individual maximizing the present discounted value of the utility stream of current and future generations in a forward-looking way over an infinite-horizon:

$$\sum_{t=0}^{\infty} \beta^t \ln(c_t)$$

with an intertemporal budget constraint (using standard arguments to rule out unlimited long-term asset or debt accumulation):

$$\sum_{t=0}^{\infty} \frac{c_t}{r^t} + \sum_{t=0}^{\infty} \frac{x_{t+1}}{r^{t+1}} \leq q_0 + \sum_{t=0}^{\infty} \frac{Af(x_{t+1})}{r^{t+1}}.$$

In the absence of any intertemporal borrowing constraints, investment decisions will be efficient, while in their presence, the initial endowment of $x$ will affect investment decisions, opening up the possibility of poverty traps (e.g., if in addition, there are indivisibilities in the production technology).

Even if capital markets are perfect as such, in most societies negative bequests are not permissible by law and violations of this are considered morally offensive, such as bonded labor. This is equivalent to an intertemporal borrowing constraint: a poor parent cannot borrow to send her child to school such that the child will pay off the loan when she is an adult.

What this discussion implies is that, to the extent bequests are required to be non-negative, this puts a constraint on intertemporal resource allocation which is separate from what is often meant by capital market frictions, namely, constraints on short-term loans. Coupled with other frictions (e.g., nonconvexities in the production technology), this can lead to poverty traps. Of course, additional capital market frictions (due to standard frictions such as problems of enforcement and informational asymmetries) will reinforce this tendency. These could be for short-term loans or for long-term loans, with the latter contributing to intertemporal borrowing constraints.

Friction-Driven Poverty Traps - The Key Implications The key points from our discussion of friction-driven poverty traps are as follows.

First, no single friction is sufficient to trap individuals in poverty. Whether it is capital market frictions or restrictions on intertemporal resource allocation as
implied by the constraint that bequests have to be non-negative, we would require some other friction, such as non-convexities in the production or the savings technology, to prevent the poor to be able to save the “right” amount of physical or human capital and for their families to escape poverty in the long-run. Therefore, the fact that some studies fail to find any direct evidence of lumpiness of investments alone is not sufficient to conclude that there is limited empirical support in favor of poverty traps. Poverty traps could still result if there are borrowing constraints in addition to lumpiness with respect to the savings technology or in the production technology with respect to some input other than capital. Similarly, the fact that some studies find that microfinance loans have not been effective in reducing poverty significantly too is not conclusive evidence against the presence of poverty traps. First of all, without the “right” amount of loan it may be hard to escape the trap. Also, to the extent there are indivisibilities in the production technology with respect to other inputs, combined with frictions in those markets, poverty traps could still result in theory, as we saw above. At the same time, we saw that multiple frictions are necessary but not sufficient for poverty traps. Therefore, one has to be very careful in interpreting existing evidence to infer the presence or absence of poverty traps and not conclude from any single piece of evidence for or against the presence of a specific friction that poverty traps at the individual level exist or not (as, e.g., Kraay and McKenzie [2014] seem to do).

Second, if capital is the only input or all other inputs have perfect rental or sales markets so that capital is, in effect, a “sufficient” input (for example, in the presence of cash-in-advance constraints), and so capital market frictions play a central role in determining whether poverty traps could arise. In this case, capital market frictions or restrictions on intertemporal resource allocation are necessary for friction-driven poverty traps to emerge independent of any other frictions.

Third, if inputs other than capital are needed for production (such as human capital or land) and these markets are subject to imperfections, then the previous conclusion has to be modified. In such cases, even if (short-term) capital markets are perfect we could get poverty traps. We saw this could happen if the production technology is nonconvex with respect to it and there are intertemporal borrowing constraints due to either restrictions on negative bequests or frictions in capital markets for long-term loans.7

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7. A deeper issue is what are the underlying sources of these frictions in capital markets and markets for other inputs, and to what extent they may be inter-related. As we know from the literature of land reform (see Mookherjee 1997) if there are agency problems, a landlord will not sell off his land to his tenant or offer a fixed rent contract instead of a sharecropping contract, even though that will give the tenant better incentives because the tenant will not be able the afford the price at which the landlord will be willing to sell. However, for exactly the same agency problem, a lender cannot step in and offer the tenant a loan to buy off the land, since in the loan repayment process, the same agency problem will raise its head.
Non-Homothetic Preferences

In the previous subsection we assumed preferences are homothetic and focused on external frictions. Now we assume there are no external frictions, and examine the role of how extreme scarcity may cause the poor behave differently from the nonpoor, and whether this can lead to poverty traps. For example, the poor may discount the future too heavily, be too risk averse, may not care enough about their children, or may be more subject to various behavioral biases. With non-homothetic preferences, income effects can play an important role, and in particular, even though the deep preference parameters are the same ($\beta$ in our framework) and there are no external frictions, for low levels of income individuals may behave differently (in terms of how much they save or leave as bequests) and this can reinforce low incomes, generating a very different mechanism for a poverty trap. We call these kind of poverty traps scarcity-driven poverty traps. While we focus on money, we also discuss the relevant scarce resource being time or attention span. This argument is to be distinguished from one which says preference-related parameters have an effect on an individual’s economic outcome. That is a conditional convergence type argument: for example, those who do not put enough weight on the future (lower $\beta$) will end up with a lower steady state income.

The main idea is there is no external friction to be potentially fixed to help people get out of a poverty trap. What is interesting about scarcity-driven poverty traps is that, short of a direct transfer of income or a general increase in productivity (an increase in $A$ that raises $\pi$, for example) they can persist even when a whole range of supply-side interventions aimed at fixing various kinds of market failures are in place.

We avoid calling this class of poverty traps “behavioral” poverty traps because that may be confused with those arising from behavioral biases only (e.g., loss aversion, hyperbolic discounting, excessive expenditure on temptation goods). That is certainly a possible channel, as we discuss below, but it is possible to have these kinds of poverty traps with standard preferences as well, as the model below indicates.

Scarcity Driven Poverty Traps - The Benchmark Model As in the benchmark one-input model of section 2, assume that output is given by $q = Af(k)$ where the technology is convex, and that capital markets are perfect, so that the income of an individual is

$$y_t = \pi + rk_t$$

where

$$\pi = \max_k Af(k) - rk.$$

---

8. Azariadis (1996) provides an overlapping generations version of a model that is similar in spirit to the one that is presented in this section.
As before, let us assume agents derive utility from consumption $c$ and from bequest $b$. Even though in a narrow sense $b$ captures financial bequests, we can interpret it as any investment (e.g., human capital) from current income that enhances the productive capacity of children (e.g., health, education). Even though this is the interpretation we will focus on, as earlier, we could also view $b$ as saving or an investment in an individual’s own human capital. For now, let us assume $b \geq 0$ but we will see below that in this particular model, this “friction” that constrains intertemporal resource allocation, does not play a major role.

In addition, we allow individuals to consume a luxury good $z$. The utility function is given by:

$$U(c, b) = \log c + \beta \log(b + B) + \gamma \log(z + Z)$$

where $B > 0$, $Z > 0$, $\beta \in (0, 1)$, and $\gamma \in (0, 1)$. We assume that the marginal utility of bequests at $b = 0$ is higher than the marginal utility of luxury goods when $z = 0$:

$$\frac{\beta}{B} > \frac{\gamma}{Z}.$$  

We can think of $c$ as basic consumption, $b$ as money passed on to children, and $z$, a luxury good (durables, a vacation) which is not essential for survival but is consumed as income goes up. Our assumption will ensure that for low levels of income, all income is spent on $c$, for moderate levels of income it is split between $c$ and $b$, and finally, for high levels of income it is split between $c$, $b$, and $z$.

Total income at time $t$ is

$$y_t = \pi + r k_t$$

and as before, $k_{t+1} = b_t$. The budget constraint is

$$c_t + b_t + z_t = \pi + r k_t.$$  

It is straightforward to derive that there will be two income thresholds, $\underline{y}$ and $\bar{y}$, and two corresponding thresholds for capital:

$$\underline{k} = \frac{B - \beta \pi}{\beta r}$$

and

$$\bar{k} = \frac{(1 + \beta)Z - \gamma B - \gamma \pi}{\gamma r}$$  

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such that $\bar{k} > \underline{k}$. This follows from our assumption

$$\frac{B}{B} > \frac{\gamma}{Z}.$$  

Using the fact that $b_t = k_{t+1}$, we get the dynamics of how the capital stock will evolve:

$$k_{t+1} = 0 \quad \text{for} \quad k \leq \underline{k}$$

$$= \frac{\beta}{1 + \beta} (rk_t + \pi) - \frac{B}{1 + \beta} \quad \text{for} \quad \underline{k} \leq k \leq \bar{k}$$

$$= \frac{\beta}{1 + \beta + \gamma} (rk_t + \pi) - \frac{(1 + \gamma)B - \beta Z}{1 + \beta + \gamma} \quad \text{for} \quad k \geq \bar{k}.$$  

This is depicted in figure 4.

We have assumed in the figure that $\frac{\beta}{1 + \beta} r > 1 > \frac{\beta}{1 + \beta + \gamma} r$ and $B - \beta \pi > 0$ (which is likely in economies with low productivity, namely, a low level of $A$). Moreover, for a poverty trap to result, the middle segment of the equation of motion needs to intersects the 45° line at a point that is lower than $\bar{k}$, the specific condition being $\frac{B - \beta \pi}{pr - (1 + \beta)} < \bar{k}$. Under these conditions, families that start poor (capital stock less than $\underline{k}$) don’t save at all and therefore, have a steady state capital stock of 0, those who start with more than $\underline{k}$ grow rapidly up to the point $k^*$. Figure 4. Income Effects & Poverty Traps
where the saving rate falls (as luxury consumption kicks in), and they converge to a high capital stock \((k^*)\). Of course, if the above conditions are not satisfied, it is possible to have a unique steady state (e.g., if \(B - \beta T \leq 0\)).

As noted above, so far we assumed \(b \geq 0\): Suppose we allow \(b < 0\) (but smaller in absolute value than \(B\), given the utility function we have assumed), that is, parents can borrow against the earnings of their children that the children will have to pay off. Given that in the current framework, this borrowing cannot be used to invest in the human capital of children that will generate returns in the next period, this option turns out not to be consequential. In particular, it is straightforward to show that instead of \(b = 0\), for families starting with low initial levels of assets, \(b < 0\) (as opposed to \(b = 0\)) will be a stable steady state under conditions similar to those derived above, in addition to a high wealth steady state.

**Time Rather than Money Being the Scarce Resource** The sources poverty traps that are possible if preferences are non-homothetic in income, can be more general than in the specific channel developed above. For example, the scarce resource in question may be time or attention span or cognitive capacity rather than physical or financial capital. Suppose individuals can allocate time between generating current income, and spending it with their children to help develop their human capital. Assume income depends on human capital only, and physical or financial capital plays no direct role in production. In particular, suppose the budget constraint is:

\[
c_t \leq wh_t (T - l_t)
\]

where \(c_t\) is consumption, \(l_t\) is the time spent with children, and \(h_t\) is human capital at time \(t\). We assume that \(w\) is the exogenously given wage rate per unit of human capital, so that someone with twice as much human capital will earn twice as much for the same amount of time spent working. Also, let \(h_{t+1} = h_t l_t\) be the equation of motion of human capital - a more educated parent is more effective in converting her time spent with the children to transmit human capital to them.\(^9\) Suppose preferences are similar as before:

\[
\log c_t + \beta \log (l_t + B) + \gamma \log (z + Z).
\]

It is straightforward to check that, for low levels of \(h_t\), individuals may choose \(l = 0\) and we can have a poverty trap.

**Extending the Scarcity Channel** It is possible to extend the scarcity channel to consider how it interacts with insufficient intergenerational altruism, as well as various behavioral biases. Interpreting \(b\) broadly as any investment in the productive capacity or welfare of children, suppose society puts a greater weight on the productive capacity or welfare of children, suppose society puts a greater weight

---

9. Notice that, in principle, we can allow for a market in hiring a private tutor - parents can buy \(b/l\) units worth of human capital for their children by paying an amount \(wb'/h\), where \(b'\) can be different from \(b\). What matters here is full income in the sense of Becker.
(say, \(\hat{\beta}\)) on the welfare of children (or, in the case of gender bias, a greater weight on the welfare of female children) than parents do (i.e., \(\beta\) where \(\hat{\beta} > \beta\). Given the income effect identified under the scarcity channel, we can readily see that the gap between the socially optimal level of investment and what will be chosen by parents will be larger, the poorer are the parents.

Similarly, we can allow individuals to have behavioral biases in addition to the channel of limited time or attention span discussed in the previous subsection (see, e.g., Banerjee and Mullainathan 2010; Bernheim, Ray, and Yeltekin 2013). The point is not that only the poor are subject to these kinds of biases, but that low incomes exacerbate these biases, or, their negative consequences. A satisfactory treatment of this issue is beyond the scope of the present exercise but we can modify the benchmark model above to briefly examine the implications. Suppose we introduce an inessential consumption good (e.g., tobacco or alcohol) \(v\) and add the term \(\delta \log(v + V)\) (where \(\delta \in [0, 1]\) and \(V > 0\)) to the utility function and make the assumption \(\delta > \frac{\beta}{V}\). This is similar to what Banerjee and Mullainathan (2010) call a temptation good. By a familiar argument, individuals will spend all their income on \(c\) for very low levels of \(k\), but now they will spend some of their incomes on \(v\) as \(k\) crosses a threshold, and only for a higher threshold they will choose a positive value of \(b\). Earlier, a cash transfer to increase the financial resources of a poor family above \(\hat{k}\) would be sufficient to help them escape the poverty trap. But now, there is an intermediate range of \(k\) such that an unconditional cash transfer will partly get frittered away on \(v\), an issue we will touch upon in section 4 where we discuss anti-poverty policy.

**Barro-Becker Altruistic Preferences** A reasonable question to ask is, will our results go through if rather than having warm-glow type preferences where parents care about the bequests they pass on to their children, they cared about the utility of their children, and through a recursive argument, all future generations. Even with Barro-Becker altruistic preferences (as introduced in section 3.1), it is possible to get multiple steady states without any external friction. For example, it has been shown that such an outcome may occur when the poor discount the future too heavily (see, e.g., Iwai [1971] and Azariadis [1996] for more references on these kind of “impatience traps”). We can illustrate the basic argument quite simply. Suppose an individual maximizes

\[
\sum_{t=0}^{\infty} \beta^t \ln(c_t).
\]

Let \(k_t\) be capital at time \(t\), let capital markets be perfect with a constant interest rate \(r > 1\), and let there being no constraints on intertemporal transfers. For simplicity, suppose individuals earn a constant flow of income \(y_t = y\) every period. Then the per-period budget constraint is:

\[
k_{t+1} = r(k_t + y - c_t).
\]
Dynamic optimization yields the standard Euler equation:

$$\frac{c_{t+1}}{c_t} = \beta r.$$ 

If $\beta$ is less than $\frac{1}{r}$ the individual will run down his assets, with decreasing consumption levels, and will eventually reach a steady-state where he would just consume at the subsistence level (e.g., assuming a constraint like $c_t \geq c > 0$ for all $t$). If instead $\beta$ is greater than $\frac{1}{r}$ then he will accumulate assets, with rising consumption levels over time. If $\beta = \frac{1}{r}$ then there would be a steady-state with a constant consumption level (higher than the subsistence level) every period. If the discount factor $\beta$ is increasing in $c$ and for low levels of $c$, $\beta < \frac{1}{r}$, we can readily see the possibility of multiple steady-states. This suggests that our results on strong income effects leading the poor to save too little are not dependent on the particular set of preferences of the individual or the particular form of non-homotheticity we introduced earlier.

**Combining Friction and Scarcity Driven Poverty Traps** Clearly, external frictions and income effects can coexist and can combine to generate poverty traps. Indeed, Banerjee and Mullainathan (2008) is an example of this. Their core model is similar to the time allocation problem in the previous subsection. They juxtapose this with a model where human capital affects income via productivity but there are nonconvexities in this relationship, while current human capital depends in a linear fashion on the previous period’s human capital. As we saw in section 3.1, these two features are sufficient to generate poverty traps via the external frictions channel alone. Therefore, from the theoretical point of view, having both these channels is not necessary to generate poverty traps. However, the interaction between scarcity and friction driven poverty traps does raise interesting conceptual issues. For example, in an environment where the population is very poor, there will be little incentives for suppliers of specific inputs to set up shop due to lack of sufficient demand, and so supply-side frictions may be endogenous. We will return to this issue when discussing policy in the next section.

Another example of a combination of a friction-driven and a scarcity-driven poverty trap is when individuals are risk-averse and the degree of risk-aversion is decreasing in income (e.g., if the utility function displays decreasing absolute risk aversion). The poor will focus on low risk and low-returns projects, while the rich will focus on high risk and high-returns projects, and these can generate poverty traps. However, this argument implicitly assumes insurance markets being imperfect, because otherwise, with full insurance all individuals would maximize the certainty equivalent of their income and this kind of poverty trap

10. Similarly, Moav (2002) shows that a convex bequest function may lead to poverty traps using a utility function that leads to corner solutions in bequests that is similar to us. However, he assumes capital markets to be imperfect.

11. In their model, individuals either choose all of their time (or attention span) at home or at work, but as we saw above, one can get a poverty trap even with interior solutions.
will be difficult to sustain. More generally, it is hard to separate the roles of credit and insurance markets, because if individuals are risk-averse then the optimal contract should factor in both liquidity constraints and uninsured risk (as in the standard principal-agent model where the principal is risk neutral and the agent is risk-averse). Therefore, the emphasis on capital market frictions should be broadened to financial markets more generally when agents are risk-averse.

Scarcity-Driven Poverty Traps - The Key Implications

The key points from our discussion of scarcity-driven poverty traps are as follows.

First, poverty traps can exist even without any external frictions due to the operation of strong income effects in the behavior of individuals. This is possible without any behavioral biases, although it is consistent with the attention span of the poor being overloaded with decisions that have to do with day to day struggle for survival, at the detriment of forward-looking planning or expending greater productive effort at work (Mullainathan and Shafir 2013).

Second, as the root cause of scarcity-driven poverty is scarcity, the most obvious policy implication is a lump-sum transfer to the poor. Of course, if there are external frictions to fix (say, in capital markets or in health or education) then these can go together, but there are likely to be strong complementarities between these kinds of policies, as we discuss in the next section.

Third, to the extent there are grounds for a paternalistic intervention, because the preferences of the individual is different from that of the policymaker (which can be due to behavioral biases or insufficient intergenerational altruism or gender bias), unconditional lump sum transfers may not be the most efficient form of intervention and there may be a case for other policy instruments (e.g., conditional cash transfers).

What Theory Can Tell Us About Policy

We now turn to discussing the implications of our theoretical framework for the design of anti-poverty policy. Various anti-poverty policies can be divided into three broad categories: those that are aimed at enabling the poor greater access to markets, those that are aimed at improving the access of the poor to public services and infrastructure, and those that are explicitly redistributive in nature. Examples of the first include reducing transactions costs in specific markets (e.g., savings, credit, insurance), providing inputs which are not readily available in the market (e.g., training specific skills), improving access to information, and reforming property rights. Examples of the second include various measures to improve accountability and reduce leakage and corruption in the provision of public services like health and education. Examples of the third class of policies involve directly transferring resources to the poor, in cash or in kind. Cash transfers can be unconditional, or conditional on children attending school and family members receiving preventative health care (e.g., programs such as Progresa, renamed Oportunidades and more recently, Prospera, in Mexico, and Bolsa
Familia in Brazil) or in-kind (e.g., food, sanitation, education, health services provided free or at a subsidized rate to the poor). We will refer to the these as UCTs, CCTs, and IKTs.

Given the focus of this article, we will ignore delivery or implementation issues that imply an entirely different set of costs and benefits of alternative anti-poverty policies. For example, conditional transfers have the advantage that they can screen out the nonpoor and achieve better targeting than unconditional cash transfers). Similarly, we will not discuss situations where externalities are important (e.g., health interventions like deworming or insecticide-treated bednets) that make certain types of conditional transfers preferable to unconditional ones.12 I will also not attempt a review of the extensive empirical literature evaluating the performance of these programs but rather will make a number of conceptual points based on the framework developed in the previous section.13

The first point is other than improving access to capital and savings, or an UCT, any other single intervention is unlikely to get rid of poverty traps. This follows from our discussion of friction-driven poverty traps where we saw that other than removing whatever constrains the ability of the poor to borrow and save, no single friction is sufficient to trap individuals in poverty. Also, for both friction and scarcity-driven poverty traps, a UCT of an appropriate magnitude will help the poor overcome poverty traps in our framework, unless there are grounds for paternalism, an issue we discuss below. More broadly, this reflects the standard economic argument that unless we know what is the specific friction, it is best to leave it to the recipient to decide what she will do with the savings or loan, or the cash transfer. Only in an extreme case where some critical noncapital input (e.g., training or land) is not available in the market or is very costly, and the income generation technology is nonconvex with respect to it, there are grounds for intervening directly to help overcome poverty traps. This is one of the arguments behind the recent policy interest in UCTs. For example, the work of GiveDirectly in Kenya, a charity that gives no-strings attached cash grants, equivalent to almost two year’s worth of local income, to the poor has received a lot of attention. While long-term impacts are yet to be known, at least in the short run the impacts are quite good in terms of helping build assets, encouraging investment in, and generating revenue from businesses (Haushofer and Shapiro 2013). In addition, several studies using randomized field experiments have highlighted the importance of capital and access to a savings technology. A well-know study by De Mel et al. (2008) have found high potential rates of return to capital in small business among Sri Lankan microenterprise owners that far exceed formal sector interest rates. Another important study shows that providing access to non-interest-bearing bank accounts led to significant increase in savings, productive investments and private expenditures (Dupas and Robinson 2013).

12. We refer the reader to Das et al (2005) for a good discussion of some of these issues.
13. See, e.g., Baird et al (2013) for a review of CCTs and UCTs in the context of developing countries.
Second, even with policies that improve access to capital or savings or a UCT, at best poverty traps in a narrow sense will be eliminated. That is, two individuals who, except for income or wealth \((y \text{ or } k)\) in terms of our model, are identical will not end up very differently in the long run. But if other markets are underdeveloped (e.g., acquiring skills), infrastructure is poor, then neither will do very well. In terms of our model the main problem is \(A\) is low, that is, the problem of conditional convergence remains and individuals who are otherwise identical but live in better environments (in terms of market access, infrastructure) will do better. As noted above, cash transfers or facilitating borrowing or saving will have limited impact on incomes if markets for certain critical (noncapital) inputs are not developed. In such circumstances, a direct intervention in improving \(A\) (or, encouraging migration from a low \(A\) to a high \(A\) area) may be the best policy, and an excessive focus on poverty traps can distract our attention from this more basic problem. Indeed, even if there does not exist multiple steady states, the elasticity of response to changes in certain policies can be quite high. In the version of the Solow model we discussed in the previous section, the steady-state level output is

\[
q^* = (A)^{\frac{\alpha}{1-\alpha}} \frac{C0}{\alpha},
\]

i.e., the steady state output is a convex function of \(A\) and so elasticity of response to policy changes could be quite high.

Third, a mix of interventions that relax the budget constraints of the poor and remove certain external frictions are likely to yield significantly high returns compared to an intervention that addresses only one of these problems. For example, if we fix financial markets or give a large cash grant, and improve access to training or infrastructure, gains are likely to be much higher than these individual interventions. Recall from our basic model that

\[
q = Af(k),
\]

that is, \(k\) and \(A\) are complements. If due to external frictions \(k\) is lower than what it could be dictated by the deep parameters, then a direct lump-sum transfer can be used to raise \(k\) but suppose that some of these resources could also be spent to increase \(A\). Given the complementarity between \(k\) and \(A\), it is likely that rather than spending the available funds either on increasing \(k\) or on improving \(A\) only, the gains will be larger if it is split between the two. Indeed, Bandiera et al. (2013) find that sizable transfers of assets and training to impart skills in Bangladesh enable the poorest women to shift out of agricultural labor and into running small businesses, which persists and strengthens after assistance is withdrawn, and leads to a 38% increase in earnings. Similarly, Blattman et al. (2014) find that cash transfers coupled with business training very effective among impoverished Ugandan women. In contrast, McKenzie and Woodruff (2014) review training business owners from a dozen randomized experiments and find little lasting impact on profits or sales.

Fourth, some interventions (e.g., credit, savings) are likely to have similar effects, and it is important to diagnose which underlying friction is more important. For example, if the main problem facing the poor is that they do not have access to a good savings technology (with or without self-commitment problems), then availability of small loans to be paid in short installments via microfinance may help them smooth consumption or purchase durables, but a better
solution yet might be to improve their ability to save. Indeed, DuPas and Robinson (2013) find that the take-up for their savings package is very high (87%), in contrast to the relatively low take-up rate in most rigorous studies of microfinance (e.g., 27% in the study by Banerjee et al. [2014] of a microfinance in India), and this suggests that access to a good saving technology may be a higher priority for the poor.

Finally, we turn to the question of under what circumstances CCTs may be strictly preferred to UCTs. In our model this can happen only in the case where the individual’s preference and the policymakers preference differs, due to the presence of behavioral biases (e.g., excessive weight on temptation goods or present consumption), insufficient intergenerational altruism, or gender bias. As we saw, a low value of $\beta$ coupled with low incomes can generate poverty traps. Even though there isn’t that much evidence that the poor fritter the money away (Evans and Popova 2014), there is fairly compelling evidence that CCTs are more effective than UCTs in raising educational outcomes. Baird et al. (2013) studied twenty-six CCTs, five UCTs, and four programs that ran both in parallel and found that school enrolment rose by 41% on average across all the CCT programs, while under the UCT programs, the increases was 25%. This does not necessarily mean CCTs are better in welfare terms than UCTs, but as with taxes or subsidies on a specific good or service, it does affect behavior through the standard combination of price and income effects. Also, if the amount the poor invest on children ($b$ in our model) depends on income ($y$) or wealth ($k$) in a way that is convex over some region (as in section 3.2), then given the complementarity between $A$ and $k$ noted above, combining a UCT with a policy that directly tackles a friction on the supply side (say, better schools or health facilities) or raises overall productivity $A$, is likely to yield higher returns than a policy (with a comparable budget) that makes a cash transfer conditional on individuals undertaking a certain minimum investment in $b$. However, if indeed the underlying grounds for paternalism are strong or externalities are significant, then arguments in favor of CCTs continue to be valid.

CONCLUSION

We developed a conceptual framework to examine conditions under which individuals can be trapped in poverty, distinguishing between the role that external frictions play, versus those that are due to choices made under extreme scarcity. We then applied this framework to discuss various types of antipoverty policies, distinguishing between policies that are aimed to facilitate market access for the poor, and those that are redistributive in nature, and in the latter category, discussed the relative merits of unconditional and conditional cash transfers and in-kind transfers.

14. As noted earlier, we are ruling out screening issues in targeting the poor, or more generally, implementation-related issues.
There are several related and interesting issues that we did not address. First, we worked with a representative agent framework and this precludes many interesting issues that heterogeneity among individuals raise. Even within the same area and similar socioeconomic characteristics, individuals have different preferences, abilities, beliefs, and aspirations; therefore, we have to think beyond a one-size-fits-all policy. Indeed, most studies evaluating specific policies find significant heterogeneity in their impact on different individuals. Second, we did not discuss problems of implementation, including targeting, and this raises a whole new set of interesting issues. Third, the policy interventions that we discussed are likely to alter individual behavior if they are expected to be in place, and as the discussion of various welfare programs in developed countries suggest, it is important to study the incentive effects of various antipoverty policies, rather than viewing them as being administered from “outside the system” to lift the poor out of poverty. Finally, another interesting issue is how to diagnose what the most binding constraint is in a given environment at the microeconomic level, similar in spirit to the growth diagnostics approach (see Rodrik 2010). Is it an external friction, and if so, which one (see Karlan et al. [2014] for an interesting experiment along these lines), or is it really the behavior of the poor under extreme scarcity? All these, and undoubtedly many more, seem potentially exciting avenues of future research.

References


Reducing Information Asymmetries in the Youth Labor Market of Jordan with Psychometrics and Skill Based Tests

Matthew Groh, David McKenzie, and Tara Vishwanath

Jordan’s labor market for educated youth is characterized by high levels of unemployment, long periods of job search, and firms complaining that youth often lack the appropriate interpersonal and work skills. Search and matching theory offers a potential explanation: if education systems are such that graduates find it difficult to signal competence and achievement through grades and the quality of their institution, then employers might have difficulty matching with suitable candidates, resulting in high unemployment. We developed and tested a labor market screening and matching service in Amman, Jordan, which aimed to generate higher employment for educated youth by reducing these matching frictions. This paper examines the first step in this process, which involved testing unemployed, tertiary-educated, youth on mental ability, English proficiency, soft skills, Excel ability, and also measuring their big five personality traits. We show that these measures have predictive power for subsequent employment and for earnings conditional on employment, even after conditioning on major, university, and other controls. Psychometric testing therefore offers the potential to reduce information asymmetries that result in labor market matching frictions. JEL codes: J64, O12, O15

Introduction

In common with a number of countries in the Middle East and North Africa, Jordan’s labor market for educated youth is characterized by high levels of unemployment, long periods of job search, and firms complaining that youth often lack the appropriate interpersonal and work skills for the job (Angel-Urdinola...
et al. 2010; Almeida et al. 2012). In 2010, unemployment rates for men and women between the ages of 22 and 26 with a post-secondary degree were 19 percent and 47 percent, respectively. In a 2011 survey we conducted of 2000 firms in Amman looking to hire workers, 60 percent of firms claimed to have difficulty distinguishing between good and bad job candidates, and 64 percent said they had difficulty finding competent graduates.

One explanation for these patterns is offered by the search and matching theory of unemployment pioneered by Peter Diamond, Dale Mortensen and Christopher Pissarides.1 In their model, unemployment can persist in equilibrium as costly search frictions make it difficult for jobless workers searching for work to match with firms with vacancies looking for workers. We might expect these search frictions to be larger in regions where education systems are less able to signal competence and achievement through grades and the quality of the institution. Improvements in the matching technology can then potentially reduce unemployment directly (through making it easier for firms to fill existing vacancies) as well as indirectly (by lowering hiring costs and thereby encouraging firms to create more vacancies). There is a large theoretical and macroeconomic literature which examines the role of search frictions in unemployment2 but far less that examines at a microeconomic level the role of policy efforts to reduce these frictions. These frictions can be particularly severe for young workers, who lack work experience that can be used as a signal of worker quality.

We developed and tested a labor market matching service in Amman, Jordan, which aimed to generate higher employment for educated youth by reducing these matching frictions. Unemployed applicants were administered a series of tests to evaluate mental ability (verbal, quantitative, and spatial), technical ability in Excel, fluency in English, soft skills, and personality type.

In order for this approach to improve employment outcomes, it must first be the case that these testable attributes of individuals add value for predicting employment beyond what can be easily observed from a curriculum vitae (CV). In this short paper, we focus on establishing this first step. We show that our tests do have predictive power for the likelihood female graduates have found employment 10 months later, even conditioning on baseline observables, and strong predictive power for the salaries that males and female earn conditional on working for both male and female graduates. Psychometric testing therefore offers the potential to reduce information asymmetries that result in labor market matching frictions.

The Study Population

We launched the pilot in January 2012 and restricted eligibility to Jordanians who had graduated from community college or university after May 2009.

2. See the reviews by Petrongolo and Pissarides (2001) and McCall and McCall (2008).
The screening and matching services were offered to participants for free, and participants were recruited through advertisements in local newspapers, radio stations, cafes, Facebook, and a telephone campaign to recent graduates from 14 universities and community colleges in and around Amman. In total, 1567 recent graduates were recruited and participated in the pilot between December 2011 and December 2012.

Appendix Table 1 summarizes some basic characteristics of the applicants: 58 percent are female, 80 percent are university graduates and 20 percent community college graduates, and the average age is 23 years. Students have a mix of majors, with accounting and business, engineering, and computing and information technology the most common. Nearly all were unemployed at the time they took our assessments, but 55 percent of the females and 74 percent of the males had some previous work experience.

**Psychometric Measurement**

Each program participant attended a one-day employment screening session at the Business Development Center (BDC), a leading employment training services provider in Jordan. During this session, program participants completed a series of job skill tests and psychometric assessments designed and validated by Dr. Marwan Al-Zoubi, a psychology professor at the University of Jordan who specializes in organizational behavior and work psychology. The tests and assessments were administered by computer except for the soft skills test; the tests include the following:

1. **Mental Ability**: A timed test consisting of 45 questions, equally divided between verbal, quantitative, and spatial reasoning. We form a principal component to aggregate scores from these categories into a single ability index.

2. **English Proficiency**: A timed test consisting of 15 vocabulary and grammar questions, 15 reading comprehension questions, and 20 listening based questions. The scores are then normalized to a score out of 100 based on comparisons to the performance of University of Jordan students on the same test prior to the launch of the pilot.

3. **Excel Proficiency**: A timed test that measures the participants’ ability to write text in cells, add and delete rows and columns, sum variables, and calculate the mean of a group of scores. The score is calculated based on the participants’ ability to complete 17 Excel tasks correctly, and the score is normalized to a score out of 100.

4. **Soft Skills**: Soft skills were measured by three interactive exercises. The first was based on a group exercise, in which five to eight participants were put in a group and tasked to redesign a failing amusement park in Jordan. They were each given a predefined role and evaluated on how they work in groups. The second exercise was a role-playing game designed to test the participant under pressure. The participant plays the role of a
## Table 1. Do Psychometrics Help Predict Employment 10 months later?

<table>
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<th>Males</th>
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<th>Males</th>
<th>Females</th>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>All 4 tests jointly zero</td>
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<td>0.000</td>
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<td>0.011</td>
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<tr>
<td>All 5 personality traits jointly zero</td>
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<td>0.314</td>
<td>0.172</td>
<td>0.010</td>
<td>0.012</td>
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<tr>
<td>Mean Employment Rate</td>
<td>0.647</td>
<td>0.642</td>
<td>0.640</td>
<td>0.495</td>
<td>0.503</td>
<td>0.502</td>
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</tbody>
</table>

**Notes:** Coefficients are marginal effects from probit estimation. Robust standard errors in parentheses.

*, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.

Baseline control variables are tawjihi score, university vs community college dummy, years since graduation, whether they have ever worked before, and whether they are unmarried.
customer service associate, and the evaluator, an angry customer who had purchased a computer that broke down. The participant’s goal is to calm the customer and come up with a solution within the framework of the company’s rules. The final assessment was a skills-based interview where the soft skills specialist asks questions to elicit examples of leadership, teamwork, and overcoming obstacles. The appendix provides additional details. We form a principal component analysis of scores in the 10 soft skill categories to form a single soft skills index.

(5) Big-5 Personality Traits: Personality traits were measured through a series of 300 questions assessing the following five characteristics: analytics, extraversion, emotions, opportunism, and dependability (Paunonen and Jackson 1996). These were translated into Arabic and validated on a sample of students at University of Jordan (Al-Zoubi 2014). We calculated the Big-5 personality traits as the mean of their subcharacteristics, and we normalized the Big-5 personality traits for ease of interpretation.

**Do these Measures Predict Employment and Earnings?**

In order for these skill tests and psychometric assessments to be useful in reducing incomplete information and hence search costs for employers, we need them to contain additional information that is useful for determining employment beyond the easily verifiable background information of contained in job candidates’ CV. Ideally, we would evaluate these tests and assessments on objective measures of labor productivity, but the heterogeneity of jobs in the labor market make this ideal approach infeasible. Instead, we investigate the extent to which test and assessment scores are predictive of subsequent employment and earnings.

We use a follow-up survey of program participants conducted in May 2013, 16 months after the program was launched, and on average ten months after the tests. The follow-up survey re-interviewed 1291 applicants, for an attrition rate of 17.7 percent. At the time of the follow-up survey, 49.5 percent of the females in our sample and 64.7 percent of the males were employed. Mean monthly earnings conditional on employment were 324 JD (US$459) for females and 378 JD (US$536) for males.

As a first step to evaluating skill tests and psychometrics predictability of labor productivity, figure 1 examines the bivariate associations between four test scores and employment outcomes. Consider first employment. We see a steep positive linear relationship between employment and English proficiency, and between employment and mental ability, for females, with much less of a relationship with these characteristics for males. There is a flatter but still positive relationship

3. Appendix Table 3 presents evidence that psychometric measures for males are not significantly correlated with attrition, but females with higher soft skills and more analytic personalities are more likely to respond. We discuss robustness to this in the appendix, and note it shouldn’t affect our main conclusions.
of soft skills with employment for both genders, and no relationship with Excel scores. Turning to earnings conditional on working, English proficiency, mental ability, and soft skills all have positive associations with the amount earned for females, and English and soft skills have positive associations with the amount earning for males.

Next, we examine whether these associations continue to hold when examined jointly with the other test results and personality characteristics, before controlling for key observable characteristics that might be observed through a CV. For ease of comparison, we standardize the test scores and personality statistics as z-scores – a one unit change then represents the impact of a one-standard deviation (SD) change in that variable.

Table 1 presents the results from probit estimation of the likelihood of being employed. The first column for each gender just contains the test scores and personality characteristics as controls, the second column adds additional observables as controls. The third column then adds additional controls for major (21 dummies), and for tertiary institution (15 dummies). Table 2 presents the same three specifications for a linear regression of monthly earnings conditional

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4. These controls are for when they graduated, whether they went to university versus community college, whether they have ever worked before, their score on the end of high school national examination (*tawjihi*), and their marital status.
<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Mental Ability</td>
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<td>7.979</td>
<td>9.324*</td>
<td>9.203*</td>
<td>11.28*</td>
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<td>29.63***</td>
<td>27.46***</td>
<td>17.14***</td>
<td>16.70***</td>
<td>13.60**</td>
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<td>(9.245)</td>
<td>(4.877)</td>
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<td>(5.525)</td>
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<td>19.80**</td>
<td>22.45**</td>
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<td>All 4 tests jointly zero</td>
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**Notes:** Coefficients are regression estimates. Robust standard errors in parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.

Baseline control variables are tawjihi score, university vs community college dummy, years since graduation, whether they have ever worked before, and whether they are unmarried.
on being employed. The foot of both tables tests the null hypotheses that the coefficients on the 4 tests are jointly zero, and that the coefficients on the five personality traits are jointly zero.

Table 1 shows that both our test scores and the personality traits are predictive of employment for females, even conditioning on all of our controls. The strong relationship with English proficiency seen in figure 1 is statistically significant and continues to hold even after adding these additional controls. A 1 SD increase in the English test score is associated with a 5 to 8 percentage point increase in employment. The mental ability score is associated with a 3 to 4.5 percentage point increase in employment for females, while the Excel test and soft skills test have no statistically significant relationship. The dependable personality trait is statistically significant as a predictor of employment for females, which is consistent with the idea that punctuality and reliability are valued by employers. Extroversion has a negative association with employment for females, which might reflect a cultural preference of employers, especially since extroversion has a positive and significant association with employment for males. Overall, the different measures have far less predictability for male employment, although males with higher soft skills have higher likelihoods of being employed.

Table 2 shows that both our soft skill measure and our English proficiency score help predict the salaries these individuals earn once they are employed. A 1 SD increase in soft skills is associated with 27 JD higher monthly earnings for males (7% of mean earnings), and 14 JD higher monthly earnings for females (4% of mean earnings). English proficiency is no longer a statistically significant predictor of conditional earnings for males once other controls are added, but continues to be statistically significant for females: a 1 SD increase in English score is associated with 30 JD higher monthly earnings for females (9% of mean earnings). Mental ability also helps predict female earnings but not male earnings. In contrast, for neither males nor females can we reject that the 5 personality traits coefficients are jointly zero.

In addition to being statistically significant, the additional predictive power of these tests is also economically significant. For females, the $R^2$ of conditional earnings increases from 0.313 for a regression with baseline controls, major, and university to 0.392 for the specification in the last column of Table 2, a 25.2% increase in predictive power. For males, the $R^2$ increases from 0.175 to 0.228, a 30.5% increase in predictive power.

**Conclusions**

Taken together, these results suggest that our psychometric measures contain additional information about future employability beyond that which would be contained in a standard CV. In particular, our English proficiency, soft skills, and mental ability measures all have some predictive power for either employment and/or earnings. The predictive power appears to be stronger for young women than young men, which may be explained by the lower employment rates
of women, perhaps reflecting higher degrees of selectivity by both young women and by employers as to whether young women work. In principle, our psychometric assessments contain information, which could reduce information asymmetries and help improve matching between employers and workers. The challenge, which we are examining in ongoing work, is to then whether this information can be successfully used to match job-seekers with firms and generate increased employment as a result.

Appendix

Appendix Table 1 provides summary statistics on the participants in this study.

Further details on the soft skills scoring

The soft skills assessment is an interactive exercise judged by soft skills specialists based on a detailed rubric designed by Marwan Al-Zoubi. Soft skill specialists are former human resource managers who lead soft skills training for BDC’s Maharat program. The detailed rubric encompasses 10 distinct categories of soft skills and is composed of five objective criteria for each category to be rated on a 10 point Likert scale. Two soft skill specialists evaluate each sub-category on a scale from 1 to 10. At the end of each day, the specialist compared their scores and reconciled differences by averaging the scores if there was a difference of 2 or less points per category. If there was a difference of more than 2, evaluators discussed the candidate and reached a compromise. Appendix Table 2 presents the soft skills scoring rubric.

Appendix Table 1. Baseline Summary Statistics of Participants

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<tr>
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<td>Years since Graduation</td>
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<tr>
<td>Ever Worked</td>
<td>0.55</td>
<td>0.50</td>
<td>0.74</td>
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<td>Single</td>
<td>0.89</td>
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<td>Tawjih Score</td>
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<td>Accounting or Business</td>
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<td>Computing or IT</td>
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<td>Mental Ability Score</td>
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<td>Soft Skills Score</td>
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<td>Excel Test</td>
<td>60.60</td>
<td>22.41</td>
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<td>English Test</td>
<td>58.24</td>
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<td>19.43</td>
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<td>Analytical Personality</td>
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<td>Emotional Personality</td>
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<td>Extroverted Personality</td>
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<td>3.84</td>
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<tr>
<td>Opportunistic Personality</td>
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<td>3.67</td>
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<tr>
<td>Dependable Personality</td>
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<td>2.57</td>
<td>4.35</td>
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<tr>
<td>Sample Size</td>
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Appendix 2. Soft Skill Evaluation Rubric

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<tbody>
<tr>
<td><strong>1. Listening</strong></td>
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<td><strong>Leadership</strong></td>
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<td></td>
<td>Active in the discussion and provides effective points</td>
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<td></td>
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<td></td>
<td>Expresses confidence in non-aggressive style</td>
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<td>Creates positive atmosphere</td>
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<td>Goal oriented</td>
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<td>Tries to reach decisions</td>
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<td><strong>2. Responsiveness (Posing Questions)</strong></td>
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<td><strong>3. Presentation</strong></td>
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<td><strong>4. Self-confidence</strong></td>
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<td><strong>5. Influence</strong></td>
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<td><strong>6. Leadership</strong></td>
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</table>

Two soft skill specialists evaluate each candidate on all 10 soft skill categories during the group discussion. The customer service role-playing game is assessed by one evaluator on soft skill components 1 through 5 in the table above. The skills-based interview was assessed by one soft skills specialist on the soft skill components 6 through 10 in the table above.

Survey Attrition and Psychometric Scores

Appendix table 3 examines the association between our psychometric measures and attrition in the follow-up survey. For males, although the English test is
## Appendix Table 3. Do Psychometrics Predict Survey Attrition?

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td><strong>Mental Ability</strong></td>
<td>-0.0108 (0.0176)</td>
<td>-0.0169 (0.0178)</td>
</tr>
<tr>
<td><strong>Soft Skills</strong></td>
<td>0.0263* (0.0154)</td>
<td>0.0312* (0.0160)</td>
</tr>
<tr>
<td><strong>Excel Test</strong></td>
<td>-0.0174 (0.0156)</td>
<td>-0.00903 (0.0161)</td>
</tr>
<tr>
<td><strong>English Test</strong></td>
<td>-0.0261 (0.0181)</td>
<td>9.78e-05 (0.0201)</td>
</tr>
<tr>
<td><strong>Analytical Personality Score</strong></td>
<td>0.00249 (0.0197)</td>
<td>0.00437 (0.0193)</td>
</tr>
<tr>
<td><strong>Emotional Personality Score</strong></td>
<td>-0.0235 (0.0188)</td>
<td>-0.0124 (0.0187)</td>
</tr>
<tr>
<td><strong>Extroverted Personality Score</strong></td>
<td>-0.000422 (0.0183)</td>
<td>-0.000268 (0.0179)</td>
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<td><strong>Opportunistic Personality Score</strong></td>
<td>0.0121 (0.0162)</td>
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<td><strong>Dependable Personality Score</strong></td>
<td>0.00142 (0.0183)</td>
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</tr>
<tr>
<td>Baseline variable controls</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Controls for major and university</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Observations</td>
<td>660</td>
<td>622</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.015</td>
<td>0.036</td>
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</table>

Notes: Coefficients are regression estimates. Robust standard errors in parentheses.
* *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.
Baseline control variables are tawjihi score, university vs community college dummy, years since graduation, whether they have ever worked before, and whether they are unmarried.
marginally significant once we control for major and university, we cannot reject the null hypothesis that our four tests jointly do not predict attrition ($p = .12$), and that the five personality traits jointly do not predict attrition ($p = .99$). For females we find soft skills, proficiency with Excel, and analytical personality traits to be positively correlated with survey response. To examine how sensitive our results are to this selective attrition, we consider a bounding exercise. If we assume that the individuals with high soft skills who answer our survey, but who wouldn’t have answered if they had lower soft skills, were all employed, then dropping these individuals would still result in a near zero and statistically insignificant association of employment with soft skills for females. Conversely, if the additional responders are those who are all unemployed, we find a positive, and marginally significant association of female employment with soft skills, with a coefficient of 0.04 ($p = .087$) in the analog of the last column of Table 2. Selective survey response therefore may have a minor impact on whether we consider soft skills to be predictive of employment, but our main conclusions that employment and earnings are predicted in part by test scores appears robust to this small amount of selective attrition.

References


The Role of Effort for Self-Insurance and Its Consequences for the Wealth Distribution

Andres Zambrano

I explore the effect of effort as a mechanism to alleviate the idiosyncratic risk faced by individuals in the presence of incomplete markets. I construct a DSGE model where costly effort determines the probability of being employed the next period and a riskless asset can be used to smooth consumption. I first show how effort and assets are inverse related, and that a unique stationary equilibrium exists. Then, in a calibrated version of the model to the US economy, I show that in the stationary equilibrium a positively skewed wealth distribution arises, which is closer to the observed data and has not been obtained by models without ex-ante heterogeneity. I then use the model to evaluate the effect of unemployment insurance on the wealth distribution. JEL codes: D91, E21, E24, E25, J22

INTRODUCTION

Heterogenous agents models with incomplete markets allow one to study the distribution of key economic variables in an economy such as earnings, consumption, and wealth. The first models in this literature, where agents have only access to a single riskless asset to smooth consumption, generate left-skewed wealth distributions since most agents accumulate assets for precautionary motives (Huggett 1993; Aiyagari 1994). However, real wealth distributions are skewed to the right: few individuals hold most of the wealth, whereas most agents have some degree of debt or have little savings (see Fig. 1). The purpose of this paper is to study the role of effort as a mechanism for self-insurance and evaluate its consequences for the wealth distribution.

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This paper is based on the second chapter of the author’s dissertation at UCLA. He would like to acknowledge the comments of Andy Atkeson, Francisco Buera, Roger Farmer, Christian Hellwig, Gonzalo Llosa, Bentley McLeod, Andy Neumeyer, Lee Ohanian, Venky Venkateswaran, and Pierre-Olivier Weill; as well as participants in the World Bank ABCDE Conference, Macro Lunch Proseminar at UCLA, LACEA, Universidad de los Andes, the Midwest Macro Conference, the Central Bank of Colombia, the University of Leipzig and The Guanajuato Workshop for Young Economists. The author is also very grateful for the financial support given by the Central Bank of Colombia. The valuable research assistance of Felipe Acero is greatly acknowledged. The usual disclaimer applies.
The model builds on the framework proposed by Huggett (1993) but includes effort as a variable determining the transition dynamics between states. In our two-state model, it can be interpreted as search effort when the individual is unemployed or effort in the job when the agent is employed. Our first result suggests a negative relationship between effort and asset holdings. The smoothing role of the assets loses importance when they are close to the debt limit, whereas effort plays a major role by increasing the likelihood of being employed next period. Thus, effort partially completes the financial markets.

We then calibrate the model to the US economy and obtain a unique right-skewed stationary distribution. The intuition behind this result is that diversification between effort and the riskless asset eliminates the need of accumulating precautionary savings. Finally, we perform an experiment by doubling the income an unemployed agent would get. Remarkably, the wealth distribution does not change importantly, thus suggesting unemployment insurance benefits do not have an important effect on wealth inequality.

Several models have been recently developed to obtain a right-skewed wealth distribution. Their strategy consists of allowing for a source of ex ante heterogeneity and calibrates it to match the observed wealth distribution. Krusell and Smith (1998) propose ex ante heterogeneity in discount rates, Quadrini (2000) in rates of return, Cagetti and De Nardi (2006) in ability, and Huggett (1996) and Castaneda, Díaz-Giménez, and Ríos-Rull (2003) in the persistence of shocks. Our paper is the first one to our knowledge to obtain such result without assuming ex ante heterogeneity.

The organization of the paper is as follows. The next section describes the environment faced by the individuals. The third section defines the equilibrium...
in this scenario. We then describe the calibration used in the model, and discuss the results and its implications. The last section concludes.

**Environment**

Consider an exchange economy with a continuum of agents with total mass equal to one who face idiosyncratic risk. There are two commodities: one perishable consumption good $c$ and asset holdings $a$. Each period, each agent receives a stochastic endowment of the consumption good $w_t$. Assume the endowment can take two possible values $w_L < w_H$, which are usually associated with unemployed/employed status, respectively.

Effort $e$ is made in order to increase the probability of having a good endowment next period. This probability is defined as $\Pr(w_{t+1} = w_H|w_t) = P(e; w_t)$, which is assumed to be increasing concave and satisfying Inada conditions with respect to $e$. We let $P(e; w_H) > P(e; w_L)$ for all $e_t$, which implies that effort to remain employed is more effective than the effort to become employed when previously unemployed. \(^1\)

Each agent is able to smooth her consumption by holding a riskless asset $a$. This asset entitles the individual to receive one unit of future consumption at a price $q > 0$. The amount of claims held must remain above the limit $a_{\min} \leq 0$, thus preventing perpetual debt. The budget constraint faced by an individual who holds $a$ claims, has a current endowment $w$, and chooses consumption $c$ and future claims $a'$, is given by $c + qa' \leq w + a$.

Each agent maximizes her expected additive separable concave utility function over her infinite lifetime, \(^2\) and future is discounted at a rate $\beta \in (0, 1)$. The agent’s problem can be represented in recursive formulation as

$$v(a, w, q) = \max_{c, e, a'} \{u(c) - e + \beta[P(e; w)v(a', w_H) + (1 - P(e; w))v(a', w_L)]\}$$

subject to the budget constraint.

**Lemma 1** For $q > 0$ and $a_{\min} + e_L - a_{\min}q > 0$, there exist a unique solution to $v(a, w, q)$. Such value function $v(a, w, q)$ is strictly increasing, strictly concave and continuous differentiable in $a$, and strictly increasing in $w$. Moreover, the optimal decision rules $c(a, w, q)$, $e(a, w, q)$, and $a'(a, w, q)$ are continuous in $a$.

The previous lemma states that the problem has standard properties. Its proof relies on a straightforward extension of the corresponding proof of theorem 1 in Huggett (1993). Just note that the problem remains bounded and that $P(\cdot)$ is

\(^1\) This assumption follows empirical data that has been studied in search models and emphasize the role of the depreciation of human capital during unemployment (Addison and Portugal 1989; Neal 1995).

\(^2\) Separability is obtained if we assume the existence of lotteries (Hansen (1985)). The linearity in $e$ is just an innocuous normalization.
independent of $a$. Therefore the first order conditions are necessary and sufficient, and the optimal decision rules $c(a, w; q)$, $e(a, w; q)$, and $a'(a, w; q)$ are given by

$$1 = \beta P'_e (e; w) [v(a', w_H; q) - v(a', w_L; q)],$$  

(2)

$$u'_c (c) \geq \frac{\beta}{q} \left[ P(e; w) \frac{\partial v(a', w_H; q)}{\partial a'} + (1 - P(e; w)) \frac{\partial v(a', w_L; q)}{\partial a'} \right],$$  

with equality if $a' > a_{\text{min}}$.

$$c + q a' \leq w + a$$  

(3)

(4)

**Lemma 2** Optimal effort $e(a, w; q)$ is decreasing in $a$ and decreasing (increasing) in $w_L$ ($w_H$).

When the agent has more assets, it is more able to smooth consumption and thus the difference of the value function when employed or unemployed becomes smaller; hence, there are less incentives to exert effort. However, when the agent is close to the maximum level of debt, she must rely heavily on effort to increase the chances of being employed next period since the assets cannot be longer used to smooth consumption. In other words, effort is used to partially complete the markets. The lemma also states that effort will be lower (greater), the greater are the benefits when unemployed (employed). The latter is a standard result in the unemployment insurance literature (see, e.g., Hopenhayn and Nicolini 1997).

Condition (3) shapes the assets’ behavior: when the individual is employed she accumulates assets, while she decreases her holdings when unemployed. Using the theory of supermartingales, it can be shown that to have an equilibrium, where consumption and asset holdings remain finite, it must be the case that $\beta < q$ (see Williams 1991). The price $q$ will be determined in equilibrium according to a market clearing condition that we describe in the next section. Moreover, it can be shown, extending Huggett’s (1993) proof of his theorem 2, that there exists an upper bound for the assets $a_{\text{max}}$, a fixed point that will be achieved if an agent remains employed forever. The boundedness of this optimal rule will be required for the existence of the stationary equilibrium defined in the next section.

**Equilibrium**

The aggregate state at time $t$ in this economy is described by the joint distribution of wealth and endowment $\lambda_t (a, w; q) = \Pr(a_t = a, w_t = w; q)$. Since this
distribution is always evolving, the price $q$ that clears the market must also change. To avoid this difficulty we focus on a stationary equilibrium where the distribution remains invariant, that is, $\lambda_{t+1}(a, w; q) = \lambda_t(a, w; q) = \lambda(a, w; q)$, which law of motion is described by

$$
\lambda_{t+1}(a', w'; q) = \sum_{i \in L, H} \lambda_t(a, w; q) \cdot \Pr(w_{t+1} = w' | e(a, w_t), w_t) da
$$

Lemma 3 There exists a unique stationary distribution $\lambda(a, w; q)$.

**Proof.** To establish the existence one needs to adapt slightly the argument in Huggett (1993). First note that there exists a compact set $W = [a_{\min}, a_{\max}] \times \{w_L, w_H\}$ such that if an agent starts in any point in $W$, the next period will remain in $W$. Then define the natural order over $W$, where $(a_{\min}, w_L)$ is the minimum and $(a_{\max}, w_H)$ is the maximum. Finally, note that the associated transition is increasing since the optimal decisions are monotone and $P(e; w_H) > P(e; w_L)$. For uniqueness, it remains to prove that the monotone mixing condition in Hopenhayn and Prescott (1992) is satisfied. Define a sequence $x_1 = a_{\min}, x_2 = a'(x_1, w_H), x_3 = a'(x_2, w_H), \ldots$ and a sequence $y_1 = a_{\max}, y_2 = a'(y_1, w_L), y_3 = a'(y_2, w_L), \ldots$. Both sequences are feasible because of the Inada conditions satisfied by $P(\cdot)$. Moreover $\lim_{n \to \infty} x_n = a_{\max}$ and $\lim_{n \to \infty} y_n = a_{\min}$. Therefore, there exists $w^* \in W$ and $N$ such that, after $N$ periods, the probability that someone in $a_{\min}$ will be in some $w > w^*$ is positive, and that someone in $a_{\max}$ will be in some $w < w^*$ is positive.

The lemma suggests that starting from any initial distribution, a sufficient number of iterations will converge to the invariant one. Moreover, since $a'(a, w; q)$ is bounded, the sequence of averaged assets will also converge. Therefore, it implies the existence of a unique stationary equilibrium.

**Definition 4** A stationary equilibrium is defined by policy rules $c(a, w; q)$, $e(a, w; q)$, and $a'(a, w; q)$; a value function $v(a, w; q)$; a price $q$; and a stationary distribution $\lambda(a, w; q)$, such that

- The policy and value functions solve the agent’s problem (1)
- Markets clear:
  1. $\int a \sum_{i \in L, H} a'(a, w_i; q) \lambda(a, w_i; q) da = 0$
  2. $\int a \sum_{i \in L, H} c(a, w_i; q) \lambda(a, w_i; q) da = \int a \sum_{i \in L, H} w_i \lambda(a, w_i; q) da$
- The stationary distribution $\lambda(a, w; q)$ is induced by the policy functions and the endogenous Markov chains generated by $P(e(a, w; q); w)$. 
Since we are interested on the effects of effort on the wealth distribution, we shut down any ex ante heterogeneity, including income. Thus we normalize the endowment to $w_H = 1$ and $w_L = 0.1$. We will later perform simulations in the hypothetical case where unemployment benefits were to double. We assume the utility function takes the form $u(c) = c^{1-\sigma}/1 - \sigma$, which is typically used in the literature. According to Mehra and Prescott (1985), estimates of the risk aversion coefficient $\sigma$ are around 1.5. We model the probability of having a high state tomorrow as a cdf of an exponential distribution with parameter $\mu = 10w_i$, that is $P(e; w_i) = 1 - \exp^{-10w_i\epsilon}$.

The rest of the parameters are calculated according to periods of 8.5 weeks approximately, that is 6 periods per year. The discount rate is calibrated to $\beta = 0.99322$ to match an annual discount rate of 0.96. The lower bound $a_{\text{min}}$ is set to $-5$, which is close to the annual average endowment of this economy and close to the natural borrowing limit of $-s_L/r$ described by Aiyagari (1994). This parameterization satisfies our initial assumptions of first order stochastic dominance and the ones described by Hopenhayn and Nicolini (1997) to characterize the optimal unemployment insurance. Moreover, the optimal probabilities in equilibrium will wander around Huggett’s calibration. This calibration replicates a coefficient of variation for the annual earnings of 20%, which is close enough to the actual data.

The computation follows the standard procedure of value function iteration for a guessed price. Then we calculate the average assets, and the price is adjusted accordingly until we reached a market clearing price. The price of assets that clears the market in the benchmark case is 0.994, which is equivalent to an annual interest rate of 3.86%; the unemployment rate is 6.39%.

The distribution of wealth in the stationary distribution differs from the one found by Huggett (1993) and similar parsimonious models. Figure 2 shows the stationary distribution is skewed to the right, just as the normalized wealth distribution we computed using the Survey of Consumer Finances (2010) in figure 1. Wealth is concentrated in fewer agents, while most of agents hold a slightly negative amount of assets. In the long run, individuals do not need to accumulate assets for precautionary motives since they have another nonmarket mechanism to smooth consumption. In other words, the incomplete markets are complemented by effort. The model also replicates the fact that consumption inequality is lower than the wealth one as a consequence of the smoothing process.

Although the model replicates a positively skewed distribution, it is not able to obtain the long right tail. Part of the explanation is that the grid is finite and the

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3. Huggett (1993) chose this length to match the average duration of unemployment spells of 17 weeks (Bureau of Labor Statistics), which is a underestimation of the current average duration of 21.6, but it fits the 5-year trend.

4. Wealth is calculated according to Wolff (2010). We used both total wealth and non-housing wealth, obtaining similar results.
computed upper bound for assets becomes smaller. This is why there is a concentration of agents at the end of the distribution that otherwise will become part of a longer right tail. However, this would not account for most of the right tail. This is also a shortcoming of models with ex ante heterogeneity in the persistence of shocks, as Huggett (1996) recognizes. Castaneda et al. (2003) estimate that to obtain such concentration of wealth, agents must receive a shock about 1,060 times the median income level with a small probability. Krusell and Smith (1998) are also able to achieve such dispersion using ex ante heterogeneity in discount rates.

We also perform an experiment by doubling the unemployment income \( w_L \) to 0.2 to evaluate its consequences for the wealth distribution. The interest rate increased to 4.24%, while the unemployment rate increased to 7.15%. The result arises because agents have less incentives to exert effort, as it was shown in lemma 2. This increases unemployment and incentivizes agents to rely more on assets for self-insurance; therefore its demand increases and the interest rate must increase to achieve an equilibrium. However, and remarkably, the stationary wealth distribution does not change importantly, it only seems a bit less dispersed in figure 2. This result suggests that unemployment insurance benefits decrease wealth inequality, although its effect is very modest.

**Concluding Remarks**

We have studied a model of heterogenous agents who face idiosyncratic risk and smooth their consumption using a riskless asset and effort, which determines the transition distribution to the next state. We have found that there is a negative
relationship between assets and effort, which could be interpreted as a role of effort to partially complete the financial incomplete markets. We also examine the effect of effort on the wealth distribution. It is shown that our parsimonious model is able to replicate a wealth distribution skewed to the right, which have not been achieved by similar models. Moreover, it is shown that such distribution is robust to changes in the relative income perceived by unemployed agents, suggesting that unemployment insurance is not an important determinant of wealth inequality.

References


Unemployment Insurance in the Presence of an Informal Sector

David Bardey, Fernando Jaramillo, and Ximena Peña

We study the effect of UI benefits in a typical developing country where the informal sector is sizeable and persistent. In a partial equilibrium environment, ruling out the macroeconomic consequences of UI benefits, we characterize the stationary equilibrium of an economy where policyholders may be employed in the formal sector, short-run unemployed receiving UI benefits or long-run unemployed without UI benefits. We perform comparative static exercises to understand how UI benefits affect unemployed workers’ effort to secure a formal job and their labor supply in the informal sector. Our model reveals that an increase in UI benefits generates two opposing effects for the short-run unemployed. First, since search efforts cannot be monitored it generates moral hazard behaviors that lower effort. Second, it generates an income effect as it reduces the marginal cost of searching for a formal job and increases effort. Even though in general it is ambiguous which effect dominates, we show that for short durations UI benefits increase unemployed worker’s effort to secure a formal-sector job and decreases informal-sector work. JEL codes: H55, I38, J65

INTRODUCTION

Several developing countries have either adopted some protection against unemployment risk or are considering the introduction of unemployment insurance (UI) benefits (e.g., Chile, Colombia, Ecuador, México, and Uruguay). Few studies have analyzed the consequences of UI benefits on labor markets with a substantial informal sector. By informal sector we mean the individuals and/or firms that are either excluded from, or have opted out of, formal institutions and state benefits. Developing countries’ dual labor markets may reduce the desirability of a UI program because of a moral hazard problem: the unemployed may work in the informal sector while receiving UI benefits (Hopenhayn and Nicolini 1994). In this paper, we model the effect of UI benefits on labor market outcomes in a developing country with a substantial informal sector. In particular, we show that UI benefits are most beneficial when the informal sector is growing and when the positive income effect outweighs the negative moral hazard effect.
1999; Mazza 2000; Alvarez-Parra and Sanchez 2009). In this paper we want to highlight an important theoretical mechanism absent in the existing literature: UI benefits also generate an income effect that may allow the unemployed to devote less time in remunerated informal activities and consequently devote more time to secure a job in the formal sector.

In order to focus on the moral hazard problem, one of the most pressing issues for a developing country considering the introduction of UI benefits, we adapt a duration model à la Fredriksson and Holmlund (2001) in a partial equilibrium environment, that is, ruling out the macroeconomic consequences of UI benefits. This feature allows us to derive analytical results. In our model the informal sector is sizeable, persistent, and the bulk of it cannot be explained by UI benefits. At the stationary equilibrium we show that UI benefits generate an income effect that reduces the marginal cost of searching for a formal job. This income effect increases unemployed workers’ efforts at the expense of their labor supply in the informal sector and therefore softens the moral hazard issue that arises from the unobservability of effort.¹ Even though in general it is ambiguous which effect dominates, we show that for short durations UI benefits increase unemployed worker’s effort to secure a formal-sector job and decreases informal-sector work. We also show that an increase in UI benefits received by short-run unemployed workers unambiguously increases the efforts of long-run unemployed workers to find a formal job.

**THE MODEL**

We construct a continuous time model in order to analyze the effects of increasing UI in an economy characterized by a significantly sized informal sector. Workers can be either employed in the formal sector or unemployed. When they are employed in the formal sector they receive an hourly wage equal to \( w^f \). Formal-sector jobs are destroyed at a rate \( \phi \), and workers become unemployed.² Unemployed agents can either be short- or long-run unemployed. When workers lose a formal-sector job, they become short-run unemployed (denoted by index \( j = I \)) and receive UI benefits. Following Fredriksson and Holmlund (2001), we assume that UI benefits may expire at a Poisson rate, \( \lambda \), independent of the policy holders’ actions. This implies that the expected duration of UI benefits equals \( 1/\lambda \). When UI benefits expire, agents become long-run unemployed, \( j = N \), and do not receive UI benefits anymore. Instead, they receive a transfer referred to as subsidy. Formal-sector opportunities arrive at rate \( p^I \) for the short-run unemployed and \( p^N \) for the long-run unemployed.

When employed in the formal sector, we assume that workers split their total time, \( T \), between formal-sector work, \( h \), and leisure, \( L = T - h \). Since we want to

¹. This effect is close to the liquidity constraint pointed out by Chetty (2008).
². The financial market is supposed to be imperfect, that is, there are not any financial assets that allow workers to be covered against the risk of losing their job.
focus on the consequences of increasing UI benefits on the decisions of unemployed workers, we suppose that the number of hours worked in the formal sector are exogenous. In contrast, when unemployed, either short or long run, agents split their total time, $T$, into three activities. First, they can devote $s^f$ units of time to secure a formal-sector job, called effort hereafter. Second, they can work $a^f$ units of time in the informal sector to earn an income. Finally, they can enjoy $l^f$ units of leisure time. The time constraint is $s^f + a^f + l^f = T$.

The total time that an unemployed worker devotes to the informal sector is then given by $T - s^f - l^f$. Crucially, we assume that $s^f$ and $a^f$ cannot be observed, that is, they are private information of the unemployed workers and consequently are not contractible. Moreover, effort affects the rate at which workers find a formal job, $p^f(s^f)$, with $p^f(\cdot) > 0$ and $p^{f\prime}(\cdot) > 0$. Finally, when working in the informal sector, which is assumed to be frictionless and without rationing, workers receive an hourly wage of $w^i = kw^f$, where $0 \leq k < 1$. We assume that there exists a positive differential of wages between the formal and informal sectors.

**Workers**

Agents are risk-averse and their preferences are represented by an increasing and concave VNM utility function, $u$. Let $V^E$ be the value of formal-sector employment, $V^I$ the value of the short-run unemployed workers who enjoy UI benefits and $V^N$ the value of the long-run unemployed workers who no longer have access to UI but benefit from a UI subsidy. The flow value of a formal-sector job is

$$rV^E = u(w^fh, T - b) - \phi[V^E - V^I],$$

where $r$ denotes the subjective rate of time preference. The flow value of a formal job depends on the income obtained and the leisure time enjoyed. A formal worker loses his job with probability $\phi$ and in this case becomes a short-run unemployed facing a capital loss of $V^E - V^I$.

The short-run unemployed receive UI benefits of $b^Iw^fh$, where $b^I$ denotes the replacement ratio. While receiving UI benefits she can work in the informal sector $a^I$ units of time, where she earns an income of $kw^fa^I$. She can also exert effort ($s^I$) to secure a formal job with probability $p^I(s^I)$, thus realizing a capital gain of $V^E - V^I$. With probability $\lambda$, the short-run unemployed becomes a long-run unemployed, loses the UI benefits, and thus faces a capital loss of $V^I - V^N$. The value function of a short-run unemployed is

$$rV^I = u^I(kw^fa^I + b^Iw^fh, T - s^I - a^I) + p^I(s^I)(V^E - V^I) - \lambda(V^I - V^N).$$

The flow value of being long-run unemployed, without access to UI benefits, is

$$rV^N = u^N(kw^fa^N + b^Nw^fh, T - s^N - a^N) + p^N(s^N)(V^E - V^N).$$
Long-run unemployed workers earn $kw' a^N$ from their labor supply in the informal sector and also benefit from a government transfer, $b^N w'h$. We naturally assume that $b^l > b^N$.

Considering the government’s instrument $(b^l, b^N)$ as given, the unemployed workers in state $j$ choose $(s^l, l^l, a^l)$, such that $(s^l, l^l, a^l) \in \arg \max V^j$. The first order conditions of this maximization program yield

$$- \frac{\partial u(kw' a^l + b^l w'h, T - s^l - a^l)}{\partial l^l} + \frac{\partial p^j(s^l)}{\partial s^l} [V^E - V^j] = 0$$ (4)

$$kw' \frac{\partial u(kw' a^l + b^l w'h, T - s^l - a^l)}{\partial c^l} - \frac{\partial u(kw' a^l + b^l w'h, T - s^l - a^l)}{\partial p} = 0.$$ (5)

Equation (4) shows that an unemployed worker undertakes effort to secure a new job in the formal sector such that the marginal benefit of this effort, composed by the marginal increase of the probability of finding a job times the difference of values between being employed ($j = E$) and unemployed ($j = I, N$), is equal to the marginal cost due to the reduction of leisure. Equation (5) shows that an unemployed worker chooses his level of informal labor supply to equalize his marginal consumption utility to his leisure marginal (opportunity) cost.

**Comparative Statics at the Stationary Equilibrium**

Similarly to Fredriksson and Holmlund (2001), we combine (1), (2), and (3) and obtain at the stationary equilibrium:

$$V^E - V^I = \frac{1}{A} [(r + p^N(s^N)) [u(w^j T) - u^I(c^l, l^l)] + \lambda [u(w^j T) - u^N(c^N, l^N)],$$

$$V^E - V^I = \frac{1}{A} [(r + \lambda + p^I(s^l)) [u(w^j T) - u^N(c^N, l^N)] + \phi [u^I(c^l, l^l) - u^N(c^N, l^N)],$$

$$V^I - V^N = \frac{1}{A} [(r + \phi + p^I(s^l)) [u^I(c^l, l^T) - u^N(c^N, l^N)] + (p^I(s^l) - p^N(s^N)) \times [u(w^j T) - u^I(c^l, l^l)]$$

where $A = (r + p^N(s^N))(r + \phi + p^I(s^l)) + \lambda (r + \phi + p^N(s^N))$. In what follows, we substitute the term $V^E - V^I$ we get at the stationary equilibrium into the first
order conditions of the short- and long-run unemployed workers. We then perform several comparative statics exercises.

First, let us analyze the effects generated by increasing UI benefits (respectively UI subsidies) on decisions taken by short-run (resp. long-run) unemployed workers.

**Proposition 1:** For short-run (long-run) unemployed workers an increase in $b^I$ (resp. $b^N$) has ambiguous effects on informal-sector work, $a_I$ (resp. $a^N$), and time devoted to searching for a formal-sector job, $s^I$ (resp. $s^N$).

**Proof.** Appendix.

Let us interpret the results for short-run unemployed workers, the intuition being the same for the results of the long-run unemployed. At the stationary equilibrium the first order conditions of the unemployed workers contain a wealth effect, which mainly occurs at an intratemporal level, and a moral hazard effect, which captures the effects of the next period policy variables on the unemployed workers’ decisions.

The condition that determines the effect of UI benefits on short-run unemployed workers’ effort $s^I$ is given by

$$\frac{ds^I}{db^I} = \frac{w^I b}{H^I} \left[ kw^I (u^I_{cc} u^I_{li} - (u^I_{lc})^2) + \frac{(r + p^N(s^N)) \partial p^I(s^I)/\partial s^I}{A} u^I_c (G^I_{aa}) \right],$$

where $H^I$ and $H^I_{aa}$ are positive and negative, respectively, due to the second order conditions (see appendix for more details). The first term $(kw^I (u^I_{cc} u^I_{li} - (u^I_{lc})^2) > 0)$ captures the wealth effect generated by the UI benefits: Thanks to UI benefits, all else being equal, short-run unemployed workers need to spend less time working in the informal sector and can devote more time to securing a formal-sector job. The second term is due to the presence of moral hazard: An increase in UI benefits in the future reduces $(V^E - V^I)$, thus weakening incentives to secure a job in the formal sector. The existence of these two countervailing effects generates the ambiguous results for the search effort summarized in Proposition 1.

The effect of UI benefits on the informal-sector labor supply is given by

$$\frac{da^I}{db^I} = \frac{w^I b}{H^I} \left[ -kw^I (u^I_{li} u^I_{cc} - (u^I_{lc})^2) - \frac{(r + p^N(s^N)) \partial p^I(s^I)/\partial s^I}{A} u^I_c (G^I_{aa}) \right]$$

$$+ \frac{kw^I u^I_c (kw^I u^I_{cc} - u^I_{lc})}{[\partial^2 p^I(s^I)/\partial (s^I)^2]/[(\partial p^I(s^I)/\partial s^I)A],}$$

where $s^I = (\partial^2 p^I(s^I)/\partial (s^I)^2)/[(\partial p^I(s^I)/\partial s^I)A].$

Interestingly, all else being equal, the same income effect that increases the short-run unemployed workers’ effort also decreases the time devoted to informal activities (because of the negative sign preceding it). Moreover, the effect generated by moral hazard on the time devoted to informal-sector work can be
divided into two components. The first is given by the second term and captures a moral hazard effect which increases short-run unemployed informal-sector work at the expense of effort. The second moral hazard effect is captured by the third term in the equation and captures the trade-off between informal-sector work and leisure time. If leisure and consumption are complementary goods, that is, $u_{cl} \geq 0$, the income effect and the second moral hazard effect decrease the labor supply in the informal sector. The first moral hazard component is a countervailing effect as it increases informal-sector work. Therefore, the sign of $da^I/db^I$ depends on the relative sizes of these effects.

**Corrolary:** For short durations of UI benefits, $1/\lambda \to 0$, $b^I$ unambiguously increases $s^I$ and decreases $a^I$.

**Proof.** Straightforward from (6) and (7) as $A \to \infty$ and $kw^I u^I_c u^I_c$ has an upper bound. ■

When UI benefits have a very short duration (like severance payments), the income effect dominates the moral hazard effect and increases in UI benefits decrease the size of the informal sector.

Let us now turn to the effect of UI benefits on long-run unemployed workers. **Proposition 2:** An increase in $b^I$ unambiguously increases $s^N$, if $u^N_{cl} \geq 0$ it decreases $a^N$ (and increases $l^N$).

**Proof.** See Appendix. ■

Interestingly, proposition 2 reveals that UI benefits, $b^I$, generates a moral hazard effect only for the short-run unemployed.³ An increase in UI benefits may decrease the unemployed workers’ effort to secure a formal job while short-run unemployed. However, the existence of UI benefits received by the short-run unemployed unambiguously increases the effort undertaken by long-run unemployed workers to secure a formal job, $s^N$. This entitlement effect emerges at the stationary equilibrium because $V^E - V^N$ increases with $u^I - u^N$, which in turn increases with $b^I$. Everything else equal, the increase of UI benefits for short-run unemployed increases the present value $V^E$ and consequently increases the effort undertaken by long-run unemployed to secure a job in the formal sector. The effects of UI benefits on informal-sector work and leisure time of the long-run unemployed depend on the cross derivative between consumption and leisure.

Finally, the expiration rate of UI benefits, $\lambda$, has a very close relationship with a key feature of UI design. The effects of changes in $\lambda$ on the time allocation decisions of short and long-run unemployed workers are summarized in the following proposition. **Proposition 3:** An increase in $\lambda$: i) increases $s^I$; if $u^I_{cl} > 0$ it decreases $a^I$ (and increases $l^I$). ii) decreases $s^N$; if $u^N_{cl} > 0$ it increases $a^N$ (and $l^N$).

**Proof.** See online appendix. ■

An increase in the expiration rate of UI benefits (or a decrease in the duration of UI benefits) reduces the moral hazard effect for the short-run unemployed

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³. Note that the subsidy $b^N$ generates for the long-run unemployed a moral hazard effect similar to the one that $b^I$ generates for the short-run unemployed.
since, *ceteris paribus*, they have greater incentives to secure a job in the formal sector. In this case, the trade-off between labor supply in the informal sector and leisure time is standard. For the same reason that $b_I$ increases the long-run unemployed’s effort, an increase of the duration of UI makes $V^E$ more attractive and consequently gives stronger incentives to the long-run unemployed to secure a formal job. Since $V^E - V^N$ decreases with $\lambda$, all else equal, an increase in $\lambda$ decreases the marginal benefit of effort. Finally, when $\mu^N_{cl} > 0$ an increase in $\lambda$ increases the labor supply in the informal sector and leisure of long-run unemployed workers, at the expense of time devoted to securing a formal-sector job.

**Discussion**

In this note, the partial equilibrium set up allows us to derive analytical results on the consequences of increasing UI benefits. Our results reveal that in developing countries with dual labor markets UI benefits generate an income effect, countervailing to the traditional moral hazard effect. Because UI benefits increase unemployed workers’ incomes they need to devote less time to informal jobs and, *ceteris paribus*, they spend more time securing a new job in the formal sector. Analytically, in general it is ambiguous whether the moral hazard or income effects dominates. Nevertheless, our results reveal that for very short durations of UI benefits, increases in UI benefits unambiguously increase the effort undertaken and reduce the labor supply in the informal sector.

Our results suggest that developing countries should not be discouraged from adopting UI benefits by the mere existence of the moral hazard effect. However, to be able to characterize the optimal design of UI benefits in developing countries we strongly believe that this analysis must be extended in several ways. This issue should be resumed in a general equilibrium framework that would contain a matching process a la Pissarides (2000) in order to take into account the effect of UI coverage on the wage bargained in the formal sector.⁴ As it is likely that the design of optimal UI coverage depends on labor market features, this general equilibrium approach should be combined with a calibration strategy using data from specific dual labor markets in developing countries. It is in our research agenda.

**Appendix: Proof of Propositions 1 and 2**

**Proof.** This appendix is organized as follows: First, we calculate the Hessian matrices of both maximization programs, that is, $j = \{I, N\}$. Next, we use them to provide the comparative static exercises that correspond to each proposition.

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⁴. See Albrecht et al. (2009) and Bosch Esteban-Pretel (2012).
Let us define the following function \( G_j = (g_j(a^j, s^j)G_j(a^j, s^j)) = (0, 0) \), where \( G_j' \) and \( G_j'' \) denote the first order condition with respect to \( a^j \) and \( s^j \) for \( j \in \{1, N \} \). The Cramer’s rule yields:

\[
H_j = \begin{pmatrix}
    u^j_{ll} + [S]u^j_l - k\omega^j u^j_{lc} + u^j_l \\
    -k\omega^j u^j_{cl} + u^j_{ll} - k\omega^j (k\omega^j)^2 u^j_{cc} - 2k\omega^j u^j_{cl} + u^j_{ll}
\end{pmatrix},
\]

where \( S = (\partial^2 p(s')/\partial s'(s')^2)/[\partial p(s')/\partial s' A] \).

**Proof of Proposition 1**

**Proof.** Applying Cramer’s rule yields:

\[
\begin{align*}
\frac{da^j}{db^j} &= \frac{u^j b}{|H^j|} \left[ -k\omega^j (u^j_{ll}u^j_{cc} - (u^j_{lc})^2) + \frac{(r + p^N(s^N))\partial p^j(s^j)/\partial s^j}{A} u^j_{l}(k\omega^j u^j_{cl} - u^j_{ll}) \\
&
+ [S]u^j_l(u^j_{lc} - k\omega^j u^j_{cc}) \right],
\end{align*}
\]

\[
\begin{align*}
\frac{ds^j}{db^j} &= \frac{u^j b}{|H^j|} \left[ k\omega^j (u^j_{cc}u^j_{ll} - (u^j_{lc})^2) + \frac{(r + p^N(s^N))\partial p^j(s^j)/\partial s^j u^j_{l}}{A} [G^j_{aa}] \right],
\end{align*}
\]

Similar computations yield for \( a^N, s^N \) and \( l^N \).

**Proof of Proposition 2**

**Proof.** Applying the Cramer’s rule gives:

\[
\begin{align*}
\frac{da^N}{db^N} &= \frac{1}{|H^N|} \begin{pmatrix} G^N_{ss} & -G^N_{sb} \\ G^N_{as} & -G^N_{ab} \end{pmatrix} \\
&= \frac{1}{|H^N|} \begin{pmatrix} \left( \frac{\partial p^N(s^N)}{\partial s^N} \phi \omega^j b \right) \left( u^j_{l} \right) & (k\omega^j u^j_{cl} + u^j_{ll}) \end{pmatrix}.
\end{align*}
\]

Therefore, a sufficient condition to have \( da^N/db^l \leq 0 \) is \( u^j_{cl} \geq 0 \). Similarly:

\[
\begin{align*}
\frac{ds^N}{ds^l} &= \frac{1}{|H^N|} \begin{pmatrix} -\left( \frac{\partial p^N(s^N)}{\partial s^N} \phi \omega^j b \right) \left( u^j_{l} \right) & (k\omega^j u^j_{cl} + u^j_{ll}) \\ 0 & [G^N_{aa}] \end{pmatrix} \geq 0.
\end{align*}
\]
\[
\frac{ds^I}{db^N} = \frac{1}{|H|^1} \begin{bmatrix}
\partial p^I(s^I)^A w_h - \frac{\partial p^I(s^I)}{A} u^N_c - kw^f u^I_{cl} + u^I_{ill} \\
kw^f u^I_{cc} - 2kw^f u^I_{cl} + u^I_{ill}
\end{bmatrix} < 0.
\]

References


This paper presents a simple model of subsidies with export share requirements (ESR) in a heterogeneous firm environment. A two-country general equilibrium version of the model with a single 100% ESR is calibrated using firm-level data from the 2002 wave of the Business Environment and Enterprise Performance Survey collected by the World Bank for China. The calibrated model is used to gauge the change in subsidies with ESR that is consistent with the fall in the share of ‘pure exporters’, firms exporting all their output, observed in China, from 25.7% in 2002 to 11.1% in 2013. Our results indicate that a 6.9% reduction in the ad-valorem subsidy rate available to firms that export all their output is consistent with the observed fall in their share of exporting firms. Expenditure in subsidies (as a share of value-added) falls by 66% and welfare in China increases by 1.76% while real income in the rest of the world falls by 0.59%.

Introduction

China’s integration into the world economy has been marked by vigorous export promotion combined with a steadfast commitment to protecting its domestic market. The dual nature of China’s trade policy regime, in which export-oriented firms coexist alongside highly protected state-owned enterprises, has been aptly described by Feenstra (1998) as “one country, two systems.” A crucial element of China’s export promotion strategy has been the use of subsidies with export share requirements (ESR). These encompass a wide range of fiscal advantages such as tax deductions, access to soft loans, duty-free imports of intermediate and capital goods and priority access to infrastructure and land, accruing to...
firms conditional on their export intensity (i.e., the share of total sales accounted for by exports) exceeding a given threshold.\(^1\) Quite often firms are required to export all their output to benefit from the subsidies.

Although it is not possible to directly observe if a firm receives subsidies with ESR, it is possible to identify firms that are eligible to benefit from these subsidies based on their observed export intensity. Thus, Defever and Riaño (2014) back out the unobserved subsidies following a calibration strategy which utilizes data on the overall export intensity distribution of a country and the productivity premia estimated for exporters identified as enjoying subsidies with ESR relative to exporters that do not benefit from this policy and domestic firms.\(^2\)

The World Bank’s Business Environment and Enterprise Performance Survey (BEEPS) reveals that the share of exporters selling all their output abroad, which we denote “pure exporters,” experienced a dramatic fall from 25.7% to 11.1% of exporting firms between 2002 and 2013 (see figure 1). This pattern is consistent with a reduction in subsidies with ESR by the Chinese government in response to greater international scrutiny of its trade policies. In this paper, we

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2. The main identifying assumption is that high export intensity exporters arise because of the use of subsidies with ESR by the Chinese Government. Defever and Riaño (2014) show that these subsidies target primarily three types of firms, foreign-invested enterprises, export processing establishments, and firms located in Free Trade Zones, and that the vast majority of high-intensity exporters belong to one of these groups.
gauge the change in subsidies with ESR which is consistent with the decline in the share of pure exporters observed in China over the last decade. To do so, we consider a simplified version of the model proposed by Defever and Riaño (2014), featuring a single ad valorem sales subsidy associated with a 100% export share requirement. The parameters of the general equilibrium model are calibrated using Chinese firm-level data from the 2002 wave of BEEPS. We use the model to quantify the effect of a reduction in subsidies with ESR on the total expenditure on subsidies, aggregate exports and welfare for China and the rest of the world. Our results provide a first assessment of the extent to which China has reformed its dual export system over the last decade.

Despite undertaking wide-reaching trade liberalization reforms such as expanding trading rights, lowering import tariffs, and eliminating non-tariff barriers in anticipation of joining the World Trade Organization (WTO) in 2001, the use of export subsidies in China, and those featuring export requirements in particular, was hardly curbed during this wave of reforms. This course of action has proven to be highly controversial. Under the terms of its accession protocol, China was required to notify the WTO of any export subsidies in place ahead of the annual Transitional Review Mechanism, the procedure monitoring China’s compliance with its WTO commitments. However, despite its commitment, China only submitted two subsidy notifications in 2006 and 2011. Both of these were deemed to be highly incomplete because they did not disclose the level of expenditure of a large number of subsidy programs listed in each notification. Additionally, subsidies granted at the sub-national, provincial and local level, which are widely considered to be important instruments of export promotion, were excluded from both notifications.

Since 2006, the United States, European Union, and other WTO member countries have actively challenged Chinese subsidies with ESR. This pressure in turn has led to the gradual dismantlement of several subsidy programmes. For instance, the corporate income tax deduction available to export-oriented, foreign-invested enterprises was terminated in 2008. Similarly, the preferential treatment for domestically owned firms located in Special Economic Zones and exporting more than 70% of their output was also terminated in 2008. In both cases, a five-year transition period was established so that the new tax legislation became operational in 2012. At the same time, several financial incentives conditional on a firm’s export intensity still remain in place, and even new ones have been introduced over the last decade. For instance, the first pilot “Export Processing Zones,” which were established in 2000 and feature strict limitations on firms’ domestic sales, tripled in number by 2010. Similarly, the “Famous Brands” initiative, a large umbrella of export support programs, which included subsidies contingent on export performance, was introduced in 2005 and was only abandoned in 2009 after being challenged by the United States and the European Union at the WTO the year before. The “Auto Export Base” program

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3. See “Request from the United States to China,” October 11, 2011, reference G/SCM/Q2/CHN/42.
introduced in 2009, was also challenged in 2012 by the Obama Administration during the 2012 presidential election. These examples illustrate how difficult it is to evaluate the extent to which the dual trade policy regime in China has been reformed.

Our results show that a reduction of 6.9% in the ad valorem sales subsidy rate offered to pure exporters (from 30 to 27.53%) suffices to replicate the observed decline in their share among exporting firms. This small reduction, however, produces a significant fall in the total expenditure in export subsidies over GDP from 1.23% in 2002 to 0.42% in 2013, a reduction of 66%. As the distortions generated by the subsidy are lessened, China’s terms-of-trade improve and the average productivity of Chinese firms increases as well due to stronger import competition. Both effects increase welfare (measured as real income) in China by 1.76%. Conversely, the rest of the world experiences a welfare loss of 0.59% due to the higher price of Chinese imports.

The paper is organized as follows: The Model section introduces a 100%-ESR subsidy in a simple partial equilibrium model of trade with heterogeneous firms. Here we characterize the conditions under which pure exporters arise and coexist in equilibrium with domestic firms and firms serving both domestic and foreign markets, which we denote “regular exporters.” The General Equilibrium and Calibration section describes how the partial equilibrium model is embedded into a general equilibrium framework and explains the moments used to calibrate the model’s parameters. Finally, the Policy Experiment section analyzes how a reduction in subsidies consistent with the fall in the share of pure exporters observed between 2002 and 2013 affects total expenditure in subsidies, aggregate exports, and welfare in China and the rest of the world.

**Model**

Assume that Chinese firms can sell their output in China ($c$) and the rest of the World ($f$). The demand function faced by a firm producing variety $\varphi$ selling in market $i$ is:

$$q_i(\varphi) = A_i p_i(\varphi)^{-\sigma}, \quad i \in \{c, f\},$$

where $p_i(\varphi)$ is the price of good $\varphi$ charged in market $i$, $A_i$ is a country-specific demand shifter and $\sigma$ is the elasticity of demand. Each variety is produced by a monopolistically competitive firm with technology $q = \varphi l$, where $l$ denotes labor input and $\varphi$ is a firm-specific productivity index.

A Chinese firm can choose between three potential modes of operation: (i) produce for the domestic market alone, which entails paying a fixed cost $f_d$, (ii) become a regular exporter selling both domestically and abroad, by paying a fixed cost of exporting $f_e$ in addition to the fixed cost of operating in the domestic market, or (iii) become a pure exporter (i.e., a firm that exports all its output...
because it faces a 100% export share requirement.\footnote{Defever and Riaño (2014) study the general case in which export share requirements can take an arbitrary value.} The latter option requires the firm to pay a fixed cost $f_x$ and enables it to receive an ad valorem subsidy $s$ on its sales.

Let $k \in \{d, x, p\}$ index the three possible modes of production: domestic, regular, and pure exporter respectively. The profit that a firm of productivity $\varphi$ attains in operation mode $k$ is:

$$
\pi^k(\varphi, s) = \begin{cases} 
\kappa A_c(\varphi)^{\sigma-1} f_d, & \text{if } k = d, \\
\kappa[A_c + \tau^{1-\sigma}A_f](\varphi)^{\sigma-1} - (f_d + f_x), & \text{if } k = x, \\
\kappa(1 + s)^{\sigma} \tau^{1-\sigma}A_f(\varphi)^{\sigma-1} - f_x, & \text{if } k = p,
\end{cases}
$$

(2)

where $\kappa \equiv (\sigma - 1)^{\sigma-1} \sigma^{-\sigma}$ and the wage in China has been normalized to 1. Both regular and pure exporters face an iceberg transport cost $\tau \geq 1$ when selling their output abroad.

A Chinese firm with productivity $\varphi$ chooses to operate under the pure exporter mode $k = p$ if $\pi^p(\varphi, s) \geq \max\{\pi^d(\varphi), \pi^x(\varphi), 0\}$, or equivalently if $\pi^p(\varphi, s) \geq \pi^d(\varphi), \pi^p(\varphi, s) \geq \pi^x(\varphi)$ and $\pi^p(\varphi, s) \geq 0$ hold together. We characterize this set of conditions by defining four different productivity cutoffs that describe combinations of productivity and subsidy rates $(\varphi, s)$ for which a firm is indifferent between a given pair of production modes.

We start with the two standard cutoffs $\varphi^*$ and $\varphi^x$ that identify domestic firms and regular exporters in the Melitz (2003) model in the absence of pure exporters,

$$
\varphi^* = \left( \frac{f_d}{\kappa A_c} \right)^{\frac{1}{\sigma-1}},
$$

(3)

$$
\varphi^x = \tau \left( \frac{f_x}{\kappa A_f} \right)^{\frac{1}{\sigma-1}}.
$$

(4)

These two cutoffs are respectively, the productivity level above which a Chinese firm would find it profitable to produce for the domestic market alone \{\varphi : \pi^d(\varphi^*) = 0\}, and the productivity level necessary for a firm to choose to become a regular exporter \{\varphi : \pi^x(\varphi^x) = 0\}. We assume that in the absence of subsidies, exporters are more productive than domestic firms in China (i.e., we assume that $f_d/f_x \leq A_c/(\tau^{1-\sigma}A_f)$, which implies $\varphi^* \leq \varphi^x$).

We define two additional cutoffs that arise in the presence of a pure exporter. Let $\bar{\varphi}(s)$ be the productivity level at which a firm would be indifferent between being a regular or a pure exporter, i.e. $\bar{\varphi}(s) = \{\varphi : \pi^p(\bar{\varphi}, s) = \pi^c(\bar{\varphi})\}$. Thus, $\bar{\varphi}(s)$
is given by,

\[ \tilde{\varphi}(s) = \left( \frac{f_d}{\kappa(A_c - \tau^{1-\sigma}A_f[(1 + s)^\sigma - 1])} \right)^{\frac{1}{1-\sigma}}. \]  (5)

Inspection of (5) reveals that \( \tilde{\varphi}(s) \) is strictly increasing in \( s \), with \( \tilde{\varphi}(0) = \varphi^* \) and \( \tilde{\varphi}(s_{\text{max}}^1) \to \infty \), with \( s_{\text{max}}^1 \) defined below. In order for a firm to choose to operate as a pure rather than a regular exporter, it must be the case that the subsidy it receives is greater than the profits it could earn in the domestic market. Thus, high productivity firms require high subsidy rates to be swayed towards operating as pure exporters.

Similarly, let \( \varphi(s) \) be the productivity level such that a firm would be indifferent between selling only in the domestic market and operating as a pure exporter. That is, \( \varphi(s) \) is defined implicitly by \( \varphi(s) = \{ \varphi : \pi^p(\varphi, s) = \pi^d(\varphi) \} \). This condition reads:

\[ \varphi(s) = \left( \frac{f_x - f_d}{\kappa(\tau^{1-\sigma}A_f(1 + s)^\sigma - A_c)} \right)^{\frac{1}{\sigma}}. \]  (6)

Under the additional assumption that \( f_x > f_d \), it follows that \( \varphi(s) \) is strictly decreasing in \( s \) whenever \( s > s_{\text{min}} \), with \( s_{\text{min}} \) defined below. Firms with productivity \( \varphi \in (\varphi^*, \varphi_x^*) \), which would prefer to operate domestically in the absence of subsidies, find it profitable to change their production mode if the additional revenue they receive because of the subsidy is greater than the difference in fixed costs, \( f_x - f_d \). Therefore, domestic firms with relatively high productivity levels would require a lower subsidy to become pure exporters. Figure 2 plots all the different cutoffs in \( \{ \varphi, s \} \)-space.

Comparing all four cutoffs (3)–(6), it follows that pure exporters arise when \( s \) is such that \( \varphi(s) \leq \tilde{\varphi}(s) \). The minimum subsidy necessary for firms to choose the pure exporter operation mode, \( s_{\text{min}} \), is given by,

\[ s_{\text{min}} = \left( 1 + \frac{A_c}{\tau^{1-\sigma}A_f} - \frac{f_d}{f_x} \right)^{\frac{1}{\sigma}} - 1 > 0. \]  (7)

Figure 2 also shows that \( \varphi(s_{\text{min}}) = \tilde{\varphi}(s_{\text{min}}) = \varphi_x^* \). Therefore, when \( s \geq s_{\text{min}} \), pure exporters start to arise around the no-subsidy export cutoff, \( \varphi_x^* \). This implies that pure exporters are more productive than domestic firms but less so than regular exporters.\(^5\)

\(^5\) Defever and Riaño (2014) show that this prediction requires that the effective fixed cost of operation of pure exporters be higher than that of domestic firms. If the converse is true, for instance if pure exporters also receive subsidies affecting their fixed cost (e.g., reduced land rental rates or public utilities), then firms choosing to operate as pure exporters would be less productive than domestic firms. Empirically, Defever and Riaño (2014) find that pure exporters in China are indeed more productive than domestic firms and less productive than regular exporters. The latter prediction of the model should hold regardless of the whether the subsidy is applied to sales or fixed costs as long as domestic firms coexist alongside pure and regular exporters in equilibrium.
As $s$ increases, the share of active firms operating as pure exporters increases at the expense of domestic firms and regular exporters. In fact, if $s$ is sufficiently high, either domestic firms or regular exporters would disappear. As noted above, let $s_{1}^{\text{max}}$ be the value of subsidy for which $\bar{\varphi}(s) > 1$, that is,

$$s_{1}^{\text{max}} = \left(1 + \frac{A_{c}}{\tau^{1-\sigma}A_{f}}\right)^{\frac{1}{\sigma}} - 1,$$

meaning that no firm would find it profitable to operate as a regular exporter. If, on the other hand, it is the case that a very large subsidy stops firms from producing uniquely for the domestic market, we can define $s_{2}^{\text{max}}$ as the subsidy value for which $\varphi(s_{2}^{\text{max}}) = \varphi^{*}$, that is,

$$s_{2}^{\text{max}} = \left(\frac{f_{d}}{f_{x}} \frac{A_{c}}{\tau^{1-\sigma}A_{f}}\right)^{\frac{1}{\sigma}} - 1.$$

Proposition 1 summarizes the conditions under which the three modes of production arise in equilibrium.

**Proposition 1.** Assume that $f_{d}/f_{x} \leq A_{c}/(\tau^{1-\sigma}A_{f})$ and $f_{d} < f_{x}$, the three modes of production $k \in \{d, p, x\}$ coexist in the presence of a positive and sufficiently large

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**Figure 2. Choice of Mode of Operation with Pure Exporters**

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subsidy $s$, such that $(s_{\text{min}}, \min\{s_{1}^{\text{max}}, s_{2}^{\text{max}}\})$. Firms with productivity $\varphi \in [\varphi^*, \varphi(s)]$ only operate domestically, firms with productivity levels $\varphi \in [\varphi(s), \overline{\varphi}(s)]$ choose to operate as pure exporters, and firms with $\varphi \geq \overline{\varphi}(s)$ self-select into regular exporters.

**General Equilibrium and Calibration**

We follow Defever and Riaño (2014) and introduce subsidies with ESR in an otherwise standard two-country, general equilibrium of trade with heterogeneous firms as in Melitz (2003). We assume that only one country (i.e., China) uses these subsidies.

There are two countries in the world, China ($c$) and the rest of the World ($f$), each of size $L_i$, $i \in \{c, f\}$. Consumers in each country have CES preferences that yield demand functions like (1), with $A_i = E_i P_{i}^{r-1}$, where $E_i$ denotes country $i$’s total expenditure and $P_i$ is the ideal price index in the same country. Labor is the only input of production; there is a mass of potential entrants who draw their idiosyncratic productivity from a Pareto distribution $G(\varphi) = 1 - \varphi^{-a}$ after paying a sunk cost $f_c$. The problem for Chinese firms is identical to the one described in the Model section, while producers in the rest of the world cannot operate as pure exporters.

Equilibrium in the model is characterized by a vector of wages, mass of active firms, and price indices such that in both countries the labor market clears, there is free entry, and aggregate income equals aggregate expenditure (i.e., trade is balanced). Subsidies with ESR in China are financed via lump-sum taxes levied on households, and the government’s budget is balanced.

Both countries are assumed to be identical in terms of size and the vector of parameters faced by firms and consumers. We calibrate the model following a similar strategy as Defever and Riaño (2014). Table 1 presents the parameters used to solve the model.

The parameters $(f_d, f_x, \tau, s)$ are chosen to match four moments: (i) the shares (among all active firms) of regular (ii) and pure exporters (i.e., firms exporting...
more than 97% of their sales) of 26% and 9%, respectively, (iii) an export/sales ratio for regular exporters of 36.1%, and a (iv) productivity premium of pure exporters vis-à-vis domestic firms of 37.6%. The first three moments are calculated using data from the BEEPS dataset for the year 2002; the total factor productivity premium is for the year 2002 and is estimated using the Levinsohn and Petrin (2003) algorithm with data for the period 2000–06 from the annual survey of Chinese manufacturing firms compiled by the National Bureau of Statistics (NBS). The magnitude of the calibrated transport cost and the fixed cost of exporting (relative to the domestic fixed cost) are within the range of estimates reported in the literature. More importantly, a 30% ad valorem sales subsidy with a 100% ESR is required to match the share of pure exporters operating in China in 2002. The calibrated subsidy is slightly smaller than the 33.2% inferred in the richer model used in Defever and Riaño (2014), which features multiple export share requirements, not only a 100% one as in the current exercise; total expenditure on pure exporter subsidies accounts for 1.23% of GDP in the benchmark model.

**Decreasing Subsidies with ESR**

We use the calibrated model to infer the reduction in subsidies with ESR that is consistent with the share of pure exporters declining from 25.7% of all exporters in 2002–03 to 11.1% in 2012–13 in the BEEPS data. We then evaluate how the fall in subsidies with ESR affected total expenditure in subsidies, exports, and welfare both in China and in the rest of the world (ROW). The results of this experiment are presented in Table 2.

A reduction in the 100%-ESR subsidy rate from 30% to 27.53% matches the reduction in the share of pure exporters among exporting firms in China. As shown in figure 2, the share of pure exporters is highly responsive to changes in the subsidy rate. Similarly, total expenditure in export subsidies falls by a staggering 65%.

Reducing subsidies with ESR improves China’s welfare, measured as real disposable income, by 1.76%. The tax burden on Chinese consumers is lessened, and they are now able to enjoy a greater variety of goods that were previously produced in China but were only available to foreign consumers (a “love-of-variety” effect increases welfare directly). Moreover, because of tougher domestic

<table>
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<th>Variable</th>
<th>2002</th>
<th>2013</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%-ESR subsidy rate</td>
<td>30.00%</td>
<td>27.53%</td>
<td>−6.90</td>
</tr>
<tr>
<td>Subsidies/GDP, China</td>
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<td>0.42%</td>
<td>−65.85</td>
</tr>
<tr>
<td>Exports/GDP, China</td>
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<td>29.97%</td>
<td>−3.10</td>
</tr>
<tr>
<td>Welfare, China</td>
<td></td>
<td></td>
<td>1.76</td>
</tr>
<tr>
<td>Welfare, ROW</td>
<td></td>
<td></td>
<td>−0.59</td>
</tr>
</tbody>
</table>
competition, the price index in China also falls. Welfare for ROW falls as its imports become more expensive, experiencing a terms-of-trade loss.

**Conclusion**

The results of our exercise suggest that indeed China has gradually diminished the degree of dualism in its trade policy regime over the last decade. Phasing out the advantages granted to export-oriented firms has reduced the tax burden on consumers, improved terms-of-trade, and produced sizable welfare gains. However, there is still scope for further reform. Our simple model suggests that China would stand to realize an additional 1 percent increase in real income if it were to fully eliminate subsidies with export share requirements.

**References**


Financial Crises, Development, and Growth: A Long-term Perspective

Carmen M. Reinhart and Vincent R. Reinhart

Observed over long periods, the upward path of the output of most economies occasionally takes jagged steps down. More often than not, these events are associated with a variety of crises, including systemic banking stresses, exchange rate crashes, a burst of inflation, and a restructuring or default on sovereign debt. Using a large panel of countries over a long period, we document that crises are typically associated with lower medium-term growth. That may be a direct causal channel, a reverse channel, or the influence of some other factors on both growth and finance. But they tend to go together. Given that the forces for convergence of income across countries are estimated to be slow, going off track around a crisis will likely have long-lived consequences for relative economic development. JEL codes: G01, N20, O4, O5

Introduction

Observed over long periods, the upward path of the output of most economies occasionally takes jagged steps down. More often than not, these events are associated with crises, including systemic banking stresses, an exchange rate crash, a burst of inflation, and the restructuring of or default on sovereign debt contracts. The shadow of these events on economic growth also tends to be long, producing the regularity in most time series across the world that the intensity of a variety of crises and GDP growth are negatively related and the effect long lived. This paper is about this association.

The issue resonates now because so many economies (mostly high-income countries) recently went through significant crises and recessions and have struggled with slow growth subsequently. The truth is that the association between crises and economic growth is a feature of the long sweep of history, which is one of the messages of Reinhart and Rogoff (2009). Our update to the dataset underlying that work allows us to document the negative link between elevated

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incidence of crises and economic growth across sixty-six countries over the past one and half centuries, which we employ to focus more about the longer-term relationship.

We intend to be careful throughout in not asserting a causal relationship between crises and growth. A crisis might undermine economic prospects by destroying financial wealth and impeding intermediation (as is the first of the possibilities underlying the link discussed in Reinhart and Reinhart, 2010). Or, a significant downward revision to the prospects for economic growth might lead households, firms, or governments to realize they have overborrowed, triggering trauma in finance (as is laid out in Buttiglione, et al., 2014). As another possibility, a haphazard national approach to the rule of law and other inadequacies in the political and regulatory infrastructure might jointly slow growth and raise the probability of crises (as is the message of Acemoglu, et al., 2003).

Ours is a more practical observation. How to spur growth is the first-order mystery of the economic development literature. How to know that growth has been spurred in real time is a daunting challenge for time-series econometrics. But we do know that a variety of crises and slow economic growth go hand-in-hand, implying that a government that attracts financial crises of any sort in a repeated manner invites disappointing economic outcomes. This might be because financial crises are a direct and major menace to economic activity. Even if they are not, they are at least the canary-in-the-coal-mine for signaling a risk to economic growth.

This especially matters for economic development because, as of yet, the other identified forces at work moving an economy along a growth trajectory appear to have only modest effects. Barro (2012) writes about the “iron law” of convergence observed across empirical growth models. Whether assessed conditionally (the association augmented by other variables) or unconditionally (the association taken in isolation), only about 2 percent of the gap between the level of a laggard economy from the advanced norm is worked off each year. Put this in perspective to the result in Reinhart and Reinhart (2010). Ten years after the fifteen worst financial crises of the second half of the 20th century, the median level of GDP per capita was 15 percent below the level predicted from the trend of the ten years prior to the crisis. If convergence is only 2 percent per year of the level difference, this slow force of adjustment implies that output makes up only two-thirds of the gap relative to its previous trend one-half century after the perturbation.

High stakes, indeed, and suggestive that an important focus of governmental attention in the development process should be building the legal and regulatory infrastructure of finance and delivering steady macroeconomic policies in a manner that avoids crisis. Those efforts, as well as avoiding the direct harm of crises, are conducive to growth in the long run.

The next section provides an abbreviated review of the literature and sketches the channels of transmission flowing back and forth between financial crises and medium-term economic growth. This includes work by Fischer (1993) and Bruno and Easterly (1998) highlighting the link between problematic policy choices (especially high inflation) and slower economic growth. Another strand
of work, begun by Ramey and Ramey (1995), delineates deleterious effects of the volatility of real growth to mean growth. The next step is to note that financial crises tend to elevate volatility, forging the link between crises and growth examined for Latin American economies by Edwards (2007) and for Asian ones by Barro (2001) and more broadly by Cerra and Saxena (2008) and Reinhart and Rogoff (2009).

The Varieties of Crises section updates to 2014 the crisis chronology first provided in Reinhart and Rogoff (2009). It reviews the six main varieties of financial dysfunction: banking crises, currency crashes, currency conversions/debasement, default on external debt, default on domestic debt, and high inflation.

This extended dataset is used in the Crises and Convergence section to characterize the relationship between a variety of crises and economic growth at both the individual country level and for regional groupings. We mostly rely on five- and ten-year averages of the data to establish the broad association between the intensity of financial crises and real GDP growth. And, indeed, the two are negatively related across countries and regions and over the broad sweep of time in a manner that seems robust. Another feature of the data is that crises are clustered across countries and persistent over time. Perhaps, then, it should not be a surprise that global economic growth has recently been and is projected to continue to be subpar.

Another aspect of the current conjuncture that is worrisome is examined in the External Risks to Convergence section. Major central banks are providing policy accommodation in unprecedented degrees when measured by the lowness of their policy rates and the scale and scope of their balance sheets (in a manner mapped out by Bernanke and Reinhart, 2004). Low interest rates at financial centers are exactly the mechanism identified in Reinhart and Reinhart (2009) tending to boost capital inflow “bonanzas” around the world. (By their definition, a capital inflow bonanza occurs whenever a country has elevated capital inflows compared to its own history.) Essentially, investors in financial centers are more likely to seek higher returns abroad when those at home are depressed. This matters because Reinhart and Reinhart also show that capital inflow bonanzas are good predictors of subsequent financial distress, including banking and currency crises and sovereign defaults. With major central banks keeping rates pinned to their zero lower bound and ballooning their balance sheets, capital inflows are currently elevated.

The concluding section repeats the advice woven throughout the paper. Avoiding crises is central to successful economic development. The advice for researchers is to try to understand why.

_channels of transmission_

Two questions focus our attention in reviewing the literature on various financial crises and economy growth. How might the two be linked? And what evidence has been put forward that they are linked?
As to the first question, economic theory offers many reasons why there would be a complicated back-and-forth connection between crises and economic growth. In principle, observation of an association between two variables invites one of three possibilities. The one causes the other. The other causes the one. Or some other force causes both.

A standard New Keynesian model would predict that a crisis produces an economic slowdown (as discussed in Reinhart and Reinhart, 2010). Most of the financial crises we tally destroy financial wealth, either through stopping payment with default, lowering equity values in the fire sale attendant to a banking crisis, reducing the real value of assets via unexpected inflation, or revaluing upward external liabilities with an exchange rate collapse. Add to this the possibilities that a banking crisis impedes intermediation in the manner discussed by Bernanke (1983) and leads to a “sudden stop” of external funding, as in Calvo (1998). All these influences cumulate to an adverse aggregate demand shock that slows economic activity if there is not sufficient policy offset. Policy offset matters because, in these sorts of models, an aggregate demand shock can always be blunted, abstracting from recognition lags. Monetary policy, however, might be constrained by the zero lower bound to nominal interest rates if little inflation is expected and fiscal policy might be hamstrung if there is a legacy of an outstanding large public debt. The result is economic contraction, followed by slow growth for some time associated with underinvestment in physical and human capital.

As another possibility, current and expected future supply might influence demand and the probability of a financial crisis. In particular, as described in Buttiglione et al. (2014), expectations of future growth determine the slope of the trajectory of future income. The net present value of that path determines the capacity of households, firms, and the government to borrow. If that path rotates down on the realization that growth ambitions were too ambitious, the reaction in financial markets might be jarring. The appreciation that economic performance will be poorer becomes the spark of financial crisis. As for precedent, consider that over-optimism on technological improvements such as the diving bell, the steam engine, the radio, and the Internet gave way to the reality of limits to growth, market correction, and economic contraction.

The third possibility is that this overstates the importance of macroeconomic dynamics. Instead, we might observe poor structural policies jointly impeding growth and raising the chance of financial crisis. Bad policies beget bad outcomes. The most forceful example of this line of argument is Acemoglu et al. (2003). They argue that the colonial past casts a long shadow. In that darkness, those economies have been unable to build the edifice of commerce, finance, and regulation to support growth. They are also more subject to extraction of private resources by those in power. Crises and slow growth are twinned because the government makes it so.

Notice there may be substantial overlap in these forces in any particular economy, indeed to the point of introducing a vicious circle that produces a development trap. An incomplete financial architecture makes it more likely the existing capital markets swing with a wide amplitude to any news on future aggregate...
supply. An adverse swing destroys wealth and sets in motion contraction for all the conventional Keynesian reasons. But recession and financial crisis brings out the worst in the elite, leading them to use their influence to get a bigger share of a shrinking economic pie. The worsening of the rule of law and undercutting of property rights tilts the growth profile down and further raises its amplitude for the next mood swing in markets.

Understanding of the association between financial crises and economic growth evolved over the years. First, there was attention paid to the negative effects of inflation and other poor policies on economic expansion. In cross-sectional and panel regressions, Fischer (1993) found that inflation, large budget deficits, and distorted foreign exchange markets impaired growth. Moreover, some of his evidence suggested that causation ran from policies to income, not the other way around. Bruno and Easterly (1998) isolated the investigation to the effect of high inflation—above 40 percent—on economic growth. They hold that an episode of high inflation takes a considerable toll on activity but, if reversed, produces an equally large snapback. Put in our terms, inflation crises and economic growth are negatively related. As with Fischer, they also find that wide parallel exchange market premiums have predicted power for ill economic outcomes. This line of inquiry was ultimately subsumed by work on empirical growth models that significantly expanded the search for potential determinants. Summaries of this work include Easterly and Levine (2001) and more recently Barro (2012).

Ramey and Ramey (1995) approached the issue from another direction. Rather than look for the effects of policy on the path of national output, they examined the moments of the GDP process. In a large sample of countries, they found a negative relationship between mean GDP growth and its volatility. The core question in interpreting this association, however, is whether volatility is directly harmful to growth or do countries with little capacity to absorb shocks have both low and volatile real GDP growth. Hnatkovska and Loayza (2005) extended Ramey and Ramey’s work to find that, indeed, the effects are more severe for countries with weak institutions. They also isolate those periods when the time series of GDP growth volatility of an economy is extreme relative to the global experience. Over time and across country, extreme volatility is strongly negatively related to economic growth.

This work is the bridge to the neighborhood this paper inhabits. Identifying extreme periods of GDP volatility is a selection method to define economic crises, much in the manner Bruno and Easterly (1998) can be reinterpreted as selecting out inflation crises from their sample. The empirical strategy is to choose selection criteria for variables such as inflation and the exchange rate, augmented by the policy narrative on the health of the banking system and sovereign debt repayments, to identify crises. Kaminsky and Reinhart (1999) did this for banking and currency crises to find, among other results, that they are twinned—that their incidence was highly correlated.1

The natural next step was to examine the systematic behavior of macroeconomic variables in and out of these crises episodes. Barro (2001) did so to put the Asian crisis of 1997–98 in perspective, finding a significant negative effect on growth in the five-year window after the crisis but none thereafter. This is similar to Reinhart and Reinhart (2010), who by examining the decade following a crisis, conclude that there was a sizable level lower in GDP per capita after the fifteen worst financial crises of the twentieth century but no growth consequence once far enough passed the crisis. Edwards (2007) considered the behavior of Latin American countries around crises to conclude that weak institutional structures make it likely that the region will fall further down the global league table of GDP per capita.

Reinhart and Rogoff (2009) broadened the search to include more indicators and a much longer history, concluding that the aftermath of a severe financial crisis is considerable on economic activity. Cerra and Saxena (2008), in a shorter but wider sample, find that the output loss appears permanent.

The most explicit linkage between crisis identification and economic modelling is found in the work of Barro (2006), Barro and Ursua (2008), and Nakamura et al. (2013). On the empirical side, this involved identifying large drops in output, consumption, and equity values over a long and broad sample. On the modelling side, they show that under certain specifications of consumer preferences, even a low probability of very adverse outcomes has profound implications for the equity premium and the risk-free interest rate.

The central question we ask: Is the effect of a variety of crises on economic growth material enough to matter in the process of economic development? To do so, crises are agglomerated into a single summary statistic, adding across the incidence of chronic high inflation or multi-year default on sovereign debt or a shorter, but more intense, systemic banking crisis or sudden currency crash. This approach lends itself to further inquiry attempting to discriminate according to crisis type, but these distinctions can be blurred by the fact that many types of crises often overlap in the historical country experiences, a point emphasized in Reinhart and Rogoff (2009).

**Varieties of Crises**

Before we can establish an association between crises and growth, we need an assured definition of crises. In this section we lay out the varieties of crises and update their identification in time series ending in 2014 extending the long time series introduced in Reinhart and Rogoff (2009) in identifying data sources and specifying six types of crises.

Those six crises types are repeated in table 1, along with the criteria for determining that an event has been triggered. Six crises types are dated: banking; high inflation; exchange rate collapses; currency debasement or conversions; sovereign domestic debt restructuring or default; and comparable sovereign credit events for external debt.

2. For an application of this idea to debt dynamics, see Reinhart et al. (2015).
This identification requires judgment, including as to how serious financial distress has to be for a banking crisis. Thresholds on defining an inflation or exchange-rate crisis are similarly subject to debate. The definitions are summarized in table 1 and are taken from Reinhart and Rogoff (2009).

Figure 1 plots the annual average number of crises around the world from 1800 to 2014. A few points of background are required to appreciate this tally. First, as there are six types of crises, the potential range of the chart spans 0 (perfect tranquility) to 6 (all that could go wrong goes wrong). Second, the number of countries varies over time, with colonial empires limiting the count to 16 at the start in 1800. The Latin American independence movement doubled the number by mid-century. Coverage steps up twice more, after the dust clears from World War I and after the African independence movement of the 1960s. Third, the line plotted is unweighted across countries, so emerging market economies have an influence on the average disproportionate to their contribution to global GDP.

Reinhart and Rogoff (2009) run through the movements in this series in some detail. The familiar feature is that crises have always been with us—the events of 2008–09 do not leap off the page. The post-2008 rise in crises is notable higher if

<table>
<thead>
<tr>
<th>Table 1. Six Crises Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crisis type</td>
</tr>
<tr>
<td>Type I: Systemic/severe</td>
</tr>
<tr>
<td>Type II: Borderline/financial distress/milder</td>
</tr>
<tr>
<td>Currency crashes</td>
</tr>
<tr>
<td>Currency conversions are added as a second variety of a currency crash</td>
</tr>
<tr>
<td>Debt crises: External</td>
</tr>
<tr>
<td>Debt crises: Domestic</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
</tbody>
</table>
the cries are weighted by the country’s share in world income, as the recent wave of crises fell largely on high income economies. The local peak of about three quarters is an 80th percentile event, not all that common, but the past few years did seem especially turbulent. Part of this is a recency bias because the 1830s, the 1930s, and the 1980s were also turbulent. But this time the banking crises were clustered in advanced economies, and there are more than twice as many emerging market economies in the later part of the sample. The monetary policy response of the central banks in the major financial centers pulled nominal interest rates to near-record lows. This created a relatively mild environment for financial markets and government finance in emerging market economies, suppressing the number of crises there. Also, note that the final chapter on the banking crises of advanced economies has not been written. We provisionally put the duration of banking crises as as long as national GDP had not recovered its prior peak. If GDP is subsequently revised lower or takes a downward turn sometime soon, historians might extend the spell of banking crises beyond what we penciled in here.

The next five charts (figures 2 through 6) track average annual financial crises for five regional subgroups: Africa, Asia, Europe, Latin America, and the “Western Offshoots” of the Old World (Australia, Canada, New Zealand, and the United States). In each, we repeat the track of the world average to give some sense

3. The four economies of Emerging Europe, which round out the sixty-six-country sample, are not shown separately but are included in the world average.
Figure 2. Varieties of Crises, Africa (13 Countries) and World Aggregate (66 Countries), 1800–2014 Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.

Figure 3. Varieties of Crises, Asia (12 Countries) and World Aggregate (66 Countries), 1800–2014 Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.
Figure 4. Varieties of Crises, Western Europe (14 Countries) and World Aggregate (66 Countries), 1800–2014, Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.

Figure 5. Varieties of Crises, Latin America (18 Countries) and World Aggregate (66 Countries), 1800–2014, Average Number of Crises per Country

Sources: Reinhart and Rogoff (2009), sources cited therein and the authors’ calculations.
of relative performance. Also, as there are the measures we will mostly rely on to compare with GDP growth (which is typically not available as far back in time), the sample starts in 1870.

Two of the main messages of Reinhart and Rogoff (2009) show through here, and another one becomes clearer with the updated data. First, some regions are systematically more volatile than others for long stretches. Africa for most of its history, Asia before World War II, and Latin America since the 1970s regularly ran a rockier road than the rest of the world. Second, all regions have crises (although underneath the overall averages their composition varies). Only for a few decades after World War II were crises not recurrent (and that holds more for advanced economies). And third, graduation to tranquility is hard. Just when it is tempting to say crises are history, as in Asia before 1997 and Europe and the Western Offshoots before 2008, they recur.

**C R I S E S A N D C O N V E R G E N C E**

Having defined the event, it is incumbent on us to describe how the event matters. To that end, we focus on the growth of real GDP per capita for the sixty-six countries in the sample. Decade averages of the six regional subgroups are provided in table 2. The sources, familiar from Reinhart and Rogoff (2009), are summarized in the note to the table.

As is evident, economic growth does vary substantially from decade to decade. “Lost” decades do appear, witness the outright declines in GDP per
Table 2. Average Annual Real GDP per Capita Growth

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>Asia</th>
<th>Western Europe</th>
<th>Emerging Europe</th>
<th>Latin America</th>
<th>Western Offshoots</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>1869</td>
<td>.</td>
<td>.</td>
<td>1.2</td>
<td>.</td>
<td>1.9</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>1879</td>
<td>.</td>
<td>.</td>
<td>1.0</td>
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<td>0.8</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>1889</td>
<td>.</td>
<td>1.2</td>
<td>1.4</td>
<td>.</td>
<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>1899</td>
<td>.</td>
<td>1.8</td>
<td>1.5</td>
<td>.</td>
<td>0.9</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>1909</td>
<td>.</td>
<td>1.4</td>
<td>1.2</td>
<td>.</td>
<td>2.1</td>
<td>2.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1919</td>
<td>.</td>
<td>2.8</td>
<td>0.1</td>
<td>.</td>
<td>0.9</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>1929</td>
<td>.</td>
<td>1.6</td>
<td>3.8</td>
<td>.</td>
<td>3.4</td>
<td>1.5</td>
<td>3.0</td>
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<td>.</td>
<td>0.7</td>
<td>1.2</td>
<td>2.1</td>
<td>0.7</td>
<td>0.8</td>
<td>1.0</td>
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<tr>
<td>1949</td>
<td>.</td>
<td>0.0</td>
<td>1.0</td>
<td>0.8</td>
<td>1.9</td>
<td>3.0</td>
<td>1.4</td>
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<tr>
<td>1959</td>
<td>.</td>
<td>3.2</td>
<td>3.9</td>
<td>4.0</td>
<td>1.5</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>1969</td>
<td>2.0</td>
<td>3.6</td>
<td>4.6</td>
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<td>2.8</td>
<td>3.1</td>
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<td>3.0</td>
</tr>
<tr>
<td>1989</td>
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<td>-0.6</td>
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<td>1999</td>
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<td>1.9</td>
<td>-0.7</td>
<td>1.7</td>
<td>1.7</td>
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</tr>
<tr>
<td>2009</td>
<td>2.4</td>
<td>4.5</td>
<td>1.2</td>
<td>3.9</td>
<td>1.9</td>
<td>1.4</td>
<td>2.4</td>
</tr>
<tr>
<td>2010 to 2014</td>
<td>1.7</td>
<td>4.5</td>
<td>0.3</td>
<td>2.7</td>
<td>3.0</td>
<td>1.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Note: Decade averages ending in year listed, percent.

Statistically significant level, with the exception of Africa. The negative association is most sizable for Asia, but it is large elsewhere.

This inverse relationship between the growth of GDP per capita and crises incidence also holds in the annual, unsmoothed observations. The inset to figure 12 provides the correlation between real GDP per capita growth and the

Sources: See Reinhart (2010) for varieties of crises. See notes to Table 2 for GDP per capita.
incidence of crises across sixty-six countries in the post–World War II era. Across all countries in the sample, the correlation is about $-0.25$, and statistically significantly so. The histogram reports along the vertical axis the frequency observed of the correlation coefficients measures along the horizontal axis. Fully
87 percent of the economies in the sample individually had negative correlation coefficients between growth and crises.

The contemporaneous correlation of about one-quarter belies how tightly growth and crises are knit. The bottom panel shows the correlation from 1955 to 2014 of real GDP growth to the current and lagged readings of the incidence of financial crises. The association is strongly negative long after the event (the
left axis) and statistically significantly so (the right axis). But the result also accords with the finding in Barro (2001) that the link between growth and crises weakens after about five years and Cerra and Saxena (2008) that the level effect is permanent.

Sources: See Reinhart (2010) for varieties of crises. See notes to Table 2 for GDP per capita.
Simple correlation coefficients, whether on annual or long-moving averages of the data, do not convey the cumulative relationship over long periods, although the fact that the association is negative over multiple lags offers the possibility that the effect adds up. The two panels of figure 13 below fill this gap by examining the extent that recent economic outcomes are related to a
TABLE 3. Correlation of Growth and Crisis Differentials for Regional Aggregates Five- and Ten-Year Moving Averages Relative to the World Aggregate

<table>
<thead>
<tr>
<th></th>
<th>Africa*</th>
<th>Asia</th>
<th>Western Europe</th>
<th>Emerging Europe</th>
<th>Latin America</th>
<th>Western Offshoots</th>
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</thead>
<tbody>
<tr>
<td><strong>Five-year/five-year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955 to 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>correlation</td>
<td>-0.03</td>
<td>-0.77</td>
<td>-0.44</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.54</td>
</tr>
<tr>
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<td>60</td>
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</tr>
<tr>
<td>t-test</td>
<td>-0.20</td>
<td>-9.25</td>
<td>-3.75</td>
<td>-4.32</td>
<td>-4.31</td>
<td>-4.84</td>
</tr>
<tr>
<td>1874 to 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>correlation</td>
<td>-0.62</td>
<td>-0.32</td>
<td>-0.31</td>
<td>-0.36</td>
<td>-0.25</td>
<td></td>
</tr>
<tr>
<td>number of observations</td>
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<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
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<tr>
<td>t-test</td>
<td>-9.16</td>
<td>-3.98</td>
<td>-3.78</td>
<td>-4.50</td>
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<tr>
<td><strong>Ten-year/ten-year</strong></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>1955 to 2014</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>correlation</td>
<td>0.17</td>
<td>-0.77</td>
<td>-0.18</td>
<td>-0.45</td>
<td>-0.37</td>
<td>-0.53</td>
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<tr>
<td>number of observations</td>
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<td>60</td>
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<td>60</td>
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<tr>
<td>t-test</td>
<td>1.18</td>
<td>-9.11</td>
<td>-1.37</td>
<td>-3.87</td>
<td>-2.99</td>
<td>-4.80</td>
</tr>
<tr>
<td>1874 to 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>correlation</td>
<td>-0.77</td>
<td>-0.27</td>
<td>-0.35</td>
<td>-0.49</td>
<td>-0.21</td>
<td></td>
</tr>
<tr>
<td>number of observations</td>
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<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>t-test</td>
<td>-14.28</td>
<td>-3.36</td>
<td>-4.39</td>
<td>-6.65</td>
<td>-2.56</td>
<td></td>
</tr>
</tbody>
</table>

* 1965 to 2010

Sources: See Reinhart (2010) for varieties of crises. See notes to Table 2 for GDP per capita.
country’s legacy of financial crises. The upper panel looks at (the logarithm of) GDP per capita, measured in US dollars, in 2014, as assessed by the IMF in the *World Economic Outlook* (10/2014). The lower panel looks at annual average inflation from 2010 to 2014, also from the same source. The horizontal axis measures the frequency of crises on average over a country’s existence or from 1800 for nations of longer vintage. As there are six different varieties of crises, the raw count is divided by six times the years of existence. 4

As is evident, countries with a checkered legacy of crises are lower in the ranking of GDP per capita. The inset box reports a regression of GDP on crisis frequency for sixty-five countries (omitting the outlier, Angola). The statistically significant

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4. This way, a country that had every type of crisis in every year of its existence would have a crisis frequency of 100 percent.
Coefficient of $-0.13$ implies that moving from around the sample average of a 10 percent probability of one of the six crises per year to 20 percent is associated with GDP per capita that is 13 percent lower. A similar doubling of crisis incidence accompanies a 1–3/4 percentage point higher inflation rate in recent years. The former result suggests that the negative correlation between economic growth and crisis incidence over time and across countries and regions cumulates to send an important message about levels. We did not address inflation dynamics in the same manner, but from a development perspective, the occurrence of higher inflation should be taken as a red flag that warns about a higher crisis risk.

Again, we are only dealing with an association, but to quantify that association, one of the variables had to be placed on the right-hand-side of a regression.

just as it was placed along the horizontal axis of a chart. Whatever that arbitrary decision, it may be that crises impede growth or that slower growth breeds crises. Whatever the channel, the frequent appearance of financial crises is paired with a lack of income convergence.

**The External Risks to Convergence**

If financial crises directly threaten, or even indicate a threat to, economic convergence, then a pattern of late should give anyone pause. Policy interest rates are understandably low in major financial centers, making it important to also understand how that poses risks to economies not as far along in the development process. A repeated pattern in the modern era of global finance is that, when interest rates in major financial centers are low, foreign investors are attracted to emerging markets. Capital flows into small and shallow local markets, leading the exchange rate to appreciate, asset prices to rally, government budgets to improve, and local leaders to congratulate themselves as the rightful recipients of capital. In such an environment, structural weaknesses remain unaddressed, or even worsened, as local institutions stretch to move up a notch among the global competition.

Reinhart and Reinhart (2009) provide a simple identification scheme to assess periods of elevated external risks. Employing a variety of datasets, they select periods when an economy receives elevated capital inflows relative to its own history. Given the paucity of data, they use the mirror to capital account surpluses, current account deficits. Mechanically, any year is identified as having a capital flow bonanza when its current account balance is in deficit and its level relative to nominal GDP is in the lower 20th percentile of experience. The shaded area of figure 14 updates this calculation using the short time series (1980 to 2014) available in the IMF World Economic Outlook (10/2014).

As is evident, there have been four prior peaks in capital inflows in the past 35 years. All came before a pickup in financial crises worldwide. The (largely) Latin American debt crisis came first, early in the sample, as many countries in that region defaulted and suffered attendant financial dysfunction. The Mexican crisis of 1994–95 and the Asian crisis of 1997–98 followed. The most recent peak in capital inflows presaged the subprime crisis of 2008–09. As shown in the inset, across sixty-six countries and thirty-five years of data, the observed unconditional probability of having one of the six possible crises is 13.5 percent in a given year. Limiting the observations to years in which a country is currently having or had in the prior two years a capital inflow bonanza raises the conditional probability of having a financial crisis to 18.4 percent. That difference is statistically significant using the z-test described in Reinhart and Reinhart

5. Of course, large-scale reserve accumulation as practiced by some important economies muddies this relationship.
Indeed, in about two-thirds of the countries, the probability of a crisis around the dates of a capital inflow bonanza is higher than for the entire sample.

The bottom panel shows the unconditional and conditional probabilities of the six possible crises across five regions of the world. In all cases, knowing that a country had at least one of the varieties of crises in a moving three-year window of data sharpens the understanding of a chance of crisis. The largest differences are among emerging market economies, consistent with the view that understanding crisis dynamics is important in the development process.

The likely reason for this link is that a heavy inflow period can persist, potentially lulling policy makers and investors to the view that the bonanza is permanent, rather than temporary. Episodes end, more often than not, in an abrupt reversal. When flows reverse, asset prices give back their gains, often forcing painful adjustments on the economy. A bonanza is not to be confused with a blessing.
CONCLUSION

Policy makers must appreciate that a variety of crises are typically associated with slower economic growth. That may be a direct causal channel, a reverse channel, or the influence of some other factors on both growth and finance. But they go together. The influence of other forces for convergence of income across countries that economists have thus far identified are estimated to be slow, so going off track around a financial crisis will likely have long-lived consequences.

Some of the seeds of crisis are scattered on the financial landscape by official action, including erratic fiscal and monetary policies and a disregard for the rule of law and property rights. But some are beyond the control of policy. The sentiment of investors seems to swing in a wide arc, for instance, and the pace of technological progress is haphazard. Developments on world financial markets, international commodity prices and interest rates at the financial centers, obviously fall into the latter camp. However, when considering alternatives along the development path, policy makers should appreciate “the mixed blessing” of capital inflows.6

The surge in inflows from the early 2000s to 2008 was predominantly directed to advanced economies, most notably in periphery Europe.7 Following the 2008–09 crises, the economic prospects of many emerging markets compared favorably with the bleak performance of the advanced economies, and these discrepancies helped fuel a marked and sustained rise in capital inflows through 2013. Taking at face value the historical patterns described here, as to the connection between inflows and crises and crises and growth, raises concerns that the relatively crisis-scarce decade of 2004–14, which facilitated a faster pace of convergence between emerging markets and advanced economies, may not repeat itself in the years to come.

Policy makers in most open economies cannot stop external waves, but they are not completely powerless as to how much of their force washes ashore. Along with policies in the realms of human capital formation, institution building, and infrastructure development, crisis avoidance supplements the list of policy initiatives to foster long-term growth.

REFERENCES


6. The “mixed blessing” view is not novel, as in the title of Reinhart and Reinhart (1998), who present a menu of policy choices aimed at mitigating the boom-bust cycle of international capital flows.

7. Greece, Iceland, Ireland, Portugal, and Spain posted record or near-record current account deficits, financed by capital inflow bonanzas on the eve of crises.


World Price Shocks, Income, and Democratization

Ben Zissimos

This paper shows how a world price shock can increase the likelihood that democratization must be used to resolve the threat of revolution. Initially, a ruling elite may be able to use trade policy to maintain political stability. But a world price shock can push the country into a situation where the elite face a commitment problem that only democratization can resolve. Because the world price shock may also reduce average incomes, the model provides a way to understand why the level of national income per capita and democracy may not be positively correlated. The model is also useful for understanding dictatorial regimes’ rebuttal of World Bank calls to keep their export markets open in the face of the 2007–08 world food crisis. JEL codes: D30, D74, F11, F13, P16

INTRODUCTION

Lipset’s ‘modernization hypothesis,’ that the level of income per capita and hence economic development drives the creation and consolidation of democracy, has recently come into question. By estimating Markov transition models, Przeworski, Alvarez, Cheibub and Limongi (2000) failed to find a significant relationship between the level of income per capita and the likelihood of transition to democracy. Taking a difference-in-difference approach, Acemoglu, Johnson, Robinson and Yared (2008) replicate this finding by controlling for country-specific factors affecting both income and democracy. Although these findings have themselves been challenged, they are taken to be supportive of the ‘new institutional economics’ view that political and economic institutions form the foundations of long-run economic growth (see Acemoglu, Johnson and Robinson 2005).

With these developments, economists have begun to consider ways in which democratization might take place without any systematic reliance on increases in income. The present paper shows how democratization can arise as a result of a world price shock that may actually reduce average incomes. Throughout

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history, price shocks, especially food price shocks, have been a key trigger of social unrest, in some cases giving rise to democratization. Yet price shocks have largely been overlooked in prior models of democratization since these tend to be based on single-sector macro models that have no role for prices. Since the model that we will develop in the present paper has the underlying structure of an international trade model with two sectors, the role of price shocks in creating the potential for democratization can be analyzed in a natural way.

Drawing on Zissimos (2014), the model of this present paper combines Acemoglu and Robinson’s (2000) closed economy model of democratization with a standard Heckscher-Ohlin (H-O) model of international trade to consider how price shocks can affect democratization. Following Acemoglu and Robinson (2000, henceforth AR), the ruling dictatorial elite may face a commitment problem in their attempts to address a threat of revolution by the rest of society. The elite would like to be able to make transfers over time large enough to quell the threat of revolution. But it is common knowledge that if the rest of society’s ability to coordinate over revolution subsides in future then so will the credibility of any commitment to make transfers. Through the $2 \times 2$ H-O model, transfers are made using international trade policy. For concreteness, and to understand the events of the 2007–08 world food crisis, we will assume that the elite own land used intensively in the production of food while the rest of society own labor used intensively in manufacturing. We will also assume that the country is relatively land abundant so that it has a comparative advantage in food. By the Stolper-Samuelson theorem there is a conflict of interest over international trade policy: the ruling elite, as owners of the abundant factor, prefer a relatively open regime while the rest of society would prefer a relatively closed one.

The model focuses on countries that are at an early stage of development and lack domestic fiscal capacity, so domestic taxation cannot be used as in AR to make transfers. But the ruling elite can effectively make transfers to the rest of society using trade policy. If the commitment problem is binding the elite cannot redistribute on a sufficient scale to maintain the status quo (i.e. avert a revolution) using trade policy. The elite can resolve the commitment problem by extending the franchise though, hence making a credible commitment over time to the trade policy that the rest of society would prefer. But if the commitment problem is not binding then the elite would prefer to maintain the status quo using trade policy, thereby retaining the ability to set trade policy to their advantage in future.

The circumstances under which the elite must democratize in order to avoid a revolution and when they can use trade policy to maintain the status quo are

1. See Carter, Rausser, and Smith (2011) for a review of the literature showing that commodity price volatility can provoke political as well as economic instability.
2. Low income countries generally lack domestic fiscal capacity and so rely extensively on trade policies for fiscal purposes including redistribution: see Zissimos (2014) for references.
similar to those in AR for domestic fiscal policy. It is when there is a high probability that the rest of society will be able to effectively coordinate their efforts to mount a revolution that the elite can use trade policy to maintain the status quo. The reason is that if the probability of being able to coordinate is sufficiently high then the rest of society’s expected return through favorable trade policy is at least as great as through revolution, which bears a cost. It is when this probability is low that the commitment problem binds and democratization must be used instead to avoid a revolution. By lowering the rest of society’s income, the food price shock is shown to increase the range of probabilities over which the commitment problem is binding and thereby increase the likelihood of democratization.

The model can be used to understand the events of the 2007–08 world food crisis, which increased the relative price of food. Between 2007 and 2011, an estimated thirty-three food-exporting countries resorted to restrictions on exports of grains, rice, and other foodstuffs in response to the initial increase in food prices (Sharma 2011). A number of these countries were dictatorships such as Egypt and Jordan. And as owners of land, the abundant factor, the ruling elites in these countries stood to gain significantly by leaving export markets open during the period of food price shocks. However, the rest of society suffered significant negative income shocks and protested violently on the streets in response. In some countries the effects of the shocks could be offset by the elite using export restrictions. But in other cases, such as Egypt, the rest of society were arguably pushed out of the range where trade policy could be used to maintain political stability and into the range where democratization would be required to maintain the status quo.3

The present paper simplifies the model of Zissimos (2014) by moving from an infinite time horizon framework to a two-period one. This simplification makes it easier to see how a world price shock could push the feasible outcome from one where trade policy can be used to maintain the status quo to one where democratization is required to avert a revolution. Zissimos (2014) does analyze the implications of a world price shock but, differently from the present paper, does so by focusing on a situation where the status quo can be maintained using trade policy before and after the shock.

Since the economic and political structure is based on Zissimos (2014), the relationship to the literature is similar (see Zissimos 2014 for a review). By focusing on how democratization becomes more likely as the result of a food price shock, the present paper forges closer links than Zissimos (2014) to the literature on income and democratization. Following Lipset (1959), important works such as Huntington (1991) and Rusechemeyer, Stephens, and Stephens (1992) argue

3. It remains to be seen whether democracy successfully consolidates in a number of the countries, such as Egypt, that have had revolutions in the Arab Spring. The theoretical framework of this paper assumes that democracy consolidates with certainty and that revolution is not observed on the equilibrium path. The logic extends to a framework where both assumptions are relaxed.
in favor of a causal positive relationship between income and democracy. The main argument that there might be a negative relationship between income and democracy is based on the idea that people are more likely to protest in favor of democracy when the opportunity cost of doing so is sufficiently low (Acemoglu and Robinson 2006). The present paper shows how the range over which this opportunity cost becomes sufficiently low is determined partly by world prices.4

The paper is structured as follows. Section 2 develops the economic model and uses this to characterize the levels of trade policy intervention that would be preferred by the elite and the rest of society, respectively. Section 3 then uses the model to determine the parameter range over which trade policy can be used to maintain the status quo. Section 4 then shows how a price shock reduces the parameter range over which trade policy can be used to maintain the status quo, increasing the likelihood of democratization. Conclusions are drawn in Section 5.

**The H-O Model with International Trade Policy**

The model developed in this section is adapted from the infinite time horizon model of Zissimos (2014) to a two period setting. The model is of a small country that takes world prices as given, populated by a continuum of risk-neutral citizens. Each citizen belongs either to the elite, \( e \), or ‘the rest of society,’ \( n \) (for non-elite). The mass of each of these groups is normalized to \( \theta \) and 1, respectively, where the elite are in a minority: \( \theta < 1 \).5 The economy is endowed with a unit each of land and labor. Each member of the elite is endowed with an equal share of land while all of the labor is distributed evenly across the rest of society. The only difference between the respective groups is their factor endowments. The model has two time periods, \( t = 1, 2 \).

The production structure is standard 2 \( \times \) 2 H-O, where the two goods are food, \( f \), and manufactures, \( m \); food is land intensive while manufactures are labor intensive. Since the model is standard H-O, we can make use of standard results. By the Stolper-Samuelson theorem,

\[
\frac{r^*_t}{p^*_t} > \frac{w^*_t}{p^*_t} > 0 > \frac{w^*_t}{p^*_t}
\]

where \( r_t \) and \( w_t \) are the rental rate and wage rate and \( p_t \) is the domestic relative price of food, which can lie anywhere between the world price and the autarky price, in period \( t \) respectively. A superscript-* on a variable \( z \) denotes proportional change: \( z^* = \frac{dz}{z} \).

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4. The opportunity cost of revolution is also discussed in the context of an open economy model by Acemoglu and Robinson (2006, Ch.10). Surprisingly, in a similar land-abundant environment their prediction is the opposite of ours: trade opening makes democratization less likely. The key difference is that they examine a setting in which the commitment problem is always binding and do not consider the possibility that endogenously determined trade policy might be used to maintain the status quo.

5. The assumption that the elite are in a minority is made to ensure that democratization shifts the power to set policy from the elite to the rest of society.
Agents $j \in \{e, n\}$ have identical preferences and the same discount factor, $\delta < 1$. The expected utility of agent $j$ in period 1 is given by $U_j^1 = 1 \left( u(c_j^1, c_m^1) + \delta u(c_j^2, c_m^2) \right)$ where $E_1$ is the expectations operator conditional on information available in period 1. Utility in period 2 is given by $U_j^2 = u(c_j^2, c_m^2)$. In period $t$, $c_j^t$ is consumption of good $i \in \{f, m\}$ by agent $j$.

The per-period utility function is given by the quasi-linear functional form $u(c_j^t, c_m^t) = c_m^t + u_f(c_j^t)$, where the sub-utility function $u_f(\cdot)$ is differentiable, increasing, and strictly concave.

Since there is no domestic fiscal capacity, the only policy instruments available are trade taxes. For convenience, and without loss of generality, we will assume that trade policy is applied to food. We will assume throughout that the abundant factor is land, so the country has a comparative advantage in food and the trade policy instrument is an export tax. Any revenue collected from a trade policy is rebated to each individual $j$ in lump sum. Then the net revenue function for an individual $j$, $tr_j(p_t)$, is determined as follows:

$$tr_j(p_t) = \left( p_t - p^w \right) \left( d_f(p_t) - \frac{1}{1 + \theta} x_f(p_t) \right), \quad (2.1)$$

where $p^w$ is the world relative price of food, while $d_f(p_t)$ and $x_f(p_t)$ are the domestic demand and supply functions for food; $d'_f(p_t) < 0$, $x'_f(p_t) > 0$. Since the policy instrument is an export tax, $p_t \leq p^w$ and so $tr_j(p_t) \geq 0$.

**Welfare of the Groups and their Preferred Levels of Openness**

The total income of individual $j \in \{e, n\}$ is given by the sum of factor income and trade policy revenue: $Y_j^t = Y^t(p_t) = y_j^t(p_t) + tr_j(p_t)$. Given the quasi-linear structure of preferences, individual $j$'s welfare can be expressed as follows:

$$W_j^t = W^t(p_t) = y_j^t(p_t) + tr_j(p_t) + s_j(p_t),$$

where $s_j(p_t) = u_f[d_f(p_t)] - p_t d_f(p_t)$ is the consumer surplus derived from consumption of good $f$, and $W^t(p_t)$ is assumed to be concave in $p_t$.

From this welfare function, we can derive preferred price levels for the elite, $\hat{p}^e$, and the rest of society, $\hat{p}^n$, respectively. We have already seen by the Stolper-Samuelson theorem that the elite will prefer a relatively high price of food, $p_t$, since this raises their factor income, and it follows that $\hat{p}^e > \hat{p}^n$. While each preferred price level would be put in place using an export tax, we will follow the international trade literature by focusing on the corresponding price level itself.

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6. Alternatively, we could have assumed that the elite keeps the trade policy revenue for itself, only redistributing it to the rest of society when this would be helpful in averting a revolution. Introducing this possibility would not change our results qualitatively but would affect the parameter range for which the commitment problem becomes binding.
If the country has a comparative advantage in food then \( p^w > p^a \), where \( p^r \) is the relative price of food in autarky. In that case the elite’s welfare is maximized at a higher level of openness than is the rest of society’s since the elite own the abundant factor. Note that in general it could be the case that \( \hat{p}^e > p^w \) and/or \( p^a > \hat{p}^n \). But \( \hat{p}^e > p^w \) would imply an export subsidy on food while \( p^a > \hat{p}^n \) would imply an import subsidy on manufactures. And any trade subsidy would require revenue to be raised through domestic taxation. Under our assumption that there is no domestic fiscal capacity, the ‘funding constrained solutions’ are \( \hat{p}^e = p^w \) and \( \hat{p}^n = p^a \). We will use these funding constrained solutions to simplify the analysis below.\(^7\)

**Trade Policy and the Form of Government**

Initially, (de jure) political power is held by the elite, which they exercise through their control of trade policy. While the elite hold power they set \( p_t \) directly. Denote the value of \( p_t \) chosen by the elite as \( p^*_t \).

To simplify the analysis, we will assume that in period 1 the threat level to the elite is high \((H)\), in that the rest of society are able to resolve their coordination problem and can mount a revolution if they wish. If they mount a revolution, then it is successful with certainty but costs \( \psi \) to each member of society (the elite and the rest of society). In period 2, with probability \( \rho \) the state will remain at \( H \). But with probability \( 1 - \rho \) the state will switch to ‘low threat’ \((L)\), in which case the rest of society cannot coordinate and hence are unable to mount a revolution.

If either in period 1 or in period 2 the rest of society mount a revolution they subsequently install democracy. Since the elite are in a minority, \( \theta < 1 \), under democracy the median voter is a member of the rest of society. So democratization involves a transfer of power to set trade policy from the elite to the rest of society. Democratization can also arise if the elite extend the franchise voluntarily. Democracy is an absorbing state: once the franchise has been extended it cannot be rescinded. This assumption enables us to focus on the use of trade policy to maintain the status quo.

*Addressing the Threat of Revolution*

If the elite extend the franchise, they make a credible commitment to \( \hat{p}^n \) in the current period and the next if there is one. But the elite may alternatively be able to avert revolution by setting \( p^*_t \) at a level whereby the rest of society are just indifferent between mounting a revolution and maintaining the status quo: the ‘status quo price’ \( p^*_t \).

In this paper we will not undertake a full characterization of equilibrium. We will focus instead on characterizing the circumstances under which revolution can be averted in period 1 using trade policy in principle and when the elite must avert a revolution by extending the franchise. To do this, we will begin by

\(^7\) Zissimos (2014) justifies this simplification at greater length and shows how it can be relaxed.
formalizing the payoffs to the respective groups under the various possible outcomes. Let \( V_j(D, \hat{p}^n) \) represent the present discounted value of democracy in period 1 for \( j \in \{e, n\} \). For a member of group \( j \), the payoff to democracy in period 1 takes the form:

\[
V_j(D, \hat{p}^n) = (1 + \delta) W_j(\hat{p}^n).
\]  

(3.1)

Denoting the occurrence of revolution by \( R \), the payoff to revolution in period 1 is given by

\[
V_j(R, \hat{p}^n) = (1 + \delta) W_j(\hat{p}^n) - \psi.
\]  

(3.2)

Clearly, both groups would prefer democracy to revolution because this avoids the cost \( \psi \) associated with revolution. So an extension of the franchise has the potential to defuse revolution in period 1.

The payoff to a member of the rest of society in period 1 when the elite redistribute by setting the status quo price \( p_s^1 \) is given by

\[
V^n(p_s^1, p_s^2; H) = W^n(p_s^1) + \delta(p_s^2 + (1 - \rho) W^n(\hat{p}^e)),
\]  

(3.3)

where \( p_s^2 \) is the status quo price adopted by the elite in period 2 if the threat level remains high and \( \hat{p}^e \) is the price they adopt if the threat level switches to low. We can now examine the circumstances under which it would be feasible for the elite to use trade policy to prevent a revolution. This is equivalent to working out when it would be feasible for the elite to credibly commit to a trade policy that would give the rest of society at least as high a level of welfare as they could obtain from mounting a revolution.

For the purpose of establishing feasibility, let \( \tilde{V}^n(\rho) \) be the maximum utility that the elite can induce for the rest of society using trade policy (as an alternative to extending the franchise). This maximum utility is induced by setting \( p_s^1 = p_s^2 = \hat{p}^n \) in (3.3):

\[
\tilde{V}^n(\rho) = V^n(\hat{p}^n, \hat{p}^n; H) = W^n(\hat{p}^n) + \delta W^n(\hat{p}^e) + \rho(1 - \delta) W^n(\hat{p}^e).
\]  

(3.4)

Then the condition for the elite to feasibly use trade policy to maintain the status quo is \( \tilde{V}^n(\rho) \geq V^n(R, \hat{p}^n) \). We can now illustrate graphically the elite’s options in maintaining the status quo using Figure 1a. The value of \( \rho \) is shown in Figure 1a on the horizontal axis while the welfare level of the rest of society is on the vertical axis. The horizontal dashed line shows the payoff to the rest of society from democracy, as calculated by (3.1). The horizontal solid line shows the payoff to revolution, as given by (3.2), where the vertical difference between them is given by \( \psi \). The upward sloping line shows \( \tilde{V}^n(\rho) \) as given by (3.4). The intercept of
\( V'/(\rho) \) with the vertical axis, where \( \rho = 0 \), corresponds to the payoff that the rest of society would receive from a policy of \( \hat{p}' \) in period 1 followed by reversion to \( \hat{p}' \) in period 2. Since \( W''(\hat{p}') > W''(\hat{p}) \), for the intercept to be smaller than \( V''(R, \hat{p}') \) we only have to choose a value of \( \psi \) sufficiently small that \( W''(\hat{p}) + \delta W''(\hat{p}^r) < V''(R, \hat{p}'). \) \( V''(\rho) \) slopes upwards from this point because an increase in \( \rho \) increases the likelihood that in the following period the rest of society can credibly threaten to mount a revolution and hence obtain a higher level of welfare. At \( \rho = 1 \) the rest of society are able to resolve their coordination problem and mount a revolution with certainty in the next period. Then the elite can credibly commit with certainty to set \( p''_2 = \hat{p}' \) in period 2, inducing the same level of welfare as democracy. At \( \rho = \bar{\rho} \), the rest of society are indifferent between revolution and maintaining the status quo with trade policy.

Now consider the elite’s options when they face the threat of revolution in period 1. We can see from Figure 1a that when resolution of the coordination problem is relatively unlikely \( (\rho < \bar{\rho}) \), the elite cannot credibly commit to raise the rest of society’s welfare using trade policy above the level of revolution. The reason is that the high threat state, \( H \), in which the rest of society receive the higher payoff associated with the status quo price, is so unlikely to arise in the next period that the rest of society would be better off bearing the cost of revolution \( \psi \) in exchange for being able to set trade policy at \( p''_1 = \hat{p}' \) in both periods for certain. On the other hand, if resolution of the rest of society’s coordination problem is relatively likely in period 2 \( (\rho > \bar{\rho}) \), redistribution using trade policy is sufficiently likely to recur in period 2 that it can be used to avert a revolution.

**World Price Shocks and Democratization**

Based on the framework set out above, the effect of a world price shock can be analyzed in a straightforward way. Recall that we are assuming \( \hat{p}' = p''_w \). In that case, a world food price shock that increases the relative price of food also increases \( \hat{p}' \). We will be able to analyze the effect of a shock to \( p''_w \) by letting
\( \hat{p}^e = p^w \) in (3.4). To analyze a shock to \( p^w \), let us rewrite \( \tilde{V}^n(\rho) \) where \( \hat{p}^e = p^w \) as \( \tilde{V}^n(\rho, p^w) \).

We will analyze the effects of a food price shock by comparing two situations in the model, one for \( p^w \) and one for \( p^{w'} \), where \( p^{w'} > p^w \). An increase in \( \hat{p}^e = p^w \) increases the price that the rest of society must pay for food, thus reducing the rest of society’s real income and hence \( W^n(p^{w'}) \), if in period 2 the state switches to \( L \). Figure 1b illustrates two situations: one for \( p^w \) and \( \tilde{V}^n(\rho, p^w) \); the other for \( p^{w'} \) and \( \tilde{V}^n(\rho, p^{w'}) \). The figure shows that the intercept of \( \tilde{V}^n(\rho, p^{w'}) \) is smaller than for \( \tilde{V}^n(\rho, p^w) \). Since the endpoint is the same for \( \tilde{V}^n(\rho, p^{w'}) \) as for \( \tilde{V}^n(\rho, p^w) \), the result of a higher world price \( p^{w'} \) is a higher value of \( \rho \) at \( \tilde{\rho} \). This enlarges the range of values of \( \rho \) from \( \rho \in [0, \tilde{\rho}] \) to \( \rho \in [0, \tilde{\rho}'] \) for which the threat of revolution must be resolved through democratization. Therefore, for any given value of \( \rho \), it becomes more likely after a positive food price shock that the threat of revolution can only be resolved by democratization.

It is worth reiterating that although the food price shock reduces the rest of society’s real income, it increases the income of the elite. So a food price shock that increases the likelihood of democratization will only reduce average per capita income if the fall in per capita income among the rest of society is large relative to the gain in per capita elite income and if the elite make up a relatively small share of the total population.

**Conclusions**

The analysis we have undertaken raises two issues. First, the likelihood of democratization increases as the result of a price shock, but average incomes do not necessarily rise. This suggests more broadly that a focus on the underlying mechanisms driving conflicts of interest between different groups over policy is necessary to fully understand the relationship between income and democratization. The second issue concerns how multilateral agencies such as the International Monetary Fund, World Bank, and World Trade Organization should manage the process of democratization and trade liberalization given that they may have an important bearing on one another. Calls for trade policy to remain open in the face of food price shocks (World Bank 2008) are likely to be ignored when increasing protectionism is key to political survival. By the same token, calls for democratization are likely to be ignored unless this is necessary to avert revolution.

**References**


Determinants of Trade Policy: Insights from a Structural Gravity Model

Joachim Jarreau

This paper studies the impacts and determinants of trade policy: preferential trade agreements and multilateral opening. I estimate sector-level trade elasticities to calibrate a multi-sector Armington model of trade. I then use it to compute the price and real wage impacts of trade policy over 2001–2007, as well as the impacts of hypothetical, nonsigned trade agreements. I find that real wage gains positively predict the probability to sign a preferential agreement. Gains from multilateral opening reduce this probability. Finally, expected production price increases, reflecting market access gains, are a stronger determinant of the signing of PTAs than gains in the form of lower consumption prices. JEL codes: F12, F13, F47

INTRODUCTION

From 1990 to 2010, the number of preferential trade agreements (PTAs) increased fourfold, reaching close to 300 presently in force (WTO 2011), while multilateral negotiations have made little significant progress in recent years. Why do countries seem to favor preferential trade liberalization, although it is not optimal from a welfare point of view? This paper examines the determinants of trade policy choices.

A multisector, structural gravity model of international trade is used to estimate potential real income gains from bilateral agreements. Sector-level trade elasticities are estimated using panel data for applied tariff protection. Results indicate positive gains in aggregate real wages for all 92 PTAs active in the period 2001–2007, ranging from 0.02 to 2.06%. I then compute the real wage impacts of hypothetical trade agreements and decompose them into producer price and consumer price impacts. A choice model is used to link these impacts to the actual signing of agreements. Results indicate that expected real wage gains from a PTA predict those agreements that were actually signed. Potential gains from...
multilateral opening reduce the probability of signing, suggesting a tradeoff between the two modes of liberalization. Finally, gains in production prices have an impact that is significantly larger on the probability of signing than gains in the form of consumer prices decreases.

I use a multisector version of the Armington model, which generates a trade equation of the “gravity” form. Arkolakis et al. (2012) defines a class of models, based on sector-specific factor endowments and CES preferences, in which the relative impacts of trade cost changes on prices and real wages, conditional on trade elasticities and initial trade shares, are identical; this class includes the Krugman (1979), Eaton and Kortum (2002), and Melitz (2003) models. Thus, estimating trade elasticities is key to predict price movements, as this parameter encompasses different margins of adjustment accounted for in these models.

This motivates my approach, which uses the structural gravity equation to estimate sector-level trade elasticities, then computes the impacts of various trade policy scenarios on price and real income levels. The model accounts for terms-of-trade impacts of trade policy changes, while other impacts through, for example, specialization changes or technology spillovers are not considered. Previous literature has shown the importance of terms-of-trade motives in driving trade policy (Baier and Bergstrand 2004); my results confirm this importance.

The political economy literature has presented trade policy choices as the result from confronting different interests (Grossman and Helpman 1995): producers in different sectors favor or oppose an agreement depending on the balance between expected market access gains and import competition; while consumers expect real income gains through lower prices, but may also expect losses by diversion if distortions in the tariff structure become important. This paper does not make assumptions on the political economy structure of countries but directly tests the impact of potential aggregate gains from trade agreements on policy decisions. Results suggest that actual trade policy differs from welfare-maximization.

The outline is as follows: section (2) presents the model and illustrates the impacts of a PTA in a simple, three-country example. Section (3) presents results on PTA impacts over 2001–2007 and section (4) estimates the determinants of the signing of PTAs.

Model

A multisector Armington model of trade is used, covering agriculture, mining, and manufacturing activities. The model yields a trade equation of the structural gravity type.

1. Note that this does not imply equivalence between these models, but rather that the trade elasticity represents a sufficient statistic to account for their differences, given that these models all generate the same gravity functional form for the trade equation.

2. In the empirical application, each sector corresponds to one code in revision 3 of the International Standard Industrial Classification (ISIC), maintained by the UN.
Once trade elasticities are estimated, the model is used to compute relative changes in prices and real income levels induced by trade agreements. Trade elasticities are the central parameter governing trade dependence on trade costs. Moreover, Arkolakis et al. (2012) show that the relative change in production prices and consumer prices, conditional on trade elasticities, takes the same expression in a large class of models sharing common assumptions on preferences and macroeconomic closure.\(^3\) Sector-specific factor supplies are fixed, and changes in specialization are not accounted for.

Preferences are Cobb-Douglas across sectors and CES across varieties within each sector. Goods in each sector \(k\) are produced using a specific factor, of which each country \(i\) has a fixed endowment \(L^k_i\). Within each sector, goods are differentiated by country of origin. Nominal bilateral trade flows are given by:

\[
X^k_{ij} = \left( \frac{p^k_i \cdot t^k_{ij}}{p^k_j} \right)^{1-\sigma_k} E^k_j\tag{1}
\]

with \(X^k_{ij}\) nominal trade flows from country \(i\) to \(j\) in sector \(k\), \(p^k_i\) the f.o.b. (free on board) price of that variety, \(t^k_{ij}\) the iceberg trade cost. \(P^k_j\) is country \(j\)'s price index in sector \(k\), defined by \((P^k_j)^{1-\sigma_k} = \sum_i (p^k_i \cdot \tau^k_{ij})^{1-\sigma_k}\). \(\sigma_k\) is the elasticity of substitution between varieties of that good, and \(1 - \sigma_k\) the trade elasticity. \(E^k_j\), country \(j\)'s expenditure on good \(k\), is given by \(E^k_j = \alpha_k Y_j\), with \(\alpha_k\) the share of expenditure on good \(k\) and \(Y_j\) country \(j\)'s total income.\(^4\)

A representative firm in country \(i\) produces a quantity \(Q^k_i\) of good \(k\) using specific factor \(L^k_i\), in fixed supply. One can set the unit factor requirement to 1, which yields identity between sector-level wages \(w^k_i\) and the f.o.b. price of the good: \(w^k_i = p^k_i\). The market clearing condition for each variety is written as: \(\sum_i X^k_{ij} = p^k_j Q^k_i\). Finally, each country’s total income \(Y_j\) is equal to the total value of sales in all sectors: \(Y_j = \sum_k p^k_j Q^k_j\).

**Impact of a PTA on prices** For illustrative purposes, let us consider a simple three-country, one-sector case with countries A, B, and C, producing and trading differentiated varieties of the same good. We assume that A is at an equal distance from B and C, with a larger distance between B and C: initial trade costs are \(\tau_{ij} = (1 + AV_{ij}) \cdot \bar{\tau}_{ij}\), with \(\bar{\tau}_{ij} = 1\) if \(i = j\); \(\bar{\tau}_{AB} = \bar{\tau}_{AC} = 1.5\); \(\bar{\tau}_{BC} = 2\). \(AV_{ij}\) is the ad-valorem equivalent of trade policy barriers applied by \(j\) on imports from \(i\). \(\bar{\tau}_{ij}\) denotes the geographic component of trade costs.

\(^3\) This class of models includes one-sector, one-factor models of trade with CES preferences, leading to a common gravity equation for trade, where the trade elasticity parameter captures different margins of adjustment: entry/exit of firms, heterogeneity in productivity. The Armington model, and the Krugman (1979), Eaton and Kortum (2002), and Melitz (2003) models belong to this class. Jarreau (2014) details the conditions for the validity of this result and its application in the multi-sector case.

\(^4\) Note: preference parameters \(\alpha_k\) and \(\sigma_k\) are assumed to be identical across countries.
I set the size of countries A, B, C to 1, 10, and 5. I assume that countries initially apply a 30% MFN tariff on all imports, and study the case of a bilateral PTA signed between countries A and B, which sets tariffs between these two countries to 0.

Figure 1 displays the relative changes in production price $p_A$ and on A’s consumer (CES) price index, $P_A$, as a function of the size of the partner country B and the elasticity of substitution $\sigma$.6

The impact on production price changes sign depending on these two parameters. In the low substitution case, the impact is positive, while it becomes mostly negative in the high-$\sigma$ region. On one hand, the PTA grants preferential access to country B’s market, which allows A’s producers to raise their production price, the more so, when demand is more inelastic. On the other hand, reciprocal tariff reductions imply a competition effect on A’s domestic market: this brings the price of A’s variety lower, the more so if competing varieties are more substitutable. Thus, in a low-$\sigma$ sector, producers in country A are to prefer a PTA with a large partner (all else equal); while in a high-$\sigma$ case where import competition dominates, they would prefer a PTA with a smaller partner country.

The impact on the consumer price index is negative: consumers in 1 gain in purchasing power. The gain is higher, the lower $\sigma$ and the larger the partner country. Note that the gradient of the impact is not aligned with that of the production price impact: for example, in the high-$\sigma$ region, the gain increases with the partner’s size, while the impact on production price becomes more negative. This illustrates a divergence of interests in trade policy: in a country trading high-elasticity goods, a policy focused on maximizing production prices would favor a PTA with a small partner country, while a focus on consumer gains would lead to choose a PTA with a large country.

Figure 2 displays the impact of the PTA on country A’s real wages $WR_A = \frac{p_A Q_A}{P_A}$. Larger gains in real wages are obtained in the low-$\sigma$, high-Q

5. A country’s size is here equal to its labor endowment.
6. The impact on the consumer price index is negative, and displayed in absolute value here.
region, where both impacts on production prices and consumer purchasing power are positive. In the high-$\sigma$ case, real wage maximization leads to favor PTA with large countries, despite negative impacts on production prices.

**Estimation of sector elasticities** Trade equation 1 and a standard functional form for trade costs yield the following specification for estimation of trade elasticities:

\[
\ln X_{ijt}^k = \beta^k \ln (1 + \text{Tariff}_{ijt}^k) + \gamma^k \ln d_{ij} + \delta^k \text{Contig}_{ij} + \eta^k \text{Comlang}_{ij} + \lambda_{it}^k + \lambda_{jt}^k + \epsilon_{ijt}^k
\]

with \(\text{Tariff}_{ij}^k\) the ad valorem equivalent of tariff barriers on \(i\)'s products exported to \(j\) in sector \(k\), \(d_{ij}\) the \(i\) to \(j\) distance, and \(\text{Contig}_{ij}\) and \(\text{Comlang}_{ij}\) indicators for contiguity and common language. Exporter-time (\(\lambda_{it}^k\)) and importer-time (\(\lambda_{jt}^k\)) fixed effects control for variables \(E_j^k\), \(p_i^k\) and \(P_j^k\) as well as other, for example, institutional country-level determinants of trade. Coefficient \(\beta^k\) is our estimate of parameter \((1 - \sigma^k)\), or trade elasticity.

Details on estimation and results are provided in Jarreau (2014). I use nominal bilateral trade values from the BACI trade database. Trade data are aggregated into 72 ISIC sectors and 68 countries.regions. Data on applied tariff protection for 2001–2007 come from the MacMap database (Bouet et al. 2008), which converts *ad valorem*, specific tariffs and tariff quotas into ad-valorem equivalents, yielding a comprehensive measure of applied tariff protection over this period. I use an ordinary least squares estimator with country-year fixed effects to estimate trade elasticities separately by sector. Country-year fixed effects (\(\lambda_{it}^k\) and \(\lambda_{jt}^k\)) control for importer and exporter time-varying variables and mitigate the endogeneity of trade policy (Baier and Bergstrand 2007). Trade elasticity
(1 − σ_k) values range from −12.97 to −0.21, with a mean of −4.37, consistent with estimates from other studies.

**Price and Real Wage Impacts of PTAs, 2001–07**

I use the calibrated model to estimate real wage impacts of all PTAs active during 2001–2007, computed as the treatment effects of tariff protection changes between partners, all else equal. Real wage impacts are then decomposed into consumer price and production price changes.

Table 1 displays estimation results for the 10 agreements delivering the highest gains for one of the partner countries. The maximum real wage gain is 2.06%. The decomposition of these gains reveals that the source of gains varies across agreements: for instance, all of Egypt’s gains in the agreement with the EU come from consumer price reductions; while production prices decreased overall. By contrast, Chile’s gains from its agreement with Argentina come equally from the consumer price and production price channels. As shown in section 2, the amplitude and source of gains in real wages vary across agreements, depending on initial protection levels, trade elasticities, and relative country sizes.

Complete results are presented in Jarreau (2014). Among all 92 PTAs active during 2001–07, real income effects are positive and vary between 0.02 and

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### Table 1. Price and Real Income Impacts of PTAs (%): 10 Largest Real Income Gains

<table>
<thead>
<tr>
<th>Country</th>
<th>Partner</th>
<th>Consumer prices</th>
<th>SD</th>
<th>Production prices</th>
<th>SD</th>
<th>Real income</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>EU</td>
<td>−2.21</td>
<td>0.38</td>
<td>−0.15</td>
<td>0.11</td>
<td>2.06</td>
<td>0.29</td>
</tr>
<tr>
<td>Algeria</td>
<td>EU</td>
<td>−1.53</td>
<td>0.06</td>
<td>−0.02</td>
<td>0.02</td>
<td>1.51</td>
<td>0.05</td>
</tr>
<tr>
<td>Chile</td>
<td>Argentina</td>
<td>−0.56</td>
<td>0.05</td>
<td>0.54</td>
<td>0.05</td>
<td>1.10</td>
<td>0.09</td>
</tr>
<tr>
<td>Chile</td>
<td>EU</td>
<td>−1.06</td>
<td>0.03</td>
<td>−0.01</td>
<td>0.04</td>
<td>1.05</td>
<td>0.05</td>
</tr>
<tr>
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<td>USA</td>
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<td>0.04</td>
<td>−0.02</td>
<td>0.02</td>
<td>1.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Brazil</td>
<td>−0.63</td>
<td>0.04</td>
<td>0.37</td>
<td>0.04</td>
<td>1.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Argentina</td>
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<td>0.37</td>
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<td>0.90</td>
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</tr>
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<td>0.76</td>
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<td>Hong Kong</td>
<td>China</td>
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<td>0.06</td>
<td>1.57</td>
<td>0.12</td>
<td>0.75</td>
<td>0.07</td>
</tr>
<tr>
<td>Colombia</td>
<td>Mexico</td>
<td>−0.63</td>
<td>0.01</td>
<td>0.04</td>
<td>0.02</td>
<td>0.68</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Notes: Bootstrap standard errors. The table considers the impact of all PTAs active in the period 2001–2007, on each country’s prices and real income. Each line displays the impact for the first named country, implied by its PTA with the second country.

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8. Among all PTAs which were signed up to 2007, are considered as active during the period 2001–2007, those for which the average tariff decrease in that period exceeded 10%. This allows to put aside those where most of the tariff dismantlement took place out of our time window.

9. Production prices and the consumption price index are aggregated across sectors. The aggregate production price is the average of sector prices weighted by the sector share in total production value. The aggregate ideal price index is the Cobb-Douglas aggregate of sector-level CES price indices.
2.06%. The impact on consumer prices range from −2.2% to +0.82%, the production price change between −0.15% and 1.57%.

**Determinants of Trade Agreements**

I now use the calibrated model to compute the price and real wage impacts of hypothetical agreements between each pair of countries in the sample. Each PTA is modeled as follows: in each sector, the two partners reduce their tariffs to half the lowest of their two initial (2001) tariffs. This is intended to capture the reciprocity and coverage that generally apply in PTAs.

**Empirical specification** I model the probability of two countries signing a PTA with the following logit model:

\[
\Pr[PTA_i^j = 1] = F(\beta_1 \hat{\hat{p}}_i^j + \beta_2 \hat{\hat{P}}_i^j + \beta_3 (\overline{Y_j/P_j})^{ML})
\]

(3)

with \( F \) is the logistic function; \( \Pr[PTA_i^j = 1] \) the probability of country \( j \) signing a PTA with country \( i \); \( \hat{\hat{p}}_i^j \) and \( \hat{\hat{P}}_i^j \) the predicted impacts (relative price changes) of a PTA with country \( i \) on country \( j \)'s aggregate production price \( p_j \) and consumer price index \( P_j \), respectively. \( (\overline{Y_j/P_j})^{ML} \) represents the predicted impact on \( j \)'s real wage level of a multilateral reduction of tariff barriers. Prospective impacts \( \hat{\hat{p}}_i^j \), \( \hat{\hat{P}}_i^j \) are obtained as the impact of a PTA between \( i \) and \( j \), all else equal (status quo on all other trade barriers).

Results are shown in table 2. The first column indicates that real wage gains from a PTA increase the country’s probability to sign the agreement. Potential gains from opening multilaterally decrease the probability to sign a PTA: for example, countries with more diversified trade across partners, or higher average distance from trade partners, have higher expected gains from multilateral opening; this leads them to engage less in preferential trade agreements.

Decomposing the real wage gains from PTAs into production prices on one hand, and domestic aggregate price index impacts on the other (column 2), shows both to have an impact on trade policy. However, the relative gains in production prices have an impact on the probability of signing more than twice that of consumer price gains. This difference suggests that gains in production prices have a larger weight on trade policy decisions than potential consumer price decreases.

Column 3 further decomposes the gains from multilateral opening into their production price and consumer price index components. The specification in

10. 42 countries are considered, excluding aggregate regions.
11. The assumption of full coverage in trade agreements is based on article XXIV, paragraph 8b of the GATT (now WTO), which requires that in a PTA “duties and other restrictive regulations of commerce ( . . . ) are eliminated on substantially all the trade between the constituent territories”. In practice, this means that member countries may not sign a “partial” agreement covering only selected sectors.
12. This variable is computed by simulating a multilateral opening of country \( j \)'s trade, modeled as a uniform cut of 50% on all tariff barriers.
col. 4 uses country fixed effects, which control for the gains from multilateral opening (invariant across partner countries) as well as for other potential factors (e.g. technology level, trade sophistication), impacting PTA choices at the level of countries. The results on production and consumer price variables still hold.

**Conclusion**

This paper uses a structural gravity model of trade to compute the impacts of actual and hypothetical trade agreements. The model focuses on short-term, terms-of-trade effects of trade policy. Using data for applied tariff protection, I find that trade agreements active during 2001–2007 all generated positive real income gains to member countries, of up to 2.06%. Decomposition of these gains into production price increases (market access gains) and consumer price reductions reveals that the relative importance of these components varies importantly across agreements. A choice model for the determinants of trade policy choices is then used, showing that expected real wage gains positively predict countries’ decision to sign PTAs and their choice of partners. Potential gains from multilateral opening reduce the probability to sign a preferential agreement. Finally, production price gains have a stronger impact on the probability to sign than consumer price decreases.
REFERENCES


In 2011, in an attempt to increase access to health care and reduce household vulnerability to out-of-pocket health expenditure, the Government of Ethiopia launched a Community-Based Health Insurance Scheme (CBHI). This paper uses three rounds of household survey data, collected before and after the introduction of the CBHI pilot, to assess the impact of the scheme on household consumption, income, indebtedness, and livestock holdings. We find that enrollment leads to a 5 percentage point—or 13%—decline in the probability of borrowing and is associated with an increase in household income. There is no evidence that enrolling in the scheme affects consumption or livestock holdings. Our results show that the scheme reduces reliance on potentially harmful coping responses such as borrowing. This paper adds to the relatively small body of work that rigorously evaluates the impact of CBHI schemes on economic welfare. JEL codes: I1, O1

I. Introduction

Various forms of health insurance have been advocated as market based risk-transfer mechanisms with the potential to guard against the impoverishing effects of ill health (see Gertler and Gruber 2002; Asfaw and Von Braun 2004). The recent proliferation of Community Based Health Insurance (CBHI) schemes in many developing countries emanates partly from a need to provide financial protection against unexpected health-care costs and to enhance access to modern health care. As a prelude to national coverage, in June 2011, the Ethiopian Government introduced a pilot CBHI scheme in 13 Woredas (districts) across the
four main regional states. The aim of this paper is to examine the impact of this scheme on measures of household economic welfare: consumption, income, indebtedness, and livestock.

The economic burden associated with the incidence of ill health has been documented in a recent but rapidly growing literature on poverty dynamics. Most of these studies examine the consumption implications of health shocks, while some delve into the portfolio of coping responses adopted by households.¹ A number of studies show that households in the informal rural sector rely on traditional coping responses such as selling assets and informal borrowing to deal with the adverse consequences of ill health.² These coping responses are not cost free but entail a compromise—protecting current consumption at the cost of future vulnerability (Flores et al. 2008).

Health insurance primarily addresses out-of-pocket health expenditure, one of two sources of household financial stress from ill health. The second source is forgone income due to declining capacity to work. While health insurance schemes are not designed to curb this source of vulnerability, they might still provide some protection to households’ agricultural income by facilitating early recovery and by reducing pressure on households to reallocate resources meant for productive purposes (e.g., to buy fertilizers and high value seeds) to medical spending. By reducing reliance on potentially harmful coping responses, such as borrowing at usurious rates, health insurance schemes might protect household’s economic welfare both in the short and the long run.

Although analyses of the impact of health insurance has been the subject of a large body of empirical literature, much of this work has focused on health-care utilization and out-of-pocket (OOP) health expenditure or on induced behavioral responses such as moral hazard. Reviews of the literature by Ekman (2004) and Mebratie et al. (2013a) conclude that the evidence base is questionable with regard to the financial protection provided by CBHI. The bulk of the CBHI evaluation literature, with few exceptions,³ relies on cross-section based association and does not identify causal effects. Ignoring self-selection in voluntary insurance uptake is likely to lead to biased estimates of the impact of CBHI.

Moreover, while there are studies that examine whether health insurance helps protect income or wealth from declining due to ill health (Lindelow and Wagstaff 2005) or have studied the effect of such schemes on consumption (Wagstaff and Pradhan 2005), there are relatively few studies that have evaluated the impact of such schemes on indebtedness and livestock.

This paper uses three rounds of household panel data—a baseline and two follow-up surveys. The presence of a baseline survey enables us to examine self-selection and to control for both observable and unobservable time invariant

². For example, Sparrow et al. (2014) and Yilma et al. (2014).
³. Jowett et al. (2003), for Vietnam, and Levine et al. (2014), for Cambodia, find statistically significant negative effects of CBHI on OOP health spending.
factors, which may affect self-selection. To identify the effect of the scheme on income, consumption, livestock and indebtedness we rely on both fixed effects and matching methods and compare results for different control groups (within and across pilot and non-pilot districts).

II. CBHI Scheme Design

In June 2011, as part of its health sector financing reform (HSFR) initiatives, the Ethiopian Government launched a pilot CBHI scheme in 13 districts in the four main regions (Tigray, Amhara, Oromiya, and SNNPR) of the country.\(^4\),\(^5\) Regional administrative bodies selected these districts based on directives provided by the Federal Ministry of Health (FMoH). The selection criteria require that the districts fulfill five conditions while in practice selection was based on two conditions: undertaking HSFRs and geographical accessibility of health centers (located close to the main road).\(^6\)

The community element to the CBHI scheme is that villages (Kebeles) decide whether or not to join (based on a simple majority vote), and are subsequently involved in management and supervision. Possibly due to prior sensitization activities, all villages in pilot districts voted in favor of the scheme. Once a Kebele agrees to join, household enrolment is voluntary. To reduce adverse selection, enrollment is at the household level rather than the individual (FMoH 2008).

Benefit packages, registration fees, premiums, and premium payment methods are similar within regions but vary slightly across regions. On average, the combined premiums for core household members (parents and underage children) amount to about 1–1.4% of household monthly non-medical expenditure.\(^7\) The CBHI scheme is subsidized by both the central and regional/district governments. The central government provides a general subsidy amounting to a quarter of the premium collected at district level while the regional and district level governments cover the costs of providing a fee waiver for the poorest 10% of the population.\(^8\)

The benefit package includes both outpatient and inpatient service utilization at public facilities. Enrolled households may not seek care in private facilities unless a particular service or drug is unavailable at a public facility. The scheme

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4. Although initially the plan was to launch the pilot scheme in three districts in each of the four regions, an additional district in Oromiya region volunteered to join the pilot scheme and was included.

5. The main components of the health sector financing reform include revenue retention and utilization by health facilities, fee waiver and exemption of certain services, and establishment of private wings in public hospitals.

6. The complete set of selection criteria include (1) willingness of district authorities to implement the scheme, (2) commitment of districts to support the scheme, (3) geographical accessibility of health centers, (4) quality of health centers, (5) the implementation of cost recovery, local revenue retention, and public pharmacy policies in health centers.

7. In 2011, monthly household non-medical expenditure was ETB 1103 (USD 1 equals ETB 18). Details on premiums are presented in Table A1 of the supplemental appendix.

8. These households are categorized as indigent groups (households without land, house, or any valuable assets). In December 2012 about 9% of total eligible households had received a fee waiver.
excludes treatment abroad and treatments with large cosmetic value such as artificial teeth and plastic surgery. The referral procedure requires members to visit health centers before they may be referred to hospitals (district or regional). Those who do not follow this referral procedure need to cover half the costs of their medical treatment. In our sample, CBHI uptake reached 41% in April 2012 and 48 percent in 2013, which is relatively high compared to experiences in other African countries.

III. Data

We use three rounds of a household panel data set, collected in March/April of 2011, 2012, and 2013. The first round was collected a few months before the launch of the CBHI scheme and serves as a baseline. Sixteen districts located across four main regions of the country (Amhara, Oromiya, Tigray, and SNNPR) are included in the survey. For each region we include all three districts that implemented the CBHI pilot and one selected nondistrict. The nonpilot districts were chosen based on the same criteria that were used to select the pilot districts. Within the districts we applied a two-stage sampling design, randomly sampling villages and households. The total sample size in the first round was 1,632 households comprising 9,455 individuals, of which 98% and 97% were successfully resurveyed in 2012 and 2013.

The survey instrument contains information on a variety of individual and household socio-economic attributes such as consumption expenditure, crop output, off-farm income, assets, outstanding loans, household demographics, employment, and health conditions. The total value of all outstanding loans at the time of the survey is used to measure indebtedness. Our measure of consumption is monthly nonmedical per adult equivalent consumption.

IV. Methods

The nonrandom nature of insurance uptake is an important empirical concern in identifying the causal effect of CBHI. Demand for health insurance may be driven by affordability or latent health status, in which case simple differences in outcomes between CBHI enrolled and nonenrolled households may not be viewed as causal effects of the scheme. Table 1 suggests non-random uptake. At baseline, households that subsequently take up CBHI have higher crop output and income, are more likely to have borrowed, have larger outstanding loans, and are more likely to have borrowed, have larger outstanding loans,
and larger livestock holdings than households that do not insure. However, we see little differences in consumption. A naive comparison of postintervention outcomes would overestimate the impact of CBHI on income and livestock and underestimate the impact on indebtedness.

We therefore estimate a household fixed effects model that controls for both observed and unobserved time-invariant confounding factors,

$$Y_{it} = \beta CBHI_{it} + \delta T_t + \varphi X_{it} + \theta_i + \varepsilon_{it},$$  

(1)

where $Y_{it}$ is the outcome of interest for household $i$ at time $t$, the dummy variable $CBHI_{it}$ indicates whether household $i$ is insured in year $t$, and $T$ indicates a set of

| TABLE 1. Baseline Differences in Outcome Variables: Insured vs Noninsured |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                             | Insured households (N = 656) | Noninsured households       |
|                             | All districts (N = 911)      | Pilot districts (N = 527)   | Control districts (N = 384) |
| **Income**                  |                             |                             |                             |
| Crop output                 | 8499.0 (9104.3)             | 5985.0*** (7044.6)          | 6551.3*** (7440.0)          | 5212.8*** (6395.8)          |
| Total income                | 10017.2 (9828.0)            | 7091.8*** (7335.5)          | 7757.6*** (8089.1)          | 6196.2*** (6075.1)          |
| **Consumption**             |                             |                             |                             |
| Total                       | 244.7 (146.9)               | 249.4 (170.4)               | 241.9 (162.5)               | 259.6 (180.5)               |
| Food                        | 201.1 (125.4)               | 206.3 (144.6)               | 200.6 (144.8)               | 214.0 (144.3)               |
| Nonfood                     | 43.8 (39.6)                 | 43.0 (45.1)                 | 41.2 (37.7)                 | 45.5 (53.6)                 |
| **Indebtedness**            |                             |                             |                             |
| Outstanding loan (%)        | 37.5 (48.4)                 | 26.0*** (43.9)              | 26.6*** (44.2)              | 25.3*** (43.5)              |
| Total outstanding loan      | 880.3 (1689.2)              | 527.6*** (1259.3)           | 492.8*** (1172.7)           | 575.4*** (1369.5)           |
| **Livestock**               |                             |                             |                             |
| Goats                       | 1.2 (5.3)                   | 0.8** (2.2)                 | 0.7** (2.2)                 | 0.8 (2.1)                   |
| Sheep                       | 1.8 (3.0)                   | 1.0*** (2.6)                | 0.9*** (2.2)                | 1.2*** (3.0)                |
| Bulls                       | 0.4 (1.4)                   | 0.3** (0.7)                 | 0.3* (0.6)                  | 0.3** (0.7)                 |
| Calves                      | 0.8 (1.2)                   | 0.6*** (0.9)                | 0.6*** (0.9)                | 0.5*** (0.8)                |
| Oxen                        | 1.4 (1.3)                   | 0.8*** (1.0)                | 0.9*** (1.0)                | 0.8*** (0.9)                |

Notes: Columns 1–4 report mean (standard deviation); statistical significance refers to differences in means between the control group and the insured households: ***0.01, **0.05, *0.1. Crop output refers to total value of production in the past one year. Total income is the sum of crop output and off-farm income. All livestock types refer to number of livestock owned. All monetary values are in Ethiopian Birr (ETB).
dummy variables for each of the three years. Household fixed effects are captured by $\theta_i$, and $\epsilon_{it}$ is a random error term. Time varying controls $X_{it}$ include demographics, various measures of socioeconomic status, shocks, and household head characteristics. We also combine the fixed effects approach with propensity score matching (PSM). CBHI uptake is modelled as a function of baseline characteristics, and we estimate equation (1) only for households on support.

We have two groups of control households: uninsured households in pilot districts and households from nonpilot districts. Each control group introduces different sources of bias. For the pilot districts, the voluntary nature of the scheme could induce selection bias. The fixed effects would purge selection effects if these are based on time-invariant characteristics. Pilot districts are also prone to spill-over effects. However, these are most likely to be relevant to health-care use and not for economic outcomes, at least not in the short term.\(^{12}\)

The control districts are drawn from the same regions and fulfill the criteria stipulated by the government in selecting CBHI districts, while any remaining geographical differences will be controlled for by the fixed effects. Although fixed effects cannot deal with aggregate shocks we explicitly control for information on 22 different shock types (natural shock, crime/conflict related shock, health shock, and economic shock). We also conduct a sensitivity analysis, where we test if the results are sensitive to excluding them.\(^{13}\)

Finally, there remains a possible confounding effect from other social programs that share targeting and selection criteria with the CBHI pilot. We are aware of only one such social safety net program in rural Ethiopia, the PSNP (Productive Safety Net Program). For both sets of control households, we estimate models with and without an indicator variable for PSNP.

V. Estimates

Table 2 presents treatment effects using different control groups. Across methods we find a statistically significant positive impact on income (crop output and total income) for the pilot district comparison only. While the magnitudes of the estimates decline as we exclude households that are off support, we find that crop output and total income increase by ETB 785 and ETB 1027, respectively, or 9%–10% of baseline values. While the coefficients are also positive when we use households in nonpilot districts as controls, the estimates are not precise. The results provide no evidence that CBHI affects household consumption, as the coefficients lack statistical significance and the magnitudes are small.

We find a negative impact on the probability of having outstanding loans ranging between 4% and 5%, depending on methods and control groups, which

12. We run a placebo test where treatment indicator takes a value of 1 if uninsured household lives in pilot district and 0 otherwise. We do not find any indication of spill-over effects. Results are reported in a supplemental appendix, table A4.
13. The robustness test is not reported here but included in a supplemental appendix, table A3.
<table>
<thead>
<tr>
<th></th>
<th>FE with covariates</th>
<th>FE with covariates after matching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All districts</td>
<td>Control districts</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
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<tr>
<td>Crop output</td>
<td>459.9</td>
<td>286.6</td>
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<tr>
<td></td>
<td>(477.4)</td>
<td>(572.4)</td>
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<tr>
<td>Total income</td>
<td>675.7</td>
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<td></td>
<td>(571.3)</td>
<td>(632.7)</td>
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<tr>
<td><strong>Consumption</strong></td>
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<tr>
<td>Total</td>
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<td>Nonfood</td>
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<tr>
<td></td>
<td>(0.0222)</td>
<td>(0.0237)</td>
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<td>(69.76)</td>
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### Livestock

<table>
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<th>Bulls</th>
<th>Calves</th>
<th>Oxen</th>
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</thead>
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<td>(0.0480)</td>
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<td>(0.0464)</td>
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</tbody>
</table>

**Notes:** The column headings refer to the choice of control group: all districts (all non-insured households included), control districts (only noninsured households in control districts included), and pilot districts (only non-insured households in pilot districts included). Standard errors (in parentheses) are clustered at the village level. Results are broadly similar when excluding the time-varying covariates. A list of covariates is given in the supplemental appendix (Table A2). In the case of livestock we exclude the asset index quintiles as the index includes number of livestock.

**Statistical significance:** ***0.01, **0.05, *0.1.
translates to about 13% of baseline values. There are also negative coefficients for the amount of outstanding loans although these are imprecise. Estimates for all types of livestock are not statistically significant.

VI. Conclusion

This paper explored the impact of Ethiopia’s CBHI pilot scheme on household economic welfare. We found the main benefit of the scheme is its effect on reducing the need to borrow. This may have longer-term benefits in reducing vulnerability to other forms of shocks. A related study has found a sharp impact on increasing health care utilization (Mebratie et al. 2013b). The combined results provide support to the government’s recent move to extend the CBHI pilot to a total of 161 districts for further testing. However, a nationwide scale up requires an examination of the scheme’s financial sustainability.

References


14. The estimates for the pilot-district control group are, however, imprecise.


Policy-Making and the Adaptability of Informal Institutions

Xiao Yu Wang

This article discusses several of the insights generated by a theory of the formation of relationships between heterogeneously risk-averse individuals who lack access to formal insurance. An example illustrates the policy relevance of the theory, and demonstrates a relationship between the emergence of entrepreneurship in developing economies and higher income inequality. Reducing aggregate risk is a strict Pareto improvement if relationships in the status quo are assumed to remain constant, but is shown to be particularly harmful for the most risk-averse individuals and to exacerbate inequality when the endogenous network response is taken into account: the least risk-averse individuals abandon their roles as informal insurers in favor of entrepreneurial partnerships. JEL codes: O1, O13, O16, O17

Economists have long recognized the gravity of the burden that risk imposes on the very poor, and the importance of understanding the channels by which the absence of formal insurance and credit institutions affects their lives (Morduch 1995). Beginning with fundamental questions, such as whether the poor insure at all in the absence of formal institutions (Townsend 1994), research has more recently focused on characterizing the differences between informal and formal insurance arrangements. But what distinguishes “informality”? The consensus thus far seems to be the contracting environment—insurance is informal when parties cannot commit to honoring their risk-sharing agreement and must enforce cooperation by severing ties with defectors in the future. Existing literature takes the risk-sharing group or the network formation process as given, and studies the insurance arrangement that emerges under limited commitment (Ligon, Thomas, and Worrall 2002; Bloch et al. 2008).

But what if there is more to informality than the contracting environment? I focus on the structure of the risk-sharing groups or networks which form

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in the first place (related papers include Legros and Newman (2007) and Schulhofer-Wohl (2006)). Instead of a single-dimensional relationship with a risk-neutral formal insurer, a risk-averse, poor individual must build and use multidimensional relationships with other risk-averse, poor individuals. For example, Rosenzweig and Stark (1989) show that insurance is layered into household formation: daughters of more risk-averse farmers are married to more distant villages, to minimize the correlation between farming incomes. Ackerberg and Botticini (2002) find evidence that insurance is layered into production: heterogeneously risk-averse farmers and landlords in medieval Tuscany strategically formed sharecropping relationships based on differing risk attitudes.

The rest of this note discusses the importance of understanding the emergence and evolution of informal institutions for policy analysis and design, as well as the connections this theory enables us to make between the equilibrium composition of informal relationships and the risk environment, income inequality, and entrepreneurship. These insights are drawn from the results of Wang (2014), where generalizations, extensions, empirical support, and proofs may also be found.

**Model**

**Agents:** There are two groups of agents, $G_1$ and $G_2$, $|G_1| = |G_2|$, where agents differ in their Arrow-Pratt degrees of absolute risk aversion $r > 0$. Type $r_i$’s utility from consuming $x$ units of output is $u_i(x) = -e^{-r_i x}$.

**Risk and production:** A project $p > 0$ returns output $Y_p = p + V(p)Y$, where $Y$ has well-defined cdf $F_Y : \mathbb{R} \to [0, 1]$, and $E(Y) = 0$, $V(Y) = 1$. This allows for a large class of symmetric and skewed distributions.

Hence, a project $p$ has mean return $E(Y_p) = p$ and variance of return $V(Y_p) = V(p)$, and $V'(p) > 0$: projects with higher mean also have higher variance. (This is without loss of generality, as projects with higher variance but lower mean are never desired by any risk-averse agent with the preferences described above.)

Any project $p$ requires the collaboration of at least two agents, one from $G_1$ and one from $G_2$, where a matched pair $(r_1, r_2)$ jointly selects a project. For example, landowners and farmers choose between portfolios of crops, land plots, and inputs which differ in price and yield risk, and investors and entrepreneurs choose between business opportunities of differing riskiness.

All matched pairs face the same spectrum of projects $p > 0$, each agent can be involved in at most one project, and there are no “project externalities”: one pair’s project choice does not affect availability or returns of any other pair’s project.

**Information and commitment:** All agents know each other’s risk types and the risk environment.

A pair $(r_1, r_2)$ commits ex ante to a feasible return-contingent sharing rule $s : \mathbb{R} \to \mathbb{R}$, where $r_2$’s share is $s(y_{p12})$, and $r_1$’s is $y_{p12} - s(y_{p12})$.

1. See Wang (2014) for a proof of equivalence between this model and one in which individuals choose own income and share the pooled returns, as well as one in which agents match within one group instead of across two groups. See Wang (2013) for an explicit treatment of moral hazard.
The equilibrium: An equilibrium is:

1. The matching pattern: a match function \( \mu : \mathbb{R}^+ \rightarrow \mathbb{R}^+ \), mapping each agent in group 1 to a single agent in group 2. Thus, \( r_1 \)'s partner is denoted by \( \mu(r_1) \), and \( \mu(\cdot) \) assigns distinct members of group 1 to distinct partners in group 2.

   Moreover, the matching pattern described by \( \mu(\cdot) \) must be stable. It must be that no agent is able to propose a feasible project and sharing rule to an agent not matched to her under \( \mu \), such that both agents are happier when matched with each other in this proposed arrangement than they are with the partners assigned by \( \mu \) ("no blocks"). Individual rationality holds, as individuals cannot produce on their own.

2. The risky projects: a project choice for each matched pair, such that no pair can achieve weakly better outcomes for both partners (and a strictly better outcome for at least one partner) by choosing a different project. In other words, the project chosen by a matched pair must be optimal for that pair.

3. Individual payoffs and sharing rules: a sharing rule for each matched pair, describing the amount each partner receives given each possible return realization, where the sum of shares cannot exceed the total return (feasibility). The sharing rule must be such that no pair can achieve weakly better outcomes for both partners (and a strictly better outcome for at least one partner) by choosing a different sharing rule. In other words, the sharing rule chosen by a matched pair must be optimal for that pair.

Individual payoffs will not be unique in the equilibrium of this model. Instead, the stability conditions will determine a set of equilibrium surplus divisions. For a matched pair \((r_i, \mu(r_i))\), let \( v_i \) denote the expected utility of \( \mu(r_i) \) in equilibrium, and \( \phi(r_i, \mu(r_i), v_i) \) denote \( r_i \)'s maximal expected utility given that \( \mu(r_i) \)'s expected utility is \( v_i \). Then a vector of individual payoffs described by \((v_1, \ldots, v_N)\) can be supported in equilibrium if and only if for each \( r_i \):

\[
\phi(r_i, \mu(r_i), v_i) \geq \phi(r_i, \mu(r_j), v_i) \quad \forall j \neq i
\]

That is, given the division of surplus described by \((v_1, \ldots, v_N)\), no two individuals who are unmatched are able to match with each other instead, and split the surplus they generate in such a way that they are both weakly better off, and at least one of them is strictly better off.

**Example**

Many of the world’s very poor depend on agriculture for subsistence. Crop price stabilization is frequently proposed as a tool for alleviating the substantial risk

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2. Individual rationality holds, as individuals cannot produce on their own.
burden shouldered by poor farmers, especially the poorest and most risk-averse. Notable examples include maize, sorghum, and rice in Venezuela, bananas and grains in Ethiopia, and many others (Knudsen and Nash 1990).

Poor farmers often face an unforgiving risk environment, and lack access to formal insurance. Because a slight increase in profitability of crop portfolio comes at the cost of extremely high variance, they are trapped into growing crops that are safe but not very profitable, and they forgo innovations for less profitable, traditional methods. To encourage the farming of crops with higher expected profitability, the government places price bands of the form \([p_L, p_H]\) on each crop’s price. If the world price of a crop happens to fall within this band, that is the price the farmer faces. However, if the world price falls below the price floor, the farmer is guaranteed to receive \(p_L\), and if the world price is above the price ceiling, the farmer faces \(p_H\). The marginal impact of stabilization is largest for crops with the most volatile prices: the variance of every crop falls, but the variance of the riskiest crops falls by the largest amount. Thus, the policy leads to a change in the curvature of the marginal variance cost across different crop portfolios.

A numeric example illustrates the effects of this change in the risk environment on the broader economy. Suppose \(G_1 = \{0.5, 0.8, 0.9, 1\}\), and \(G_2 = \{1, 2, 3, 4\}\), so that the agents in the second group are more risk-averse than the first (typically believed to be the case with landowners and tenant farmers, although any risk types could be chosen, as the predictions for matching depend only on the risk environment, not on population specifics).

For simplicity, assume that the returns of different crop portfolios are distributed normally. In particular, suppose that pre-policy, the profits of a crop with mean \(p\) are: \(\pi_p \sim N(p, p^{2.05})\). Following the stabilization policy, the distribution of profits is \(\pi_p \sim N(p, p^{1.95})\). Note that the policy changes the risk environment in two ways: the variance of each project \(p > 1\) has fallen, and the previously convex marginal variance cost becomes concave in mean return. The change in levels of risk is small (\(V_{\text{pre}}(p) = p^{2.05}\) is similar to \(V_{\text{post}}(p) = p^{1.95}\)), but the change in curvature is great (global convexity to global concavity). The change in levels is intentionally minimized, to isolate the change in curvature: we know from Wang (2014) that it is the change in curvature which triggers a change in the unique equilibrium matching. Pre-policy, individuals match negative assortatively in risk attitudes, while post-policy, the match is positive assortative. This enables us to characterize the welfare impact stemming solely from the endogenous response of the informal insurance network.

Now, suppose we analyze this policy without accounting for the response of informal institutions.

**Lemma 1** A policy that reduces the variance of every available project is a strict Pareto improvement if the composition of partnerships remains unchanged.

The proof is intuitive: suppose that the four matched partnerships in the status quo undertook projects \(\{p_1, p_2, p_3, p_4\}\). Following the introduction of a policy
which decreases the variance of every project, each partnership has the opportunity to stay on its original project, or to switch projects. If a partnership retains its original project, it is strictly better off, since the project has the same mean, but a lower variance, and all individuals are risk-averse. If a partnership switches to a different project, then by revealed preference, they must be even better off facing the new project than facing the old project with decreased variance. But this means that each partnership is strictly better off.

Now, suppose we account for the endogenous re-formation of partnerships triggered by the policy.

What happens to the expected utility generated by the collaboration of each matched pair? The following two figures are taken from Wang (2014). Figure 1 shows the expected utility of the $i^{th}$ least risk-averse pair pre- and post- policy (i.e., “1” on the x-axis represents the least risk-averse pair, and “4” on the x-axis represents the most risk-averse pair). Clearly, the least risk-averse benefit at the cost of the more risk-averse (and this is true of individual payoffs as well as pairwise payoffs):

In addition, equilibrium crop portfolio choices experience the following change (Figure 2):

Clearly, this risk-reduction policy is not a Pareto improvement. We see that the more risk-averse agents are worse off after implementation of the policy, purely as a result of the endogenous network response: the policy causes the least risk-averse agents to abandon their roles as informal insurers of the most risk-averse agents, in favor of entrepreneurial partnerships with fellow less risk-averse agents. The poorest, most risk-averse agents are thus harmed via two
channels: first, they’ve lost their informal insurers, and this weakens their capacity to smooth consumption, which reduces their welfare. To make matters worse, because the most risk-averse agents, who are now paired with each other, have very little capacity to smooth a given risk (as neither is willing to bear the volatility to smooth her partner’s consumption), they must instead manage risk by choosing projects with low variance, which traps them into growing crop portfolios with low mean returns.

On the other hand, the least risk-averse agents, who are now paired with each other, no longer play the role of informal insurer, and this enables them to take advantage of the decreased aggregate risk and undertake the higher mean, entrepreneurial projects (e.g., use a new technology). They are better off post-policy.

Hence, a price stabilization policy which especially reduces the risk of crops with higher mean and higher variance of yield and is intended to reduce the risk burden of the poor, may in fact exacerbate income inequality and particularly harm the most risk-averse, most impoverished agents. Further, the emergence of entrepreneurship may correspond with increased inequality.

This insight provides an interesting complement to the existing literature. Attanasio and Rios-Rull (2000) model the introduction of formal insurance as a policy which reduces the aggregate riskiness of the environment. They also find that such a policy may hurt the welfare of the most risk-averse agents. However, their model, which builds off Ligon, Thomas, and Worrall (2002), considers a fixed group of risk-sharing members whose informal insurance arrangement is constrained by limited commitment. Two agents sustain informal risk-sharing by threatening credibly to cut off all future ties if someone reneges, that is, does not
honor the risk-sharing agreement (e.g., a member keeps her own income realization instead of transferring some of it to an unlucky partner). Thus, anything that lowers the cost of autarky (the state of being alone and unable to share risk with somebody else) will decrease the level of informal insurance that can be sustained, because the punishment has become less costly. Since the introduction of formal insurance reduces aggregate riskiness, such a policy reduces the cost of autarky, and as a consequence informal insurance is weakened.

However, if commitment were perfect in Attanasio and Rios-Rull (2000), the introduction of formal insurance would strictly improve welfare, because lowering the cost of autarky matters only through the punishment of cutting off future ties, which would no longer be relevant. One contribution of this example, then, is to show that, even when commitment is perfect, introducing formal insurance might still reduce the welfare of the most risk-averse agents, because the composition of the informal risk-sharing network changes in response. Reducing the riskiness of the environment does increase the value of autarky, but it also increases the value of being in a relationship, and increases it heterogeneously across partnerships of different risk compositions.

This example also contrasts with Chiappori et al. (2011), who estimate that the least risk-averse individuals are the ones left worse off after the introduction of formal insurance, since they have been displaced as informal insurers. However, this exactly illuminates the need for a model of the equilibrium network of relationships—I show that the least risk-averse agents do leave their roles as informal insurers, but only because they prefer to undertake entrepreneurial pursuits instead. It would be interesting to see how their estimation changes after accounting for the endogeneity of matching.

**Conclusion**

This note discusses several of the many policy insights yielded by a theory of informal insurance as the risk-sharing achieved within an equilibrium network of partnerships, rather than within a single, isolated partnership. Furthermore, these insights illustrate what can be gained from broadening the way we think about informal insurance beyond the strength of the contracting environment. By developing a theory of the multi-dimensional relationships that poor, risk-averse individuals build and use with each other to manage risk in the absence of formal institutions, we are able to observe how individuals endogenously switch between and assume different informal roles in the economy, and we are able to make connections between informal relationships and the risk environment, income inequality, and entrepreneurship. Failing to account for the emergence and evolution of informal institutions in equilibrium may have grave consequences: we must be careful not to focus so much on what we would like the poor to do that we neglect an understanding of what they are already doing.
REFERENCES


This paper discusses a general equilibrium model consisting of a productive sector generating externalities on another sector having clean production, and on consumers, affecting the property of resilience of a natural system that feeds the economic system. The scope of efficiency of economic incentives is analyzed simultaneously with production activities in the polluting sector and the use of a pollution abatement technology. Our model predicts a boomerang effect: the polluting sector could find itself in a worse situation in the equilibrium with externalities; this sector initiated the problem, but at the end it is highly affected. In any case, the use of economic incentives helps keep pollution levels to maintain more valuable equilibria of nature. JEL codes: D50, H23, Q56

I. BACKGROUND RESEARCH

The instruments that regulate externalities may be grouped into two categories: command and control (CAC) and economic incentives. CAC refers to emission caps—performance standards—and technological constraints—design standards—while economic incentives apply to taxes, subsidies, tradable permits, and deposits. Economic incentives are preferable in a first best world, but their effectiveness depends mainly on the ability to measure all indirect marginal damages, low market transaction costs, the possibility of defining and protecting property rights, their ease of implementation, regulation and surveillance,

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the state’s fiscal appetite, technical possibilities, and the costs of using abatement technologies. There may also be classification criteria such as equity, political and ethical dilemmas (Eskeland 1999; Fullerton and Heutel 2007). Additionally, Loeb and Magat (1979) and Popp et al. (2010) have stated that when abatement technologies are available, market-based regulations encourage behavior through market signals rather than through explicit directives regarding CAC, thus allowing firms some flexibility to choose or identify the lowest-cost solutions to meet the policy goal.

Instrument effectiveness depends on a series of factors associated to the characteristics of innovation and pollution; whether the companies are heterogeneous or they have market power; whether technology is available and it is possible to adapt the abatement technology, or investments on research and development should be done, taking into consideration the underlying disincentives due to the probabilistic character of the innovation and its becoming a public good once it is produced; whether the abatement technology type completely reduces pollution—which is pure fiction—or slightly mitigates it; whether technology helps reduce pollution per product, per input, saves power consumption per unit produced, or whether replacement for a cleaner energy source is approved (Löschel 2002). It also depends on the concavity or convexity of the function that represents the effects of pollution on the economy (Xabadia et al 2005). Moreover, some regulator behaviors (such as commitment or shortsightedness) have been researched once the abatement technology is already available or under development (depending on the phase and success of innovation) in order to foster its diffusion (Nelissen and Requate 2007; Montero 2011; Goulder and Parry 2008).

The ranking of policy instruments also depends on the number and type of interactions, and on the innovator’s ability to appropriate spillover benefits. An initial motivation to include subsidies is that market-based policies also reduce production, and a mix of tax pollution and subsidies may be better suited to overcoming the joint market failure: a negative externality from pollution and a positive externality of R&D, given the public nature of innovation (Popp et al., 2010). In addition, the presence of a successful innovator could motivate discriminatory regulations since even this innovator would prefer CAC to raise costs for competitors.

Under conditions of uncertainty concerning the costs of pollution or the benefits of its reduction1, and considering monitoring and enforcement costs and the regulator’s commitment, among other second best situations, a combination of certain features of both price-based (market signals) and quantity-based (CAC) regulations in their pure form—usually named hybrids—has been suggested (Perino 2008; Montero 2011). These conditions may provide further justification for setting performance standards or mandating a particular suite of technologies on certain sector failures (Goulder and Parry 2008). Linares and Labandeira

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1. Goulder and Parry (2008) also argue, “Abatement costs uncertainties would be accompanied of provisions such as banking and borrowing or subsidies, however the instruments and the level of support are less clear and lesser when technologies are available.”
(2010), for example, emphasize on the necessity of mixed market-based regulations with subsidies or standards to account for uncertainty, bounded rationality, and social acceptability.2

However, the whole is not necessarily the sum of its parts; the use of multiple instruments is not the same as the use of a hybrid instrument. As the number of policy instruments grow, so does the interaction, being either detrimental or beneficial. For instance, those CAC instruments that help reduce the risk of high emissions but entail high costs for the emitters provide an opportunity to pay a tax or purchase a permit in order to cover the emission excesses over the standards, thus reducing the abatement costs (Montero 2011). These additional emissions or the quantities of permits have a cap, but these permits may reduce incentives for innovation, which would be motivated by emission caps (Perino 2008).

Fankhauser et al. (2011) show that in order to achieve an adequate carbon price and constrain its fluctuations to combat climate change, some European policy makers are combining cap and trade with carbon taxes or with feed in tariff—renewable energy obligations. Adding a carbon tax or feed-in tariff to the existing carbon system (EU ETS) also reduces the carbon price to such an extent that the overall price signal would remain unaffected. It aims to shift the burden of payment and depress the carbon price, rather than to achieve any additional emission reductions, unless the tax is so high that it replaces and thereby intensifies the price signal from the trading scheme. In any case, it must be clear that the best policy would be to auction original permits (caps) to pollute rather than to grant them free. For example, they could be assigned in an options market since the spot market may lower the prices of a license for using abatement technologies and, consequently, may reduce incentives for innovation (Laffont and Tirole 1996; Fairley 2009).3

2. “Carbon taxes may be more attractive theoretically. However, auctioned cap-and-trade systems, while retaining the rent-capturing feature of taxes, also allow for redistributing more explicitly and more easily than taxes a part of the cost, and may therefore be more politically acceptable. Their acceptability would even be higher if they are combined as hybrid instruments, such as safety valves, to hedge against unexpected high costs. These more efficient instruments should probably be coupled in some sectors – those closer to the final customer – with technology standards to account for bounded rationality and also to improve acceptability; with technology policies (both market-pull and market-push, depending on their situation in the learning curve) to counteract knowledge spillovers; with education and training policies to reduce bounded rationality and to decrease perceived costs, and with voluntary approaches when performance is not easily observable” (Linares and Labandeira 2010).

3. Lastly, the type of innovation must be distinguished. If it reduces marginal pollution, it is called an end-of-pipe solution—such as installing a water treatment plant adjacent to the production plant. On the other hand, it might involve changing the production process, thereby making the marginal abatement cost steeper. Note that in this last case, CAC policies would be more efficient than market-based policies for promoting innovation, since they also imply diminishing production. Nonetheless, if high levels of mitigation are required, marginal abatement costs will rise acutely, so it is better to invest in new production processes. In this sense, moderate efficiency gains in conventional technologies will have a great impact on the economy, since these technologies are widely used (Caper et al. 2008; Popp et al. 2010).
II. RESILIENCE OF A NATURAL SYSTEM

A natural system N has two fundamental properties: Stability, or the existence of multiple equilibria and the possibility to return to them after a disturbance, and Resilience, or its persistence and its capacity to absorb changes and shocks while maintaining the same relation between its populations and functions, such that it allows for the provision of environmental goods and services (Holling 1973). A natural system can eventually return to an equilibrium similar to the one that existed prior to the disturbance, and depending on the distance to its ecological threshold, the response will be smooth or abrupt (Groffman et al. 2006). Therefore, if the disturbances are of sufficient magnitude or duration, they can deeply affect the original equilibrium, thus reaching another less desirable equilibrium with different processes and structures, and may take up to a critical point where recovery is not feasible.

Figure 1 shows the negative relation between the production of polluting sector X and N’s production assuming a one to one relation between the production of X and the amount of contamination that it generates. Given the characteristics of resilience, N reacts to negative externalities striving to keep balance; that is, trying to maintain its initial equilibrium.

It can be observed that every oscillation produced by X represents less valuable equilibria. If the system surpasses the critical point, it will inevitably go down, being impossible to go back to the “safe” zone. Moreover, the dotted line represents the envelope function: changes of concavity also reflect the critical point (cp), where its resilience drops more quickly. The mechanics of natural systems should be considered in general equilibrium models that incorporate natural capital, given the increasing environmental problems associated to pollution, resource extraction and removal of functional groups, being resilience a fundamental property that involves other characteristics of natural systems.

This property has become a fusion of ideas from multiple traditional disciplines, including the stability of ecosystems (Holling 1973; Gunderson 2000), infrastructure engineering (Tierney and Bruneau 2007), psychology (Lee et al. 2009), behavior sciences (Norris 2011), and the risk reduction of disasters\(^4\) (Cutter et al. 2008).

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4. Particularly, Computable General Equilibrium (CGE) models, according to Rose and Liao (2005), is a promising approach for analyzing the impact of disasters on resilience, as it is possible to model the behavioral response to the shortage of inputs and changing market conditions. Rose and Liao (2005), Rose and Liao (2002) analyze natural disasters in regional economies, conceiving resilience as an inherent property of the system that enables it to return to its previous situation within a reduced time horizon after a crash caused by an unforeseen event (an earthquake, a natural disaster, a terrorist attack). For this preparation, they considered the importance of avoiding overlooking costs and essential investing in actions to mitigate the effects and maintain or increase this capacity for resilience. Meanwhile, Fadali et al. (2012) found that the value of water in the U.S. is in constant motion and that this is because resilience is affected by changes in water supply, demand, changes in prices of inputs and factors, prices of production, income, government policies and institutions. See Schouten et al. (2009) for a discussion of the issues brought about by resilience in rural areas. On a macro level, resilience can be linked to financial institutions and norms, and to the role of scarce resources.
Multilateral organizations have recently appropriated this property, which is an example of how the capacity of recovering theory to the politics and practice in general is being developed (Bahadur et al. 2010; Brown 2011; Herr 2011).

III. The Model

We propose formalizing a general equilibrium model splitting the world into a polluting industrial sector $X$, a clean industrial sector $Y$, a representative consumer $C$, and nature $N$ (Christopherson et al. 2010; Wing 2011). This model admits a simultaneous selection between production activities, pollution, the use of economic incentives (Pigouvian taxes) and the option of adapting abatement technologies. We include an end-of-pipe solution for a given production process, available in the market, in a first best world. This model is static and there are not transaction costs or the figure of a regulator explicitly coordinating agents. Preferences and technologies are given by the following equation system:

$$
U = X^a Y^b N_{C}^{1-a-b} X^{-\gamma}, \quad X = H N_{X}^{\delta} Y_{X}, \quad Y = M N_{Y}^{\pi} X_{Y}^{\theta} X^{-\rho}
$$

$J_i$ suggests that the firm produces good $i$ using input $j$. In its turn, $i$ represents the production of good $i$. $H$ and $M$ are the technology of sectors $X$ and $Y$ where the

5. For the sake of clarity, we can imagine an economy grouped in either polluting or non-polluting sectors and heavily relying on a natural system. See Wing (2011) for a proposal of a general equilibrium model incorporating varied interactions of nature and the remaining sectors, even though nature appears as receiving negative externalities and as a provider of common use public goods (positive externalities). This author also analyses the incidence of taxes, CAC measures and the option of acquiring abatement technologies, but without establishing any prioritization among them.

6. The nonexistence of transaction costs and the fact that the firms are owned by the representative consumer cause the allocation of pollution permit payments to be equivalent to taxes, in terms of efficiency and welfare.
initial values of different parameters are in agreement with a neoclassical economy, and \( \gamma \) and \( \rho \) show the negative marginal impact of sector X.

Yet, Nature is also affected by X pollution, disturbing particularly its resilience. In order to model N, a specific functional form is proposed considering: (1) an initial natural capital stock \( A \); (2) a marginal contribution of human resources intended to try to maintain, increase or shift such a stock \( (Y_N) \) \(^6\); and (3) a component accounting for the resilience capacity. We are assuming that \( N \) should be transformed to produce a profit-generating environmental service, but with costly reproduction, which might become highly expensive or impossible depending on the level of X.

Therefore, \( N = AY_N^\sigma f(X) \), so that \( \sigma \rightarrow 0 \). The function \( f(X) = g(X) + \lambda(X) \) accounts for the resilience property, where \( g(X) = s \sin(\omega \cdot X) \) represents the function associated to the long-run trajectory oscillations \(^7\) and \( \lambda(X) = aX^3 + bX^2 + cX + d \) denotes the envelope function. \(^8\) The mechanics call for building several general equilibrium models to analyze the following cases: differences between efficiency allocation and market equilibrium, payment of taxes, and the option of acquiring pollution abatement technologies, and making a hybrid with them both. As property rights on \( N \) are supposed to be allocated taking into consideration that it is considered to be a private good, this system allows for three markets and three price levels: \( P_X, P_Y, P_N \). The equilibrium prices were found using simultaneously the Newton-Raphson, the Secant and Brent’s method in order to find the roots of resultant non-linear equation system. \(^9\)

\(^7\) This continuous function allows to model required oscillations; parameters \( s \) and \( \omega \) are associated to the amplitude and period of the function.

\(^8\) The characteristics of the function are \( \frac{d\lambda}{dX} < 0 \) and \( \frac{d^2\lambda}{dX^2} > 0 \) if \( X < cp \), \( \frac{d^2\lambda}{dX^2} < 0 \) if \( X > cp \), \( \frac{d^2\lambda}{dX^2} = 0 \) if \( X = cp \), being \( cp \) the critical point.

\(^9\) We used Wolfram Mathematica software for this calculus.
IV. MAIN RESULTS

In market equilibrium, sector X maximizes its private benefits, pollutes, and does not internalize the social cost of pollution. When comparing this situation with a world without externalities, the welfare of all agents in the economy drops as a consequence of them. Unexpectedly the externality that X generates is reverted in a fall in its own demand, price and benefits (Xeq-E vs. Xeq-NE). We called this a *Boomerang effect*. Additionally, Nature loses its resilience at increasingly higher rates. This is reflected in such an overproduction of X that the critical point threshold is exceeded (Figure 2).

When the market is intervened to correct the externality, sector X maximizes its benefits, but it is subject to its technological restriction and tax payment. If taxes are equal to the marginal social damage the economy enters a “safe” or more resilient “zone”, because affectation by X has not yet reached the critical point. The insurance that society pays for maintaining itself inside a resilient zone can also mean unemployment, poverty and other undesirable consequences given that X decreases again (Xeff). Therefore, the tax highly increases $P_X$ affecting significantly the allocation of resources in the whole economy.

Finally, if an *Abatement Technology* is available, a portion $L$ of X production could be cleaned; while a tax is levied to another portion $Z$. Sector X’s benefits will be an increasing function of abatement technology productivity. This translates into an increase of the other agents’ profits and the economy moves farther from the critical point.

V. STRESSING THE MODEL

By increasing the initial natural capital stock parameter $A$, the level of economic activity and the level of X will also grow, but also the size of externality and, in consequence, the *boomerang effect* and the required taxes. Moreover, if N reacts positively, trying to maintain its initial equilibrium after a disturbance, taxes will be reduced. However, N loses its resilience property inevitably, being taxes the only insurance to not to lose this property (left side of Figure 3). By changing

**Figure 3.** Stressing the Model
the relative importance that \( N \) has in the consumer preferences, and contrary to the previous case, the level of economic activity and the level of \( X \) will be reduced, as well the boomerang effect. However, taxes will increase dramatically, even if the negative externality is lowered (right side of Figure 3).

**VI. Conclusions and Future Work**

This is a model of representative sectors whose inner interactions are not broken down. The main result of the market equilibrium with externalities is that the sector generating externalities as a whole is in a worse situation, but we may believe that inside the model, if it were to be broken down, there would always be those who benefit and those who are harmed in a higher proportion, which would depend on the relative demand for that sector’s products by other sectors of the economy. Therefore, incentives to invest in abatement technologies would not be homogeneous.

The equation representing Nature aims to incorporate the resilience characteristic as a version of working within a natural ecosystem and shows its interrelation with the economic system. Thus, knowledge about this function in a feature summarizing an ecosystem’s properties and its affectations is a result of resource extraction, pollution or random endogenous and exogenous events. While our model states that the use of taxes allows for maintaining the polluting sector’s level of production so that resilience \( N \) is in a “safe” zone, it is also true that the tax is quite high in relative terms and agents take on much of it because of price increases, which could also be interpreted a kind of insurance for resilience.

It would be interesting to make some additional considerations within the bounds of this paper. First, to model the inclusion of uncertainty in resilience, reflecting the fact that it is virtually impossible to know to which extent nature would be able to endure affectation made on itself. Second, to analyze incentives to invest in abatement technologies between several polluting agents instead of supposing a representative agent. Third, to study the differences when pollution abatement technologies are not end-of-pipe solutions, but rather modify the production process of the polluting good. Last, to expand the model to a dynamic character so that, for example, accumulative or de-accumulative polluting functions represents better the nature inner functioning and how accumulating pollution affects it.

**References**


Overcoming Obstacles: The Internet’s Contribution to Firm Development

Caroline Paunov* and Valentina Rollo

Based on 49,610 firm observations across 117 developing and emerging countries for 2006–2011, we show that their respective industries’ adoption of the Internet had positive spillover effects on firms’ productivity across world regions and economies at different development stages. We find that even firms facing financial constraints, frequent power outages, skills shortages, corruption and cumbersome labor regulations gained. Quantile regression results confirm these conclusions hold across different levels of productivity. They also show that the most productive firms benefited much more than the least productive firms. This suggests absorptive capacities are critical for the Internet to support firm development. JEL codes: D22, L6, L8, O14, O12, O33

I. Introduction

The uptake of the Internet in developing economies has been ubiquitous, bringing about one of the most fundamental changes in firms’ business environments (ITU 2014). There are multiple ways in which the Internet can help boost firms’ performance in developing countries: by improving access to relevant market information also for smaller and informal businesses, by facilitating more effective coordination of firms’ production and delivery chains, and by creating new business opportunities (Kaushik and Singh 2004; Aker and Mbiti 2010). Moreover, Paunov and Rollo (2014) identify positive impacts from Internet-enabled knowledge spillovers: the Internet provides a more effective means for disseminating new knowledge and in this way expands opportunities for firms to access relevant knowledge produced by others independently of their own investments in

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generating new knowledge.¹ Such evidence supports optimistic conclusions about the Internet’s potential for improving firm performance in developing economies. However, cumbersome business framework conditions, which include shortcomings in physical infrastructures, weakly developed financial markets, and an often insufficiently skilled labor force, challenge efforts to boost enterprise development. Those obstacles might also reduce possible contributions of the Internet to firm productivity and require difficult-to-address framework conditions are resolved for firms’ development.

This paper investigates how widespread gains from using the Internet on firm’s productivity effectively are and what effects cumbersome business framework conditions have. It builds on the work by Paunov and Rollo (2014), who demonstrate how industries’ adoption of the Internet affected the performance of firms belonging to such industries. It analyses whether firms’ productivity gains that result from Internet-driven knowledge spillovers differ across world regions, across economies at different stages of development, as well as across the productivity distribution. Moreover, it tests whether business framework conditions constrained productivity gains. Our analysis is based on 49,610 firm observations across 117 developing and emerging countries for 2006–2011 from the World Bank Enterprise Surveys. The impacts of an industry’s use of the Internet on firms’ labor productivity are identified using within country-year differences in the adoption of the Internet across sectors. An industry’s use of the Internet is unlikely to be affected by its individual firms’ productivity performance, and therefore the risk of reverse causality is low. We employ ordinary least squares regressions as well as quantile regressions.

We find that positive impacts of industries’ Internet adoption on firms’ labor productivity were widespread: firms in different world regions and firms at different development stages benefitted equally. We also show that firms facing cumbersome business environments saw their labor productivity increase in response. However, benefits were lower where labor market regulations were more cumbersome, where financial markets were less developed, and where electricity outages were more prevalent. Also, we find our general conclusions are confirmed across firms’ productivity distribution. Only cumbersome labor regulations significantly affected the least productive firms more. Moreover, we find that benefits from the Internet are higher for the most productive firms, possibly a result of these firms’ larger absorptive capabilities. Overall, our results support optimistic conclusions regarding the potential of the Internet to boost firm productivity even where business framework conditions are difficult. Thus, expanding firms’ use of the Internet is valuable in support of their development. Investments in firm’s capabilities to take advantage of the Internet will help ensure benefits to be more widespread across firms at different levels of productivity.

The paper contributes to the work on the impact of information and communication technology (ICT) investments on firms’ productivity. Extensive research

¹. Knowledge spillovers in turn have been identified as critical for economic growth (Romer 1986).
found positive impacts of ICTs (Jorgenson and Vu 2005; Bartel et al. 2007). Several studies have identified positive association between firms’ ICT use and their productivity in developing countries (World Bank 2006; Commander et al. 2011; Paunov and Rollo 2014). Our paper also relates to the literature that has documented the impacts of business framework conditions on firm development (Tybout 2000; Dollar et al. 2006).

The remainder of the paper is organized as follows. Section 2 describes the empirical framework, while Section 3 gives an overview of the data we use in our analysis. Section 4 describes the results of the analysis. The last section concludes.

II. Analytical Framework

In order to study the impact of industries’ adoption of the Internet on firms’ productivity performance in different country contexts, we adopt the following baseline estimation model:

$$Prod_{ict} = \alpha + \beta_1 * ICT_{sct} + \gamma * X_{ict} + \lambda_{st} + \lambda_{ct} + \varepsilon_{ict}$$  \hspace{1cm} (1)

where $Prod_{ict}$ is a measure of firm $i$’s labor productivity. $ICT_{sct}$ is an indicator of sector $s$’s uptake of using email to communicate with clients and suppliers for country $c$ at year $t$, whereas $X_{ict}$ is a full set of firm-level control variables. Coefficient $\beta_1$ is our parameter of interest to identify spillover effects.\(^2\) Seker (2012) and Dollar et al. (2006) apply a similar approach to identify impacts of different business conditions on firm’s performance. We also add $\lambda_{st}$ and $\lambda_{cts}$ respectively a set of sector-year and country-year dummies. That is, our identification strategy exploits differences in sectors’ adoption of the Internet across countries controlling for differences characterizing specific industries or countries in specific time periods.

Two major challenges affect the analysis of the impacts of firms’ ICT use on firm’s performance: i) endogeneity (i.e. the fact that while ICT might support productivity performance, it could also be the case that more productive firms rely more on ICT), and ii) omitted variable biases (i.e. the fact that there might be other unaccounted unrelated factors that affect the estimated $\beta_1$). Endogeneity is less of a challenge for our analysis, which focuses on the adoption of the Internet at the sector level: it is unlikely that firms’ innovation and productivity performance has a direct impact on their sector’s adoption of the Internet. Furthermore, to avoid potential endogeneity concerns firm $i$’s own use of the Internet is excluded from the industry average we compute. The use of an aggregate measure also reduces risks of measurement error. Moreover, we address

\(^2\) The set-up is similar to that of the prior literature on knowledge spillovers from industries’ R&D or foreign direct investment (FDI) as, for example, in Acs et al. (1994) or Haskel et al. (2007) to provide but one example for each.
omitted variable biases by introducing sector-year and country-year fixed effects. The inclusion of country-year fixed effects allows isolating the potential differences across countries including also specific government policies that might affect the firms’ productivity and innovation performance. Controlling for industries in given years is also important because certain industries are more technology-intensive than others, so that allowing for the variation of control variables across industries would lead to spurious results. In addition, we introduce a set of firm-level controls which include: firms’ employment and age, indicators of public ownership and of multi-plant establishments, controls for whether the firm has connections abroad (i.e. foreign-ownership and exporter status), proxies for managerial quality, access to finance, and whether the firm owned a website.\footnote{We introduce the latter variable to control for firm investment in ICTs so as to identify spillover effects from the Internet.}

In order to assess differential impacts across world regions and different income levels, we obtain separate coefficients for the different regions of the world and economies’ different income levels.

Moreover, we test for differential effects of business framework conditions by using the following estimation approach:

\[
\text{Prod}_{ict} = \alpha + \beta_{ADV} \times [ICT_{sct} \times ADV_{ict}] + \beta_{DIS} \times [ICT_{sct} \times DIS_{ict}] + \\
\gamma \times X_{ict} + \lambda_{st} + \lambda_{ct} + \varepsilon_{ict}
\]

where \(ADV_{ict}\) and \(DIS_{ict}\) are dichotomous variables indicating whether firms face cumbersome business framework conditions or not. We focus on five business framework conditions: power outages, corruption, financing constraints, skills shortages, and cumbersome labor regulations.

We apply ordinary least squares regressions as well as quantile regressions to assess whether impacts differ. Quantile regressions can be expressed in the general form \(Prod_{ict} = z_{ict}' \beta + \varepsilon_{ict}\) with \(Q_0(Prod_{ict} | z_{ict}) = z_{ict}' \beta_0\), where \(z_{ict}\) includes all explanatory variables including our variable of interest as in (1) and (2) (Koenker and Basset 1978). Estimating \(\theta\) from 0 to 1 gives the entire distribution of \(Prod_{ict}\) conditional on \(z_{ict}\). Finally, robust standard errors clustered at the country-sector-year level are applied systematically following the procedure suggested by Moulton (1990).

III. DATA

Our analysis makes use of the World Bank Enterprise Surveys (WBES), which collect comparable information on a representative sample of formal firms in the nonagricultural sector. Our estimating sample consists of 49,610 firm observations across 117 countries in 2006–2011. As to the composition of our dataset, 40% of our observations are from Latin America or the Caribbean, 27% from
Africa, 22% from Eastern Europe, Central Asia or the Middle East, and 11% from the East Asia Pacific and South Asia regions. The sector coverage is diversified; 53% of firms are from the manufacturing sector, while the remaining 47% are firms in the services (including construction) sector. About 73% of the firms in the sample have fewer than 50 employees. Further detail is provided in Paunov and Rollo (2014).

Interestingly for our purposes, the WBES include information on whether firms used email services to communicate with suppliers and customers. The indicator is suitable for our analysis since it relates to the exchange of knowledge with clients and suppliers, which are both critical sources for firms’ acquisition of relevant knowledge for their business activities. Evidence from our dataset, shown in Figure 1, indicates that in 2006–2011 a large share of firms used the Internet to communicate with clients and suppliers. Even among firms in low-income economies, 45.2% of firms had adopted this communication tool. Also, while small firms were less active users than their larger counterparts, even among the smallest uptake was 44.5%.

Moreover, the questionnaire provides rich information on business climate conditions that firms face. This allows for a more detailed analysis on how these conditions affect firms’ benefits from the Internet. The correlation between the five different business conditions we analyze (as described above) is weak. We can therefore assess how these distinct factors affect the Internet’s contribution to firms productivity. Finally, the data provide rich information on firm characteristics, which allows computing firm productivity and a set of firm level controls for our analysis. Detailed descriptions of variables used are provided in the appendix.

**Figure 1.** Share of Firms that Communicate with Clients and Suppliers by Email (in Percentages)

![Figure 1](image_url)

**Notes:** Statistics provided are obtained for the 49,610 firms included in our baseline sample.
IV. Results

First, we investigate how widespread gains are across world regions and economies at different development stages. As a starting point, we report baseline results from Paunov and Rollo (2014) in column (1) of Table 1. These results show positive significant spillover effects of the Internet’s adoption on firms’ labor productivity. Regarding the magnitude of the estimated effects, all else equal, our findings indicate that an increase in the intensity of a firm’s industries’ use of the Internet by 1 standard deviation would raise its labor productivity by what is equivalent to an increase from the 50th to the 55th percentile of the distribution. However, as shown in Figure 2, benefits differ across the productivity distribution with the most productive firms benefitting about three times more than their less productive counterparts.

Turning to the question of gains across world regions, column (2) of Table 1 shows positive effects for firms in Africa, Eastern Europe, Central Asia, and the Middle East as well as Latin America and the Caribbean. Only for East Asia

| Table 1. Impacts of Internet Adoption across World Regions and Stages of Economic Development |
|---------------------------------|-----------------|-----------------|-----------------|
|                                  | (1)             | (2)             | (3)             |
| Industry Email Use_{sect}        | 0.007***        | 0.008***        | −0.004          |
|                                  | (0.001)         | (0.002)         | (0.007)         |
| * Africa                         |                 | 0.002           |                 |
| * East Asia Pacific and South Asia |                 | 0.006**         |                 |
| * Eastern Europe, Central Asia   |                 | (0.002)         |                 |
| and Middle East                  |                 |                 |                 |
| * Latin America and the Caribbean|                 | 0.011***        |                 |
|                                  | (0.002)         |                 |                 |
| Industry Email Use_{sect}        |                 |                 |                 |
| * High-Income Economies          |                 | 0.007***        |                 |
|                                  |                 | (0.007)         |                 |
| * Upper-Middle-Income Economies  |                 | 0.007***        |                 |
|                                  |                 | (0.002)         |                 |
| * Lower-Middle-Income Economies  |                 | 0.007***        |                 |
|                                  |                 | (0.002)         |                 |
| * Low-Income Economies           |                 | 0.007***        |                 |
|                                  |                 | (0.002)         |                 |
| Firm Level Controls              | Yes             | Yes             | Yes             |
| Sector-Year Fixed Effects        | Yes             | Yes             | Yes             |
| Country-Year Fixed Effects       | Yes             | Yes             | Yes             |
| Observations                     | 49,610          | 49,610          | 49,610          |
| R-squared                        | 0.81            | 0.81            | 0.81            |

Notes: The dependent variable is labor productivity. Firm controls included are described in the appendix. Robust standard errors clustered at country-sector-year level are shown in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively.
Pacific and South Asia we do not identify any impacts. These findings shows that the benefits of the Internet for firm’s development were effectively widespread. Table 2 shows that these effects differ depending on firms’ levels of productivity: while for firms in Latin America and the Caribbean effects are positive and significant across the distribution, in Table 2 we find that for African firms effects are low for less productive firms but high for more productive firms. For firms in East Asia Pacific and South Asia we find positive significant effects for median performers while for Eastern European, Central Asia, and the Middle East it is the least productive firms that benefit most.

We also test whether we have widespread effects for firms in economies at different stages of development. Results, reported in column (3) of Table 1, confirm that estimated effects are the same across middle-income and lower-income economies. Only for the small number of firms from high-income economies we do not identify significant effects. Unreported results from quantile regressions show greater impacts for firms with higher levels of productivity for different income levels. There are no statistically significant differences across firms at different levels of development across the productivity distribution. Findings from quantile regressions confirm results reported in column (3) of Table 1.

Second, we analyze whether cumbersome business conditions affected impacts on firm productivity. We evaluate five challenges: i) electrical power outages, ii) corruption, iii) financing constraints, iv) skills shortages, and v) difficult labor regulations. In Table 3 we find that positive effects from the Internet on firm productivity are maintained even where business conditions posed challenges: first, findings show that corruption (column 2) and skills shortages

4. All unreported results are available from the authors upon request.
## Table 2. Quantile Regression Results of the Impacts of the Internet by World Region

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
</tr>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>Industry Email Use (_{act})</td>
<td>0.001</td>
<td>0.002</td>
<td>0.004**</td>
<td>0.005***</td>
<td>0.007***</td>
<td>0.008***</td>
<td>0.008***</td>
<td>0.010***</td>
<td>0.010***</td>
</tr>
<tr>
<td>* Africa</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
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<td>(0.002)</td>
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<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Industry Email Use (_{act})</td>
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<td>0.003</td>
<td>0.004*</td>
<td>0.005*</td>
<td>0.006*</td>
<td>0.004</td>
<td>0.007</td>
<td>0.005</td>
<td>-0.002</td>
</tr>
<tr>
<td>* East Asia Pacific and South Asia</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Industry Email Use (_{act})</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.004</td>
<td>0.005</td>
<td>0.004</td>
<td>0.003</td>
<td>0.001</td>
<td>0.001</td>
<td>0.008</td>
</tr>
<tr>
<td>* Eastern Europe, Central Asia and Middle East</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Industry Email Use (_{act})</td>
<td>0.009***</td>
<td>0.007***</td>
<td>0.008***</td>
<td>0.010***</td>
<td>0.009***</td>
<td>0.011***</td>
<td>0.012***</td>
<td>0.012***</td>
<td>0.008</td>
</tr>
<tr>
<td>* Latin America and the Caribbean</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
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<td>Firm Level Controls</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Sector-Year Fixed Effects</td>
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<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
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<td>0.80</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.80</td>
<td>0.79</td>
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</table>

Notes: The dependent variable is labor productivity. Firm controls included are described in the appendix. Robust standard errors clustered at country-sector-year level are shown in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively.
(column 4) are not reducing benefits. Second, although obstacles faced in terms of power (column 1), financing (column 3) and labor regulations (column 5) reduce the positive impact of ICTs, we find that firms still reap significant positive productivity effects. However, it might be the case that business conditions affect mostly the least productive businesses. Unreported results from quantile regressions reject this hypothesis: while generally impacts rise with higher levels of productivity, the difference between firms facing cumbersome and less problematic business conditions does not change along the productivity distribution. The only exception is labor regulations. Results, provided in Table 4, show that difficult relations reduce any benefits from spillovers for the least productive businesses but have less of a differential impact at higher levels of productivity.

**Table 3. Impacts of the Internet Depending on Different Business Conditions**

<table>
<thead>
<tr>
<th>Power Outages</th>
<th>Corruption Challenges</th>
<th>Financing Constraints</th>
<th>Skills Shortages</th>
<th>Labor Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Email Use</td>
<td>0.008***</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.007***</td>
</tr>
<tr>
<td>* Few Power Outages</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Industry Email Use</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.007***</td>
</tr>
<tr>
<td>* More Power Outages</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
</tbody>
</table>

**Notes:** The dependent variable is labor productivity. Firm controls included are described in the appendix. Robust standard errors clustered at country-sector-year level are shown in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively.
### Table 4. Quantile Regression Results on the Impacts of the Internet Depending on Labor Regulations

<table>
<thead>
<tr>
<th></th>
<th>Q1 (1)</th>
<th>Q2 (2)</th>
<th>Q3 (3)</th>
<th>Q4 (4)</th>
<th>Q5 (5)</th>
<th>Q6 (6)</th>
<th>Q7 (7)</th>
<th>Q8 (8)</th>
<th>Q9 (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Email Use</td>
<td>0.004***</td>
<td>0.005***</td>
<td>0.006***</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.008***</td>
<td>0.009***</td>
<td>0.007***</td>
<td></td>
</tr>
<tr>
<td>Less Difficult Labor Regulation</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>Industry Email Use</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
<td>0.004*</td>
<td>0.005**</td>
<td>0.005**</td>
<td>0.008***</td>
<td>0.007***</td>
</tr>
<tr>
<td>Difficult Labor Regulation</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>P-Value of the Difference in Coefficients</td>
<td>0.10</td>
<td>0.04</td>
<td>0.00</td>
<td>0.02</td>
<td>0.12</td>
<td>0.10</td>
<td>0.30</td>
<td>0.56</td>
<td>0.85</td>
</tr>
<tr>
<td>Firm Level Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector-Year Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country-Year Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.78</td>
<td>0.80</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.81</td>
<td>0.80</td>
<td>0.79</td>
</tr>
</tbody>
</table>

**Notes:** The dependent variable is labor productivity. Firm controls included are described in the appendix. Robust standard errors clustered at country-sector-year level are shown in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% confidence levels, respectively.
V. Conclusion

This paper documents the capacity of the Internet to support firm productivity in spite of multiple obstacles that are well known to affect enterprise development. We show that the Internet had positive impacts on firm’s productivity across world regions and across different stages of development. Even firms facing financial constraints, frequent power outages, skills shortages, corruption, and cumbersome labor regulations gained. However, our results also indicate that the most productive firms benefitted much more than their less productive counterparts. This result points to the critical role of boosting firms’ absorptive capacities for the Internet to benefit a wider group of firms.

Appendix: Definitions of Variables Used

A. Business Conditions

Power outages: The variable is defined as the share of firms reporting power outages for sector $s$ in location $l$ in country $y$ at year $t$. Environments with a high (low) incidence of power outages are defined as those above (below) the median value.

Corruption: The variable is defined as the share of firms which report corruption to be a major obstacle for their operations for sector $s$ in location $l$ in a country $y$ at year $t$. High (low) corruption environments are defined as those where more (less) than half of the firms report corruption to be a major obstacle.

Financing constraints: The variable is defined as the share of firms reporting to have a credit line for sector $s$ in country $y$ and year $t$. Environments with high financial constraints are defined as those where the share is above (below) the median value.

Skills shortages: The variable is defined as the share of skilled workers in total employment in a given sector $s$ in county $y$ and year $t$. Environments with high (with low) skills shortages are defined as those where with below (above) the median value.

Cumbersome labor regulations: The variable is defined as the share of firms reporting labor regulations to be a major obstacle for operations in sector $s$ in country $y$ at year $t$. Environments with cumbersome (less problematic) labor regulations are defined as those where less (more) than one third of firms reported them to be a major challenge.

B. Country Classification by Income Level

Countries covered (using the World Bank country classification for distinct categories):
• **High-income economies**: The Bahamas, Barbados, Croatia, Czech Republic, Estonia, Hungary, Latvia, Poland, Slovak Republic, Slovenia, Trinidad and Tobago.

• **Upper-middle-income economies**: Albania, Antigua and Barbuda, Argentina, Azerbaijan, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Fiji, Gabon, Grenada, Jamaica, Kazakhstan, Lithuania, Macedonia, Mauritius, Mexico, Montenegro, Namibia, Panama, Peru, Romania, The Russian Federation, Serbia, South Africa, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Turkey, Uruguay, Venezuela.


### C. Firm-Level Variables

**Labor Productivity**: Logarithm of the ratio of total annual sales over full time employment windsorized at the top and bottom 1% for any country-year, reported in thousand USD, value in parenthesis.

**Employment**: Logarithm of the firm’s full time employment.

**Age**: Logarithm of the difference between the year the survey was conducted and the year the firm was created.

**Public ownership**: A dummy equal to one if the government or state owns a share of 40% or more of the firm and zero otherwise.

**Multi-plant firm**: A dummy equal to one if the firm belongs to at least one other business and zero otherwise.

**Foreign ownership**: A dummy equal to one if the share of foreign ownership is bigger or equal to 40% and zero otherwise.

**Exporter status**: An indicator that is equal to one if the firm has exporter activities (includes both direct and indirect activities).

**Credit access**: Dummy variable that is equal to one if the firm has a line of credit or loan from a financial institution and zero otherwise.

**Managerial expertise**: Logarithm of years of the manager’s experience.
**Website:** An indicator that is equal to one if the firm has its own website and zero otherwise.

**Sectors:** A variable indicating in which of the following sectors the firm is operating: i) food, ii) wood and furniture, iii) textiles, iv) garments, v) leather, vi) non-metallic and plastic materials, vii) chemicals and pharmaceuticals, viii) electronics, ix) metals and machinery, x) auto and auto rvlces.

**References**


CAUSALITY AND EXTERNAL VALIDITY
Causality between FDI and Financial Market Development: Evidence from Emerging Markets

Issouf Soumaré and Fulbert Tchana Tchana

This paper studies the causal relationship between foreign direct investment (FDI) and financial market development (FMD) using panel data from emerging markets. Most studies of the relationship between FDI and FMD have focused on the role of FMD in the link between FDI and economic growth, with no deep understanding of direct causality between FDI and FMD, especially in emerging markets, where financial markets are in the development stage. We document bidirectional causality between FDI and stock market development indicators. For banking sector development indicators, the relationship is ambiguous and inconclusive. Care is therefore needed when analysing the relationship between FMD and FDI, as results may depend on whether the FMD variables used to evaluate causality are stock market or banking sector development indicators. JEL codes: F21, O16

I. INTRODUCTION

In general, the literature on the relationship between foreign direct investment (FDI), financial market development (FMD), and economic growth falls into...
two categories. The first finds FDI is only efficient at spurring growth when certain conditions are met, one of which consists of a fairly developed financial sector (e.g., Hermes and Lensink 2003; Alfaro et al. 2004, 2010). The second provides evidence that well-functioning financial sector or market liberalization can help spur growth (Levine and Zervos 1998; Levine et al. 2000; Bekaert et al. 2005; and many others).

In this paper, we study the direct causal relationship between FDI and FMD. We perform an empirical assessment of this relationship using panel data from emerging markets. Our focus on emerging markets has at least four advantages. First, data are available for almost all the countries of our sample. Second, the quality of institutions is less diverse in these countries than it would be in a sample that included developed markets, therefore a common explanatory variable that can link economic development and other variables in given economy (such as GDP per capita) will have less effect on the results. Third, our focus on emerging economies allows us to study stock market and other financial development variables often used in the literature. And fourth, emerging markets are the most relevant sample with which to study our topic: developed markets are irrelevant, and less developed or the poorest countries may have difficulty attracting FDI even if they have a well functioning financial sector, because their smaller market power or lack of resources make them less attractive.

We use a system of simultaneous equations to explore the causality link between FDI and FMD, where the key endogenous variables are FDI and FMD, while controlling for other factors that drive inflows of FDI and the development of financial markets. We document bidirectional causality between FDI and stock market development variables. Hence, studies involving both FDI and FMD, especially stock market development, must account for potential problems of endogeneity. For FMD variables other than variables related to the development of the stock market, such as banking sector development indicators, the relationship is ambiguous and inconclusive. For that reason, care is needed when analysing the relationship between FMD and FDI, as results may depend on whether the FMD variables used measure development of the stock market or development of the banking sector.

The rest of this paper is structured as follows. In Section 2, we describe the data and discuss the empirical analysis results. We conclude in Section 3.

II. Empirical Analysis

Data

Our sample is composed of the following 29 emerging markets: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hong Kong, Hungary, India, Indonesia, Iran, Israel, Jordan, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, Saudi Arabia, Singapore, South Africa, Tunisia, Turkey, Vietnam, Thailand, and South Korea. These markets are located in Africa (four countries), Asia (15 countries), Eastern Europe (four countries) and
Latin America (six countries). Our data cover 1994 to 2006. We began in 1994 because some countries in our sample are former communist nations that did not have a stock market before 1994. After 2007, because of the financial crisis, the data are too unstable to use.

We consider the ratio of FDI to GDP (FDIGDP) as the indicator of FDI. As for FMD, we divided five indicators into two subgroups: the stock market development (SMD) indicators subgroup and the banking sector development (BSD) indicators subgroup. The SMD indicators consist of (i) the ratio of stock market capitalization to GDP (STMKTCAP) and (ii) the ratio of stock value traded as a percentage of GDP (STKVALTRA). The BSD indicators consist of (i) the ratio of private credit by deposit money banks and other financial institutions to GDP (CREDIT), (ii) the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) divided by GDP (LLIAB), and (iii) the ratio of commercial bank assets divided by commercial bank plus central bank assets (CCB). We extracted the data for these variables from the World Bank’s World Development Indicators and Global Development Finance databases and the International Monetary Fund’s International Financial Statistics database. The complete definition and the sources of these variables are provided in Table 1. The table also lists the control variables used in the regression analysis below.

Figure 1 shows scatter plots of FDI and FMD variables, where we computed the average of each variable for each country. From this figure, a linear relationship between stock market development variables (STMKTCAP and STKVALTRA) and FDIGDP seems to exist. We observe the same linear relationship between FDIGDP and banking sector development variables (CREDIT, LLIAB and CCB).

### Causality Analysis

Studying causal relationships when using panel data is always a challenge because one must consider dynamics. Like Arellano (2003), we consider various specifications of a bivariate VAR(2) model for the FDI and FMD variables, denoted \( FDI_{it} \) and \( FMD_{it} \) respectively. Individual and time effects are included in both equations. The form of the model is

\[
FDI_{it} = \delta_1 + \alpha_1 FDI_{i(t-1)} + \alpha_2 FDI_{i(t-2)} + \beta_1 FMD_{i(t-1)} + \beta_2 FMD_{i(t-2)} + \eta_i + \nu_{1it},
\]

1. Note that stock market turnover, another indicator of stock market development, is related to stock market liquidity and equals the total value of domestic shares traded divided by market capitalisation. As such, it is obtained by combining STMKTCAP and STKVALTRA. For that reason, we omit stock market turnover from our analysis.
### Table 1. Descriptions of the Variables and of the Sources of Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FDI variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDIGDP</td>
<td>FDI / GDP</td>
<td>The World Bank’s World Development Indicators and Global Development Finance databases</td>
</tr>
<tr>
<td><strong>FMD variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STKMKTCAP</td>
<td>Stock market capitalisation / GDP</td>
<td>The World Bank’s Global Development Finance database and the International Monetary Fund’s International Financial Statistics database</td>
</tr>
<tr>
<td>STKVALTRA</td>
<td>Value traded as a percentage of GDP</td>
<td></td>
</tr>
<tr>
<td>CREDIT</td>
<td>Total credit by financial intermediaries to the private sector / GDP</td>
<td></td>
</tr>
<tr>
<td>LLIAB</td>
<td>Liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) / GDP</td>
<td></td>
</tr>
<tr>
<td>CCB</td>
<td>Ratio of commercial bank assets / commercial bank plus central bank assets</td>
<td></td>
</tr>
<tr>
<td><strong>Economic and policy variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFLATION</td>
<td>Percentage change in GDP deflator</td>
<td>The World Development Indicators database of the World Bank; the UNESCO database (EDUCATION only)</td>
</tr>
<tr>
<td>INFRA</td>
<td>Log(Phones per 1000 population)</td>
<td></td>
</tr>
<tr>
<td>OPENNESS</td>
<td>Log(Import + Export) / GDP</td>
<td></td>
</tr>
<tr>
<td>LOG(GDPt−1)</td>
<td>Logarithm of lagged real GDP</td>
<td></td>
</tr>
<tr>
<td>NATRES</td>
<td>Share of fuel and minerals in exports</td>
<td></td>
</tr>
<tr>
<td>EXHRATE</td>
<td>Exchange rate</td>
<td></td>
</tr>
<tr>
<td>BALANCE</td>
<td>Current account balance / GDP</td>
<td></td>
</tr>
<tr>
<td>INTRATE</td>
<td>Lending interest rate adjusted for inflation as measured by the GDP deflator</td>
<td></td>
</tr>
<tr>
<td>EDUCATION</td>
<td>Gross enrolment ratio for all levels of education</td>
<td></td>
</tr>
<tr>
<td><strong>Governance and institutional quality variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOVERNANCE</td>
<td>The GOVERNANCE index is the average of six Worldwide Governance Indicators:</td>
<td>The Worldwide Governance Indicators project (see <a href="http://info.worldbank.org/governance/wgi/index.asp">http://info.worldbank.org/governance/wgi/index.asp</a>)</td>
</tr>
<tr>
<td>(1) Voice and accountability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Political stability and absence of violence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Regulatory quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Government effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Rule of law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) Control of corruption</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: FDI = foreign direct investment; GDP = gross domestic product.*

**Figure 1.** Scatter Plots of Foreign Direct Investment and Financial Market Development

*Notes:* FDIGDP is the ratio of foreign direct investment (FDI) to gross domestic product (GDP). STMKTCAP is the ratio of stock market capitalization to GDP. STKVALTRA is the ratio of stock value traded as a percentage of GDP. CREDIT is the ratio of private credit by deposit money banks and other financial institutions to GDP. LLIAB is the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) divided by GDP. CCB is the ratio of commercial bank assets divided by commercial bank plus central bank assets.

\[
FMD_{it} = \delta_{2t} + \gamma_1 FMD_{i(t-1)} + \gamma_2 FMD_{i(t-2)} + \lambda_1 FDI_{i(t-1)} + \lambda_2 FDI_{i(t-2)} + \eta_{2i} + \nu_{2it},
\]  
(2)
where $\delta_{1t}$ and $\delta_{2t}$ capture the time effect and $\eta_{1i}$ and $\eta_{2i}$ capture the individual effect. The hypothesis that FDI does not Granger-cause FMD, conditional on individual and time effects imposes the restrictions $\lambda_1 = \lambda_2 = 0$. Conversely, to test whether FMD Granger-causes FDI, we examine the restrictions $\beta_1 = \beta_2 = 0$.

Practically, we first estimate the VAR system consisting of equations (1) and (2) and then use a Wald-type test to verify these two non-causality restrictions. We use Arellano (2003, p. 118)'s two-step generalized method of moments (GMM) estimator. More precisely, we use two variants of this estimator: (i) the two-step GMM in differences (which we denote by GMM2—Diff.), which captures the effect of greater persistence and is consistent with the presence of unobserved heterogeneous intercepts; and (ii) the two-step GMM in level and differences (denoted by GMM2—Level Diff.) proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This last estimation technique is appropriate for capturing mean stationarity. Note, however, that both estimation methods are two-step GMM. The two-step estimator is useful in this context because it both solves endogeneity issues as well as observed heterogeneity.

From the unit root tests, we know that STKMKTCAP and LLIAB are I(1) processes. Given that the Granger causality test can only be performed on stationary variables, we have performed the causality test between FDIGDP and the first difference of STKMKTCAP (denoted by D.STKMKTCAP) and LLIAB (denoted by D.LLIAB).

Table 2 presents the result of causality with the appropriate method for each case. It shows that D.STKMKTCAP Granger-causes FDIGDP at least at the 6.7% confidence level, independently of the type of instrument used. We also observe that FDIGDP causes D.STKMKTCAP at the 5.1% confidence level. Intuitively, these results suggest that if a country experiences a large increase in its stock market capitalisation, it will tend to attract more FDI in following years. Similarly, everything else being equal, countries that have attracted large amounts of FDI in recent years will tend to increase the speed of their stock market capitalisation. Moreover, it appears that STKVALTRA Granger-causes FDI at the 10% confidence level, but that FDIGDP does not Granger-cause STKVALTRA.

For the BSD, at best, we find a unidirectional relationship. More precisely, CREDIT Granger-causes FDIGDP, but FDIGDP does not Granger-cause CREDIT. We also find that FDIGDP Granger-causes D.LLIAB, but D.LLIAB does not Granger-cause FDIGDP. There seems to exist no causal relationship between FDIGDP and CCB, whatever the estimation method and whatever the direction. Thus, these two variables may be determined exogenously.

In sum, stock market development variables interact differently with FDIGDP. While there is a bidirectional causal relationship between STKMKTCAP and FDIGDP, the causality test between FDIGDP and STKVALTRA seems unidirectional. The causality tests between banking sector development indicators and FDI are inconclusive. Below, we perform further multivariate analyses of the causal relationship between FDI and FMD indicators by way of endogenous simultaneous multivariate regressions.
REGRESSION MODEL SPECIFICATION AND RESULTS

To achieve our objective of studying the relationship between FDI and FMD, and given the likelihood of endogeneity problems between the two set of variables, we turn to the following system of simultaneous equations:

\[
F_{DI\text{it}} = a_0 + a_1 F_{MD\text{it}} + a_2 EDUCATION_{it} + a_3 INFLATION_{it} \\
+ a_4 EXHRATE_{it} + a_5 GOVERNANCE_{it} + a_6 \log(\frac{GDP_{it-1}}{C0_{i}}) \\
+ a_7 OPENNESS_{it} + a_8 NATRES_{it} + a_9 INFRAS_{it} + \epsilon_{it},
\]

\[
F_{MD\text{it}} = b_0 + b_1 F_{DI\text{it}} + b_2 EDUCATION_{it} + b_3 INFLATION_{it} \\
+ b_4 EXHRATE_{it} + b_5 GOVERNANCE_{it} + b_6 \log(\frac{GDP_{it-1}}{C0_{i}}) \\
+ b_7 BALANCE_{it} + b_8 INTRATE_{it} + \nu_{it}.
\]

This system of endogenous simultaneous equations has been set to achieve identification that is at least theoretically sound. We chose the explanatory control variables on the basis of the existing literature on the determinants of FDI and FMD (e.g., Hermes and Lensink 2003; Alfaro et al. 2004; Kholdy and Sohrabian 2008; Al Nasser and Soydemir 2010; Asiedu and Lien 2011). The control

### Table 2. Causality Test Results

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>Chi-square test</th>
<th>Df</th>
<th>P-value</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMM2—Diff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.STKMKTCAP</td>
<td>FDIGDP</td>
<td>5.42*</td>
<td>2</td>
<td>0.067</td>
<td>248</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>D.STKMKTCAP</td>
<td>5.94*</td>
<td>2</td>
<td>0.051</td>
<td>248</td>
</tr>
<tr>
<td>CCB</td>
<td>FDIGDP</td>
<td>0.63</td>
<td>2</td>
<td>0.729</td>
<td>254</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>CCB</td>
<td>0.01</td>
<td>2</td>
<td>0.993</td>
<td>253</td>
</tr>
<tr>
<td>GMM2—Level. Diff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STKVALTRA</td>
<td>FDIGDP</td>
<td>4.74*</td>
<td>2</td>
<td>0.093</td>
<td>306</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>STKVALTRA</td>
<td>3.87</td>
<td>2</td>
<td>0.141</td>
<td>301</td>
</tr>
<tr>
<td>CREDIT</td>
<td>FDIGDP</td>
<td>32.51*</td>
<td>2</td>
<td>0.000</td>
<td>302</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>CREDIT</td>
<td>0.0256</td>
<td>2</td>
<td>0.987</td>
<td>302</td>
</tr>
<tr>
<td>D.LLIAB</td>
<td>FDIGDP</td>
<td>3.45</td>
<td>2</td>
<td>0.178</td>
<td>275</td>
</tr>
<tr>
<td>FDIGDP</td>
<td>D.LLIAB</td>
<td>13.70*</td>
<td>2</td>
<td>0.001</td>
<td>275</td>
</tr>
</tbody>
</table>

Notes: FDIGDP is the ratio of foreign direct investment (FDI) to gross domestic product (GDP). STKMKTCAP is the ratio of stock market capitalization to GDP. STKVALTRA is the ratio of stock value traded as a percentage of GDP. CREDIT is the ratio of private credit by deposit money banks and other financial institutions to GDP. LLIAB is the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) divided by GDP. CCB is the ratio of commercial bank assets divided by commercial bank plus central bank assets. D.STKMKTCAP and D.LLIAB denote the first difference of STKMKTCAP and LLIAB, respectively. ***p < .01; **p < .05; *p < .1, if p < .1 then A Granger-causes B.
variables we used to estimate the determinants are given in Table 1 with their definition and source of data.

Our analysis uses the 2SLS method as the main estimation method for the panel data. Table 3 presents the regression results of the 2SLS panel regressions of equations (3) and (4). We see that FDIGDP and the SMD indicators (STKMKTCAP and STKVALTRA) impact each other positively and significantly. In all the regressions, we see that the BSD variables do not affect FDIGDP. We also note that FDIGDP only negatively and significantly affects CREDIT at the 5% confidence level, but it does not significantly affect the other BSD variables. In other words, over the 1994–2006 period, BSD variables had no significant effect on FDI, nor did FDI significantly affect BSD indicators. For CREDIT, the impact of FDI on BSD is even negative. The negative significant impact of FDI on CREDIT is less obvious and may be explained by the fact that an increase in FDI translates into an increase in the country’s GDP: since the CREDIT variable has GDP as its denominator, a marginal increase in the amount of credit to the private sector (the numerator) that is smaller than the marginal increase in GDP following an increase in FDI means that more FDI will cause the ratio of credit to the private sector over GDP (i.e., CREDIT) to fall. The other determinants of the FDI and FMD indicators have the expected signs.

For robustness, we also run our regressions by controlling for the fact that some FMD variables are I(1) processes. We use the 2SLS estimation method with Error Correction Model panel regressions to see if earlier results still hold. As additionally robustness analysis, we also use the 3SLS estimation method to estimate our system of simultaneous equations. Given that almost no software has implemented the 3SLS method for panel data, we have used the 3SLS method with pool data, having assumed that the data can be pooled. Because previous analyses have proven the relevance of FMD indicators’ growth rates, we focus on the first differences of FMD indicators. The results for these additional analyses, available from the authors upon request, are almost the same as in the first specification but the amplitude of the effect of some variables differs.

III. Conclusion

This paper is an empirical study of the relationship between foreign direct investment and financial market development. We considered 29 emerging market economies over the 1994–2006 period, using two indicators of stock market development and three indicators of banking sector development.

Given the endogenous nature of the linkage between FDI and FMD, we run a system of simultaneous equations using panel data. We find that FDI and stock market development indicators positively impact each other at the same time. When we use banking sector development indicators to measure financial market development, however, causality is ambiguous and inconclusive. We must
<table>
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<tr>
<th>Variables</th>
<th>(1) FDIGDP</th>
<th>(2) STKMKTCAP</th>
<th>(1) FDIGDP</th>
<th>(2) STKVALTRA</th>
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(Continued)
### Table 3. Continued

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Notes: FDIGDP is the ratio of foreign direct investment (FDI) to gross domestic product (GDP). STKMKTCAP is the ratio of stock market capitalization to GDP. STKVALTRA is the ratio of stock value traded as a percentage of GDP. CREDIT is the ratio of private credit by deposit money banks and other financial institutions to GDP. LLIAB is the liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries) divided by GDP. CCB is the ratio of commercial bank assets divided by commercial bank plus central bank assets. The other variables are described in Table 1. Standard errors are in parentheses. ***p < .01; **p < .05; *p < .1.
therefore exercise great caution when analysing the relationship between FMD and FDI, as findings may depend on whether the FMD variables used to determine causality indicate stock market development or banking sector development.

There are several ways to explain the bidirectional link between FDI and stock market development in these emerging economies. On one hand, foreign investment helps develop local stock markets by its investment spillover effects. This is because more foreign investment increases the likelihood that the affiliates of multinationals involved in FDI activities will be listed on local stock markets, since multinationals tend to hail from industrialised countries where financing through the stock market is a tradition. Furthermore, consistent with the political economy argument, one can conjecture that FDI inflows encourage the country’s political elite to adopt market-friendly regulations—especially investor protection and better governance regulations: this promotes the development of the stock market. On the other hand, a relatively well-developed stock market helps attract foreign investors, as such a market is perceived as a sign of vitality, of openness on the part of country authorities, and of a market-friendly environment. This is especially true in emerging markets, whose stock markets are more developed than are the markets of other developing countries.

These findings suggest a key policy recommendation: that policies to attract more FDI be accompanied by market-friendly regulations, especially stock market regulations such as mechanisms to improve governance and protect investors. This will allow countries to maximise the benefits of the spillover effects of FDI.

References


Causal Interaction and External Validity: Obstacles to the Policy Relevance of Randomized Evaluations

Seán M. Muller

The ability to generalize effects estimated from randomized experiments is critical for their relevance to policy. Framing that problem in terms of causal interaction reveals the extent to which the literature to date has failed to adequately address external validity. An analogy with matching estimators illustrates the current inconsistency in approaches to estimating causal relationships and generalizing these estimates to other populations and contexts. Contrary to some claims, atheoretic replication is not a plausible solution. Better knowledge of, and more information on, interacting factors is required for credible, formal extrapolation. In the absence of that, modesty is recommended.

Randomized evaluations have become widespread in development economics in recent decades, largely due to the promise of identifying policy-relevant causal effects. A number of concerns have been raised in response, among them that: randomized control trials (RCTs) and quasi-experimental methods may not identify causal relationships of interest (“internal validity”) in practice; these methods are not suitable for addressing important development questions at the macroeconomic level; therefore, analysis using RCTs is not obviously superior to alternative approaches using observational data. A final concern, which is the subject of the present contribution, is that current research based on experimental methods does not adequately address the problem of extrapolating from empirical findings to policy claims relating to other populations (“external validity”). In order to

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1. Muller (2014) provides a first, detailed review of the contributions to methodological debates regarding RCTs and the cross-disciplinary literature on external validity.
isolate the challenges posed by extrapolation, I assume away the other problems. Specifically, the analysis that follows assumes that the research question is of genuine policy interest, that researchers have been able to conduct an “ideal experiment” —with no problems of experimenter effects, noncompliance or anything else that would compromise internal validity—and that the identical policy would be implemented in a new population.

Combining insights from prior literature on experimental methods in social science (Cook and Campbell 1979) and econometric formulations of external validity (Hotz, Imbens, and Mortimer 2005) yields three important insights. First, that plausibly attaining external validity requires \textit{ex ante} knowledge of covariates that influence the treatment effect along with empirical information on these variables in the experimental and policy populations. This, in turn, implies that “atheoretical” replication-based resolutions to the external validity problem are unlikely to be successful except for extremely simple causal relations, or very homogeneous populations, of a kind that appear unlikely in social science. Finally, the formal requirements for external validity are conceptually analogous to the assumptions needed for causal identification using observational data. Together these imply a much more modest interpretation of the policy relevance of past work that has not addressed these issues. Furthermore, the resultant challenges for making policy claims premised on randomized evaluations are substantial, if not insurmountable, in many cases of interest.

\textbf{Interaction and External Validity}

The term “external validity” was coined by Campbell and Stanley (1966) and in a detailed analysis of the problem Cook and Campbell (1979) argue that “all of the threats to external validity [can be represented] in terms of statistical interaction effects” (Cook and Campbell 1979, 73). A similar point has been made more recently by Leamer (2010) in his discussion of what he calls “interactive confounders.” Cook and Campbell’s (1979) analysis is informal and therefore somewhat ill-defined for econometric purposes, but it is straightforward to extend their basic insight into the formal (“Neyman-Rubin”) statistical framework of counterfactuals, that is now widely used in econometrics. In that notation, \( Y_i \) is the outcome variable for individual \( i \), which becomes \( Y_i(1) = Y_{1i} \) denoting the outcome state associated with receiving treatment \( (T_i = 1) \) and \( Y_i(0) = Y_{0i} \) denoting the outcome state associated with not receiving treatment \( (T_i = 0) \). The effect of treatment for any individual is \( \Delta_i = Y_{1i} - Y_{0i} \), and the researcher’s interest is typically in the average treatment effect \( E[Y_{1i} - Y_{0i}] \).

The basic conception of external validity utilized by Cook and Campbell (1979) is that the treatment effect estimated in one population is the same as the effect that would occur under an identical intervention in another population. Following Hotz, Imbens, and Mortimer (2005), define a dummy variable \( D \) that indicates whether a given individual is in the experimental sample \( (D_i = 0) \) or in
the population of policy interest \((D_i = 1)\), in which case we can represent ‘simple external validity’ as:

**Definition** Simple external validity

\[
E[Y_i(1) - Y_i(0)|D_i = 1] = E[Y_i(1) - Y_i(0)|D_i = 0].
\]  

(1)

Given this, it is straightforward to show in what sense interaction is an obstacle to external validity. Where some other variable, \(W\), interacts with \(T\) in the causal relation producing \(Y\), then simple external validity will fail if the mean of \(W\) differs across the two populations. Equations (2) and (3) capture a simple case in the counterfactual framework.

\[
Y_{0i} = \tau_0 + X_i \beta + W_i \gamma + u_{0i}
\]

(2)

\[
Y_{1i} = \tau_1 + X_i \beta + W_i (\delta + \gamma) + u_{1i}.
\]

(3)

For the purposes of estimation there is nothing particularly remarkable about interactive functional forms of this kind; it is possible to obtain unbiased estimates of the ATE from a least-squares regression even if the interaction effect is omitted.\(^2\)

For extrapolation, however, neglect of interaction may lead to entirely misleading conclusions about the ATE outside the experimental sample. Given (2) and (3) we can write the ATE as:

\[
E[Y_{1i} - Y_{0i}] = (\tau_1 - \tau_0) + E[W_i|T = 1] \delta.
\]

(4)

This now depends in part on the mean value of the covariate(s) \((W)\) in the population.\(^3\)

As an illustrative example—invoked in related contributions by Imbens (2010), Angrist and Pischke (2010), and Pritchett and Sandefur (2013)—consider the case of random or quasi-random evaluations of the effect of school class sizes on student test scores. Virtually all contributions to this literature assume an additive educational production function, implying that the effect of class size \((T)\) is independent of other variables. Assume instead that this remarkably strong assumption is false and, for example, teacher quality \((W)\) partly determines the effect of class size on test scores. Then the above result implies that, for the simple model in (2) and (3), the estimated average treatment effect from an RCT will only be a reliable predictor of the effect of this intervention in another population where average teacher quality is similar.

\(^2\) This follows from the general result that \(E[Y|X, W, f(X, W)] = E[Y|X, W]\), provided \(E[Y|X, W]\) is linear in the parameters.

\(^3\) Similar formulations have recently been used in the context of discussions of external validity by Allcott and Mullainathan (2012) and Pritchett and Sandefur (2013), although without explicit recognition of the key role played by interactions that we develop here.
Besides the important, but relatively neglected, methodological work of Hotz, Imbens, and Mortimer (2005) and some recent working papers that address the importance of implementer characteristics (Allcott and Mullainathan 2012; Bold et al. 2013), the empirical literature has addressed this issue only symptomatically through ad hoc analysis of “heterogeneity” in estimated treatment effects. The credibility of such ex post testing for significance across covariates has been criticised in other disciplines—for example, Rothwell (2005) in the context of medical trials—and in a few recent contributions to the econometric literature. Crump et al. (2008), for instance, have proposed a more systematic approach to this kind of testing. As those authors note, however, this kind of approach can only tell us—if significant heterogeneity is found—that simple external validity will fail. It does not provide a positive basis for extrapolation, precisely because it does not address the source of the problem as identified by Cook and Campbell (1979).

To go further requires explicitly formulating external validity in terms of covariates. Hotz, Imbens, and Mortimer (2005) develop such a formulation which they refer to as “conditional external validity”.

**Definition** Conditional external validity

\[
E[Y_i(1) - Y_i(0)|D_i = 1] = E_W[E[Y_i|T_1, D_i = 0, W_i] - E[Y_i|T_0, D_i = 0, W_i]|D_i = 1]
\]

(5)

This states that the ATE in the population of interest can be expressed in terms of an expectation of the covariate-varying treatment effect in the experimental sample \((D_i = 0)\), taken across the covariate \((W)\) distribution in the population of interest \((D_i = 1)\).\(^4\)

Hotz, Imbens, and Mortimer (2005) show that given independence of treatment assignment and outcomes in the experimental sample—as produced by a successful experiment—two further conditions are sufficient for (5) to hold. “Location independence” states that potential outcomes do not vary across locations except as a result of differences between individuals in values of the variables in \(W\).

**Assumption 1.1. Location independence**

\[
D_i \perp (Y_i(0), Y_i(1))|W_i
\]

(6)

The assumption of overlapping support (assumption 1.2) states that there is a non-zero probability of being in either location for any realized values of the covariates \((W_i = w)\).

\(^4\) A related contribution is the analysis by Angrist and Fernandez-Vål (2013), which examines the extrapolation problem in the more complicated case (relative to an ideal experiment) of estimating a local average treatment effect.
Assumption 1.2. Overlapping support

\[ \forall w, \delta < \Pr(D_i = 1 | W_i = w) < 1 - \delta, \]
\[ \delta > 0 \text{ and for all } w \in W. \]  

(7)

While (5) only loosely informs Hotz, Imbens, and Mortimer’s (2005) empirical analysis, in the presence of interaction it implies—I argue—clear formal and empirical requirements for obtaining external validity that are comparable to the well-known sets of alternative assumptions that must be satisfied to obtain internal validity.

**Empirical Requirements for External Validity**

What are the implications, then, of interaction for empirical analysis? Consider the simplest case where there is one, dichotomous interacting variable \( W \in \{0, 1\} \) and the experiment allows us to identify \( E[\Delta | W = 0, D = 0] \) and \( E[\Delta | W = 1, D = 0] \), where:

\[
E[\Delta | D = 0] = \Pr(W = 0 | D = 0)E[\Delta | W = 0, D = 0] \\
+ (1 - \Pr(W = 0 | D = 0))E[\Delta | W = 1, D = 0] 
\]

(8)

In our previous example, \( W \) might now denote low- and high-quality teachers. If we then know the distribution of \( W \) in the target population, the average treatment effect of policy interest can be expressed in terms of these estimated values:

\[
E[\Delta | D = 1] = \Pr(W = 0 | D = 1)E[\Delta | W = 0, D = 0] \\
+ (1 - \Pr(W = 0 | D = 1))E[\Delta | W = 1, D = 0]. 
\]

(9)

To implement the above procedure in practice a number of conditions need to be satisfied. The researcher must know what the interacting variable is. Assuming that is the case, the empirical distribution of \( W \) in the policy population \( (D = 1) \) must be observed. It must also be possible, in terms of having data on \( W \) and sufficient power from the experimental sample, to obtain unbiased and accurate estimates of the conditional average treatment effect. These in themselves are very demanding requirements.

Furthermore, in order to collect the necessary data, researchers will need to know, or anticipate, the identity of all interacting variables at the experimental design stage. In the class size case, few studies have collected data on teacher quality. If that variable interacts with class size to any appreciable degree then formal extrapolation of the kind implied by (5) is likely to be impossible.

Lastly, it must be the case that such variables are meaningfully comparable across the two populations. This means, first-and-foremost, having empirical measures that are comparable. It also requires that the variables in question are
conceptually comparable across contexts, something implicit in the overlapping support assumption. For example, if social institutions vary across contexts due to history, they may be fundamentally incomparable; where such institutions interact with the treatment variable extrapolation may therefore be impossible.

Resolution through Sampling?

The above challenges have not been addressed in the empirical literature to date, which is problematic given that many contributions to that literature are intended to inform policy in populations beyond the experimental sample. However, in some instances there may be an alternative to formal extrapolation of this kind. Much as Cook and Campbell (1979) identify interaction as the primary challenge to external validity, they argue that sampling is the basis for solving the extrapolation problem. Two approaches are noteworthy from an econometric perspective: random sampling from the population of policy interest; and, “sampling for heterogeneity.” The former presumes the existence of a known “target population” prior to conducting the experiment, in which case random sampling will assure—in the limit—that $E[W_i|D_i = 0] = E[W_i|D_i = 1]$ for all $W_i \in W$. In many cases of interest, however, this is either not practically feasible, or researchers have the more ambitious aim of generalising beyond a single, prespecified population.

The second approach, I suggest, is best understood in terms of the overlapping support assumption in (7). The idea is that while the experimental sample of any given study may not be representative—in terms of $W$—of the population of interest, researchers may be able to conduct individual studies across a wide enough range of experimental populations so that when combined they satisfy this requirement.

On the face of it this may appear to support proposals (e.g., Duflo, Glennerster, and Kremer 2006; Angrist and Pischke 2010) that replication is the appropriate way to address external validity. However, further to Keane’s (2010) more general critique of RCTs, there is clearly no basis for determining the formal prospects of “atheoretic” replication: if the interacting factors are unknown it is not possible to deliberately sample for heterogeneity, so researchers must rely on an unsubstantiated presumption that the extent of interaction is limited enough to be revealed through uninformed replication.5

Even in the event that the interacting factors are known, we require a formal method for integrating evidence from multiple experiments for the purpose of extrapolation. The most widely used procedure for integrating evidence from experiments in the social and health sciences is metaanalysis, but methods for dealing with heterogeneity are in their infancy and the determination of relevance to other populations remains a qualitative exercise.

5. Related points are made by Deaton (2010, 30) and Rodrik (2008, 21). Imbens (2010, 420) mentions the possibility of approximating the conditional average treatment effect using multiple experiments but does not explain how the relevant covariates would be determined ex ante.
Practitioners favouring randomized evaluations may take the view that interacting variables can be identified, and results extrapolated, using a researcher’s “expertise.” Indeed, as the preceding analysis should make clear, this is implicit in most extant policy recommendations premised on RCTs. However, there is an inherent inconsistency in this stance.

Consider methods for estimating causal effects with observational data using matching estimators. The intuition for these is that the researcher matches every individual with $T = 1$ not obtained through random assignment with a maximally similar individual who has $T = 0$, where neither state was obtained through random assignment. Where enough individuals across the two groups are sufficiently similar on all dimensions that matter for the effect of treatment and are matched accordingly, it is possible to obtain an unbiased estimate of the average treatment effect even with observational data.

If a researcher takes the view that randomized evaluations are inherently superior to approaches based on matching, then this implies—leaving other practicalities aside—that they do not believe it is possible to identify and observe all characteristics that are important for selection bias and heterogeneity of treatment effects. Formally, they do not believe it is possible to choose $X$ such that the “selection on observables” assumption in (10) holds.

**Assumption 1.3. Unconfoundedness**

$$\begin{align*}
T_i \perp (Y_{0i}, Y_{1i}) | X_i 
\end{align*}$$

But notice that the structure of (10) is identical to the location independence assumption in (6) required for extrapolation. This has two important implications.

First, consider the case where researchers directly apply results from a single RCT to populations other than the experimental sample, thereby assuming simple external validity holds. For that to be correct, interacting factors must either not exist or be balanced across the experimental and policy populations. However, a similar assumption across “treatment” and “nontreatment” populations in observational data would imply that internal validity could be obtained without randomization.

Alternatively, consider the second, more sophisticated, case where researchers implement an empirical procedure for extrapolation premised on Hotz, Imbens, and Mortimer’s (2005) notion of conditional external validity. As we have seen, that requires a “location independence” assumption (6), which rests on the use of the correct set of covariates (interacting factors) and in form is identical to the unconfoundedness assumption in (10). The first difference between these assumptions is in the two populations: the experimental sample and policy population for conditional external validity versus the treatment recipient and
non-recipient populations for matching estimators. The second difference is in the vector of conditioning variables. The vector of factors influencing whether individuals have $T = 1$ or $T = 0$ absent random assignment may differ from ones representing factors that determine presence in either the experimental sample or policy population. Nevertheless, to date no author has provided any reason to believe, \textit{ex ante}, that one assumption is more plausible than the other. In which case it is not clear why even formal extrapolation of estimated treatment effects from ideal experiments is any more likely to be successful than the use of matching estimators to identify causal effects using observational data.

The analogous nature of the assumptions required should put to rest the notion that policy-oriented economic analysis must use random or quasi-random variation to obtain internal validity, but can rely on weakly substantiated, subjective assessments of external validity. This inconsistency has previously been emphasised by, among others, Cartwright (2010), Deaton (2010), and Manski (2013). There is no doubt that the role of theory is, at least in part, to inform empirical analysis in this way and that “atheoretic” replication cannot plausibly suffice to resolve the problem. Whether theory can provide \textit{ex ante} knowledge to an extent sufficient to produce confident extrapolation of results from one context to another remains, for now, a wholly open question.

References


In this paper, we focus on the effectiveness of video-based interventions in inducing behavioural changes in poor countries. We first review relevant literature from different disciplines. This suggests both that information targeted to an individual’s specific needs is more effective than broader messages and that videos featuring role models similar to viewers reinforce persuasiveness as the latter relate to the character. We then discuss some of the challenges in designing non-laboratory randomized controlled trials to evaluate video-based interventions. We draw on our design of a recently completed study in remote rural Ethiopia, which showed that simple documentaries of relatively successful individuals from the same region affected both viewers’ investment in their children’s education and other future-oriented behaviors (Bernard, T., S. Dercon, K. Orkin, and A. S. Taffesse. 2014. “The Future in Mind: Aspirations and Forward-Looking Behaviour in Rural Ethiopia.” Paper presented at Centre for the Study of African Economies conference on economic development in Africa, Oxford, UK, March 25). We discuss the importance and challenges of placebo treatments to evaluate the effects of exposure to video and gatherings, explore the potential for controlling variation in the exposure of an individual’s network of friends to the same treatment, and

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Globalization and decreases in ICT costs have led to rapid increases in exposure to media, especially in the developing world. More recently, development interventions are starting to use specifically tailored video content as part of behavioral change campaigns. Relying on TV and internet networks but also mobile display video equipment, such as basic projectors or tablet computers, these media are remarkably effective at delivering homogenous messages even in remote rural communities. They are accessible to illiterate viewers. The costs of producing content are fixed, so any intervention becomes progressively more cost-effective as it is scaled up. Even in linguistically diverse countries, videos can be easily dubbed into other languages.

In this paper, we focus on the effectiveness of such media in inducing behavioral changes in poor countries. We first review relevant literature from different disciplines. This suggests both that information targeted to an individual’s specific needs is more effective than broader messages and that videos featuring role models similar to viewers reinforce persuasiveness as the latter relate to the character. We then discuss some of the challenges in designing non-laboratory randomized controlled trials to evaluate video-based interventions. We draw on our design of a recently completed study in remote rural Ethiopia, which showed that simple documentaries of relatively successful individuals from the same region affected both viewers’ investment in their children’s education and other future-oriented behaviors (Bernard et al. 2014). We discuss the importance and challenges of placebo treatments to evaluate the effects of exposure to video and gatherings, explore the potential for controlling variation in the exposure of an individual’s network of friends to the same treatment, and discuss external validity. Our experiment only partially addresses the issues we highlight, so we suggest directions for future research.

**Video-based Interventions and Behavioral Change**

There is extensive work on the effects of exposure to television on attitudes and behaviors. Some has focused on access to news channels and political beliefs (e.g., DellaVigna and Kaplan 2007). Other work has examined the effects of TV or radio soap operas, which are not designed with particular messages in mind. Exposure to TV soaps for instance, has had effects on fertility and women’s empowerment in Tanzania (Vaughan and Rogers 2000), Brazil (La Ferrara, Chong, and Duryea 2012), and India (Jensen and Oster 2009).

In a more pro-active way, the genre of educational entertainment (Singhal et al. 2004) explicitly includes educational messaging in soap operas as vehicle for behavioral change messaging. For instance, educational operas have shown discuss external validity. Our experiment only partially addresses the issues we highlight, so we suggest directions for future research.
to be effective in altering multiple dimensions of attitudes and behaviour, from adoption of agricultural practices in Vietnam (Heong et al. 2008); to use of oral rehydration therapy for children in Egypt (Abdulla 2004); co-operative behaviors in Rwanda (Paluck 2009); and in reduction in gambling and use of lower-interest rate in South Africa (Berg and Zia 2013).

There are two aspects to effective messaging. First, messages tailored to the specific information needs of individuals have been shown to be more powerful at affecting behavior. As economists, we “typically assume that only one type of persuasive content matters: objectively useful information” (Mullainathan et al. 2008: 1). This is supported by Jensen (2010) and (2012), and Hanna et al. (2012) who find a positive effect of targeted information on individuals’ choices related to business opportunity in India, children’s education in the Dominican Republic, and inputs on seaweed farms in Indonesia. Further evidence is also given by research in other social science fields where trials find motivational messages where content is tailored to have larger effects on behavior compared to non-tailored messages: in public health on physical activity (Marcus et al. 1998; Bull et al. 1999), weight gain (Campbell et al. 1994), and smoking cessation (Prochaska et al. 1993; Shiffman et al. 2000), and in education on study habits and grades (Kim and Keller 2008). The boom in microtargeting of political advertising has shown similar results.

Second, and possibly more important, persuasion also rests on framing a message in a way that individuals relate to. Communication through relevant individuals narrating their stories has been shown to be effective in “transporting” individuals into the story (Green and Brock 2000). This translates into cognitive and emotional engagement and attention among viewers and is associated with attitude change in the direction of the story’s conclusions (Slater and Rouner 2002; Green et al. 2004). Partly, this is simply because people receive messages better from those whom they recognize as similar to them. Social cognitive theory from social psychology suggests that attitudes and behaviors are strongly affected by the experience of others in one’s immediate environment (Bandura 1977, 1986). Exposure to role models with whom a viewer identifies can substitute for an individual’s experience of actual peers and may be a particularly powerful way of framing a message to promote attitude and behavior change. Instead of simply receiving information, viewers watching a soap receive a “vicarious experience” (Bandura 1977): a resonant, salient experience of what a different life might be like.

Thus, videos are increasingly being used, even outside the broad radio/TV network, as part of interventions geared at providing information and inducing behavioral changes. For example, Digital Green, an India-based NGO, produces videos on locally relevant agronomic, health and livelihood practices to motivate and educate community members organized into small screening and discussion groups. Characters are not agronomic technicians, but farmers from nearby communities. The Awethu Project, a small business incubator in South Africa, recruits candidates by going door-to-door in low-income communities. Their
recruiters display videos about successful Awethu entrepreneurs on small tablets and sets of speakers. In India, a campaign to increase awareness of one’s right to access the National Employment Guarantee Scheme included screening of a movie in which a seasonal migrant returning to his home village hears about the program and decides to stay (Ravallion et al. 2013). The character is designed to be ‘locally relevant’ so as to “engage viewers emotionally [in order to] to shift their knowledge” (page 5).

**Design of RCTs of Video-based Interventions, with an Example from Rural Ethiopia**

In an experiment in rural Ethiopia, we aimed to test if there is a link between exposure to potential role models and subsequent outcomes. Poor people often do not make investments, even when returns are high. One possible explanation is that they form mental models that ignore some options for investment. We aimed to alter poor people’s perceptions of the possibilities for their own lives, by showing them four video documentaries of 15 minutes each, in which people from similar backgrounds to the audience tell stories about their lives. They describe how they have improved their socioeconomic position from being poor or of average socioeconomic position in their communities, to being relatively successful, without help from government or NGOs.

The experiment took place in 64 remote villages of Eastern Ethiopia, grouped in fours around a screening site (a school or a farmer training center). In each village, both spouses from six randomly selected households were randomly invited to a screening of documentaries, while both spouses of an additional six households per village served as control. The baseline survey was implemented before allocation of tickets. A short follow-up survey was conducted straight after the documentary screening, and endline data were collected six month later. To ensure compliance with an individual-level treatment, screenings occurred in closed venues which individuals could only access with tickets; individuals were also given in-kind incentives for attendance to treatment and survey time. Overall compliance was high, with 96% of the individuals who were allocated tickets attending the correct screening, despite an average 29 minutes travel time.

**Direct Treatment Effect**

Individuals featured in the documentaries did not provide any advice on particular actions or investments one should undertake in order to replicate their success. Instead, they report on how they achieved their current socioeconomic status through setting goals, careful choices, perseverance, and hard work. After seeing the documentary, we find that individuals invited to a screening of documentaries were hoping for significantly higher level of education for their eldest children than individuals in the control group. Six months after the intervention,
treated individuals had higher numbers of children enrolled in school and more spending on school-related expenses than in the control group.

Importantly, these outcomes are not driven by the information content of the documentaries. While Jensen (2010) finds lower drop-out rates among individuals with access to specifically tailored information on local returns to education, none of the individuals in our documentaries had achieved positive socio-economic outcomes through higher-than-usual levels of education, nor did they provide any education-related advices in the documentary. One way to interpret our findings is that individuals were well aware of educational returns, given the Ethiopian government’s campaigns for enrollment in years, but that they did not think their children would be able to achieve such returns. The documentaries may have shown the possibility of a brighter future for individuals of similar background.

A mere emotional connection with a successful individual would thus induce a person to revise her behavior toward higher investments in future-enhancing domains. If true, one would expect to observe larger effects when the viewer and the character displayed share a number of characteristics. Women for instance may be more responsive to stories featuring successful women; poorer individuals may be more affected by stories of individuals starting from a similarly impoverished background. In the present experiment, all treated individuals watched all four 15-minutes documentaries in a row. Two of them related to a female character, the other two to a male. Three of them related to successes in agriculture, one to a successful small trade business. Because of lack of resources and to preserve statistical power, we were unable to further vary invitations - by inviting some women to female-only stories, while others would have been invited to male-only stories for instance.

**Placebo Effect**

The simple occurrence of a video screening in very remote communities can affect viewers’ mindsets in rather unpredictable ways. The mere effect of bringing people together, whatever the reason, may lead to exchange of information that can also affect their perceptions and behavior. Invited individuals may have also felt ‘elected’ to be in the screening session, especially with a large group of outsiders with technological equipment. This may have affected survey response and behavioral decisions.

To assess the extent to which the content of the documentary mattered above and beyond the screening event, we simultaneously ran a perfectly symmetric placebo experiment, similar in approach to that of Card et al. (2012). In our intervention both heads and spouses from an additional six randomly chosen households in each village were also surveyed but invited to a screening of an entertainment program from Ethiopian TV depicting short plays and traditional Ethiopian songs. The placebo screenings also lasted for an hour and occurred in the same school or training center, on the same day although at a different time.
Descriptive evidence suggests the placebo screening was an important event. Although the treatment videos were significantly more enjoyable and more widely discussed than the placebo videos (Table 1), the latter did generate extensive interest and discussion. Results further suggest that invitation to a placebo screening also led to increased investments in children’s education, although these effects were of smaller magnitude and lower statistical significance than the treatment effect.

### Peer-Mediated Treatment Effect

As discussed in Paluck (2009) and Ravallion et al. (2013), part of the effect of a video-based intervention may occur at the community level, through a shift in public knowledge that may contribute to reinforce the mere effect of having been exposed to the screening itself. Video-based interventions in relatively remote village communities will inevitably trigger discussion, further diffusing and eventually re-interpreting the video content. Table 1 provides clear evidence of this in our setting. Further, consecutive changes in one’s behavior may also affect one’s peers. In education in developing countries, families who were not eligible for conditional cash transfers in Mexico but who lived close to eligible families were more likely to enroll children in primary (Lalive and Cattaneo 2009) and secondary school (Bobonis and Finan 2009).

With randomization at the household level (instead of village level), peer effects may however contribute to lower impact estimates of direct treatment effects. If nontreated peers also (indirectly) benefit positively from the intervention, the difference between treatment and control group is best seen as a lower bound on the treatment effect. This downward bias on the impact estimate is likely to be greater as time passes and opportunities for spillovers expand. To

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**Table 1: Assessment of Documentaries and Placebo after Six Months**

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Placebo</th>
<th>p: Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyed watching what I saw</td>
<td>0.958</td>
<td>0.732</td>
<td>0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td>Discussed film I saw a lot with my neighbours</td>
<td>0.873</td>
<td>0.713</td>
<td>0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.0453)</td>
<td></td>
</tr>
<tr>
<td>Discussed film others saw a lot with my neighbours</td>
<td>0.693</td>
<td>0.573</td>
<td>0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.022)</td>
<td></td>
</tr>
<tr>
<td>Discussed film I saw at least once with neighbours in the past two weeks</td>
<td>0.331</td>
<td>0.216</td>
<td>0.000***</td>
</tr>
<tr>
<td>What I saw generated a lot of discussion within village</td>
<td>0.932</td>
<td>0.731</td>
<td>0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.018)</td>
<td></td>
</tr>
<tr>
<td>N answered question</td>
<td>638</td>
<td>668</td>
<td></td>
</tr>
<tr>
<td>N given ticket but didn’t answer</td>
<td>37</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

*** p below .01. Standard errors in parentheses. The last column gives the p value of the difference between the treatment and placebo group.

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assess the importance of peer effects, we generated exogenous variation in the extent to which an individual’s network was exposed to the treatment. In each screening site of four villages, we randomly assigned two villages to be “intense treatment” villages and two to be “intense placebo” villages (Figure 1). In the “intense treatment” villages, shaded dark grey, we randomly selected 18 additional households (heads and spouses) to receive invitations to the documentary but did not collect data on these individuals. In the “intense placebo” villages, shaded light grey we randomly invited 18 additional households (heads and spouses) to the placebo session.

Each surveyed individual was asked to list their four closest friends at baseline. We matched these lists to the lists of invitees to treatment or placebo screening sessions to capture how many of a respondent’s friends were invited to the documentary and to the placebo screening. For 93% of the respondents, all four individuals cited lived within the same village, as would be expected given the remoteness of these communities. Only 14% of the respondents listed any of their siblings within the four individuals, suggesting that any peer effect cannot be fully explained by family-level characteristics. With imperfect correlation between one’s village and one’s social network, this design offers the advantage of generating an almost continuous distribution of network-level intensity of treatment (Baird et al. 2012).

Such design is not immune to eventual sorting effects (Manski 1993). In fact, peers from a given network may be relatively similar, and hence react somewhat homogenously to the treatment. Our specification therefore includes an interacted term between a person’s own treatment status and the number of her peers who were also invited to treatment. We find an insignificant coefficient on this
interacted term, rejecting presence of sorting effect—along with potential additional peer-mediated treatment effects on the treated individuals. Overall, our results point towards a positive and significant peer-mediated effect on the level of spending towards children education.

Two important points are worth mentioning. First, these results are at best lower bound estimates. Absent a pure control group, such as a set of randomly selected villages were no intervention occurred, we are unable to compare the behavior of control individuals in treatment villages to that of individuals in villages where no screening occurred. For the current study, budgetary constraints forced us to prioritize maximal statistical power on direct treatment effects at the cost of lower capacity to fully assess the magnitude of peer-mediated treatment effects. Second, these estimates do not inform us about the potentially different effects in relation to the way the screening occurred. People may react differently to video content displayed in large groups, in small groups or individually, and to the composition of the group (e.g., Janis, Kaye, and Kirschner 1965; Druckman and Nelson 2003; Ruiz-Belda et al. 2003). Further research on video-based interventions should be designed to further explore these.

**LASTING EFFECTS AND IMPACT PATHWAYS**

As discussed, several studies have empirically documented how TV or radio soaps have significantly affected behaviors in such diverse fields as fertility choices, agriculture, health or conflict resolution. These studies essentially provide reduced-form impact estimates, and do not provide clear evidence of the psychological channels that may have triggered these changes. Other studies have focused on these channels in laboratory experiments (in the aspirations literature, see, e.g., Greene et al. 1982; Stout et al. 2011). These studies are however limited by the artificial nature of laboratory experiments and only measuring outcomes straight after screening.

The Ethiopia video experiment built on these two approaches, by combining short and medium term effects on both psychological pathways and concrete behavior. Alternative psychological impact channels were specified and indicators collected at baseline, minutes after screening of documentary/placebo content (while control individuals were interviewed at the same time in their homes), and again six months following the intervention. These channels can be broadly categorized into two groups. The first related to changes in one’s sense of control over life using indicators such as locus of control (Levenson 1981), perception of poverty (Feagin 1972), or designed and pretested measures of aspirations (Bernard and Taffesse 2014). The second related to risk aversion (Binswanger 1980) or subjective future discount factors (Hill et al. 2011).

Results point toward positive improvements on all indicators in the first category, while no effects are found in the other. We find however that these effects, while still significant, decrease in magnitude over time. As discussed above, this may result from contamination of the control group, which cannot be measured
in the absence of control villages group in the design. They may, however, relate
to the effects vanishing over time, calling for repeated interventions if behavioral
changes are to be sustained. The same is true for concrete behavior change.
Although positive effects on concrete behavior related to children education were
found six months following the intervention, one may wonder if such behavior
are sustained over time, suggesting a structural shift in individuals’ behavior, or
whether one observes “dis-adoption” of future-enhancing behavior after a few
more months—or years.

**EXTERNAL VALIDITY**

There is strong evidence that real-world conditions associated with media con-
sumption play a nontrivial role in its impact (see Paluck 2009). Although RCTs
offer real-world but clean links between exposure and outcomes, they reduce ex-
ternal validity in one important respect. In the real world, people increasingly
choose their exposure to media and to information more broadly according to
existing attitudes and behaviors, and may engage more closely with material that
accords with attitudes they already hold (Hovland 1959; Iyengar et al. 2008).
In other words, were people free—and nonincentivized—to choose the video
they wanted to be exposed to (e.g., documentaries or placebo), results from the
Ethiopian experiment may have been different. Assessing the magnitude of such
selection effect may be assessed through randomized offer of video menus on
DVD, as in Iyengar et al. (2008).

**CONCLUSION**

This paper offers insight on research design meant to assess the effectiveness of a
type of video-based interventions that increasingly take part in development in-
terventions. We argue that such studies need to account of video content, screen-
ing characteristics, peer effects, impact channels, the extent to which any impact
is sustained over time, and eventual self-selection in non-experimental condi-
tions. We illustrate the discussion using a recently completed video-based experi-
ment in rural Ethiopia. Features of the experiment are presented along with
insights on some of its results. We also discuss the study’s pitfalls and offer in-
sights toward potentially more complete research designs to empirically study
video-based interventions.

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An anti-capitalist cultural bias, through directed within-family human capital transmission, adversely affects the supply of entrepreneurial talent and risk-taking. This limits economic progress if aggregate productivity is low. When productivity is high, economic incentives can overcome cultural inertia. Though the income level depends on culture, the growth rate in this case does not. JEL Codes: O11, O43, Z13

INTRODUCTION

The best-known case for the salience of culture in economic lives is probably Max Weber’s classic work, The Protestant Ethic and the Spirit of Capitalism (1904–05, 1930). In it Weber underscores the tensions inherent in the Calvinist doctrines of predestination and vocation, tensions that were resolved by prioritizing material well-being and wealth accumulation through thrift, hard work, and restrained living. These capitalist values, Weber argues, explain England’s early start relative to Catholic Italy and Spain, as well as Lutheran Germany.

In subsequent research, anecdotal evidence has often been used to advance the premise that culture matters for growth. The success of minority populations, such as the Chinese in Southeast Asia, the Lebanese in West Africa, and Indians in East Africa, is held up as an instance of culture trumping adversity. More systematic evidence, mindful of potential endogeneity issues, has been offered in recent years. For instance, Tabellini (2010) identifies trust as a cultural value behind Europe’s regional development. Gorodnichenko and Roland (2013) point to individualism, as opposed to collectivism, as an explanation for cross-national differences in output per worker and innovation. To these kinds of evidence one could add Michalopoulos and Papaianou’s (2014) general finding
that one cultural institution, tribal affiliation, has been more influential for Africa’s local development than national political and economic institutions.

Yet, just as culture has been favored by many researchers, it has also been met with skepticism (e.g., Srinivasan 1984). As late as 1915, when Japan was well in the throes of radical change, an Australian expert had this to say about the Japanese: “...you are a very satisfied easy-going race who reckon time is no object. When I spoke to some managers they informed me that it was impossible to change the habits of national heritage” (ibid., 53). More than likely, softer cultural attitudes like work ethic do change when circumstances change. Consider also Weber’s subsequent works on China (1951) and India (1958), where Confucian values and the caste system are deemed hostile to capitalist values, future prosperity.1 Those values are unlikely to have shifted fundamentally in the intervening decades. What then are we to make of China and India’s impressive growth now?

There is room here for theory to inform us about the relevance of culture in long-term growth and development. The first challenge is identifying a hard cultural trait, one slow to adapt, that fundamentally affects economic development. We focus on the simplest—an attitude towards entrepreneurship—that can be broadly thought of as an aversion towards striking out on one’s own rather than the safety of established choices such as wage-work, public sector employment, and low-risk less-innovative businesses. Secondly, the theory should be dynamic since it is important to understand how the cultural trait alters intertemporal trade-offs, which then feed back into cultural change. Thirdly, any theory of culture and development should be able to account for growth take-offs from “opening up” as we have seen in Japan, China, India, and some Eastern Bloc countries since the fall of the Berlin Wall. The conclusion we reach from such an analysis is that an anti-entrepreneurial culture can constrain economic progress for a while but is readily subjugated by economic changes that improve aggregate productivity.

**A Model of Capitalist Culture**

The development of an entrepreneurial, or capitalist, base is widely presumed to favor national prosperity. As Lewis (1955) notes: “economic growth is bound to slow unless there is an adequate supply of entrepreneurs looking out for new ideas and willing to take the risk of introducing them” (82).

The economy in any period \( t \) is populated by active agents of mass one who were born in \( t-1 \) and die at the end of \( t \). The population differs in two types of human capital. One is specific to entrepreneurship, business expertise \( x_t \), with lower values corresponding to higher expertise. The other, conventional labor productivity pertaining to wage-work, is denoted by \( h_t \). The former can be improved through business experience, the latter through skill investment prior to working. These human capitals are intergenerationally transmitted, from parent to (biological or cultural) offspring. At \( t = 1 \), the initial population starts out

1. Surprisingly, the empirical case for Weber’s original hypothesis is also weak; see Cantoni (2014).
with basic and homogeneous labor productivity $h > 0$ but different types of business expertise: a fraction $m_1$ is endowed with $x > 0$, the remaining fraction with $\tilde{x} > x$. This $m_1$ fraction becomes the initial entrepreneurs, and we denote the entrepreneurial share by $m_t$ for $t \geq 1$.

**Occupations**

As children, agents acquire human capital from their parents or through social influence. As working adults they choose an occupation, acquire further human capital, and have children, one per parent, whom they try to socialize into their own occupation-specific human capital. Since agents die by the end of $t$, there is no consumption smoothing. They are risk averse, their utility from consumption (income) being logarithmic. Wage-work is risk-free, with agents accurately projecting the rational expectations equilibrium wage determined in competitive markets. A worker with human capital $h_t$ earns labor income $w_t h_t$, $w$ being the wage rate per effective unit of labor. Entrepreneurial activity, on the other hand, is inherently risky. The profit from a typical business is $\pi_t = e^{-(q_t-\phi_t)^2}[2a_t l_t^{1/2} - w_t h_t]$, where $a_t$ is technology-specific productivity and $q_t$ the “ideal way” to operate the firm (Jovanovic and Nyarko 1996; Hassler and Mora 2000). Note that $a_t$ maps into total factor productivity at the aggregate level.

The entrepreneur chooses her business action $\phi_t$ and efficiency units of labor $l_t$ to hire. Profits are uncertain because the entrepreneur does not know the best level at which to operate the business. She knows that $q_t$ fluctuates around a mean $\theta$, that is, $q_t = \theta + v_t$ where $v_t$ is an i.i.d. $N(0, \sigma^2)$ shock. The mean level itself is unknown to her though she has normal priors over it with mean $\mu_t = \mathbb{E}_t(\theta)$ and variance $\sigma_t = \mathbb{V}_t(\theta)$. Maximizing $\mathbb{E}_t[\ln \pi_t]$ implies the entrepreneur’s best action is simply her expected value of $q_t$, $\phi_t = \mu_t$, while labor is demanded in line with its marginal product, $l_t = (a_t/w_t)^{1/2}$. Together these choices yield the maximal expected return $\mathbb{E}_t[\ln \pi_t^2] = 2 \ln a_t - \ln w_t - (x_t + \sigma^2)$. Evidently the tighter the entrepreneur’s prior over $\theta$, that is smaller is $\sigma_t$, the higher the expected return from entrepreneurship. This is why smaller values of $x$ are akin to better business skills.

The only market that needs to be cleared is that for labor. Aggregate labor demand is $m_t l_t = m_t (a_t/w_t)^{1/2}$ and aggregate labor supply $(1 - m_t) h_t$ since each individual inelastically supplies a unit time. It follows that the market-clearing wage rate is $w_t = a_t m_t/[(1 - m_t) h_t]^{1/2}$, increasing in the share of the entrepreneurs in the population ($m_t$) and directly proportional to the productivity of technology ($a_t$). Labor earnings, $w_t h_t$, are increasing in $h_t$ as expected.

**Production and Transmission of Human Capital**

Now turn to formation of human capital. Each individual starts her adult life with a vector of human capital in the two occupations acquired during childhood from the previous generation. Based on that vector, she chooses an occupation. Subsequently, an entrepreneur’s income depends only on her business expertise $x_t$, a worker’s depends only on her labor productivity $h_{t-1}$.
An entrepreneur, through her lifetime experience, gains a better understanding of running a business. This Bayesian learning produces a posterior variance 

\[ \sigma^2_{x_t} + \sigma^2 + x_t \]

that she then tries to pass on to her offspring. A worker, on the other hand, can further her human capital prior to working. Specifically, she can invest \( s_t \) resources in additional skills at the average cost \( \varphi w_t > 0 \), which depends on the wage rate to account for opportunity and tuition costs that are not being explicitly modeled. This produces human capital according to the technology, \( h_t = s_t h_{t-1}^{\lambda} \), where \( \lambda, \chi \in (0, 1) \) and \( \lambda + \chi < 1 \). Factoring in the optimal level of skill investment, this means the worker’s effective productivity is \( h_t = G(h_{t-1}) = (\lambda/\varphi)^{\lambda/(1-\lambda)} h_{t-1}^{\chi/(1-\lambda)} \). Both human capital production functions, \( F \) and \( G \), are increasing and concave. In the limit the two kinds of human capital converge to \( (x_1; h_1) = (0; h) \), the fixed points of \( F \) and \( G \) respectively. It is reasonable to assume that \( h < \bar{h} \).

This brings us to the intergenerational transmission of human capital. Within-family transmission is, of course, the centerpiece of the Beckerian approach, where the family environment is a key influence on the development of skills and attitudes among children. Departing slightly from the Beckerian tradition, suppose within-family influence is imperfect: children do not always acquire the human capital their parents intended. When within-family transmission fails, the child acquires the human capital – through observation and imitation – of a randomly matched working adult who may well be in an occupation different from her parent’s. Vertical (parent to biological child) and oblique (parent to cultural child) transmission of this sort has been introduced into economics through Bisin and Verdier’s (2000) influential work. Oblique transmission, in particular, creates the possibility for social influence to directly matter for intergenerational outcomes. In contrast to Bisin and Verdier’s work, it is human capital that is affected here, not preference.

Within-family socialization takes place after production and income generation. A parent expends effort \( \tau_t \in (0, 1) \) towards her biological child in order to transfer her human capital. The cost of doing so, \( \psi(\tau_t) \), is increasing and convex in the effort. The parent evaluates the benefit of this transmission based on her perception of the child’s welfare in her occupation relative to the alternative one. To be specific, the parent calculates her child’s income based on her own business and labor earnings. Secondly, parents dislike the possibly that their children may be in a different occupation. Working parents also have an occupational bias, \( \delta \geq 1 \), because of which they view wage-work more favorably and, conversely, entrepreneurship less so. This is meant to reflect a general anti-capitalist attitude among some population groups in developing countries, possibly from the experience of colonization, post-colonial policies, or cultural practices. The bias may come to be widely shared over time through the transmission of human capital and occupational choice.

Denote by \( V^{\alpha} \) an occupation \( \alpha \) parent’s perceived benefit, based on her own experience and human capital, of her child choosing occupation \( \alpha \) and by \( V^{\beta} \) of choosing occupation \( \beta \). Then one possible set of altruism payoffs
are: $V_{w}^{we} = \ln(w_t h_t)$, $V_{w}^{we} = 2 \ln a_t - \ln w_t - (\bar{x} + \sigma^2) - \ln \delta$, $V_{w}^{ew} = \ln(w_t h)$ and $V_{w}^{we} = 2 \ln a_t - \ln w_t - (x_t + \sigma^2)$. When within-family socialization fails to transmit the parent’s human capital, which occurs with probability $1 - \tau$, the child automatically takes on the human capital of a randomly matched economically active adult, her cultural parent. Equilibrium effort from each type of parent increases, ceteris paribus, as that type becomes less numerous since social influence cannot be relied upon to mold children as parents would like and as the perceived welfare differential between the two occupations increases: $\tau = \tau(m_t, V^{ii}_t - V^{ij}_t)$ with $\partial \tau / \partial m > 0$, $\partial \tau / \partial m < 0$, and $\partial \tau / \partial (V^{ii} - V^{ij}) > 0$. The anti-entrepreneurial bias $\delta$ conditions the transmission process. A higher value increases socialization efforts among working parents, as they have another reason to prefer that their children become workers.

The upshot of the socialization process is occupation-specific human capital being transferred through time. Generation-$t$ working parents, all of whom are identical, transfer their labor productivity $h_t$ to their biological or cultural offspring, whose uninformed business priors take the value $\bar{x}$. Entrepreneurial parents who are also identical, transfer their informed business prior $x_t$, their offspring’s labor productivity taking the lowest value $h$. Individuals do not accumulate the alternative occupation’s human capital. If they become wage workers, they do not use their business expertise at all which therefore does not get sharpened. If they become entrepreneurs, on the other hand, they do use their expertise and learn from it but do not get an opportunity to hone their labor skills. Consequently, only occupation-specific human capital accumulated over time and through experience gets transferred to future generations.

Endowed with these human capitals, the child then makes an occupational choice by comparing expected returns (expected log income). As a cultural lineage builds up a history of entrepreneurship, it will have much higher business expertise relative to labor productivity than a cultural lineage of wage workers. Then a child successfully indoctrinated by an entrepreneur parent as part of a cultural lineage of entrepreneurs will have higher expected profits than one successfully indoctrinated by a worker parent as part of a cultural lineage of workers. This creates persistent occupational choice across generations in many cases. Workers pass on to their biological or cultural children dispersed priors and high labor productivity, creating future workers as those offspring will be worse at entrepreneurship. Entrepreneurs pass on tight priors and create future entrepreneurs by the same token.

**Steady State**

Focus now on the stationary equilibrium by imposing $a_t = a > 1$ for all $t$. Steady state requires that the two occupational and human capital types maintain constant proportions so that each type is investing the same socialization effort, $\tau^{''} = \tau^{'}$. The fraction of entrepreneurs whose children end up in entrepreneurship in steady state is the same as the fraction of workers whose children become workers. On the path to the steady state, these fractions are not constant but
there are conditions under which occupational choice is consistent with the human capital transfer. With each generation, the business expertise of entrepreneurs evolves toward perfect mastery of the technology and the productivity of workers evolves towards a high $\frac{h}{C}$.

How does culture—the subjective anti-entrepreneurial bias $\delta$ and the directed parent-to-child transmission process—affect the steady-state supply of entrepreneurial talent and, therefore, risk-taking? Using the equilibrium wage equation, the steady-state fraction of entrepreneurs can be implicitly solved from the equation:

$$m \left[ \ln \left( \frac{h}{C} \right) + \bar{x} + \ln \delta \right] + \ln \left[ m \left( 1 - m \right) \right] = \ln \left( \frac{h}{C} \right) - \sigma^2.$$  
This steady state, call it $\bar{m}$, depends negatively on the anti-entrepreneurial bias and in appropriate ways on the three human capitals. That is, $\bar{m} = m(\delta, \bar{h}, \bar{h}, \bar{x})$.

Is this too little entrepreneurship? To answer, we need some notion of the socially desirable level of entrepreneurship. Consider the Benthamite social welfare function defined over consumption, $W(m) = mE(\ln \pi(m)) + (1 - m)\ln(\omega(m)\bar{h})$, with the caveat that, since parents also care about their offspring, this cannot be a good measure of overall welfare. The level of entrepreneurship $m'$ that maximizes $W$ (subject to the participation constraints) turns out to be higher than $\bar{m}$ for plausible parameterizations. Inefficiency occurs and is maintained over time because human capital is partly acquired through purposeful, directed, transmission within the family. Moreover, the anti-entrepreneurial bias of worker parents intensifies the transmission of labor-specific human capital, making it harder for their children to become entrepreneurs. Therefore we can say that an anti-entrepreneurial cultural attitude, through its effect on human capital acquisition and the supply of entrepreneurial talent, lowers social welfare and national income.$^2$

**Growth through Technology Adoption**

There is, of course, no growth in income in this steady state. An entrepreneurial culture, or the lack thereof, matters only for the level of output. Now imagine entrepreneurs having access to not one but multiple technologies that are distinguished by their overall productivity and human capital requirement.

Index the baseline technology specified above by $n = 1$. Suppose that technologies are ordered such that $\theta_{n+1} = \alpha^{1/2} \theta_n + \eta$ for $n \geq 1$, where $\eta$ an i.i.d. $N(0, \sigma^2)$ shock and $\alpha \in (0, 1)$. Moreover, the productivity of technology $n + 1$ is $a^{n+1}$ compared to $a^n$ for technology $n$. Higher grade technologies are more productive but come at a cost: since $\alpha < 1$ and $\sigma^2_\eta > 0$, expertise in technology $n$ does not transfer smoothly to $n + 1$. This means even though upgrading technologies, one step at a time, increases inherent productivity, entrepreneurs with a lot of expertise in a given technology may be reluctant to sacrifice their specific knowledge. What happens, though, if entrepreneurs were to continuously upgrade, learn about the new technology and transfer that knowledge to their

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2. The level of entrepreneurship that maximizes steady-state national income is $1/2 > m'$. For more on the dynamic adjustment to $\bar{m}$, see Chakraborty et al.’s (2014) related work.
biological or cultural offspring? Business expertise converges to a value \( \hat{x} > 0 \): no technology is fully mastered and expertise remains somewhat diffuse.

Entrepreneurs will choose not to upgrade so long as the expected profit from a given technology with a precise business prior exceeds the expected profit from a more advanced technology with a more dispersed prior. If so, an entrepreneurial class can emerge whose business expertise evolves to a perfect understanding of existing technologies. Upgrading to more productive technologies is never optimal because of proficiency with existing ones. This requires that agents act consistently with their socialization experience so that no one acquiring human capital in wage-work chooses to be an entrepreneur and vice versa. The latter is ensured if the initial demographics keep wages higher than expected business returns for a first-generation worker with the uninformed prior of \( \hat{x} \) and expected business returns exceed wages for an entrepreneur who goes into production with the more informed prior of \( \hat{x} \).

We could, with some increase in complexity but no substantive change in the model’s outcomes, allow for a more general distribution of business priors. So long as entrepreneurs’ priors were sufficiently tight to begin with, the outcome would still be a steady state with technological and economic stagnation. The accumulation of substantial skills over existing production methods leads to a sort of innovator’s dilemma where entrepreneurs never find it optimal to make the costly move to more productive methods. It is here that culture matters. Through its effect on the intergenerational transmission of human capital, the anti-capitalism bias raises the supply of labor, lowers that of entrepreneurial talent. In doing so, it ensures that even before they acquire substantial expertise in existing production methods, entrepreneurs enjoy exaggerated profits that discourage them from “looking out for new ideas”. The problem only worsens as they get continually better at existing methods.3

How can we generate economic growth, fueled by constant technology upgrading, in this economy? This can happen most simply if total factor productivity, \( a \), were to increase sufficiently. Imagine that this happens through economic liberalization or the easier availability of new technologies in previously closed systems. Though entrepreneurs lose proficiency, the inherently higher productivity gain from the newer technology raises expected profits. They begin to upgrade, passing on to future generations the knowledge acquired from using newer technologies such that each successive generation too finds upgrading profitable. Workers, in turn, benefit from this as rising productivity raises labor demand. Wage incomes grow, in the limit at the (gross) rate \( a \) per generation, same as expected profits and national income.

The growing economy also moves closer to the efficient supply of entrepreneurial talent. Since entrepreneurs never fully master new technologies (recall

3. There can be some growth in this steady state as long as it is exogenous and common across all technologies. One example would be profits \( \pi_t^n = \exp[-(g_n - \phi_t)] [2a^n b_t l_t^{\alpha^n} - w_t l_t] \) from technology \( n \), where \( b_t = b_0 (1 + g)^t \) is the same for all \( n \) and \( g \geq 0 \).
that \( \dot{x} > 0 \), even though profits keep rising, the income differential between entrepreneurship and wage-work narrows. Parents recognize this based on their own experience. So, when it comes to socializing their offspring, they are less compelled to transfer their occupation-specific human capital since the alternative occupation is no longer viewed to be as undesirable. With within-family transmission weakening, social influence takes on a more active role and family background matters less for occupational choice.

Culture is often slow to change compared to political and economic institutions (Roland, 2004). In the model, the behavioral change that follows from the productivity shock occurs purely from economic change and (bounded) rationality. In other words, culture at the individual level does not change—\( \delta \) is the same as before—but cultural behavior towards offspring does. A more pro-entrepreneurial attitude, lower \( \delta \), would help of course. But it is not limiting: while the income level continues to depend on the culturally determined share of entrepreneurs, that share is now larger and the growth rate itself is independent of cultural factors.

What this illustrates is that even when certain aspects of culture are slow to change, significant economic change can make them irrelevant for long-run growth. And the possibility of growth ultimately fosters a more growth-oriented cultural environment.

**Conclusion**

We used a dynamic model of culture to identify how an anti-entrepreneurial bias affects society’s appetite for innovation and risk-taking. The bias affects the intergenerational acquisition of human capital, resulting in too little entrepreneurship. That may, in turn, make entrepreneurs unwilling to adopt productive technologies and adversely affect economic growth. This state of underdevelopment can be overturned by a large enough productivity shock. The cultural bias itself does not change, the changing environment makes the bias easier to overcome. There is no a priori reason to believe, therefore, that culture matters for long-run development. This is not to suggest that culture never affects long-run development (see Doepke and Zilibotti [2013] for an example where it does) or that understanding the cultural context in which economic development occurs is not important (Klitgaard 1994), only that it may be secondary to the economic and political restraints on the productivity of poorer nations.

**References**


Selection into Migration within a Household Model: Evidence from Senegal

Isabelle Chort and Jean-Noël Senne

This paper intends to fill the gap between individual selection models and household approaches to migration. It presents a theoretical model to account for household-based migration decisions and derives its implications on migrant selection within the household. The predictions are tested on unique multi-sited and matched samples of Senegalese migrants and their origin household, using a three-step estimation procedure based on an extension of the Roy-Dahl model of mobility and earnings. Our results suggest that expected remittances, along with earnings differentials between host and home countries, play a major role in shaping intra-household selection patterns. JEL codes: F22, F24, C51, D13

INTRODUCTION

While the household dimension of migration decisions has been acknowledged since the 1980s by a large strand of literature, initiated in particular by Stark and Bloom (1985), no paper has yet investigated the implications of a household-level migration decision on migrant selection. Yet, if migration results from a household welfare-maximizing strategy, the selection of migrants among household members may not be equivalent to individual self-selection: future remittances to nonmigrant members should be accounted for in the household decision-making process, along with comparative advantages in earnings.

One major reason why the issue of intra-household selection into migration has not been studied to date is probably the absence of suitable data. Indeed, in order to uncover the main factors that shape selection patterns within the household, we need to compare counterfactual allocations of household members across alternative locations, accounting for the nonrandom double selection of who migrates and where. To control for this double selection, detailed

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information on the characteristics of both migrant and nonmigrant members from the same origin household is required. We exploit in this paper unique multi-sited and matched survey data collected among Senegalese migrants in three host countries and members of their origin household who remained in Senegal.

This article contributes to filling a gap in the migration literature by providing and estimating a household model for migrant selection. We first build a household-based theoretical model for migration decisions, where household members’ location choices result from the maximization of a household utility function that depends on expected household members’ earnings and remittances at each location. The subsequent empirical application is based on a three-step estimation procedure of a structural discrete choice model of location choices derived from a Roy-Dahl (2002) selection model extended to a household-level joint selection process with multiple alternatives. Our main results show that, after controlling for earnings differentials across members between host and home countries, households select into migration members who are more likely to remit higher amounts. This finding is fully consistent with the predictions of our household migration model.

**Theoretical Framework**

We consider an origin household \( h \) made of \( n \) members who can either stay in the home country or migrate to one of \( J \) possible destination countries.\(^1\) Each member’s individual utility is defined as a function of earnings abroad and sent remittances if she migrates, or pooled home country earnings and received remittances if she remains in the origin household. Yet, while remittances enter the utility functions \( U_k \) of the \((n-1)\) nonmigrant members \( k \) positively, we assume that they enter the migrant \( i \)’s own utility \( U_i \) negatively and that they are discounted by a multiplicative, positive and lower than one individual-specific factor \( d_i \). This discount factor reflects any positive but indirect or deferred utility derived from sending money back home and is general enough to encompass any motive for remittances.\(^2\) The model is detailed in Chort and Senne (2013).

The household total utility \( U_h \) is then defined as an additively separable function of the weighted sum of each household member’s individual utility plus a migrant-specific taste factor \( T_{bij} \). This taste factor aims at capturing the nonmonetary determinants entering the total utility function and includes in particular migration costs and any other nonmonetary or psychic costs and benefits for the household of having one member abroad. Therefore, the utility \( U_{hij} \) for household \( h \) associated with having member \( i \) in destination country \( j \) and all other

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\(^1\) Since our focus is on migrant selection within their household, we do not model the household decision to participate in migration. In addition, for the sake of simplicity, we assume that households have one migrant member only.

\(^2\) Put differently, the closer \( d_i \) is to 0, the lower the negative effect of remittances in the migrant’s direct utility.
members in the home country \( s \) is:

\[
U_{ij} = \sum_{k \neq i} \theta_k U_k \left( \frac{\sum_{k \neq i} Y_{ks} + R_{ij}}{n - 1} \right) + \theta_i U_i (Y_{ij} - \delta_i R_{ij}) + T_{bij} \quad \forall i, j
\]

(1)

where \( \{U_i; U_k\} \) are concave and twice differentiable utility functions, \( Y_{ks} \) stands for earnings of nonmigrant \( k \) in home country \( s \), \( Y_{ij} \) (resp. \( R_{ij} \)) stands for earnings (resp. remittances) of migrant \( i \) in (resp. from) destination country \( j \), and \( \{\theta_i; \theta_k\} \) are the individual weights—or bargaining powers—of members \( \{i; k\} \), with \( \sum \theta = 1 \).

We represent the household migration decision in a unitary model that can be characterized by a consensus model à la Samuelson (1956). Household members agree on a common objective so that individual migration and remittances decisions are taken at the household level in order to maximize the above defined household utility. Deriving the F.O.C. from equation (1), it can first be shown that the optimal amount of remittances \( R_{ij} \) is unsurprisingly an increasing function of migrant’s earnings \( Y_{ij} \) and a decreasing function of nonmigrants’ earnings \( Y_{ks} \). Besides, \( R_{ij} \) is a decreasing function of the remittances discount factor \( \delta_i \). Since any of the \( n \) household members can migrate to one of \( J \) destination countries, the household’s decision then boils down to choosing among \( n \times J \) alternatives the \{migrant \( i \) - destination \( j \)\} allocation that maximizes the value of its utility at the remittances optimum, i.e. such that \( V_{bij} = U_{bij}(R_{ij}^*) > V_{bkl} = U_{bkl}(R_{kl}^*) \forall (k, l) \neq (i, j) \).

By application of the envelope theorem, it is easy to show that this optimal value is an increasing function of the comparative advantage in earnings across locations among potential migrant members, that is to say the difference between \( (Y_{kj} - Y_{ks}) \) and \( (Y_{ij} - Y_{is}) \) for two different members \( k \) and \( i \). The household selects into migration the member with the highest earnings differential between host and home countries. Second, the optimal value of the household utility is a decreasing function of the remittances discount parameter \( \delta_i \). This result, consistent with the related stated effect of \( \delta_i \) on remittances amounts, is quite intuitive: at the household level, when \( \delta_i \) is lower than one and small enough, the marginal gain from each additional unit of remittances in nonmigrants’ utilities outbalances the concurrent marginal loss in the migrant’s utility, therefore inducing an increase in both the equilibrium amount of remittances and the value of the utility at the optimum.

These two findings merely put forward the fact that, conditional on earnings, bargaining powers, and tastes, the household additionally selects into migration the member with the lowest value for \( \delta_i \), i.e., who is expected to remit the highest amounts.

**Estimation Procedure**

We want to investigate the responsiveness of household member’s migration propensity to both earnings’ differential across locations and remittances potential. Taking a linear approximation of the above defined household utility function
and assuming that household members have accurate expectations about individual earnings, remittances, and tastes and that bargaining powers are equal across household members, the value $V_{hij}$ of the household random utility of locating member $i$ in country $j$ can then be written:

$$
\tilde{V}_{hij} = \alpha (\sum y_{ks} + y_{ij}) + \beta (1 - \delta) r_{ij} + \gamma_{ij} t_{ij} + \epsilon_{hij} \quad \forall i, j
$$

with:

$$
y_{ks} = E(Y_{ks} | x_k); \quad y_{ij} = E(Y_{ij} | x_i); \quad r_{ij} = E(R_{ij} | x_i); \quad t_{ij} = E(T_{hij} | z_{ij})
$$

where $x_k$ is a set of characteristics of nonmigrant member $k$ affecting home earnings, $x_i$ is a set of characteristics of migrant $i$ affecting destination earnings and remittances, $z_{ij}$ is a vector of migrant $i$ and destination $j$ characteristics affecting tastes and $\epsilon_{hij}$ is an error term, which stands for composite deviations from mean earnings, remittances, and tastes. Consistent with our theoretical framework, the remittances discount factor $\delta_i$ can be proxied by a subset $x_{1i}$ of individual characteristics $x_i$ that affect remittances amounts conditional on earnings.

Considering that the household selects among $n \times J$ alternatives the migrant-destination allocation that maximizes the value of its random utility, the intrahousehold selection rule can be written as:

$$
M_{hij} = \begin{cases} 
1 & \text{if } \tilde{V}_{hij} > \tilde{V}_{hkl} \\
0 & \text{otherwise}
\end{cases} \quad \forall (k, l) \neq (i, j)
$$

where $M_{hij}$ is a dummy variable, which is equal to one if member $i$ from household $h$ migrates in destination country $j$ and all remaining members $k$ stay in the home country. Equations (2) and (3) therefore define an extended Roy model of location choices, such as in Dahl (2002), but resulting from a household utility-maximizing strategy.

We specify Mincer-type equations for earnings and remittances and specify tastes as a set of interactions $x'_i \phi_j$ between destination dummies and individual characteristics. Under the statistical assumption that error components $\epsilon_{hij}$ are i.i.d

3. Allowing bargaining powers to differ across members only induce heterogeneity in the predictions of the theoretical model, which is rejected empirically to support the equality assumption. See Chort and Senne (2013).

4. Formally, $n \times J$ binary variables $M_{hkl}$ can actually be defined, corresponding to $n \times J$ selection equations. $M_{hij}$ equals one if alternative $[ij]$ is chosen (and then observed), implying that all the remaining $M_{hkl}$ equal 0 since only one (optimal) allocation can be selected.

5. While the country-specific dummies account for the costs or benefits of migration across destinations, we assume that these costs and benefits may vary across individuals within a particular destination.
and have a type-1 Extreme Value distribution, the probability $P_{bij} = P(M_{bij} = 1) = P(\bar{V}_{bij} > \bar{V}_{hkl})$ that household $h$ locates member $i$ in destination country $j$ then writes:

$$P_{bij} = \frac{\exp[\alpha(y_{ij} - y_{is}) + \beta(1 - \delta_i) r_{ij} + x_i' \phi_j]}{\sum_{k=1}^n \sum_{l=1}^m \exp[\alpha(y_{kl} - y_{ks}) + \beta(1 - \delta_k) r_{kl} + x_k' \phi_l]} \quad \forall (k, l) \neq (i, j)$$

We are particularly interested in estimating the set of structural parameters $\{\alpha, \beta\}$ on earnings and remittances, which is equivalent to estimating a within-household conditional logit model of members’ locations. A first identification issue stems from the fact that earnings and remittances are only observed at one location for each individual. We therefore need to compute counterfactual earnings and remittances for each household member at each location, corrected for the endogenous selection into locations, which is partially driven by observed and unobserved characteristics explaining earnings and remittances gaps. A second estimation issue lies in the fact that households have different sets of available alternatives since they vary in size. We thus estimate a conditional logit model with a varying number of alternatives across observations depending on the number of potential migrant members within the household.

We implement a three-step parametric estimation procedure derived from the methodology suggested by Dahl (2002). We first estimate a reduced-form conditional logit model of intra-household migration probability with a varying number of alternatives, using individual characteristics of household members. Second, we estimate individual Mincer-type equations for earnings and remittances corrected for endogenous selection into migration, using a flexible correction function of predicted probabilities obtained from the first-step. Third, based on the second-step results, we compute unbiased counterfactual earnings and remittances predictions that we plug in the structural-form conditional logit model of migration probability to recover the earnings and remittances parameters $\{\alpha, \beta\}$ of the household decision.

**Empirical Results**

The empirical analysis uses matched data from the MIDDAS surveys conducted between 2009 and 2010. The data collection was carried out in two stages. First, surveys were conducted among representative samples of Senegalese migrants in France, Italy, and Mauritania. Second, migrants’ origin households were tracked and interviewed in Senegal. We collected, in particular, individual wage and remittances data for migrants and each member of their origin household. Our final sample is made of 326 migrant-origin household pairs.6

6. Estimations are then conducted on the whole sample of working-age migrants and nonmigrants from their origin household, i.e., aged 18–59 at the time of the migrant’s departure. It includes 1,567 individuals.
Throughout the three-step estimation, two possible destinations are considered: Europe (pooling France and Italy) and Mauritania. Dependent variables are thus alternatively (i) a dummy variable equal to one for the chosen (observed) allocation, corresponding to having one member abroad, either in Europe or in Mauritania, and having all other members stay in Senegal (step one and three) or (ii) individual remittances and/or earnings in PPP for each household member at her observed location (step two). Consistent with the standard Mincer framework, the basic set of independent variables includes gender, age, and (formal) education level. We include three additional dummy variables for koranic schooling, for being the eldest child, and for being the eldest sibling of the household head. We indeed expect those variables to have no or limited impact on earnings but to capture individual variations in the propensity to remit and stand as relevant proxies for the $\delta_i$ parameter. First, koranic schooling is expected to capture a higher commitment to the prevailing solidarity norms conveyed by the Islamic religion. Second, the two eldest dummies account for the fact that first-born children in the Senegalese society traditionally bear a greater responsibility for providing for their household.7

Identification at each step primarily relies on intra-household variation in individual characteristics of household members. Yet, crucial exclusion restrictions are additionally needed. Identification of the second-step correction function of predicted location probabilities is indeed achieved through the exclusion of rainfall shocks in Senegal at the time of the migrant’s departure, which are assumed not to affect current earnings and remittances at each location but which are used as an exogenous determinant of emigration in the first-step estimation. Identification of the third-step structural parameters is achieved through the exclusion of education level, which is assumed to affect second-step earnings and remittances but to have no direct impact on location choices once earnings and remittances are accounted for. The data, identification issues, and the maximum-likelihood estimation procedure of conditional logit models with a varying number of alternatives are extensively described in Chort and Senne (2013).

We focus here on our main results obtained from the third-step of our estimation procedure. First and second steps results are only briefly summarized here, and corresponding tables can be found in Chort and Senne (2013). Results from the first-step show that being a man, relatively younger and educated, increases the probability to be selected as a migrant within the household, whatever the chosen destination. In addition, koranic schooling and eldest dummies are found to be important determinants of intra-household selection, with fairly large and significant positive coefficients. Reduced-form parameters at this stage identify the joint effect of individual characteristics through overall differentials in individual earnings, remittances, and tastes. Steps two and three aim at disentangling these channels.

7. Using the same data, Chort et al. (2012) indeed point out the significant impact of koranic schooling on both the probability to remit and remitted amounts.
Results from the second step show quite standard earnings profiles in both home and destination countries, with a wage premium for men and positive returns to age and education. More importantly for the matter at hand, while koranic education and eldest dummies are found to have no impact on earnings, they are strong and positive determinants of remittances amounts, conditional on migrant and nonmigrants’ earnings. This result implies that the latter variables may proxy for low values of $d_i$ and, together with their above stated effect on migration probabilities, may suggest that expected remittances play a role in the household decision.\(^8\)

Table 1 reports the third-step estimation results of the conditional logit model of location choices in its structural form, i.e., using second-step imputed and unbiased counterfactual earnings and remittances for each member at each location, which are included as explanatory variables to recover their respective role in the household decision. Specifications in column (1) first investigate the role of expected earnings differentials and other individual characteristics—gender, age, koranic schooling, and eldest dummies in interaction with destination-specific dummies—that aim at capturing the nonwage determinants of migration. Unsurprisingly, results show that earnings differentials between home and destination countries play a major role in shaping intra-household selection patterns. Consistent with our theoretical framework, origin households are found to select into migration the member with the highest comparative advantage in earnings across locations in order to maximize the total earnings surplus.

Yet, even when controlling for earnings, most of the coefficients on individual control variables are significant, which suggests that nonwage components affect intra-household migration decisions. In particular, individuals with koranic education and who are the eldest child or sibling of the origin household head have a higher probability of being located abroad. Besides, the point estimates of the effect of these three variables are fairly large in comparison to that of the other controls. In line with the estimation results of remittances equations at the previous step, this result points out the fact that, conditional on earnings, origin households are found to select into migration the members with a higher propensity to remit (with a low value of $d_i$), which is fully consistent with the second prediction of our theoretical model.

However the latter interpretation may be challenged, if the koranic schooling and eldest dummies capture both the impact of tastes and the role of remittances potential in the intra-household selection process.\(^9\) Hence, to disentangle the

---

8. Rainfall shocks interacted with individual characteristics are jointly found to significantly affect emigration from Senegal in the first-step estimation. The second order polynomial of the predicted first-best choice probability included as a correction function in the second-step estimations is found to be significant and consistently correct for selection in equations of home earnings and remittances from Europe.

9. A possible alternative interpretation is that these individual characteristics account for differential costs or benefits of moving abroad (Bertoli et al., 2013). For instance, religious networks at destination may lower the cost of migrating abroad and therefore foster migration of members with koranic schooling.
TABLE 1. Intra-Household Migration Probability, Conditional Logit Estimates

<table>
<thead>
<tr>
<th></th>
<th>Clogit (1)</th>
<th>Clogit (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earnings differential, PPP (/100)</td>
<td>0.236***</td>
<td>0.215***</td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
<td>(0.046)</td>
</tr>
<tr>
<td>Remittances, FCFA (/10,000)</td>
<td>0.176*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.103)</td>
<td></td>
</tr>
<tr>
<td>Remittances × Koranic</td>
<td>0.118**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.055)</td>
<td></td>
</tr>
<tr>
<td>Remittances × Oldest child</td>
<td>0.076**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td></td>
</tr>
<tr>
<td>Remittances × Oldest brother/sister</td>
<td>0.096*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
<td></td>
</tr>
</tbody>
</table>

France/Italy
Male (d)                     | 0.395*       | 0.338*       |
                                | (0.236)      | (0.199)      |
Age                           | −0.016*      | −0.013*      |
                                | (0.009)      | (0.007)      |
Koranic school (d)            | 0.628**      | 0.276*       |
                                | (0.291)      | (0.142)      |
Oldest child (d)              | 1.271***     | 0.607        |
                                | (0.485)      | (0.456)      |
Oldest brother/sister (d)     | 0.969**      | 0.595*       |
                                | (0.478)      | (0.307)      |
Mauritania
Male (d)                     | 0.340*       | 0.195        |
                                | (0.169)      | (0.119)      |
Age                           | −0.042***    | −0.046**     |
                                | (0.016)      | (0.019)      |
Koranic school (d)            | 2.058***     | 0.393        |
                                | (0.785)      | (0.287)      |
Oldest child (d)              | 1.302***     | 0.619*       |
                                | (0.497)      | (0.365)      |
Oldest brother/sister (d)     | 1.413***     | 0.486*       |
                                | (0.509)      | (0.279)      |
Rainfall variables            | yes          | yes          |
Destination dummy             | yes          | yes          |
Observations                  | 1,567        | 1,567        |

Notes: Sample is restricted to individuals aged 18–59 at the time of migrant’s departure. Dependent variable is a dummy equal to 1 if member i of household h lives in destination country j. (d) stands for dummy variables. PPP refers to USD Purchasing Power Parity amounts, using the consumption conversion factor published by the World Bank (2009). Coefficients reported, bootstrapped standard errors in brackets (1000 replications), to correct for the extra sampling variability in imputed variables.

*p < 0.10; **p < 0.05; ***p < 0.01

respective contribution of each of these two components, we include as additional explanatory variables imputed remittances amounts as well as interaction terms with the koranic schooling and eldest dummy variables. Indeed, as suggested by the structural equation (4), to the extent that the latter variables proxy for low
values of $\delta_i$ and therefore accurately capture the role of remittances potentials, we should thus empirically observe heterogeneity in the effect of remittances with respect to those individual characteristics: the lower $\delta_i$, the higher the propensity to remit and the higher the role of remittances in explaining the migration probability. Results are shown in specification (2). First, all the coefficients on remittances amounts and the relevant interaction terms are positive and significant. Second, the point estimates of the direct effect of the koranic schooling and eldest dummy variables substantially drop and become marginally significant. Overall, even if we cannot rule out the fact that part of the effect of our variables of interest may be due to differential tastes, these additional results lend further support to the hypothesis that the higher propensities of members with koranic schooling or who are the eldest child or sibling of the household head to be located abroad are mainly explained by their higher remittances potential. These findings have strong implications on migrant selection within the household: households are found to select into migration members with the highest comparative advantages in both earnings and remittances.

**Conclusion**

While migrant selection has been addressed by a large strand of the migration literature, it has been exclusively modeled to date as the result of an individual income-maximizing strategy. Individual selection models may not fully account for most migration patterns observed in particular in developing countries where migration is part of a household welfare-maximizing strategy that includes expected remittances. This paper contributes to developing an analysis of the selection process of migrants within their origin household.

We first suggest a household-based theoretical model of migration decisions, whose estimation is derived from an extension of the seminal Roy-Dahl model of self-selection. In our framework, a unitary household chooses where to locate its members based on the maximization of a household utility function whose components include home earnings of nonmigrant members and earnings and remittances of migrant members abroad. Using observed location choices of household members, we develop a three-step estimation procedure to estimate the respective role of earnings and remittances in the structural intra-household selection decision. We provide an empirical application using survey data on a unique multi-sited and matched sample of migrants in France, Italy, and Mauritania and their origin households in Senegal.

Our main results show that, together with earnings, expected remittances play a significant role in shaping intra-household selection patterns. After controlling for earnings differentials between destination and home countries, we find that households are more likely to select into migration members with the highest remittances potential. This feature can be observed by modeling the migration decision at the household level and is therefore ignored by individual self-selection models. This framework is relevant to explaining the higher migration
propensities of household members with koranic schooling or being the eldest child or sibling of the origin household head although they have no obvious comparative advantage in earnings.

References


Viktoria Hnatkovska and Amartya Lahiri

This paper characterizes the gross and net migration flows between rural and urban areas in India during the period 1983–2008. Using individual data from the National Sample Survey of India we show that the 5-year gross migration flows constitute about 10% of India’s labor force and are stable over time. Migrants tend to be younger and more educated than nonmigrants. They also are more likely to work part-time and in regular employment and less likely to be self-employed. Migrants from rural and urban areas have higher mean and median wages relative to nonmigrants in the same locations. However, there are differences in the size of the wage gaps along the wage distribution and their dynamics over time. JEL codes: J6, R2

INTRODUCTION

Structural transformation in developing economies is typically associated with a declining share of agriculture in output and employment. Given that the agricultural sector is primarily rural while the nonagricultural sectors are mostly urban, the process of structural transformation potentially necessitates massive transfers of factors and resources across both sectors and locations. Indeed the typical narrative of this transformation process suggests urbanization to be an associated feature of this process, with Harris and Todaro (1970) being the most well-known work along these lines. Impediments in the movement of factors and goods across locations, however, induce potential misallocations and thereby affect aggregate productivity of the economy as well as its speed of transformation. Consequently, management of factors and goods movement across sectors and locations is possibly one of the biggest policy challenges in transforming economies.

Indian economy has been on exactly such a path of rapid structural transformation over the past 30 years. In this paper we document how the movement of one of the factors—labor—between rural and urban locations has unfolded in India during this time. In our analysis we used the data from the three rounds of
the National Sample Survey (NSS) of households in India that contain migration particulars of the individuals between the years of 1983 and 2008. We analyze both gross and net migration flows between rural and urban areas, and study how the characteristics of migrants differ from those of nonmigrants.

We show that gross migration flows were about 10% of India’s labor force in the five years preceding 1983 and remained relatively stable over time. The majority of migrants move between rural areas. The rural-to-urban migrants constituted about 20% of all gross flows. There is also a substantial reverse flow of migrants from urban to rural areas equal to about 8% of gross flows. As a result, the net flow from rural to urban areas is smaller at about 5% of the urban labor force. Importantly, this flow has been quite stable during 1983 and 2008 period. We also find that a large share of migrants into urban areas (from both rural and other urban areas) are moving for job-related reasons, while migration into rural areas is mainly due to other factors, such as marriage.

We explore the individual and household characteristics of migrants, types of work they do, and their educational achievements and wages, and compare them with the corresponding characteristics of nonmigrants. We find that migrants tend to be younger, more likely to be married and female, and tend to come from smaller households. Migrants are more likely to work in part-time jobs and regular jobs. They are also less likely to be self-employed relative to nonmigrants. Interestingly, we also find that migrants tend to be more educated than nonmigrants, with the difference being especially pronounced in secondary and above education category. This educational upper hand of migrants holds true for all types of jobs in which migrants and nonmigrants participate.

We also compare real wages of migrant and nonmigrant full-time employed workers. We find that migrants from rural and urban areas have been earning higher wages than nonmigrants in the same locations over the past 30 years. This was particularly the case at the bottom end of the wage distribution where all types of migrants have outperformed even urban nonmigrant workers in 2007–08. At the top end of the wage distribution, however, the picture is more mixed. At that point of the distribution, the migrants from rural areas earn more than rural nonmigrants, but their wages remain significantly below the wages of urban workers and the gap has been increasing over time. The rich migrants from urban areas remain the top earners throughout the sample period.

Going forward, our results could be used to understand wage differences between rural and urban areas and their dynamics over time. They could also be used to infer migration costs of labor between rural and urban locations and thus help to understand the process of structural transformation of the Indian economy. Furthermore, both could be inform the design of policies on migration in India and developing countries more generally.

The rest of the paper is organized as follows. Section 2 presents summary statistics on our sample and characterizes rural and urban migration flows. Section 3 asks, who are the migrants, while section 4 studies the wages of migrants. Section 5 concludes.
Migration Flows

Our data come from successive rounds of the Employment and Unemployment surveys of the National Sample Survey (NSS) of households in India. The survey rounds that we include in the study are 1983 (round 38), 1999–2000 (round 55), and the smaller survey round conducted in 2004–05 (round 64). These are the only rounds in which migration particulars of individuals are available. We identify migrants as individuals who reported that their place of enumeration is different from the last usual residence and who left their last usual place of residence within the previous five years. These variables are available on a consistent basis across the three survey rounds. For these individuals we also know the reason for leaving the last usual residence and its location. Since we are interested in documenting migration flows and their role in the Indian labor force we restrict the sample to individuals in the working age group 16–65, who are not enrolled in any educational institution, and for whom we have both education and employment status information. When studying wages of migrants and nonmigrants we also restrict our attention to those who are working full time (defined as those who worked at least 2.5 days in the week prior to being sampled) and belong to male-led households.1 More details on our data can be found in the appendix of Hnatkovska and Lahiri (2012).

Table 1 reports the key statistics in our sample. The table breaks down the overall patterns by migrations status (migrants vs nonmigrants). It is easy to see that migrants are significantly younger than nonmigrants, more likely to be married, and are predominantly female. Migrants also belong to smaller households than nonmigrants and are less likely to be members of the backward castes as measured by the proportion of scheduled castes and tribes (SC/STs).

Table 2 shows the main patterns of migration for the three rounds. The first feature to note is that the number of recent migrants (those who migrated during the preceding five years) as a share of all those in the labor force has remained relatively stable: at 10% in 1983 relative to 9.8% in 2007–08. Of these migrants, the largest single group were those who moved between rural areas, although the share of rural-to-rural migration in overall migration flows has declined slightly from about 55.5% in 1983 to just over 53% in 2007–08. The share of urban migrants to rural areas has stayed relatively unchanged around 8–9% during this period. In contrast, urban areas have experienced an increase in migration inflows from both rural and urban areas. Thus, the share of rural-to-urban migration in total migration flows has increased from 19.8% in 1983 to 21.4% in 2007–08. Urban-to-urban migration, which stood at 16% in 1983, rose to 17% in 2007–08. Interestingly, the majority of the increase in migration to urban areas took place in the latter half of our sample—since 1999–2000.

It is interesting to put these flows in perspective of the rising urban labor force during this period. The rural-to-urban migrants accounted for around 8% of urban labor force in 1983. This share has declined slightly to 7.6% by 2004–05.

1. This avoids households with special conditions since male-led households are the norm in India.
Note that the net flow of workers from rural to urban areas is lower as there is some reverse flow as well. Specifically, the net inflow of migrants from rural to urban areas in the five years preceding 1983 was about 4.9% of all urban workforce, while in 2007–08 the corresponding number was 5%. As a share of all labor force of India, net migration flows from rural to urban areas remained relatively stable at about 1% throughout the 1983–2008 period.

Table 3 reports the share of workers that reported job-related reasons behind their migration decision. Thus, among rural-to-urban migrants, about 40% reported moving for job reasons during our sample period. The share of “for job” migrants is also large among urban-to-urban migrants, although there was a decline in this share from 38.6% in 1983 to 32.1% in 2007–08. A similar decline in job-related migration was observed among those moving between rural areas and among urban-to-rural migrants. The other reasons for migration include for marriage, due to natural disaster, social problems, displacement, housing based movement, health care, etc.

Who Are the Migrants?

Next, we take a closer look at the characteristics of migrants. In particular, we are interested in the types of jobs that they do and their educational achievements relative to nonmigrants.

Table 4 contrasts the labor market characteristics of migrants and nonmigrants in the three survey rounds. The panel on the left shows the shares of employed and unemployed workers in the total labor force, with the employed share being split between full-time and part-time employment. The panel on the

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2. These bidirectional migration flows were emphasized also in Young (2012).

3. Full-time workers are identified as those who worked at least 2.5 days in the week prior to being sampled, while part-time are the remaining employed workers.
<table>
<thead>
<tr>
<th>Year</th>
<th>Migrant Total LF</th>
<th>Rural-to-urban</th>
<th>Urban-to-urban</th>
<th>Rural-to-rural</th>
<th>Urban-to-rural</th>
<th>Rural-to-Urban</th>
<th>Net Rural-to-Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>0.100 (0.001)</td>
<td>0.198 (0.003)</td>
<td>0.161 (0.003)</td>
<td>0.555 (0.004)</td>
<td>0.079 (0.002)</td>
<td>0.082 (0.001)</td>
<td>0.049 (0.002)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>0.103 (0.001)</td>
<td>0.190 (0.003)</td>
<td>0.162 (0.003)</td>
<td>0.548 (0.004)</td>
<td>0.090 (0.002)</td>
<td>0.075 (0.001)</td>
<td>0.039 (0.002)</td>
</tr>
<tr>
<td>2007–08</td>
<td>0.098 (0.001)</td>
<td>0.214 (0.004)</td>
<td>0.171 (0.003)</td>
<td>0.533 (0.004)</td>
<td>0.075 (0.002)</td>
<td>0.076 (0.001)</td>
<td>0.050 (0.002)</td>
</tr>
</tbody>
</table>

Note: LF, labor force.
right reports the types of work that employed workers engage in—regular employment, casual works, and self-employment.

A few interesting results in the labor force patterns of migrants and nonmigrants emerge from table 4. First, migrants and nonmigrants have very similar employment rates at 97% of labor force. The changes in the employment rates over time are small and have shown similar dynamics in the two groups. Second, migrants are much more likely to be employed in part-time jobs than nonmigrants. Moreover, the share of part-time employment has increased over time among migrants, while showing very little change in the nonmigrants group. Thus, in 1983, part-time employment rate among migrants was 55%. This rate has increased to 61% in 2007–08. The corresponding rates among nonmigrants were 39% in 1983 and 38% in 2007–08. The flip-side of this is that the full-time employment rate has declined among migrants but remained relatively unchanged for the nonmigrants.

Next, we focus on the employed workers and contrast the types of jobs that migrants and nonmigrants engage into. We distinguish regular workers, casual employment and self-employment. Migrants are over twice more likely to be employed in regular jobs than nonmigrants. For instance, in 2007–08 the employment rate in regular jobs was 39% for migrants and only 15.7% for nonmigrants. This rate has also shown an increase over time for both groups, but the increase was more pronounced for migrants. The other big difference between migrants and nonmigrants is in the self-employment rates. Migrants are significantly less likely to be self-employed with the rates showing a slight increase over time. Interestingly, the reverse pattern characterizes the self-employment rates of nonmigrants, which have declined from over 57% in 1983 to just under 54% in 2007–08. Lastly, the employment rates in casual jobs were quite similar for migrants and nonmigrants in 1983 at about 27%–28% of all employed labor force. By 2007–08 these rates have diverged substantially between migrants and nonmigrants, with the casual employment rate of 23.5% for migrants and 30.5% for nonmigrants. Overall, this suggests that the migrants are more likely to be employed in more stable jobs than nonmigrants and have been increasing their exposure to such jobs over time.

Table 5 reports the distribution of the migrant and nonmigrant labor force by education category. Education categories edu1, edu2, edu3, edu4, and edu5

<table>
<thead>
<tr>
<th></th>
<th>Labor Force</th>
<th></th>
<th>Employed</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Full-time</td>
<td>Part-time</td>
<td>Unemployed</td>
<td>Regular</td>
<td>Casual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migrants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>0.418</td>
<td>0.553</td>
<td>0.029</td>
<td>0.364</td>
<td>0.273</td>
<td>0.363</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.001)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>0.394</td>
<td>0.577</td>
<td>0.029</td>
<td>0.316</td>
<td>0.280</td>
<td>0.403</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>2007–08</td>
<td>0.367</td>
<td>0.612</td>
<td>0.021</td>
<td>0.390</td>
<td>0.235</td>
<td>0.375</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.001)</td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Nonmigrants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>0.583</td>
<td>0.389</td>
<td>0.029</td>
<td>0.146</td>
<td>0.281</td>
<td>0.573</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>0.609</td>
<td>0.364</td>
<td>0.027</td>
<td>0.145</td>
<td>0.311</td>
<td>0.544</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>2007–08</td>
<td>0.594</td>
<td>0.379</td>
<td>0.027</td>
<td>0.157</td>
<td>0.305</td>
<td>0.539</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>
refer, respectively, to “illiterate,” “literate but below primary education,” “primary,” “middle,” and “secondary and above.” In 1983, 51% of the migrant labor force and over 59% of the nonmigrant labor force was illiterate. These numbers have declined dramatically since with only 26.5% of migrants and 37.6% of nonmigrants still being nonliterate in 2007–08. More broadly, the share of workers with primary or below education is significantly smaller among migrants than among nonmigrants. The share of this category among migrants was 72.6% in 1983, as opposed to 82.4% among nonmigrants in the same year. By 2007–08 the share of workers with primary or below education has fallen for both groups, with migrants experiencing a sharper fall. At the same time, migrants are more likely to have middle school education and above relative to nonmigrants. Moreover, the share of workers in these education categories grew more rapidly for migrants than for nonmigrants. For instance, among migrants, this category has expanded from 27% in 1983 to over 51% in 2007–08. Correspondingly, the share of the middle and secondary and higher educated nonmigrant workers rose from just around 17.6% of all nonmigrant labor force in 1983 to just over 38% in 2007–08.

Figure 1 summarizes the gaps in labor force distribution across education categories between migrants and nonmigrants. The migrants were overrepresented in the three higher education categories in 1983 with the gap being the largest in the secondary and above education category. The distributional differences have become smaller over time, but the pattern of higher education of migrants relative to nonmigrants have remained unchanged.

Lastly, we consider a joint distribution of education and employment types of migrants and nonmigrants. To present the results succinctly we compute the average years of education of migrants and nonmigrants in each type of employment, and report the ratio of the education years between the migrants and nonmigrants. Figure 2 presents our findings.

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**Table 5. Educational Achievements of Migrants: 1983–2008**

<table>
<thead>
<tr>
<th></th>
<th>edu1</th>
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<tr>
<td><strong>Migrants</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1983</td>
<td>0.512</td>
<td>0.083</td>
<td>0.131</td>
<td>0.110</td>
<td>0.164</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>0.379</td>
<td>0.087</td>
<td>0.116</td>
<td>0.152</td>
<td>0.265</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>2007–08</td>
<td>0.265</td>
<td>0.083</td>
<td>0.141</td>
<td>0.185</td>
<td>0.326</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td><strong>Nonmigrants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>0.595</td>
<td>0.106</td>
<td>0.123</td>
<td>0.090</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>0.467</td>
<td>0.108</td>
<td>0.113</td>
<td>0.135</td>
<td>0.178</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>2007–08</td>
<td>0.376</td>
<td>0.099</td>
<td>0.143</td>
<td>0.162</td>
<td>0.219</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
</tbody>
</table>
Notice from panel (a) of figure 2 that, in line with our earlier findings, migrants are more educated relative to nonmigrants, and that this is the case for all employment types. For instance, the overall gap in years of education between migrants and nonmigrants was 1.46 in 1983. The gap has declined over time, by remained well-above one at 1.30 in 2007–08. The gaps in education years for those employed in full-time and part-time jobs are even higher. Panel (b) shows that migrants are more educated than nonmigrants in all types of employment. The difference was particularly pronounced in regular jobs (in which migrants are also overrepresented as we showed earlier) in 1983, with the gap declining over time. Casual jobs and self-employment showed no pronounced trends in the education gaps over time.

**Figure 1.** The Gap in Education between Migrants and Nonmigrants

![Figure 1](image1.png)

**Figure 2.** The Gap in Years of Education between Migrants and Nonmigrants, Different Types of Employment

![Figure 2](image2.png)

Notes: (a) Overall and employed; (b) By employment types.
WAGES

What do the wage profiles of the recently migrated workers look like? Our measure of wages is the daily wage/salaried income received for the work done by respondents during the previous week (relative to the survey week), if the reported occupation during that week is the same as worker’s usual occupation (one year reference).\(^4\) Wages can be paid in cash or kind, where the latter are evaluated at current retail prices. We convert wages into real terms using state-level poverty lines that differ for rural and urban sectors. We express all wages in 1983 rural Maharashtra poverty lines.\(^5\) Since we are interested in wage comparison we restrict our attention to full-time employed workers only in this evaluation. As a result, the sample used in this section is smaller than the sample we used in the previous sections.

We perform a simple evaluation of migrant workers wages by estimating a regression of the log real wages of individuals in our sample on a constant, controls for age (we include age and age squared of each individual) and a set of location and migration dummies for each survey round. The four migration dummy variables each identify a migration flow between rural and urban areas. We also include the rural dummy to distinguish rural nonmigrant workers. Thus our benchmark group is urban nonmigrants.\(^6\) The controls for age are intended to account for potential life-cycle differences between migrants and nonmigrants. We perform the analysis for different unconditional quantiles as well as the mean of the wage distribution. We use the recentered influence function (RIF) regressions developed by Firpo, Fortin, and Lemieux (2009) to estimate the effect of the migration dummies for different points of the wage distribution.

Table 6 reports our results for mean and median (log) wages. We find that the coefficient on the rural nonmigrant dummy is negative and significant, suggesting significant wage gaps between rural and urban nonmigrants. At the same time, the coefficient has increased over time implying significant convergence between the wages of rural and urban nonmigrant workers. Specifically, urban-rural median wage gap for nonmigrant workers stood at 59% in 1983 but declined by

\(^4\) This allows us to reduce the effects of seasonal changes in employment and occupations on wages.

\(^5\) In 2004–05 the Planning Commission of India changed the methodology for estimation of poverty lines. Among other changes, they switched from anchoring the poverty lines to a calorie intake norm towards consumer expenditures more generally. This led to a change in the consumption basket underlying poverty lines calculations. To retain comparability across rounds we convert the 2007–08 poverty lines obtained from the Planning Commission under the new methodology to the old basket using a 2004–05 adjustment factor. That factor was obtained from the poverty lines under the old and new methodologies available for the 2004–05 survey year. As a test, we used the same adjustment factor to obtain the implied “old” poverty lines for the 1993–94 survey round for which the two sets of poverty lines are also available from the Planning Commission. We find that the actual old poverty lines and the implied “old” poverty lines are very similar, giving us confidence that our adjustment is valid.

\(^6\) We distinguish rural and urban nonmigrant wages since Hnatkovska and Lahiri (2012) showed that rural-urban wage gaps in India are significant during the period of 1983–2010, although the gaps have declined over time.
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td>Rural nonmig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>−0.507***</td>
<td>−0.398***</td>
<td>−0.279***</td>
<td>−0.586***</td>
<td>−0.360***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Rural-to-urban</td>
<td>−0.021</td>
<td>−0.027</td>
<td>−0.046**</td>
<td>0.035</td>
<td>0.062**</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.023)</td>
<td>(0.024)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Urban-to-urban</td>
<td>0.367***</td>
<td>0.529***</td>
<td>0.506***</td>
<td>0.257***</td>
<td>0.261***</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.041)</td>
<td>(0.033)</td>
<td>(0.025)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Rural-to-rural</td>
<td>−0.279***</td>
<td>−0.205***</td>
<td>−0.069***</td>
<td>−0.361***</td>
<td>−0.231***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.023)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Urban-to-rural</td>
<td>0.258***</td>
<td>0.213***</td>
<td>0.340***</td>
<td>0.113***</td>
<td>0.125***</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.050)</td>
<td>(0.053)</td>
<td>(0.037)</td>
<td>(0.044)</td>
</tr>
</tbody>
</table>

N | 63981  | 67322  | 69862  | 63981  | 67322  | 69862  |

Notes: This table reports the estimates of coefficients on the rural dummy and dummies for rural-urban migration flows from the OLS and median RIF regressions of log wages on a set of aforementioned dummies, age, age squared, and a constant. N refers to the number of observations. Standard errors are in parenthesis. *p-value ≤ .10, **p-value ≤ .05, ***p-value ≤ .01.
more than half to 21.3% in 2007–08. Both the initial size of the gap and its reduction over time are consistent with the findings in Hnatkovska and Lahiri (2012) who study the evolution of rural and urban wages in India during 1983–2010 period.

The dummies for migration flows from urban areas have coefficients that are positive and significant, suggesting that urban migrants earn more (on average and at the median) than the benchmark group – urban nonmigrants. Migrants from rural areas, in contrast, earn less than urban nonmigrants, but the difference is significant mainly for rural-to-rural migrants. Note also that the negative effects on wages for this group is declining over time, providing further support for the wage convergence of urban and rural wages. Wages of migrants who moved from rural to urban areas are no different than the wages of urban nonmigrants, suggesting to us that rural-to-urban migrants were able to integrate well into the urban labor market.7 These results apply to both mean and median wages.

Next, we compare the wages of migrants and nonmigrants at the two ends of the wage distribution. Thus, table 7 presents the regression results from the RIF regressions for the 10th and 90th percentile of (log) wages. The results are generally similar to those we reported for mean and median wages with a few important exceptions. Let’s begin with the bottom 10th percentile. First, the coefficient on rural nonmigrant dummy in the regressions for the 10th percentile starts off negative and significant in 1983 but turns positive and significant in 2007–08. This implies that wages of poor rural nonmigrants were 19% below the wages of poor urban nonmigrant workers in 1983. The gap, however, is reversed in 2007–08 when poor rural nonmigrants earned 12% more than poor urban nonmigrants. This reversal of the wage gap in favor of the rural workers for the poor segment of the wage distribution was first noted in Hnatkovska and Lahiri (2012) and is confirmed here for nonmigrants. Second, rural-to-urban migrants at the bottom end of the wage distribution earn more than poor urban nonmigrants and this positive gap has increased over time. This suggests that poor migrants from rural to urban areas do better than poor urban nonmigrants in the urban labor market.

Turning to the top of the wage distribution notice that the coefficient on the rural nonmigrant dummy is negative, significant and becomes more negative over time. Therefore, rural nonmigrants at the top end of the wage distribution are significantly worse off than the urban nonmigrants, and the gap in their wages has increased over time. This result confirms the divergence of urban-rural wages at the upper end of the wage distribution in India during 1983–2010 period noted in Hnatkovska and Lahiri (2012). Rural-to-urban migrants are doing a little bit better in this regard as their wages are below the wages of urban nonmigrants, but the gap is much smaller than for rural nonmigrants. However, the difference has

7. The only exception is 2007–08 round where wages of rural-to-urban migrant workers are significantly lower than wages of urban nonmigrants, but the difference is small.
<table>
<thead>
<tr>
<th>Migration Type</th>
<th>10th Percentile</th>
<th>90th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural nonmigr</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.192***</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td></td>
</tr>
<tr>
<td>Rural-to-urban</td>
<td>0.086***</td>
<td>0.116***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td></td>
</tr>
<tr>
<td>Urban-to-urban</td>
<td>0.149***</td>
<td>0.134***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td>Rural-to-rural</td>
<td>-0.175***</td>
<td>-0.046*</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td></td>
</tr>
<tr>
<td>Urban-to-rural</td>
<td>-0.029</td>
<td>0.141***</td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: This table reports the estimates of coefficients on the rural dummy and dummies for rural-urban migration flows from the RIF regressions of log wages on a set of aforementioned dummies, age, age squared, and a constant for the 10th and 90th percentiles. N refers to the number of observations. Standard errors are in parenthesis. *p-value ≤ .10, **p-value ≤ .05, ***p-value ≤ .01.
also increased over time, with rural-to-urban migrants at the top 10% of wage distribution making 45% less than urban nonmigrants in 2007–08.

Overall, our results suggest that migrants have done much better than their nonmigrant counterparts over the past 30 years in India. These improvements are particularly pronounced at the bottom end of the distribution where all types of migrants have outperformed even urban nonmigrant workers in 2007–08. The picture is less bright at the top end of the distribution, where the wage gaps for migrants from rural areas have widened relative to urban wages. At the same time these migrants have been earning significantly more than rural nonmigrants.

Of course these conclusions are subject to an obvious caveat that the migration decision itself is endogenous to wage gaps between rural and urban areas. Such an analysis is left for future research.

Conclusion

We have documented the size and dynamics of migration flows between rural and urban locations in India during 1983–2008 period, as well as tried to shed some light on who are the migrants. We found that 5-year gross migration flows constitute about 10% of the entire Indian labor force during this period and these flows have remained stable over time. The majority of migration happens between rural areas, followed by rural-to-urban migration. Those moving to urban areas do so primarily for job-related reasons, while the flows to rural areas are mainly due to other reasons, such as marriage. We also show that migrants tend to work in part-time, but in regular jobs, as opposed to nonmigrants who are predominantly self-employed. Furthermore, migrants tend to be more educated and earn more relative to nonmigrants in their respective locations.

We also documented interesting distributional changes in wages of migrants and nonmigrants during our sample period. In particular, we found that the poor migrants have been earning more than both rural and urban nonmigrants, and the difference has been increasing over time. On the other hand, at the top end of the wage distribution, the urban migrants have become richer than urban nonmigrants, while the migrants from rural areas earn less than urban nonmigrants and have seen this gap widen over time. Explaining these developments is left for future work.

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