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## Abstract

Joseph E. Stiglitz, 2001 Nobel Laureate in Economics, helped create the theory of markets with asymmetric information and was one of the founders of modern development economics. He played a leading role in an intellectual revolution that changed the characterization of a market economy. In the new paradigm, the price

system only imperfectly solves the information problem of scarcity because of the many other information problems that arise in the economy: the selection over hidden characteristics, the provision of incentives for hidden behaviors and for innovation, and the coordination of choices over institutions.

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# JOSEPH E. STIGLITZ

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**Stiglitz, Joseph E. (born 1943)**

Joseph E. Stiglitz helped create the economics of information, which analyzes equilibrium in markets in which there are asymmetries of information among the market participants. For that work, he received the Nobel Prize in Economics in 2001, jointly with George A. Akerlof and A. Michael Spence. Stiglitz's work demonstrated the many and sometimes subtle ways in which markets can fail to lead to efficient outcomes. His work elucidated a broad set of phenomena that had largely been ignored before 1970 because they were outside the limits of the standard paradigm: incentive contracts, bankruptcy, quantity rationing, financial structure, equilibrium price distributions, innovation, and dysfunctional institutions. This work contributed to a paradigm shift in economics. In the new paradigm, the price system only imperfectly solves the information problem of scarcity because of the many other information problems that arise in the economy. Stiglitz has also proved central theorems in many fields: development economics, finance, trade theory, public economics, and industrial organization.

The broad plan from which much of Stiglitz's work originates had two central goals. The first was to show that many of the implications of the standard neoclassical model do not remain valid once the assumption of perfect information is dropped. His famous paper on adverse selection (Rothschild and Stiglitz, 1976) opens with these words:

Economic theorists traditionally banish discussions of information to footnotes. Serious consideration of costs of communication, imperfect knowledge, and the like would, it is believed, complicate without informing. ... [T]his comforting myth is false. Some of the most important conclusions of economic theory are not robust to considerations of imperfect information. (1976, p. 629)

The second goal was to provide a better theoretical understanding of the workings of the economic system as a whole. As Stiglitz (2007) explains,

By the time I had finished my graduate studies, I had realized that the model of the economic system that was being taught – and that was at the center of policy

analyses – was *not* a model of a modern capitalist economy. It was little more than a fancy version of a primitive agriculture exchange/production economy, slightly updated to include manufacturing – so long as there were diminishing returns. There was but a short distance between Ricardo and Walras, and between Walras and Samuelson. . . .

...Capital was nothing more than seed that was harvested but not consumed...

...technology was stagnant (or at most exogenous).

A critical assumption of the standard neoclassical model is that there is a price for each quality of good in the market and for each action one would wish to contract for. Buyers have no problem ascertaining quality, and firms produce the quality that they have agreed to produce. Firms do not need to motivate their workers. Lenders do not worry about borrowers repaying. Owners do not worry about managers taking the right actions. Stiglitz in his lectures to students in the 1980s gave the example of a stylist cutting hair: in the standard model, there would be a price for each hair that he cut.

A real-life experiment that helped economists evaluate the standard neoclassical theory were the experiences with market socialism in Eastern Europe, in which government owned the firms but there was a manager of each firm whose job it was to maximize profits of that firm, facing market prices. Stiglitz (1994) argues that if the neoclassical model were an accurate characterization of a market economy, then market socialism would have been successful. Because of the importance of incentive problems and of non-price institutions (such as banks) within the economy, the inefficiencies that arose under market socialism were not accidents, but rather the inevitable consequence of (a) the limitations of the information contained in prices, and (b) the gap between the set of goods for which markets can practically exist and the much broader set of present and future goods and actions on which welfare depends.

Two ideas inform much of Stiglitz's work.

1. The 'control/information' system of market economies embraces far more than the price system of the neoclassical model. The exchange problem is intertwined with the process of selection over hidden characteristics, the provision of incentives for hidden behaviors and for innovation, and the coordination of choices over institutions.

2. Competitive equilibrium in economies with imperfect information and missing markets is not, in general, Pareto efficient. Market outcomes can be improved on by government intervention, e.g., taxes and subsidies. A simple illustration is that if the care that the insured take to avoid an accident is not observable to the insurance company, then commodities like fire extinguishers that decrease insured agents' losses should be subsidized, while commodities like alcohol that increase their losses should be taxed (Greenwald and Stiglitz, 1986, p. 247).

Until Arrow's work on medical care (Arrow, 1963), the only reasons for a missing market that had been well explored were environmental externalities and the inability, or undesirability, to exclude from use (the problem of public goods). Stiglitz's contributions would help to radically broaden the understanding of the sources of externalities to include information externalities, group reputation effects, agglomeration effects, knowledge spillovers, and pecuniary externalities (see, for example, Greenwald and Stiglitz, 1986 on pecuniary externalities and Hoff, 2001 on coordination failures). In the process, Stiglitz's work would help to change the profession's understanding of capitalism, although the policy recommendations of economists did not change as much as Stiglitz had hoped.

Citations are an objective, if imperfect, measure of influence. Kim, Morse and Zingales (2006) compiled a list of the 146 articles published in economics journals from 1970 to 2002 that had received by June 2006 more than 500 citations from the ISI Web of Science/Social Science Citation Index. Six of Stiglitz's papers appear on this list (no other author has more). In descending order of number of citations, the papers are Stiglitz and Weiss (1981), Rothschild and Stiglitz (1970), Dixit and Stiglitz (1977), Shapiro and Stiglitz (1984), Rothschild and Stiglitz (1976), and Grossman and Stiglitz (1980). This article will place each of these papers in the context of Stiglitz's research program.

### **Biographical data**

Stiglitz's early experiences shaped his lifelong professional interests in understanding how an economy handles risk, and in bringing economic theory to bear on real-world problems. Stiglitz was born in Gary, Indiana, a city marred, in his words, by 'huge inequality, poverty, and discrimination' (Stiglitz, 2007). He was the middle of three

children. After the failure of an earlier business, his father became an independent insurance agent. One part of his job was to find new insurers for firms whose businesses had burned down and whose insurance policies had been cancelled. Stiglitz's mother worked in the family insurance business when Stiglitz was young and later taught elementary school in a low-income inner city neighborhood of Gary. After retiring from elementary education, she worked in adult remedial education, where she encountered some of the same students whom she had taught as children in inner-city schools.

Stiglitz's genius was recognized early. In high school, he was assigned independent study in lieu of some of the regular classes, which he had outstripped. (His father apparently took this the wrong way: he was concerned that something might be wrong with the other children in the school.) Stiglitz followed his older brother to Amherst College and graduated in 1964. There he studied economics, physics, history and mathematics, and was president of his senior class. In that position, he was a maverick: he tried unsuccessfully to stop the college from funding the training of Amherst sports teams in Bermuda during college vacations, and organized an exchange program between Amherst and a segregated college in the US South.

He obtained a Ph.D. from the Massachusetts Institute of Technology (MIT) in 1967. Stiglitz (2007) writes that particularly important influences at MIT on his later work were his statistics teacher, Harold Freeman, who taught the recently developed theory of subjective probability, and Ken Arrow, with whom he took a class as a second-year graduate student. At that time, Arrow was writing the final formalization of the Arrow-Debreu paradigm. Realizing the model's limitations, Arrow was also beginning a research agenda into the consequences of imperfect information.

Stiglitz joined the faculty of MIT in 1966, spent time between 1969 and 1971 at the Institute for Development Studies at the University of Nairobi under a Rockefeller Foundation grant, and then moved from university to university: Yale (1967-74), St Catherine's College, Oxford (Visiting Fellow, 1973-74), Stanford (1974-76), All Souls' College, Oxford (1976-79), the Institute of Advanced Studies at Princeton (1978-79), Princeton University (1979-88), Stanford (1988-2000), and Columbia University (2000 to date).

Stiglitz received the John Bates Clark Medal in 1979, awarded biennially by the American Economic Association for the most distinguished work by an economist under the age of 40. In 1987, Stiglitz became founding editor of the *Journal of Economic Perspectives*.

In 1993 Stiglitz joined President Clinton's Council of Economic Advisors, which he chaired in 1995–97. In 1997, Stiglitz was appointed to the position of Chief Economist of the World Bank. The East Asian financial crisis occurred in 1997-99, and Stiglitz argued publicly against the policies of the International Monetary Fund (IMF) towards the crisis. Disagreements arose both about the consequences of the policies (given the uncertainties about both the structure of the economy and future events), and about welfare judgments of the acceptable trade-offs between competing goals. Stiglitz's positions led to conflict with other officials in Washington. In November 1999, he resigned from the World Bank and returned to academia. At Columbia, he co-founded the Initiative for Policy Dialogue, which studies policy issues and provides training to policymakers from developing countries.

### **The economics of uncertainty**

The economics of uncertainty is concerned with the principles that an individual uses in evaluating a random distribution of returns. Applications extend from how individuals allocate their portfolios between safe assets and risky assets, to how farmers allocate their land among different crops. The work in the 1960s by James Tobin and others equated an increase in risk with an increase in variance. Rothschild and Stiglitz (1970) set forth an alternative definition of an increase in risk. Comparing income distributions with the same mean, they proposed a definition that corresponded to a preference ordering among every expected-utility-maximizer with a concave utility function. This ordering was not the same as a ranking based on increases in variance. In a companion paper, Rothschild and Stiglitz (1971) demonstrated the usefulness of their definition in deriving comparative static results. They showed that such results depended on a simple criterion: the concavity or convexity of a 'first-order condition' characterizing the individual's optimal decision with respect to the random variable that was the source of risk. That work unified work in an area that until then had been in great confusion.

## **The economics of information**

In the 1960s, James Mirrlees (1971) began working on the problem of how a government could design an optimal tax schedule, taking into account that government can observe individuals' incomes, but not their ability and effort. Given this asymmetry of information, the analytical problem is to distribute a given tax burden according to differences in ability to pay. Stiglitz recognized the similarities between this problem and the problems that arise in *markets* with asymmetric information. For example, insurance companies and banks want to design a menu of offers that will maximize their profits, taking into account that they do not know each individual's risk of accident or bankruptcy and the care that an individual expends to avoid the insured for event. Employers want to design labor contracts to maximize productivity, taking into account that they can observe only imperfectly workers' ability and effort. Together with a small group of pioneers in the 1970s, and influenced in particular by Akerlof (1970) and Spence (1974), Stiglitz devised models in which these kinds of problems could be analyzed. The work on hidden characteristics (adverse selection) and incentive problems (moral hazard) came to be the core of the economics of information.

## **Hidden characteristics**

A selection problem arises whenever there is imperfect information about the characteristics of the items being transacted, and different sides of the transaction know different things (so information is *asymmetric*). This problem is pervasive. Rothschild and Stiglitz (1976) constructed a celebrated model of the insurance market in which individuals differ only in terms of their privately known risk type, and the insurance firms know the overall distribution of risks in the population. The model uses the canonical textbook apparatus of consumer choice – budget lines and indifference curves – but produces very surprising (and counter-Walrasian) results.

To illustrate Stiglitz's *modus operandi* – to begin with highly simplified models of particular markets that allow him to identify a general principle – I describe the Rothschild and Stiglitz (1976) model in detail.

Consider a risk-averse individual whose situation is described by his income if he is lucky enough to avoid an accident ( $W_{NA}$ ) and his income if an accident occurs ( $W_A$ ). His initial endowment point E is  $(W, W - d)$ , where  $d$  represents the damages incurred in the accident. An individual purchases insurance in order to smooth his income across these two 'states of nature.'

Begin with the benchmark case in which insurance companies know an individual's probability of accident. Given this probability, let  $\bar{W}$  denote his expected income. Then competitive equilibrium would be at a point A, illustrated in Figure 1, where the insurance company breaks even and the individual's indifference curve, denoted  $\bar{U}^L$ , is tangent to the budget line. Since risk-averse individuals who are offered a break-even price for insurance will choose full insurance, the equilibrium is along the 45 degree line. The line that goes through the endowment point E and the point A is the locus of contracts at which an insurance company breaks even ('the fair-odds line').

Next, bring in asymmetric information. Suppose that individuals are of two types that differ in their accident probability, and each individual knows his own type. Given the differences in risks, the high-risk individual has lower expected wealth (denoted  $\hat{W}$  in Figure 2) than the low-risk individual (denoted  $\bar{W}$ ). If the insurance company could observe who was low-risk and who was high-risk, then, on the same reasoning as above, the equilibrium contracts would be at A and B in Figure 2. A higher accident probability gives rise to a flatter indifference curve (the two types' indifference curves satisfy the 'single crossing property'), and also to more costly insurance (a flatter fair-odds line). If, however, the insurance firms do not know the characteristics of individuals, then clearly they cannot offer contracts A and B. For in that case all individuals would claim they were the low-risk type and choose the contract A, and the insurance companies would not break even. Offers that survive the competitive process cannot specify a price at which customers choose to buy all the insurance they want, because the high-risk individuals would always purchase more insurance at that price than the low-risk individuals, and the insurance firms would not break even. Competitive offers of contracts instead consist of both a price and a quantity.

Consider then the price and quantity offer at point C in Figure 3, which would break even if all individuals purchased it (a 'pooling' contract). Rothschild and Stiglitz

demonstrate that this *cannot* be equilibrium. Any contract such as  $C'$  in the shaded area in Figure 3 – with slightly *less* insurance coverage than  $C$  but at a *lower* price per dollar of coverage – would attract only the low-risk individuals. Given that, the contract  $C$  generates losses and would be withdrawn.

The only possible equilibrium, which is illustrated in Figure 4, is one in which the market distinguishes types by offering a contract  $B$  with complete coverage (which will be chosen by the high-risk individuals), and a contract  $D$  with partial insurance coverage (which the low-risk individuals prefer to full insurance at  $B$  and which the high-risk individuals do not prefer to full insurance at  $B$ ). In this case, the market ‘solves’ the screening problem, but at the cost of foreclosing otherwise feasible and desirable exchanges.

If, however, there are so few high-risk types that low-risk individuals are strictly better off at a pooling contract, then there can be no competitive equilibrium at all! The pooling contract with full insurance breaks the candidate separating equilibrium, but a contract at a slightly lower price and lower quantity of insurance cream skims the low-risk individuals. Thus the contract with full insurance cannot break even and is withdrawn.

With these intuitive graphs, Rothschild and Stiglitz demonstrate the nonrobustness to considerations of imperfect information of two central results of the neoclassical model—that equilibrium is characterized by supply equals demand, and that equilibrium always exists. Their paper represented the market as a more complicated interaction—as a game in which the uninformed party uses a menu of contracts to screen individuals by their hidden characteristics.

In papers published over the next two decades, Stiglitz demonstrated how market responses to the screening problem could explain puzzles in equity, credit, and labor markets. In equity markets, when insiders in a firm have more information than outsiders, the controlling insiders’ willingness to issue equity conveys a signal that says that on average the shares are overpriced. The market responds by lowering the price. This discourages firms from issuing new shares and provides an explanation for the fact that firms have limited access to equity (Greenwald, Stiglitz and Weiss, 1984).

In credit markets, if prospective borrowers have more information than lenders about the riskiness of their investments, there are situations in which a lender will set his interest rate below the market-clearing rate. He will not wish to raise his interest rate to what the market will bear if an increase in the rate would lead the lowest-risk borrowers to drop out of the market and reduce the lender's expected return. In this case, credit rationing will occur, as demonstrated in Stiglitz and Weiss (1981).

In many markets, individuals can, at a cost, provide credible information about their characteristics. Then 'hidden characteristics' become public information. This led Stiglitz to examine the incentives to acquire and transmit information. A central point is that the *private* returns to the provision of information differ from the *social* returns; thus the level of information that is public in a signaling equilibrium has, in general, no efficiency properties. To see this, consider the following simple example from Stiglitz (1975).

Suppose that there are two ability types whose productivity is  $A^H$  and  $A^L$  (the more able can do in one hour what the less able take  $A^H/A^L$  hours to do). Suppose a fraction of the population  $p$  is high ability and a fraction  $1 - p$  is low ability. Ability is private information but, at a cost  $C$ , an individual can reveal it (as would occur, for instance, if there is a credential that only a high-ability type is able to obtain but that certifies a skill unrelated to productivity). Then there exist two equilibria – a *separating* equilibrium and a *pooling* equilibrium – if

$$A^L < A^H - C < pA^H + [1 - p]A^L.$$

If all other high-ability types screen, then the first inequality implies that the remaining high-ability individual has an incentive to screen. In doing so, he earns more than his alternative wage in the screening equilibrium,  $A^L$ . This establishes that a separating equilibrium exists.

However, if no other high-ability types screen, then both types are paid their average productivity, and the second inequality implies that the remaining high-ability individual has no incentive to screen. This establishes that a pooling equilibrium exists, as well, and that it Pareto dominates the separating equilibrium. In the separating equilibrium, each

worker fails to take into account the effect of his decision to screen on the wage of unscreened individuals. Individual decisions create a diffuse externality.

The fact that the investor in information must obtain a positive expected private return from his information-gathering activities led Stiglitz to a fundamental result in finance. There had long been a theory, the *efficient markets theory*, which states that the observation of prices in capital markets suffices to reveal all relevant private information. Grossman and Stiglitz (1980) showed that the theory was incorrect: if information is costly and markets are competitive, then there must be an ‘equilibrium degree of disequilibrium’ – persistent discrepancies between prices and ‘fundamental values’ that provide incentives for individuals to obtain information. In capital markets, prices serve two functions: besides being used in the conventional way to clear markets, they also convey information. When individuals invest in information and thereby learn that the return to a security is going to be high (or low), they bid its price up (or down), and thus the price system makes that information publicly available. But if all information were publicly conveyed, there would be no incentives for individuals to invest in information.

Differential information can be a source of pure economic rents. Stiglitz argued that firms exploit that fact by creating ‘noise’. Knowing that it is costly for customers to search, Salop and Stiglitz (1977) showed that stores can exploit that by varying their prices to extract rents from customers with high search costs. The market equilibrium prices serve to discriminate (imperfectly) among individuals with different search costs. These results overturned a standard theory, *the law of the single price* (a given commodity is sold at the same price in all stores). In a similar vein, Edlin and Stiglitz (1995) argued that managers will have an incentive to enhance asymmetries of information between them and rival managers and boards of directors, and thereby limit the scope for takeovers.

### **Hidden actions and agency theory**

In the standard neoclassical model, there are no conflicts of interest between economic actors. *Principal–agent* theory introduces conflicts of interest by specifying actions that cannot be observed. In this theory, a principal, who delegates a task to an agent, designs a contract that makes payment depend on observable circumstances (for

example, revenues) that are correlated with the desired, but unobservable, actions of the agent. Stephen Ross, James Mirrlees, and Joe Stiglitz contemporaneously developed principal–agent theory.

Stiglitz's initial contribution was stimulated by his observations in Kenya during parts of 1969-71. He analyzed a puzzle that had been recognized at least since Alfred Marshall – the apparent inefficiency of the institution of sharecropping, which assigns the tenant only a share of the marginal return to his effort. Stiglitz (1974) showed that sharecropping could be advantageous to tenants and landlords because of the *savings in monitoring costs* compared to a wage system with costly monitoring, the *increases in output* compared with a wage system with imperfect monitoring, and the *reduction in risk borne by tenants* compared with a system where workers pay fixed land rents but do not have access to risk markets.

Four insights in this paper and Stiglitz's other work in principal–agent theory have been important for further developments in economics.

1. It is sometimes useful to take the *transaction*, rather than the *market*, as the unit of analysis.
2. There is a trade-off between incentives and insurance if the principal has greater ability to bear risk than the agent. Since the first-order effect of distorting incentives is zero, the provision of a small level of insurance is in this case always welfare-increasing.
3. The distribution of wealth influences the extent of agency problems, in both rich and poor countries.
4. Agency problems are pervasive in a complex modern economy. Agency theory has contributed to new theories of public finance, of corporate governance, and of positive political economy.

However, in many situations, incentive contracts cannot be written because an individual's individual contribution to output is not well observed. In that case, pure economic rents can play an important role in providing incentives, as in Shapiro and Stiglitz (1983). But integrating the idea of rents into a model of a competitive economy

initially posed a puzzle. If price exceeds marginal cost, why doesn't competition lead to price-cutting?

An antecedent to Shapiro and Stiglitz (1984) was the model in Shapiro (1983) of rents as an incentive to quality that is unobservable at the time of purchase. In that model, firms develop a reputation for quality by the goods that they produce. The prospect of the loss of rents to a firm that 'milks' its reputation by selling at a high price less than the promised quality induces the firm to live up to consumers' expectations. Competition does not lead to price-cutting because consumers come to learn that, if the price is too low, firms do not have an incentive to maintain their reputation, and therefore the offer of high-quality goods at a low price is not credible.

Shapiro and Stiglitz (1984) extends to a labor market the idea of rents as an incentive device for difficult-to-monitor effort. Workers in this model are identical (so there is no selection issue). Firms observe at random intervals whether a worker is working or shirking. To elicit effort, each firm would want to offer a higher wage than other firms so that, if it finds a worker shirking, he suffers a cost when he is fired. But if it benefited one firm to raise its wage, it would benefit all firms. This might seem like the dilemma where, if every spectator in the stadium stands up to get a better view, no one sees any better. But, when all employers raise their wages, those actions have a real effect on the economy: unemployment emerges since the higher wage rations firms' demand for workers. Now a worker who is fired cannot immediately find another job. This makes job loss costly. Unemployment creates an incentive to work on the job rather than shirk, and so competitive equilibrium will be characterized by unemployment and pure labor rents.

### **Macroeconomics**

Informational imperfections limit the scope of equity and credit markets, as well as insurance and labor markets. In a series of papers with Bruce Greenwald and Andrew Weiss (for example, Greenwald, Stiglitz and Weiss, 1984), Stiglitz drew out the implications for the fluctuations in output and employment that have characterized capitalism throughout its history. The central argument was this. Limitations in the scope of equity markets in the presence of significant bankruptcy costs lead firms to

behave in a risk-averse manner. They pay attention to own risk, while traditional theory suggests that the only risk that firms should care about is the correlation with the stock market. Higher levels of investment or production entail increased debt, and, as debt is increased, the bankruptcy probability is increased. Firms will therefore produce and invest only up to the point where expected marginal returns equal expected marginal bankruptcy costs. This has four implications that contrast with what would occur with perfect markets:

1. *Amplification of small shocks.* Changes in the net worth of the firm or in the riskiness of the environment affect the production and investment decisions of the firm (in contrast to the standard theory). For a highly leveraged firm, small changes in demand can result in large changes in output and employment. Thus, disturbances to the economy tend to be amplified.

2. *Persistence.* If for some reason net worth is reduced at a given time, production falls in subsequent periods. Only gradually will production be restored to normal, as net worth builds up again.

3. *Risk-averse banks.* Banks are a specialized kind of firm whose production activity is making loans. A reduction in the net worth of banks and an increase in the riskiness of their environment will lead them to contract their output – that is, to make fewer loans, which has multiplier effects throughout the economy.

4. *Worsening of the applicant pool for loans during a recession.* For any given bankruptcy cost, there is a critical net worth such that, below that net worth, firms act in a risk-loving manner, and, above that net worth, in a risk-averse manner. If the economy moves into a recession and firms find their net worth decreases, good (that is, risk-averse) firms reduce their loan applications, bad (that is, risk-loving) firms increase their loan applications, so that there is an increasing proportion of bad (that is, low net worth) applicants. These effects may be so strong as to lead to a situation where banks make no loans at all!

During Stiglitz's tenure as Chief Economist of the World Bank, the contrast between his perspective on macroeconomics and the perspective based on well-functioning markets came to a head. These are two starkly different ways of looking at the world. If there are well-functioning markets, then opening up capital markets will lead to efficient

outcomes. This view was identified with the US Treasury Department and the IMF in the 1990s. During the 1997–99 East Asian financial crisis, a condition of IMF financial support was that the East Asian economies adopt contractionary fiscal and monetary policies. The contractionary monetary policy would raise interest rates and, at some point, reverse private capital outflows and restore the ability of the East Asian countries to repay their foreign debts. It was argued that the basic reason for the East Asian financial crisis was lack of transparency, or corruption, in the business practices of these economies, which frightened away foreign investors.

In contrast, Furman and Stiglitz (1998) argued that a lack of transparency did not cause the crisis (although it aggravated the effects of the downturn once it began). They argued that small developing countries are financially fragile. There are pervasive externalities in banks' and firms' decisions to obtain short-term loans from abroad. Each bank and each firm takes the risk environment as given, and yet the aggregate set of decisions determines the risk of a financial crisis. This meant that some limits on free capital markets were appropriate in developing countries. Moreover, Furman and Stiglitz argued that policies that increased interest rates in the East Asian economies would greatly erode the net worth of debtors, and the erosion of their net worth would lead to a recession that could not easily be reversed.

Stiglitz's views ultimately were influential. However, the openness of his conflict with the IMF and US Treasury frayed his relationships with many people in Washington and hastened his departure from the World Bank.

### **Development economics**

Whereas macroeconomics remains split between different schools with contrasting views on the importance of market imperfections, the centrality of market imperfections in the field of development economics is not questioned. Before the development of the economics of information (and also the development of game theoretic models of political economy), economists lacked a broad framework for understanding of the sources of the imperfections in markets. Economists who tried to design policies to fit developing country markets generally assumed rigidities in markets, but did not explain them by reference to a choice-based perspective. Abhijit Banerjee (2001, p. 465) has

characterized development economics in this era as the ‘ugly duckling’ of economics: ‘It was full of strange assumptions and contrary logic, and all the other [fields of] economics made fun of it.’

Stiglitz’s work in development economics played a major role in transforming the field. His models were important in establishing (a) that positive feedback mechanisms can give rise to multiple equilibria and underdevelopment traps; (b) that, because the causes of market failures and constraints on growth vary greatly from setting to setting, analysis has to be done case by case; and (c) that non-market institutions need have no efficiency properties. Important applications of these ideas are below.

*Trade-off between diversity of goods and scale economies.* In a path-breaking model, Dixit and Stiglitz (1977) posed a question seemingly unrelated to development. This paper addressed the question: will a market solution yield the socially optimum kinds and quantities of commodities if there are multiple possible varieties of goods, each produced by a single firm with increasing returns to scale in production? The desire by consumers for diversity meant that there would be many firms, but not necessarily the optimal number.

Dixit and Stiglitz used a modeling assumption that turned out to be very useful analytically. By assuming a continuum of goods, their set-up lets the modeler respect the discrete nature of many location decisions and yet analyze the model in terms of the behavior of continuous variables like the share of manufacturing in a particular region.

This model became a building block in models in the new fields of endogenous growth theory and economic geography. To understand the flavor of this work, consider an economy with three sectors: a low-technology sector, an advanced sector, and an intermediate sector that produces an array of non-traded, i.e., domestic, goods, modeled as Dixit–Stiglitz commodities, which are inputs into the advanced sector. An expansion of the advanced sector increases the demand for non-traded inputs, and so lowers their average costs and increases the available variety. With a greater variety of intermediate inputs, production in the advanced sector is more efficient. It can thus be the case that, when many other firms enter the advanced sector, it pays the remaining firms in the traditional sector to do so; but, when all other firms remain in the traditional, low-

technology sector, it pays the remaining firm to do so, too. A low-level equilibrium can therefore be sustained even when the economy is fully open to international trade.

*Breakdown of the Washington consensus.* The standard neoclassical model predicts that growth is inevitable in capital-poor market economies: over time, all economies will converge in per capita income. This model led a generation of economists to a simple set of policy prescriptions that would set the preconditions for growth: maintain macroeconomic stability (since high inflation interferes with the workings of the price system), limit government ownership of enterprise, and deregulate ('stabilize, privatize, and liberalize'). This so-called Washington consensus has broken down, in part because it has become clear that there are no sure-fire formulas for success, and in part because of the evolution of economic theory away from the perfect markets paradigm. The three central and closely related developments in economic theory have been the economics of information, game theory, and institutional economics. In the new economic theory, development is no longer seen primarily as a process of capital accumulation, but instead as a process of organizational change. Evidence of the breakdown of the Washington consensus is that a recent World Bank volume that reviews economic growth in developing countries in the 1990s states that 'The central message of this volume is that there is no unique universal set of rules [to promote growth]..[W]e need to get away from formulae and the search for elusive 'best practices' ....' (World Bank, 2005, p. xiii).

*Dysfunctional institutions.* In the past, many scholars have made the argument that institutions that emerge out of individual actions are necessarily optimal: they are there because their benefits outweigh the costs. Stiglitz's work on sharecropping (Stiglitz 1974) exemplifies that approach. However, as Stiglitz has often remarked, that analysis is partial equilibrium. That analysis studies the optimal contract while holding fixed everything else in the economy.

In many cases, however, contracts that individuals enter into impose externalities on other agents. There may be no forces that ensure the Pareto efficiency of the set of contracts that individuals adopt. For instance, when insurance is provided through family and friends as well as through the market, the informal insurance will *raise* welfare if it provides (sufficient) peer monitoring (Arnott and Stiglitz, 1990), but, otherwise, such insurance will *lower* welfare because the additional insurance exacerbates moral hazard

and so raises the cost of market insurance – an effect that no individual internalizes. The analysis of the inefficiency of contracting choices generalizes widely, for example, to technological change (Acemoglu, 1997), to neighborhood formation (Hoff and Sen, 2005), and to institutional change, as I discuss next.

One of the most important economic transformations in modern history began with the collapse of Communism in Eastern Europe and the former Soviet Union. The transition process in the 1990s entailed the creation of a new set of economic and political institutions and, in most countries, produced an unexpectedly deep and prolonged depression. In Russia and many other transition countries, the rapid transfer of state enterprises to private hands ('Big Bang privatization') did not lead to a political demand for institutional reforms needed to govern private property, as many economists had expected. Hoff and Stiglitz (2004; 2007) investigate the influence of economic policies on the demand for a rule of law. They show that Big Bang privatization can create powerful incentives to strip assets and to delay the establishment of a rule of law. This may result in a long period of economic decline. The cause is that no individual takes account of the effect of his economic choices on long-run institutional change.

### **Evaluation**

The high level of idealization in much of Stiglitz's formal work, and the surprising (or at least counter-Walrasian) results often obtained, have led his harshest critics to see in his work a predilection for the intriguing exception rather than the general rule: granted that market failures occur, how much do they really matter? From a staunch admirer, Avinash Dixit, one hears the statement that a paper by Stiglitz begins with the phrase, 'Assume there are two types'. However, the statement that 'there are two types' (or 'two actions') in Stiglitz's papers of the 1970s and 1980s marked a radical departure from the standard model, which implicitly assumes that in each market there is only one type (or one action); that is, that information in the market is symmetric. This modest relaxation of the perfect information assumption reveals that symmetric information is essential to the results of the standard neoclassical paradigm.

Stiglitz's work demonstrates that the standard theory misconstrues many of the virtues of the market. The standard theory exaggerates the role of prices in conveying

information about scarcity, and fails to take account of the difficulties of making the price system work. At the same time, the standard theory fails to recognize some central virtues of the market – its ability to address problems of selection, incentives, information gathering, and innovation – because the standard paradigm is silent about all these problems.

Compared to the state of economics in 1970, mainstream theory can now accommodate a far broader range of phenomena. But there is no unified single framework, as there was in the Walrasian paradigm. Instead, there is a fragmented collection of disparate models. Distinct models are capable of explaining the same phenomena but are difficult to distinguish empirically.

A further problem that remains for future work is that multiple forms of private information exist within any sector. With multiple incentive problems, it is necessary to consider the distortions that result when incentives for more easily observed actions are created at the expense of less easily observed actions.

In these ways, Stiglitz's theoretical work has contributed to the resurgence of empirical work in economics. Kim, Morse and Zingales (2006) document a reversal in the previous 30 years in the importance of theoretical work, which dominated the profession in the 1970s and 1980s, and gave way to the primacy of empirical work in the early 1990s. Much of that empirical work is a response to a body of theory that established that neither markets nor governments work perfectly. Stiglitz's demonstration that imperfect information undermines the results of the standard neoclassical model has shifted not only models of thought in economics, but also the relative importance of different sources of knowledge about the economy.

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Figure 1

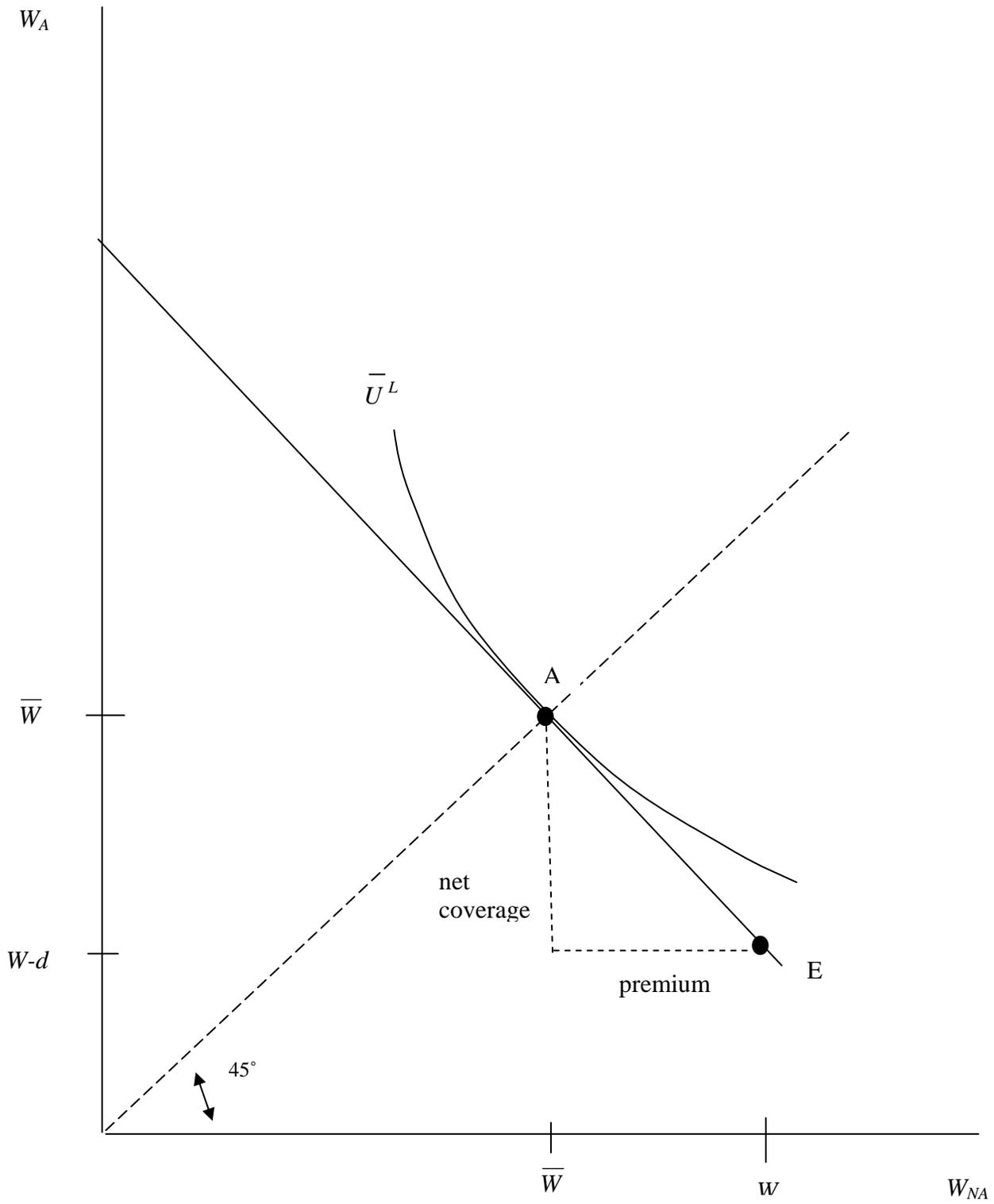


Figure 2

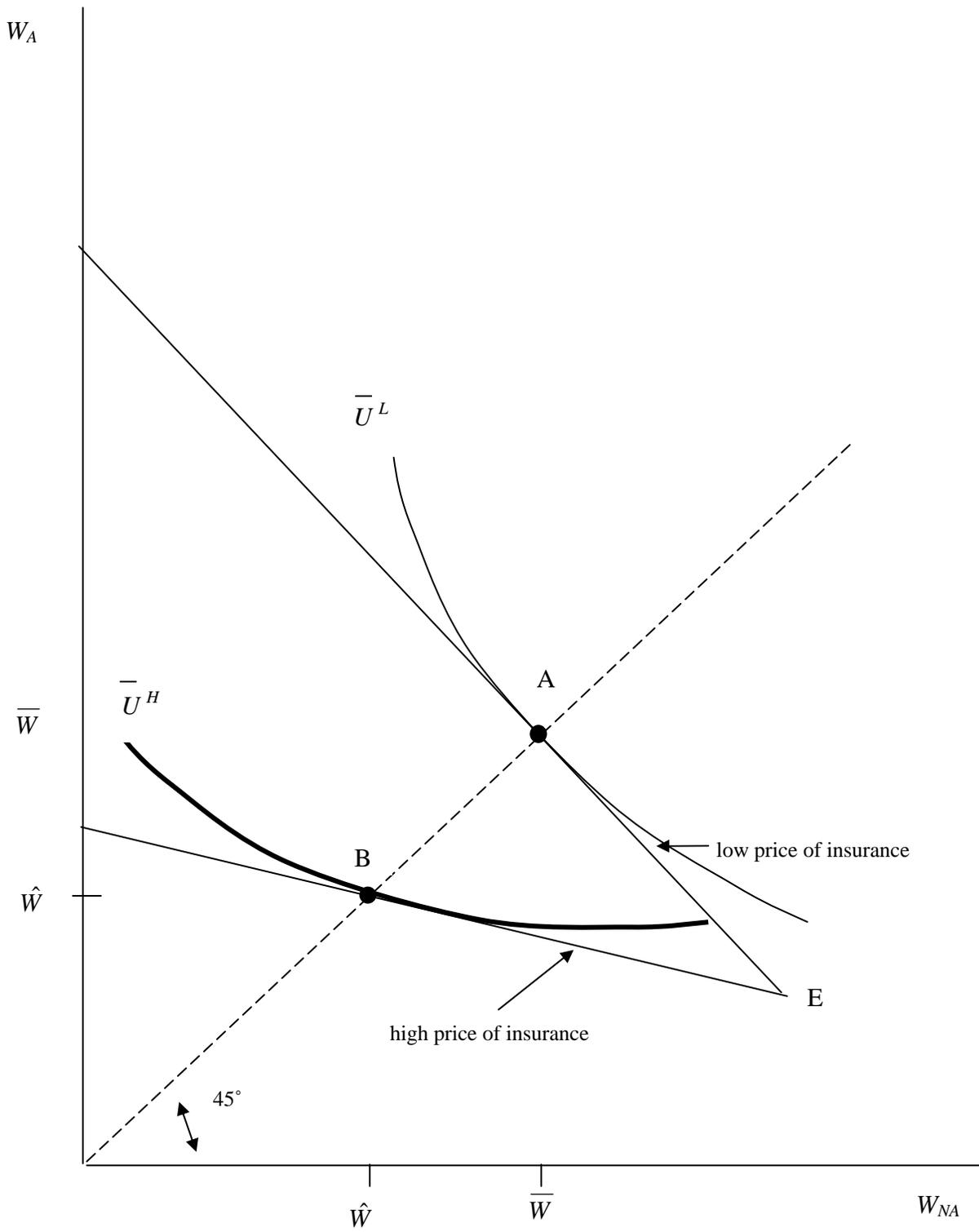


Figure 3

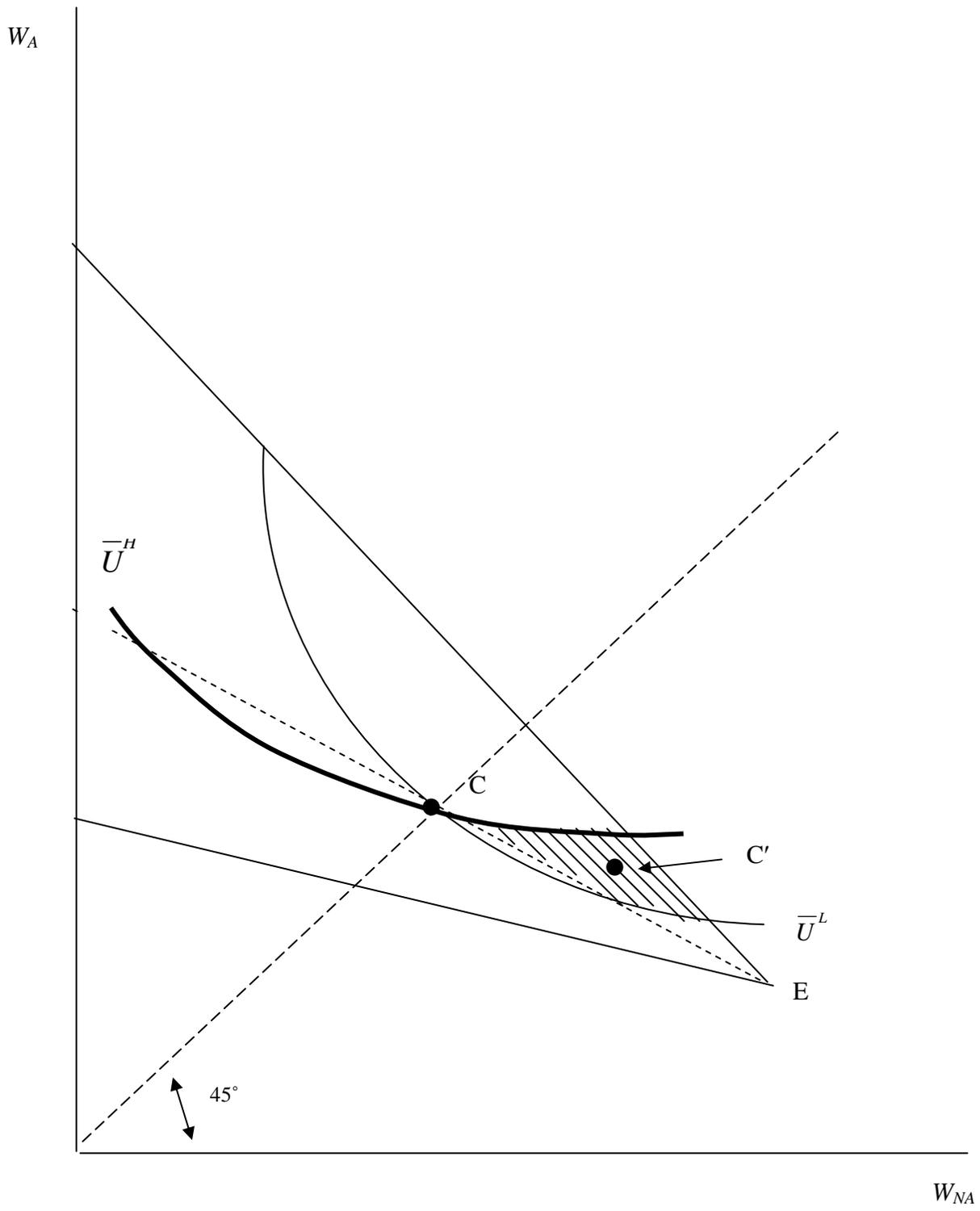


Figure 4

