Local Impacts of Resource Abundance: What Have We Learned?

Introduction

A well-developed academic literature examines the socioeconomic impacts of resource abundance, especially at the country level. The focus has been on whether natural resource abundance is bad for economic development—the natural resource curse. Aragón, Chuhan-Pole, and Land (2015) systematically review the evidence and theoretical arguments behind the resource curse, along with other impacts at the country level. In this chapter, we develop a simple analytical framework to understand how resource booms affect local communities. The framework identifies four ways in which this can have a local economic impact—specialization in the resource sector and reallocation of inputs away from tradable sectors such as manufacturing; the market channel of increased demand for local labor, goods, and services; the fiscal channel of increased public spending on local services through the taxation of natural resource wealth; and negative production externalities such as environmental pollution.

This analysis highlights the importance of the market compared with fiscal mechanisms to create positive impacts, and shows that the channel through which resource rents reach a local community matters. This chapter also underscores the importance of local institutions for the effectiveness of the fiscal channel in creating beneficial impacts, because resource wealth creates rents—and often very large ones—that can be easily appropriated when institutions are weak.

Available empirical evidence on the impact of resource abundance on local growth, employment, and living standards is examined to better understand the importance of these different mechanisms. Similar to recent country-level findings, the evidence suggests that a local resource curse is not inevitable, and that in some cases extractive activity has lifted local growth. It also supports the importance of the channel through which resource rents are distributed. When these are
distributed using public channels, a resource windfall does not seem to improve welfare. But when resource rents reach a local community through the market channel, some positive effects may occur. More research is needed to see whether developing local supply chain linkages is more effective in improving local living standards than sharing revenue windfalls with local governments when institutions are weak. Despite the paucity of empirical evidence, especially for developing countries, the emerging literature is opening new ways of looking at the relationship between natural resources and economic development.

**Theory and Evidence on the Impact of Resource Abundance at the Country Level**

The literature on the economic impact of natural resources in developing countries is largely dominated by the phenomenon that some resource-rich economies tend to perform worse than resource-poor ones; that is, they are afflicted by the resource curse. Examples abound of poor outcomes in countries with abundant natural wealth. For instance, Nigeria’s oil revenues increased almost tenfold between 1965 and 2000, but real income stagnated and poverty and inequality increased (van der Ploeg 2011). Similarly, Venezuela, a primary beneficiary of increases in oil prices in the 1970s, suffered a steep decline in output per capita of 28 percent from 1970 to 1990 (Lane and Tornell 1996). In Zambia, Africa’s largest copper exporter, the incidence of poverty remained virtually unchanged, at 60 percent, during 2000–10, despite a doubling of economic output. There are exceptions to the resource curse—notably, Botswana, Chile, and Norway, all of which were successful in transforming their resource wealth into economic prosperity. Moreover, resource-abundant countries such as Canada, Sweden, and the United States, which are now high-income countries, were long ago able to diversify their economies and reduce their dependence on natural resources.

**Analytical Underpinnings of the Negative Impact of Resource Abundance**

Theoretical explanations for the resource curse can be grouped into three broad categories. First, a boom in extractive industries can crowd out other industries, such as manufacturing, that are more conducive to long-term economic growth—the Dutch disease argument. Second, dependence on primary sectors could leave an economy vulnerable to changes in commodity prices, which may be more volatile. And third, the windfall from natural resources can exacerbate rent seeking, corruption, and conflict in a society. These phenomena can lead to bad economic policies, the deterioration of institutions, and lower income and growth. We now look in more detail at the three categories of explanations for the resource curse.
**Dutch disease.** This provides one of the earliest explanations of the linkage between resource abundance and lower economic growth (Corden 1984; Corden and Neary 1982). Dutch disease models typically assume that an economy produces traded goods (manufacturing) and nontraded goods (services). In these models, a boom in natural resource exports represents an income windfall that increases aggregate demand and raises the price of nontraded goods relative to traded goods. In the short run, this relative price movement, which is effectively an appreciation of the real exchange rate, causes the output of the nontraded sector to expand, while the traded sector contracts and factors of production such as labor and capital reallocate from the traded sector to the nontraded sector. The effect on the wage-rent ratio depends on the labor intensity of the nontraded industry. In particular, if this industry were more labor intensive, the wage-rent ratio would increase.

This market response to a revenue windfall is not by itself negative. To explain why resource booms can weigh down economic growth, one needs to assume that the traded sector, crowded out by extractive industries, is somehow more conducive to supporting growth. This would be the case if the traded sector benefits most from learning by doing and other positive externalities, such as human capital externalities (Krugman 1987; Matsuyama 1992; Sachs and Warner 1995; Torvik 2001). If the traded sector exhibits increasing returns to scale, as in big push models (Murphy, Shleifer, and Vishny 1989), then a shift of resources away from this sector could also be detrimental to growth.

**Exposure to changes in commodity prices.** A second argument for the negative effect of resource abundance on growth relies on the observed pattern of higher volatility and, until early 2000, the long-term decline of commodity prices. Thus, natural resource exporters may be exposed to higher terms-of-trade volatility. The uncertainty stemming from this could, in turn, reduce investment in physical or human capital. If technological progress is assumed to be driven by learning by doing or human capital externalities, then the decline of investment associated with price volatility can constrain economic growth. In resource-exporting countries, fiscal revenue is often heavily dependent on resource revenue. For example, Angola, the Republic of Congo, and Equatorial Guinea rely on oil for about 75 percent of government revenues. Price volatility and associated boom/bust cycles can make it more difficult to implement prudent fiscal policies.

**Rent seeking, corruption, and conflict.** Political economy channels for explaining poor development outcomes in resource-rich countries is receiving increasing attention. This is because resource abundance, as noted earlier, creates rents that can be easily appropriated when institutions are weak. In the absence of strong institutions, resource rents may foster rent-seeking behavior, increase corruption, erode the quality of institutions, and, in extreme cases, even generate violent conflict.
Aragón, Chuhan-Pole, and Land (2015) identify at least five political economy channels in the literature through which resources can hinder economic growth and welfare. First, resource abundance may increase rent seeking—for example, the appropriation of resource rents via production taxes or other transfers—and reduce net return to investments, which lead to lower growth (Lane and Tornell 1996; Tornell and Lane 1999). Second, resource windfalls can attract entrepreneurial skills away from productive activities to more profitable but socially inefficient rent seeking (Mehlum, Moene, and Torvik 2006; Torvik 2001). Third, rent-grabbing possibilities can increase political corruption (Brollo et al. 2013), and undermine the development of democratic institutions (Ross 2001). With additional revenues, politicians can appropriate rents, while increasing spending to appease voters. The increased opportunities for grabbing rents, in turn, attract other corrupt individuals to the political arena, leading to a deterioration in the quality of politicians. The high reliance of budgetary revenue on natural resources, as opposed to the taxation of citizens, also weakens government incentives to build or strengthen institutions of accountability. Fourth, resource booms can increase the returns to predation and promote rapacity over these resources, which can fuel violence and civil conflict (Collier and Hoeffler 2005; Grossman 1999; Hirshleifer 1991). Conflict can have adverse consequences for a country’s capital stock and investment, reversing development gains and weakening state capacity. But resource booms do not necessarily increase violence. Dal Bó and Dal Bó (2011) argue that resource booms could reduce violence if they raise the opportunity cost of participating in violence—for example, by increasing the returns from productive activity. And fifth, ethnic differences allow the formation of stable coalitions, which can facilitate resource-fueled conflict (Caselli and Coleman 2013).

Country-Level Evidence of the Natural Resource Curse

Several studies systematically examine the empirical evidence on the resource curse. Early analyses from a cross-section of countries found a negative association between resource abundance (measured as the relative size of primary exports) and gross domestic product growth (Gylfason, Herbertsson, and Zoega 1999; Leite and Weidmann 1999; Sachs and Warner 1995, 2001; Sala-i-Martin 1997). Recent empirical studies (Lederman and Maloney 2007, 2008), however, find that evidence of the natural resource curse is far from conclusive.

One concern regards the robustness of the results to alternative specifications and measures of resource abundance. A fundamental critique offered is that the measure of resource abundance (usually the relative size of commodity exports) is endogenous. For instance, other confounding factors, such as the quality of institutions, may affect the growth and size of commodity exports. In that case, the resource curse would just reflect the fact that countries with bad
institutions have lower growth and are less industrialized, and therefore are more dependent on primary sectors. For instance, Sala-i-Martin and Subramanian (2003) and Bulte, Damania, and Deacon (2005) find that when adding measures of institutions as additional controls, the relation between resource abundance and growth disappears. Brunnschweiler (2008) and Brunnschweiler and Bulte (2008) go a step further by arguing that the usual measures of resource abundance are actually a measure of resource dependence. They treat this variable as endogenous, and find that the negative relation between resource dependence and growth disappears.

One possibility emerging from the empirical literature is that the effects of resource abundance on growth may be heterogeneous, and could depend on the quality of institutions. For instance, the effect could be negative in a country with bad institutions, but positive where institutions are good (Robinson, Torvik, and Verdier 2006). Failing to account for this heterogeneity may lead to the wrong conclusion that the effect is insignificant.

**Political Economy Explanations for the Resource Curse**

The cross-country empirical evidence points to the relevance of institutions, though it offers mixed support for Dutch disease and terms-of-trade volatility as explanations for the resource curse. This suggests that rent seeking and worsening governance play an important role in explaining the resource curse.

Three sets of results point to the importance of institutions in understanding the natural resource curse. The first suggests that the resource curse may be associated with “point source” resources. These are resources such as oil, minerals, and plantation crops whose production is concentrated in a few geographic or economic areas. This concentration makes it easier for interest groups to control and capture rents. For instance, Isham et al. (2005) and Bulte, Damania, and Deacon (2005) find that point source resources are associated with weaker political institutions and lower growth. Boschini, Pettersson, and Roine (2007) extend this analysis by interacting the type of resource with the quality of institutions. They find the combination of abundance of point source resources with low-quality institutions is detrimental for economic growth.

The second set of results suggests that resource abundance is associated with an increase in corruption, deterioration of democracy, and armed conflict, especially in countries with weak democratic institutions. These results are consistent with the rent-seeking explanation of the resource curse. For instance, Ades and Di Tella (1999), using a cross-section of countries, find that natural resource wealth is negatively correlated with subjective measures of political corruption. Bhattacharyya and Hodler (2010), using panel data for countries, find that natural resource abundance is associated with perceived corruption only in countries with a history of nondemocratic rule. They interpret this as evidence that resource rents lead to corruption if the quality of
democratic institutions is poor. Tsui (2011) uses panel data for countries and oil discoveries to show that oil discoveries reduce the quality of democratic institutions, but only in already-nondemocratic regimes. Oil does not seem to affect institutions in countries with established democracies. A large body of cross-country evidence points to a positive relation between resource abundance and violent conflict (Collier, Hoeffler, and Söderbom 2004; Fearon 2005; Fearon and Laitin 2003; Humphreys 2005; Lujala 2010; Ross 2004). This relation seems to be driven by point source resources, such as oil, diamonds, and narcotics. These results, however, may not be robust to including country fixed effects, which account for several time-invariant unobserved omitted variables. For example, Cotet and Tsui (2013), using panel data for countries and including country fixed effects, fail to find a significant effect of oil discoveries (large and small) on conflict. But nonlinearities in the relation between resource abundance and conflict might exist because, using a similar approach, Lei and Michaels (2011) find a positive relation between large oil discoveries and conflict.

The third set of results suggests that a negative relation between resource abundance and growth is present only in countries with bad institutions. In an influential paper, Mehlum, Moene, and Torvik (2006) show the evidence for the resource curse is essentially driven by countries with low-quality institutions; in countries with high-quality institutions, resource abundance does not affect growth. Similar results are obtained by Collier and Hoeffler (2009), who define poor-quality institutions as those lacking strong checks and balances; and Boschini, Pettersson, and Roine (2007), who find the resource curse is present only in countries with low-quality institutions and easily appropriable resources, such as precious minerals and diamonds.

**Insights from the Country-Level Literature**

Three conclusions emerge from the literature examining the impact of natural resource abundance at the national level. First, natural resources, by themselves, do not seem to be bad for economic growth. But they become a problem in the absence of good institutions. Second, the problem is bigger for some types of resources that are easily appropriated, such as oil, minerals, and diamonds. And third, deindustrialization and price volatility may also matter, but not as much as initially believed. We now discuss these conclusions in greater detail.

At the country level, the policy implications that flow from these insights relate to savings and investment of resource rents and macroeconomic measures to address commodity price volatility. The country-level empirical evidence, however, suggests that the main challenge is not to identify the right policies but to encourage the development of societies that are willing or able to adopt them. Hence, the main policy recommendation from this literature is that resource-rich countries should improve their institutions to make the best use
of a resource boom and avoid its deleterious effects. This is consistent with several efforts to improve governance in resource-rich economies and to understand how to build durable and effective institutions. This recommendation is consistent with the vast literature in development economics that highlights the importance of institutions—especially the ones that improve property rights—for economic development (Acemoglu, Johnson, and Robinson 2005; Acemoglu, Robinson, and Woren 2012; Nunn 2009).

The use of country-level data has significantly advanced our knowledge about the impact of resource abundance. This literature, however, has several limitations. There are still relevant concerns over the causal interpretation of results, and the presence of omitted variables, reverse causality, and measurement errors are important empirical challenges. Scholars have tried to address them by including a richer set of covariates, exploiting panel data sets, and using instrumental variables. But these solutions still fall short relative to the experimental and quasi-experimental approaches currently used in applied economics.

The positive or negative impacts of resource abundance are unlikely to be uniformly distributed in a country. For instance, many negative spillovers, such as pollution and population displacement, have a local geographic scope, and the distribution of resource rents usually targets certain populations. Similarly, the impact of the demand by extractive industries for inputs may be felt more intensively in specific local markets. These local phenomena cannot be studied by looking at cross-country variations.

The main policy implication of all this—that countries need to improve institutions to benefit from a resource boom—may only offer limited practical policy insights. An unsolved question is what stakeholders—such as extractive firms, local communities, and funding agencies—can do short of fostering institutional reform to ameliorate the negative effects of resource abundance and enhance its potential benefits. Exploring the local impacts of resource abundance may shed some light on this question.

Assessing the Local Impacts of Resource Abundance

Attention is increasingly turning to analyzing the impact of resource windfalls on local communities where these resources are sourced. In contrast to the country-level literature, which focuses on the country as a unit of observation, the focus on subnational units such as states, counties, or municipalities has improved the empirical strategy for assessing the impact of resource booms by exploiting variations within a country. However, new empirical challenges need to be taken into account, in particular confounding changes in prices and population that may affect the interpretation of results.
Analytical Framework
The economic literature suggests at least four possible ways to analyze the local economic impact of natural resource booms. One is to analyze resource abundance as a change in local endowments, leading to specialization in primary sectors and corresponding changes in relative prices at the expense of other traded sectors, such as agriculture and manufacturing—in effect, a local Dutch disease. Another is to consider natural resources as a source of fiscal revenue for local communities, so that a resource boom translates into a fiscal revenue windfall. This fiscal channel is at the center of the country-level literature. A more novel approach relies on viewing resource booms as an increase in the demand for local goods and inputs; that is, a positive demand shock. There are also the impacts of resource abundance on local environmental and social conditions, such as pollution, which have started to receive empirical attention.

Resource Endowments and Specialization
If we treat local areas as small open economies, we can study the change in endowments within the framework of the standard Hecksher-Ohlin model of international trade. Specialization in the primary sector involves an increase in input prices such as wages, prompting a reallocation of inputs. In turn, this increases the cost and price of nontraded goods relative to traded goods. If traded sectors experience faster productivity gains, then specialization in natural resources would hinder long-term economic growth and local income, assuming the population is fixed. A schematic of this model is presented in annex figure 2A.1. Predictions from models incorporating this specialization mechanism can be tested empirically: a change in relative prices, with the price of nontraded goods rising relative to traded goods; a reduction in the local size of industries producing nationally traded goods—for example, measured by employment shares, share in wage bills, or share in local income; and a negative impact on local economic growth and income.

Local Fiscal Revenue Windfall
Natural resources can be considered a source of fiscal revenue for local communities; that is, a fiscal revenue windfall. This windfall eases the hard budget constraint of local governments and supports higher public spending. The revenue windfall could have both positive and negative effects on economic welfare. Figure 2.1 presents an analytical framework of the transmission channels and the impact on local outcomes. As long as the windfall is used to improve the quantity or quality of local public goods and services, such as roads, hospital, schools, and housing, the potential is there to improve welfare outcomes, such as in health and education.

Moreover, to the extent that public goods are productive inputs or create positive spillovers, as in the case of transportation infrastructure, a resource boom could also increase local income and growth. The positive effect of fiscal
revenue windfalls is underpinned by several assumptions: local politicians are responsive to the broad population, which requires well-functioning local institutions and a healthy degree of political competition (Besley and Burgess 2002), and local bureaucracies have the technical capacity to provide those public goods and services. Lack of responsiveness from local politicians to demands from the broad population, or lack of technical capacities among local bureaucrats, may undermine the positive effect of fiscal revenue windfalls on the provision of public goods and local living conditions.

At the local level, a vast literature suggests that clientelism and vote buying are important distortions. Clientelism refers to transfers made by a political elite to a narrow group of poor or disadvantaged voters to secure their votes and maintain political power. Evidence shows this targeted redistribution may cause a deterioration in the provision of public goods. For instance, Khemani (2013) documents a negative relation between vote buying in the Philippines and the delivery of primary health services. A case study of local governments in rural Maharashtra shows that clientelism may lead to poor governance, even in a context of free and fair elections and active political competition (Anderson, Francois, and Kotwal 2015).

The “rapacity” and “opportunity cost” effects, which are discussed in the country-level literature on conflict, may also explain a failure of resource windfalls to be converted into welfare gains at the local level. Booms associated with “point” resources such as oil and gold (as distinct from “dispersed” resources) may be more prone to generate a rapacity effect, since they mostly increase appropriable rents, but may have a relatively smaller impact on local wages. The literature also indicates that an absence of adequate reallocation and
compensation policies amid competition for scarce resources will have negative redistributional consequences and can lead to conflict.

The fiscal revenue windfall channel highlights the importance of local institutions, especially political institutions and fiscal decentralization arrangements. These institutions are the subject of increased attention in the local-level literature. The theoretical political economy literature has emphasized the importance of political institutions, such as electoral rules and the form of government (Lizzeri and Persico 2001; Persson 2002). Subnational evidence is consistent with these predictions. For instance, Besley and Case (2003) find that different political institutions between U.S. states—such as voter registration procedures, use of primaries, restrictions on campaign contributions, and supermajority requirements—affect the degree of political competition and representativeness of elected authorities. In turn, this translates into differences in spending and taxation. Pande (2003) finds that political reservation in India—where some seats in state legislatures are reserved to candidates from minority castes—affects the size of public transfers to some disadvantaged groups. Zhang et al. (2004) find that the use of elections to select local authorities in China (instead of appointment by the central government) was more conducive to a better allocation of public expenditures. Similarly, Besley and Coate (2003) find that elected utility regulators implement more proconsumer policies than appointed ones.

A second set of institutions includes fiscal decentralization arrangements. These are rules that define how fiscal revenue will be collected, distributed, and used at the subnational level. The literature on fiscal decentralization is discussed in more detail in a later section on the role of institutions at the local level.

Local Demand Shock
A resource boom can represent an increase in demand for local goods and inputs (Aragón and Rud 2013). A positive demand shock is plausible in contexts in which extractive industries use locally supplied inputs, such as labor or intermediate materials. Note that a similar effect could occur if the rents of extractive industries are transferred directly to the local population. Think of this as a direct dividend. Examples of this are the impact benefit agreements in Canada and the permanent fund dividend in Alaska. The extent of the economic linkages of extractive activities determines the size of the local demand shock. It should be noted, however, that strong backward linkages cannot be assumed in all contexts.

A useful framework for examining the general equilibrium effect of such localized demand shocks is provided by models of spatial equilibrium, which are increasingly used to analyze local housing and labor markets. One commonly used model is the Rosen-Roback framework, in which a country is made up of
several cities or local economies, and every local economy produces a single internationally traded good using labor, land, and a local amenity. Labor is homogenous and in infinite supply, while land is in fixed supply and immobile. A resource boom would mostly benefit owners of immobile factors, and real wages are equalized across locations. Figure 2.2 shows a framework for understanding how this positive demand shock impacts local outcomes.

Extending this framework to incorporate an upward-sloping supply curve for both labor and land or housing (Greenstone, Hornbeck, and Moretti 2010; Moretti 2011) yields more nuanced effects for a local demand shock. A positive shock in local demand for labor would initially increase nominal wages. This, in turn, would attract workers from other cities, pushing down wages and increasing housing costs. The net effect, however, depends on the elasticity of

Figure 2.2 Effects of a Local Demand Shock

- Natural resource abundance
- Increase in local labor demand
- Increase in nominal wages
- Increase in real wages
- Attracting workers from other cities, increase in population
- Agglomeration economies
- Increase in productivity
- Decrease in nominal wages, increase in housing costs
- Congestion in public services (that is, education)
- No significant effect on real wages
- Increase in nontradable sectors’ output, ambiguous effect on tradable sectors’ output
supply of both labor and housing. Thus, the demand shock can lead to an increase in real wages and the welfare of workers. Under certain conditions—for example, if workers in different industries are substitutable—wider positive spillovers are also possible.

Spatial equilibrium models suggest that local demand shocks attract workers and increase the local population. But this may well also increase congestion and create additional pressure on local services, such as education and health. Yet, population growth can also generate positive effects from agglomeration economies—gains in productivity associated with the clustering of economic activity. A growing body of evidence, mostly from the United States, suggests the size of agglomeration economies in manufacturing and high-tech industries is not trivial. However, there is little evidence on the size of agglomeration economies generated by extractive industries. Agglomeration effects are explored by Fafchamps, Koelle, and Shilpi (2015) on the contribution of gold mining to proto-urbanization in Ghana, which draws on central place theory.

Spatial equilibrium models also suggest heterogeneous effects across tradable and nontradable sectors. In particular, Moretti (2011) predicts that demand shock will mostly benefit the nontradable sector, such as services. The effect on tradable sectors is ambiguous, and may be negative due to the increase in wages and land rents. But a beneficial effect may arise from increasing agglomeration economies associated with larger populations. It is therefore not clear whether a resource boom encourages or crowds out manufacturing, and therefore contrasts with the standard Dutch disease argument, which would predict deindustrialization.

Thus, a spatial-equilibrium-type framework for examining the effect of localized demand shocks predicts several impacts of a resource boom if there are strong backward linkages:

- Resource booms have a positive effect on nominal wages and labor outcomes, such as participation rate, number of hours worked, or employment rates.
- Resource booms can increase real wages and real incomes of local populations, and lower the incidence of poverty.
- Positive spillovers may occur in industries not directly linked to the extractive activity and surrounding localities.
- Resource booms may be associated with the migration of workers and an increase in the prices of nontraded goods, such as housing.

These predictions have important implications for empirical analysis. One is that migration induced by a resource boom may change the spatial distribution of a population’s productivity. This could happen, for instance, if high-productivity workers benefit from the boom or face lower migration costs, or if low-productivity workers are displaced from resource-rich areas. The worry is
that an increase in local real incomes would just reflect changes in the composition of populations and not real improvements in economic well-being. The importance of these compositional effects is case specific.\textsuperscript{12}

While this framework predicts a possible positive impact of resource booms on real income, it is less clear what the effect would be on other measures of well-being, such as education and health. These outcomes could improve due to an income effect. Also, if the resource boom is biased toward high-skilled workers, it could increase the returns to education. But the increase in wages could also increase the opportunity cost of education and discourage educational attainment (Atkin 2012). A similar effect could occur if the extractive industry demands low-skilled workers, thus reducing the skill premium. An added consideration for health is that environmental pollution can reduce or offset the benefits from higher income.

However, the literature on country case studies amply highlights that extractive industries in less developed and remote settings are associated with limited local hiring, procurement, product sales, and distribution of profit, especially if large-scale and foreign owned. In the policy arena, the central pillar of the Africa Mining Vision of 2009 is the aspiration to move mining out of the enclave and into a more locally integrated form of socioeconomic development.

**Negative Externalities**

Mining and mineral processing are associated with several types of negative externalities affecting local community welfare. For instance, these activities often generate significant amounts of air pollutants, such as dust from blasting and earth-moving operations, fumes from smelters and refineries, and the engines of heavy machinery. If toxic emissions are quite large, they can deposit on the ground as acid rain, which contributes to environmental degradation (Menz and Seip 2004). Extractive activities also release industry-specific pollutants—such as cyanide, sulfuric acid, mercury, heavy metals, and acidic drainages (Dudka and Adriano 1997; Salomons 1995)—which also contribute to the negative, cumulative effects on the quality of soil and water sources. Similarly, small-scale and artisanal mining operations can pollute the air and water. The most notorious example is pollution from mercury used in gold amalgamation.

Environmental pollution can adversely impact health (Currie et al. 2013; Graff-Zivin and Neidell 2013) and, more broadly, labor supply and productivity (Graff-Zivin and Neidell 2012; Hanna and Oliva 2011). There is evidence that pollution adversely affects cognitive outcomes and educational attainment (Almond, Edlund, and Palme 2009; Lavy, Ebenstein, and Roth 2012) and increases school absenteeism (Currie et al. 2009; Gilliland et al. 2001; Park et al. 2002; Ransom and Pope 1992).

Loss of agricultural productivity is another important pollution externality (Aragón and Rud 2015), and recent literature has examined the mechanisms
through which this takes place. One is by directly affecting crop health and growth (Heck et al. 1982; Miller 1988; Marshall, Ashmore, and Hinchcliffe 1997), which translates into lower yields. Another is by degrading the quality of key agricultural inputs, such as soil and water (EPA 2012; Menz and Seip 2004). For instance, deposition of air pollutants in the form of acid rain can lead to soil degradation. The increased acidity leaches nutrients from the soil, reduces the ability of plants to absorb remaining nutrients, and releases toxic metals such as aluminum. Air pollution can reduce labor productivity in general (Chang et al. 2014; Graff-Zivin and Neidell 2012). The loss of agricultural productivity can have a negative impact on agricultural output, which affects the incomes of farmers and rural populations. This externality is particularly relevant when extractive industries are located in the vicinity of rural areas where agriculture remains an important source of livelihood.

Figure 2.3 presents the framework for understanding the negative externalities of environmental pollution from mining. This framework has several implications for empirical analysis. It suggests that examining the effect of resource booms on nonincome measures of well-being, such as indicators of human health (mortality rate and incidence of illness), would be worthwhile. It points to other possible outcomes, such as worker productivity, labor supply, and agricultural output. It also emphasizes the loss of agricultural productivity, through which resource booms could negatively affect local incomes, especially in rural areas.

**Figure 2.3 Negative Externalities of Environmental Pollution**

- Natural resource abundance → Environmental pollution
- Environmental pollution → Decrease in agriculture productivity
- Environmental pollution → Negative effect on human health
  - Loss of human capital
  - Decrease in labor supply and productivity
    - Decrease in income and living conditions
    - Decrease in rural income
  - Negative effect on school and cognitive outcomes, increase in school absenteeism
- Decrease in agriculture productivity
  - Decrease in rural income
Empirical Evidence on Mining’s Local Impacts

In contrast to the country-level literature, the empirical literature exploiting within-country variation is more recent and less developed. A growing number of studies are nevertheless expanding this literature, which is reviewed by Aragón, Chuhan-Pole, and Land (2015). Broadly, it focuses on the impact of resource abundance on growth, employment and local living standards, corruption and conflict, and pollution.

Impact on Growth

Using a cross-section of subnational data from the United States, several studies have replicated the growth regressions used in the cross-country literature (Douglas and Walker 2013; James and Aadland 2011; Papyrakis and Gerlagh 2007). Similarly, Zuo and Schieffer (2014) examine the impact of resource abundance on growth using data from Chinese provinces. For the most part, these studies detect a local resource curse (table 2.1). However, it is difficult to interpret these results in a causal way because they suffer from the same limitations of omitted variable bias, reverse causality, and measurement error as country-level resource curse empirics.

Impact on Employment and Local Living Standards

In a shift away from the cross-country growth regressions, several studies treat resource booms and busts in developed resource-rich countries (Australia, Canada, and the United States) as shocks to the local demand of labor and examined the resulting economic spillovers (table 2.2). These studies show that booms in coal mining, oil, and natural gas generate positive employment spillovers—that is, an increase in jobs and nominal wages in other industries—in

<table>
<thead>
<tr>
<th>Paper</th>
<th>Explanatory variable</th>
<th>Outcome variable</th>
<th>Sign</th>
<th>Country, data level</th>
<th>Identification strategy</th>
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<tbody>
<tr>
<td>James and Aadland (2011)</td>
<td>Share of earnings in resource-extraction industries</td>
<td>– United States, county level</td>
<td>Cross-sectional OLS</td>
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<tr>
<td>Zuo and Jack (2014)</td>
<td>Provincial annual energy production per capita, or provincial annual energy production, or ratio of regional energy production to GDP</td>
<td>– China, province level</td>
<td>Fixed-effect panel model</td>
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Source: Aragón, Chuhan-Pole, and Land 2015.
Note: – = a negative relation; OLS = ordinary least squares.
### Table 2.2  Empirical Evidence of the Impact of Resource Abundance on Local Living Standards

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<thead>
<tr>
<th>Paper</th>
<th>Explanatory variable</th>
<th>Outcome variable</th>
<th>Sign</th>
<th>Country, data level</th>
<th>Identification strategy</th>
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<td>Allcott and Keniston (2014)</td>
<td>Whether the county produces any oil or gas in any year after 1969</td>
<td>Income growth rate, wages, Manufacturing employment and output</td>
<td>+</td>
<td>United States, county level</td>
<td>Difference-in-differences</td>
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<tr>
<td></td>
<td></td>
<td>Factor productivity</td>
<td>0</td>
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<tr>
<td>Aragón and Rud (2014)</td>
<td>Gold mine production</td>
<td>Household income</td>
<td>+</td>
<td>Peru, household level</td>
<td>Difference-in-differences</td>
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<tr>
<td></td>
<td>Mining transfer</td>
<td>Municipality revenues and expenditures</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Household income</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black et al. (2005)</td>
<td>Whether the county is the coal boom county</td>
<td>Employment and wages</td>
<td>+</td>
<td>United States, county level</td>
<td>Instrumental variables</td>
</tr>
<tr>
<td>Caselli and Michaels (2013)</td>
<td>Oil output</td>
<td>Local government revenues</td>
<td>+</td>
<td>Brazil, municipality level</td>
<td>Instrumental variables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local government spending</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local public service</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Household income</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fleming and Measham (2014)</td>
<td>Indicator of having a coal seam gas operation</td>
<td>Income growth, employment</td>
<td>+</td>
<td>Australia, individual level</td>
<td>Cross-sectional OLS</td>
</tr>
<tr>
<td>Jacobsen and Baker (2016)</td>
<td>Whether the county is the oil and gas boom county</td>
<td>Nominal income, wages, employment, and population</td>
<td>+</td>
<td>United States, county level</td>
<td>Fixed effect panel model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturing employment</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agriculture employment</td>
<td>−</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Women: service sector employment</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: skilled manual jobs employment</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mine closings</td>
<td>Women: agriculture employment</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: agriculture employment</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loayza et al. (2013)</td>
<td>Mining production</td>
<td>Household consumption, literacy</td>
<td>+</td>
<td>Peru, district level</td>
<td>Matching and propensity score</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poverty rate</td>
<td>−</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Consumption inequality</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marchand (2012)</td>
<td>Indicator of getting 10% or more of their total earnings from the energy extraction sector</td>
<td>Employment and earnings</td>
<td>+</td>
<td>Canada, census subdivision level</td>
<td>Difference-in-differences</td>
</tr>
</tbody>
</table>

(continued next page)
the short term. But they provide less clarity on the crowding-out of local manufacturing, with some documenting a reduction in the relative size of manufacturing and others finding evidence of increased manufacturing activity. This points to resource booms generating possible agglomeration effects (increase in the size of local markets) that benefit local manufacturing. Another limitation of these studies is that they do not examine the effects on real income and other measures of well-being.

Whether the local effects of resource booms carry over to less developed countries is being addressed by a limited but growing literature. The analytical framework for local demand shocks suggests that the economic effects at the local level depend on several context-specific factors, such as the degree of economic linkages of extractive activities, which determine the size of the local demand shock, substitutability of labor among industries, and labor mobility.

Caselli and Michaels (2013) use municipality-level data to examine the local economic effect of oil-based fiscal windfalls in Brazil, and find that oil production is associated with an increase in oil royalties paid to local governments and in public spending. However, the impact on the provision of local public services is minimal. No significant improvement was found in housing quality or quantity, supply of educational or health inputs, or welfare receipts. Oil production also had a negligible effect on household income and population size. These findings suggest that oil production has not been particularly beneficial for local populations because the extent of economic linkages between oil companies and local economies is limited in Brazil. Instead, circumstantial evidence suggests that oil revenues were used to fund patronage and extract rents, and were embezzled by officials. Using data from all municipalities (not only the recipients of oil royalties), Brollo et al. (2013) find that fiscal windfalls are indeed associated with an increase in political corruption.

Table 2.2 (continued)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Explanatory variable</th>
<th>Outcome variable</th>
<th>Sign</th>
<th>Country, data Level</th>
<th>Identification strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michaels (2011)</td>
<td>Indicator of whether the county is located above an oil field or part of an oil field (or multiple oil fields) that contained at least 100 million barrels of oil before any oil was extracted</td>
<td>Employment share of mining</td>
<td>+</td>
<td>United States, county level</td>
<td>Fixed-effect panel model</td>
</tr>
<tr>
<td></td>
<td>has an oil field, or part of an oil field</td>
<td>Employment share of agriculture</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(or multiple oil fields) that contained at least 100 million barrels of oil before any oil was extracted</td>
<td>Employment share of manufacturing</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock of educated workers</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nominal income</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Aragón, Chuhan-Pole, and Land 2015.
Note: + = positive relation; − = negative relation; 0 = statistically insignificant; OLS = ordinary least squares.
Two studies have examined the impact of mining on local economies in Peru. Aragón and Rud (2013) analyze the importance of economic linkages in Yanacocha, a large gold mine in the Peruvian highlands. Using household-level microdata and a difference-in-differences approach, they find that backward linkages had a positive impact on real income and poverty reduction; and the benefits of the local demand shock extended to the local population not directly linked to mining, such as farmers and service workers. Similar to the findings of Caselli and Michaels (2013), Aragón and Rud find that the increased local revenue and public spending associated with a resource boom do not translate into higher household income. Using a rich data set at the district level, Loayza, Teran, and Rigolini (2013) find a positive relation between measures of living standards (such as poverty, consumption, and literacy) and mining production, but not with government transfers associated with mining tax revenue. Findings from Brazil and Peru cast some doubt on the usefulness of revenue-sharing schemes as a policy instrument for local communities seeking to benefit from resource booms.

The more recent, though limited, literature on developing countries suggests that the presence of backward economic linkages from mining might play an important role in determining local economic outcomes. But more research is needed to understand how revenue-sharing schemes can be an effective policy instrument for local communities seeking to benefit from resource booms.

In one of the few studies focusing on Africa, Kotsadam and Tolonen (2015) examine the effect of mining on local employment. They use a rich data set at the individual level for several Sub-Saharan African countries, and implement a difference-in-differences approach exploiting the opening and closure of mines. Their study finds that mine openings seem to create new employment opportunities outside agriculture and significant structural shifts. Interestingly, these effects are differentiated by gender. Women switch to service sectors, while men move to skilled manual jobs. Moreover, the participation rate of women decreases with mine openings, but it increases for men. These structural changes seem to persist after mine closures, at least for women. After a mine closure, men return to agricultural jobs, but women do not shift back to agricultural production; instead, they leave the labor force. The authors interpret these findings as evidence that mining works as a boom/bust economy at the local level in Africa, but with permanent (negative) effects on participation of women in the labor market.

Impact on Corruption and Conflict
A small but growing literature on within-country evidence linking resource booms to corruption and conflict is emerging (table 2.3). As discussed above, evidence from Brazil (Brollo et al. 2013; Caselli and Michaels 2013) suggests the fiscal revenue windfall associated with oil royalties has increased corruption
Table 2.3  Empirical Evidence of the Impact of Resource Abundance on Corruption and Conflict

<table>
<thead>
<tr>
<th>Paper</th>
<th>Explanatory variable</th>
<th>Outcome variable</th>
<th>Sign</th>
<th>Country, data level</th>
<th>Identification strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brollo et al. (2013)</td>
<td>Oil royalty revenue</td>
<td>Political corruption</td>
<td>+</td>
<td>Brazil, municipality level</td>
<td>Regression discontinuity</td>
</tr>
<tr>
<td>Dube and Vargas (2013)</td>
<td>Oil, coal, and gold prices</td>
<td>Quality of political candidates</td>
<td>−</td>
<td>Colombia, municipality level</td>
<td>Difference-in-differences</td>
</tr>
<tr>
<td>Monteiro and Ferraz (2010)</td>
<td>Oil royalty revenue</td>
<td>Incumbency advantage</td>
<td>+</td>
<td>Brazil, municipality level</td>
<td>Instrumental variables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Public employment</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Educational and health supply</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vicente (2010)</td>
<td>Oil discovery announcements</td>
<td>Perceived vote buying and corruption on public services</td>
<td>+</td>
<td>Africa, individual level</td>
<td>Difference-in-differences</td>
</tr>
</tbody>
</table>

Source: Aragón, Chuhan-Pole, and Land 2015.
Note: + = positive relation; − = negative relation; 0 = statistically insignificant.

and rent seeking at the local level. A fiscal revenue windfall is also associated with changes in political outcomes. For example, Brollo et al. (2013) argue that an increase in revenues allows bad politicians to increase public spending, while diverting rents. This translates into higher reelection rates of incumbent politicians. Monteiro and Ferraz (2010) document a similar increase in incumbency advantage, but only in the short term.

Anticipation of a windfall could change political behavior even before resources are extracted. This could happen because anticipated rents (from future resource extraction) increase the value of political positions, and politicians immediately start competing for office to capture future rents. Vicente (2010) examines this in the context of São Tomé and Príncipe’s announcement of oil discoveries, using microdata at the individual level with retrospective information on perceived corruption. The author finds that oil discovery announcements are associated with an increase in perceived vote buying and corruption across a range of public services, including customs, public procurement, state jobs, health care, and the police.

The empirical study of resource abundance vis-à-vis local conflict has focused on exploring two possible mechanisms, the opportunity cost and the
rapacity effect, which have different implications for the effect of resource booms on conflict, depending on the type of resource being exploited. Resources that increase local wages, such as agricultural products, decrease conflict by affecting the opportunity cost of conflict. By contrast, resources that create appropriable rents, such as oil, diamonds, and minerals, may encourage conflict through a rapacity effect. Dube and Vargas (2013) provide convincing evidence of the importance of both opportunity and rapacity effects. Using municipality-level data from Colombia, they find that increases in oil, coal, and gold prices are associated with intensified conflict, while the opposite is true for increases in the international prices of agricultural products, such as coffee, banana, sugar, palm, and tobacco.

Impact on Pollution
A vast literature highlights the potential for mining and other extractive industries to pollute the environment. The negative effect of pollution on human health and, through that channel, on labor supply and labor productivity has also been documented in several studies (see the section on negative externalities). Despite these findings, empirical work directly examining the socioeconomic impacts of mining-related pollution is limited.

Recent work examining mining pollution points to localized impacts on health and education. Rau, Reyes, and Urzúa (2013) examine the impact on educational achievement of children living in proximity to a deposit of mineral waste with hazardous levels of lead and other heavy metals, in northern Chile. These children were found to have higher concentrations of lead in their blood, and worse academic performance. The study estimates this translates into a significant loss of earnings in adulthood. Von der Goltz and Barnwal (2014) examine the effect of mining on health outcomes using a rich micro-level data set from 44 countries and a difference-in-differences approach. They find suggestive evidence that mining is associated with an increase in stunting among women and anemia among children. The effects are localized in the vicinity of mines (that is, within 5 kilometers). Interestingly, these effects occur despite an increase in household wealth, spotlighting the trade-off between economic benefits and health costs that mining communities may face. These results are, however, not conclusive. In a related study, Tolonen (2016) finds that among African countries, the opening of gold mines significantly reduces infant mortality. This evidence suggests that, in some cases, the local economic benefits from mining may offset pernicious effects due to pollution.

The importance of a pollution externality (that is, loss of agricultural productivity) that may occur when potentially polluting industries are located in the vicinity of rural areas is well highlighted by Aragón and Rud (2015). Their study focuses on the effect of pollution on agriculture in the context of large-scale gold mining in Ghana. The authors find robust evidence that cumulative gold
production (a measure of the stock of pollution) is associated with a significant reduction in agricultural productivity, with the effects concentrated closer to mines; that is, within a 20-kilometer radius and declining with distance. This loss of productivity is associated with an increase in rural poverty. They rule out alternative explanations—such as mines competing for local inputs (and increasing input prices), or changes in the composition of the local population—that may occur in the presence of selective migration (table 2.4).

**Insights on Impacts at the Local Level**

Although the literature on the local impact of natural resource abundance is still emerging, it is already providing valuable insights. In line with the country-level literature, it suggests that a local resource curse is not inevitable; indeed, there are examples in which resource abundance has no detrimental effects. A provocative idea is that the channel through which resource rents reach a local economy might matter. When resource rents are distributed using public channels (such as a revenue windfall to local governments), resource booms do not seem to improve living standards, and may even foster negative side effects such as conflict, rent seeking, and corruption. But when these rents are distributed through market channels (such as an increase in demand for local workers), resource booms may bring some economic benefits to the local population, at least in the near term. The failure of fiscal channels can reflect preexisting institutional factors that limit the responsiveness of local politicians and facilitate rent seeking, as suggested by the country-level literature.

No conclusive evidence has emerged showing that resource booms lead to deindustrialization, despite the increase in the price of local inputs. In some

**Table 2.4 Empirical Evidence of the Impact of Mining-Related Pollution**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Explanatory variable</th>
<th>Outcome variable</th>
<th>Sign</th>
<th>Country, data level</th>
<th>Identification strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Poverty</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiratory diseases among children</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rau et al. (2013)</td>
<td>Distance to the mineral waste site</td>
<td>Academic performance, earnings in adulthood</td>
<td>−</td>
<td>Chile, individual level</td>
<td>Two sample instrumental variables</td>
</tr>
<tr>
<td>von der Goltz and Barnwal (2014)</td>
<td>Indicator of whether the cluster is within 5 kilometers of the nearest mine</td>
<td>Stunting and anemia among children and young women</td>
<td>+</td>
<td>44 developing countries, individual level</td>
<td>Difference-in-differences</td>
</tr>
</tbody>
</table>

Source: Aragón, Chuhan-Pole, and Land 2015.

Note: + = positive relation; − = negative relation.
cases, resource booms are even associated with an increase in manufacturing activity. This finding is the opposite of what we would expect from the standard Dutch disease argument, and suggests that other effects, such as agglomeration economies, may be relevant.

The literature on the local impact of natural resource abundance highlights the importance of examining a broad range of outcomes, besides income and growth. Evidence linking resource booms to local demand shocks, employment shifts, and pollution suggests that natural abundance may also affect other measures of well-being, such as inequality, education, and health.

**Input-Output Analysis**
Analyses based on input-output and social accounting models are useful for economic planning and ex-ante impact evaluation. These tools construct mathematical models of an economy and then calculate the change on economic outcomes associated with changes in some variables, including spending or output. Depending on data availability, these models can be built to describe regional and local economies, and thus inform about impacts at the subnational level. Their predictions are informative about what the economic effect of a mining project could be. Some countries, including Canada and the United States, routinely use input-output models to assess the ex-ante economic impact of extractive industries. But a major limitation of these models is that they do not tell what the effect is, for reasons that are well known (the Lucas critique).

**Role of Institutions at the Local Level**
As noted above, a second set of local institutions for the effective use of fiscal revenues includes fiscal decentralization arrangements. These are rules that define how fiscal revenue will be collected, distributed, and used at the subnational level. Aragón, Chuhan-Pole, and Land (2015) find the literature points to a limited scope for the decentralization of mining-related taxes. The main sources of mining revenue, such as corporate tax and royalties, may be better managed by higher government tiers (national or regional) on grounds of efficiency, equity, and reduced administrative costs. Some tax tools, however, could be suitable to local governments, such as property taxes, surtaxes, and land-use fees. Importantly, this also points to the importance of intergovernmental transfers to match increased local needs and to compensate local populations.

In practice, intergovernmental transfers are important tools for redistributing mining revenue among local populations. Transfers consist of nonmatching unconditional transfers, nonmatching conditional transfers, and selective matching transfers (cost-sharing programs). From an analytical perspective, nonmatching transfers create an income effect, while matching transfers change the relative price of public goods, thus also creating a substitution effect.
Another way to classify transfers is based on their source of funding. Some transfers are paid for with funds from national budgets. Others are linked to a particular source of revenue or tax; this type of transfer, also called a revenue-sharing or tax-sharing scheme, is commonly used to distribute mining revenues. Revenue-sharing schemes usually define the sharing rate and allocation procedure by law and so are less subject to the uncertainties of annual budget negotiations. These schemes effectively give local recipients ownership over part of the stream of future fiscal revenue.

The main advantages of revenue-sharing schemes are their simplicity and transparency, but they also give incentives to local politicians to support mining activities. These schemes, however, have four distinct disadvantages. First, if based only on certain taxes, they may bias national tax policy; in particular, they may discourage national fiscal efforts to collect those taxes. Second, if they share the revenue from origin-based production (as in the case of mining-related sharing schemes), they can break the linkage between revenue needs and revenue means at the local level. In other words, targeted localities may end up receiving too many resources. In turn, this can reduce the accountability of local politicians and their incentives to spend public funds efficiently. A similar phenomenon can occur if the sharing rate is applied uniformly, and thus revenue is unrelated to actual spending needs. Third, if revenue-sharing schemes depend on only a few taxes (such as mining firm taxes), then their funding is exposed to industry shocks, such as changes in commodity prices. This can increase the volatility of local fiscal revenue. And fourth, if tax collection is done locally and shared with the national government, then revenue-sharing schemes can create perverse incentives among local authorities to reduce fiscal efforts or underreport tax revenues.

There has been a lack of quantitative studies examining how different fiscal decentralization arrangements to distribute mining revenues can shape the effect of mining revenue windfalls. The current literature mostly focuses on examining how different degrees of decentralization affect income growth or corruption at the country or regional level. These studies use measures of expenditure or revenue decentralization, such as the share of subnational governments in tax revenues or public spending. Although not aimed at understanding how decentralization of mining revenues affects local communities, the literature can be informative about the overall impact of fiscal decentralization.

Empirical work on the linkage between decentralization, corruption, and local capture in less developed economies shows that decentralization can facilitate capture of local governments and collusion between local officers and local elites. For instance, Galasso and Ravallion (2005) find the targeting performance of the Food for Education Program in Bangladesh is worse in communities where land inequality is greater; they interpret this as evidence of elite capture. In Ecuador, Araujo et al. (2008) found evidence that local capture of a social development fund was more likely in villages with greater inequality.
Jia and Nie (2015) show how decentralization has facilitated collusion between coal mines and industry regulators in China, and that this has poorer safety standards and an increased mortality rate for workers.

**Conclusion**

A review of the emerging research on the local impact of natural resource booms and sharing of resource rents is beginning to provide new insights on how the channels through which these shocks are transmitted matter. A number of empirical studies find that resource abundance may have negative effects, such as increasing corruption, causing a deterioration of local political processes, and even increasing conflict. This evidence is similar to the cross-country literature, but is far from conclusive.

The emerging research highlights the importance of studying other local phenomena, such as the general equilibrium effects of local demand shocks, migration, and environmental pollution. These factors may also affect welfare and make the impact of natural resources more nuanced. A well-developed literature is also discussing tools to distribute resource rents, and the principles that guide fiscal decentralization. Still, several limitations and unsolved questions merit further study.

A main limitation of the literature on the local impact of natural resource booms is that it is still emerging and, consequently, there is a paucity of robust empirical evidence on the effect of resource abundance on employment, local income, distribution of income, and poverty, especially in developing countries. The available evidence is sparse and focuses on a handful of countries—namely, Canada and the United States among developed countries and Brazil and Peru among developing countries. Research into other resource-rich contexts, particularly Sub-Saharan Africa, is needed to increase the external validity of these results and to better inform policy makers and practitioners.

A related issue is the limited number of quantitative studies exploring the effect of extractive industries on nonincome outcomes such as health, education, and pollution externalities. The few studies there are on this issue suggest that the impacts on health and agricultural productivity can be important and costly. Again, more research is needed to gain a more complete view of the scope and magnitude of these negative spillovers, and to better understand the mitigating actions.

Because the empirical literature on the local impacts of resource booms is still emerging, findings need to be interpreted carefully. For example, research highlights the importance of market compared to fiscal mechanisms to create positive local impacts. It suggests that in the context of already-weak institutions of governance, developing local supply chain linkages may be more effective in improving local living standards than sharing the revenue windfall with
local governments. More empirical analysis is needed, however, to confirm these initial findings, and to evaluate the effectiveness of different policies in developing these local linkages.

The findings of the literature review suggest that more quantitative research is needed to examine the effect of resource abundance on political outcomes. The existing evidence, mostly from Latin America (Brazil and Peru), suggests that revenue windfalls from resource abundance may hinder political selection and increase corruption. There is a paucity of evidence, however, from other regions with different institutional contexts, such as Sub-Saharan Africa. Different institutional arrangements may attenuate or exacerbate these negative effects. Because the delivery of public services and programs is increasingly being shifted to local governments, focusing the analysis on local politicians, local governance issues and institutions of accountability is of paramount importance. Evidence examining the effect of resource abundance on less violent forms of conflict, such as riots and civil unrest, is also lacking.

Empirical evidence assessing the impact of different fiscal decentralization arrangements on the political economy is also scant. The existing evidence examines the effect of the overall degree of decentralization, but it does not inform on the importance of specific institutional arrangements, such as type of transfers, type of revenue-sharing schemes, or type of competences devolved. These features may affect the impact of resource revenues on local income, corruption, and local political responsiveness. Similarly, evidence is thin on which institutional factors contribute to the success or failure of fiscal decentralization. Understanding these questions is crucial to inform the design of fiscal decentralization.

A related issue is the role of technical capacities of local bureaucrats and public officials. Even if local governments have the political will to use revenue windfalls to promote local development, they may lack the technical capacity to formulate and implement necessary public programs and projects. Some studies using the case of Peru suggest that lack of capacity may be important and affect the spending ability of local governments (Aragón 2013; Aragón and Casas 2009). More research is needed to understand the main technical constraints faced by local governments, their effect on the ability of communities to benefit from a revenue windfall, and the best policies to alleviate them.

Annex 2A: Schematic Model of Resource Endowment Changes

Figure 2A.1 presents a schematic model of a change in resource endowments within the framework of the standard Heckscher-Ohlin model of international trade, and the resulting specialization in the resource sector and crowding-out of tradable sectors such as manufacturing.
Notes

1. This chapter is a summary of Aragón, Chuhan-Pole, and Land (2015).
2. The literature on this is vast and has been reviewed extensively. For example, see Deacon (2011); Frankel (2011); Rosser (2006); Stevens (2003); and van der Ploeg (2011).
3. See van der Ploeg (2011, section 3.1) for a formal exposition.
4. This happens because the price of nontraded goods is set domestically, while the price of traded goods is set in international markets.
5. Note that in this context, short run and long run refer to whether capital is fixed or not. A more realistic model would assume that the extractive sector also employs labor and capital. In that case, in addition to the short-run changes in relative prices and crowding out of the traded sector (the spending effect), there would also be a reallocation of resources to the extractive sector, with negative effects on both traded and nontraded sectors.
6. Aghion et al. (2009) argue that with imperfect financial institutions, firms exposed to exchange rate fluctuations are more likely to hit liquidity constraints and be unable to invest. Gylfason, Herbertsson, and Zoega (1999) propose a model in which price volatility deters firms from moving toward high-skilled tradable sectors, which demand investments in human capital, and instead keep them producing commodities.
7. In the absence of good democratic checks and balances, the revenue windfall can fail to significantly improve the provision of public goods (Caselli and Michaels 2013) and lead instead to corruption and a worsening of political selection (Brollo et al. 2013).
8. For a comprehensive review of the literature, see Bardhan and Mookherjee (2012) and Vicente and Wantchekon (2009), and the references in these works.
9. In contexts with weaker democratic institutions, political capture may also be relevant. We discuss this literature in more detail in the section on the role of institutions at the local level.
10. However, booms associated with dispersed agricultural resources, such as coffee, bananas, and tobacco, may have a greater effect on local wages, and thus increase the opportunity cost for conflict participants (Dube and Vargas 2013).
11. See Moretti (2011, section 4.1) for a review of the evidence.
12. Some empirical strategies to address this concern include using individual panel data; focusing on subpopulations that reside in the locality before and after a resource boom; and examining observable population characteristics, such as measures of human capital, that may be indicative of the importance of compositional changes.
14. Using the same case but a different methodology, Monteiro and Ferraz (2010) document that oil windfalls are associated to reported increases in expenses and size of the public sector, but no improvement in public services to the local population.

15. Moreover, they find suggestive evidence that mining is associated with an increase in inequality. The authors highlight that this increase in inequality, among other factors, may explain the opposition of local communities to mining projects. A similar relationship among resource booms, income, and inequality was observed in Australia (Reeson, Measham, and Hosking 2012). Interestingly, this study suggests the relation between mining and inequality may have an inverted U-shape.

16. These economic linkages can also generate negative, unintended effects. For instance, Santos (2014) finds that the gold boom in Colombia increased child labor and reduced educational attainment.

17. This is a case of environmental negligence in northern Chile, in which hundreds of houses were built near a deposit of mineral waste.

18. The estimated figure is about $60,000 for the average affected individual.

19. Using satellite imagery, they also document an increase in the concentration of air pollutants near mines.


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Santos, Rafael José. 2014. “Not All That Glitters Is Gold: Gold Boom, Child Labor and Schooling in Colombia.” Documentos CEDE 31, Universidad de los Andes, Colombia.


