

# The Local Economic Impacts of Resource Abundance

What Have We Learned?

*Fernando M. Aragón*  
*Punam Chuhan-Pole*  
*Bryan Christopher Land*



**WORLD BANK GROUP**

Africa Region

Office of the Chief Economist

May 2015

## Abstract

What are the socioeconomic impacts of resource abundance? Are these effects different at the national and local levels? How could resource booms benefit (or harm) local communities? This paper reviews a vast literature examining these questions, with an emphasis on empirical works. First, the evidence and theoretical arguments behind the so-called resource curse, and other impacts at the country level, are reviewed. This cross-country literature highlights the importance of institutions. Then, a simple analytical framework is developed to understand how resource

booms could impact local communities, and the available empirical evidence is examined. This emerging literature exploits within-country variation and is opening new ways to think about the relation between natural resources and economic development. The main message is that other factors, such as market mechanisms and local spillovers, are also relevant for understanding the impact of resource abundance. Finally, the paper discusses issues related to fiscal decentralization and provides ideas for future research.

---

This paper is a product of the Office of the Chief Economist, Africa Region. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at [f.m.aragon@gmail.com](mailto:f.m.aragon@gmail.com) and [pchuhan@worldbank.org](mailto:pchuhan@worldbank.org).

*The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.*

# The Local Economic Impacts of Resource Abundance:

## What Have We Learned?\*

Fernando M. Aragón<sup>a</sup>

Punam Chuhan-Pole<sup>b</sup>

Bryan Christopher Land<sup>b</sup>

JEL Classification: H70, I30, O11, O33

Keywords: Local Impact, Natural Resources, Resource Curse, Welfare

---

\* This paper is part of the Socioeconomic Impact of Mining on Local Communities in Africa (P148422) research study, which is supported by the Africa Regional Studies Program of the World Bank. We thank Stuti Khemani for valuable comments on an earlier draft. We acknowledge the contributions of Francisco H. G. Ferreira and other participants at the Mid-Term Review Workshop of the study in May 2014. The findings and views expressed in this paper are entirely those of the authors.

<sup>a</sup> Department of Economics, Simon Fraser University.

<sup>b</sup> World Bank Group.

# 1 Introduction

The literature on the impact of resource abundance starts with the puzzling observation that some resource-rich countries tend to have worse economic performance than resource-poor countries. This phenomenon, the so-called natural resource curse, has dominated the debate on the economic impact of natural resources in developing countries. For instance, compare resource-rich Nigeria to resource-poor Republic of Korea; Singapore; and Taiwan, China. A telling example is República Bolivariana de Venezuela, a primary beneficiary of the increases in oil prices in the 1970s, which suffered a decline in per capita output of 28 percent from 1970 to 1990 (Lane and Tornell 1996, 216). Similarly, from 1965 to 2000, oil revenues in Nigeria increased almost tenfold. In that period, real income stagnated and both poverty and inequality increased (van der Ploeg 2011, 367).

The exceptions to this rule of the resource curse have, naturally, drawn attention. For instance, in the modern age, Botswana, Chile, and, Norway have been 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.

In this paper, we start by reviewing the literature on the economic effects of natural resource abundance. We focus on nonrenewable resources such as oil, gas, and minerals, although we also discuss some work that refers to a wider definition of natural resources. We start by reviewing the literature that motivates the natural resource curse and evaluates the impact of resource abundance at the country level (Section 2). This literature is well developed and has been reviewed extensively.<sup>1</sup> The main finding of this cross-country literature is that institutions are important in shaping the impact of natural resources.

The main contribution of this paper is reviewing the literature on the local impact of natural resource abundance (Section 3). The works reviewed define local community in a broad way as any subnational jurisdiction. This includes major subdivisions such as in federalized countries with states or provinces, and lesser subdivisions such as counties, districts, or even municipalities. The important feature is the use of within-country variation as a basis for

---

<sup>1</sup> For additional literature reviews, see Deacon (2011); Frankel (2011); Rosser (2006); Stevens (2003); and van der Ploeg (2011).

undertaking empirical analysis. This emerging literature reflects an active area of research and is currently shedding new light on mechanisms through which resource abundance can affect local communities (Section 3). This literature highlights the importance of considering market mechanisms and local negative spillovers, such as pollution, corruption and conflict, in addition to local institutions, for better understanding the impact of natural resources. At the core of this new approach is the understanding that the costs and benefits of resource abundance are not homogeneously distributed within a country. Instead, costs and benefits are usually borne, or captured, by different groups.

Finally, we discuss issues related to fiscal decentralization of mining revenues (Section 4), and provide some ideas for future work (Section 5).

## **2 Impacts at the country level**

In this section, we first discuss an analytical framework to think about how resource abundance could have negative economic effects. Then we examine the evidence available in the literature. Finally, we discuss the policy implications and the main limitations of country-level studies.

### **2.1 Analytical framework**

The theoretical explanations for the resource curse can be grouped into three categories. First, a boom in extractive industries can crowd out other industries, such as manufacturing, that are more conducive to long-term economic growth. This is the Dutch disease argument. Second, dependence on primary sectors could leave an economy overexposed to changes in commodity prices, which may be more volatile. Finally, the windfall from natural resources can exacerbate rent-seeking, corruption, and conflict in a society. These phenomena can lead to bad economic policies, deterioration of institutions, and lower income and growth.

#### **2.1.1 Dutch disease**

Dutch disease is one of the earliest theories linking resource abundance to lower economic growth (Corden 1984; Corden and Neary 1982). Dutch disease models usually consider an economy that produces traded and nontraded goods (we can think of them as manufactures

and services), and treat a boom in export of natural resources as an income windfall.<sup>2</sup>

This windfall increases aggregate demand, which in turn increases the price of nontraded goods relative to traded goods.<sup>3</sup> This is effectively an appreciation of the real exchange rate. In the short run, this change in relative prices triggers several adjustments in the economy. First, output of the nontraded sector expands while the traded sector contracts. Second, consistent with this change in output, production factors (such as labor and capital) reallocate from the traded sector to the nontraded sector. Finally, the economy fills its increased demand by importing more traded goods. In the long run, the effects on output and import are similar, though there would also be changes in the wage-rent ratio. The effect depends on labor intensity of the nontraded industry. In particular, if this industry were more labor intensive, the wage-rent ratio would increase.<sup>4</sup>

The argument above assumes that the extractive sector does not use any production factor. In that case, the effects are driven exclusively by changes in aggregate spending. 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. This is called the resource movement effect (Corden and Neary 1982). The effects in the long run are more nuanced. If the resource sector is labor intensive and manufacturing is capital intensive, a resource boom could actually lead to more industrialization. On the contrary, if the resource sector also uses capital, then the traded sector would decline, and labor would reallocate to the nontraded sector. In turn, this may lead to a depreciation of the real exchange rate.

In sum, under reasonable assumptions, Dutch disease models suggest that resource booms would lead to (1) an appreciation of the real exchange rate, and (2) reduction in output from traded sectors, such as manufacturing.

These effects by themselves are not negative. They are a market response to a revenue windfall, and reflect the adjustments of an economy to exploit its comparative advantages.

To explain why resource booms may reduce economic growth, we need to assume that the

---

<sup>2</sup> See van der Ploeg (2011, section 3.1) for a formal exposition.

<sup>3</sup> This happens because the price of nontraded goods is set domestically, while the price of traded goods is set in international markets.

<sup>4</sup> Note that in this context, short run and long run refer to whether capital is fixed or not.

traded sectors crowded out by extractive industries (like manufacturing) are somehow special: they are the engine of growth. Models usually attain this by assuming that traded sectors benefit most from learning by doing and other positive externalities, such as human capital externalities (Krugman 1987; Matsuyama 1992; Sachs and Warner 1995; Torvik 2001). In standard endogenous growth models, these positive externalities determine technological progress, and long-run economic growth. In this view, by reducing investment and employment in the traded sector, resource booms could reduce technological progress and have negative, long term, effects on growth and welfare.

Similar results could be obtained if trade sectors exhibit increasing returns to scale, as in big push models (Murphy, Shleifer, and Vishny 1989). In these models, the economy could make the transition from low-productivity cottage industries to high-productivity factory production if the size of the manufacturing sector is large enough. In that case, a resource boom that diverts resources away from manufacturing could frustrate or even reverse industrialization (Sachs and Warner 1999).

### **2.1.2 Exposure to changes in commodity prices**

A second argument relies on the observation that commodity prices tend to be more volatile and, until early 2000, exhibited a long-term decline. Thus, economies with high dependence on natural resources may be exposed to higher volatility of terms of trade.

The uncertainty stemming from this volatility would reduce investment in physical or human capital. For instance, 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.

The link with growth is similar to the Dutch disease argument. It is assumed that technological progress is driven by learning by doing or human capital externalities. Thus, the decline of investment associated to price volatility can hinder economic growth.

Price volatility can also affect growth by making it more difficult to implement sound, prudent policies. For instance, a resource boom may make a government more willing to increase spending and borrowing, using future resource revenue as collateral. If it fails to

anticipate a decline in commodity prices, this can leave the country with high debt and a low flow of foreign resources to service it. Thus, a resource boom could generate a debt-overhang problem (Manzano and Rigobon 2001).

### **2.1.3 Rent-seeking, corruption, and conflict**

The third set of explanations emphasizes political economy channels. The key idea is that resource abundance creates rents that, in the absence of good institutions, can be easily appropriated. The rents may foster rent-seeking behavior, increase corruption, and erode the quality of institutions. In extreme situations, competition for these rents can generate violent conflict.

The existing literature discusses at least five political economy channels through which resource abundance can hinder economic growth and welfare. First, resource abundance may increase costly rent-seeking and reduce net return to investment. For instance, Lane and Tornell (1996) and Tornell and Lane (1999) develop a model in which multiple powerful groups can appropriate resources via production taxes and targeted transfers. Note that the tax rate can be thought of as, effectively, the expropriation rate. In this scenario, a resource boom increases demand for transfers, which lead to an increase in the tax rate and a reduction in the net return to investment. This discourages investment and, through the reduction of learning by doing and capital externalities, has a negative effect on growth.

Second, resource windfalls can divert entrepreneurial talent away from productive activities toward unproductive rent-seeking. This idea is formalized in Torvik (2001) and Mehlum, Moene, and Torvik (2006). In these models, there are a fixed number of individuals with entrepreneurial skills. These skills can be used in two activities: a modern sector, or unproductive rent-seeking. It is assumed that the modern sector generates positive growth externalities, either through human capital externalities or demand complementarities, as in big push models (Murphy, Shleifer, and Vishny 1989). A resource boom makes rent-seeking more profitable and attracts more entrepreneurs to the rent-seeking sector. While this is optimal from an individual perspective, it is socially inefficient. In particular, the loss of positive externalities in the modern sector can lead to an overall negative impact on income and growth.

Third, resource windfalls can increase political corruption and, more broadly, hinder the



quality of governance. For instance, Brollo et al. (2013) develop a model in which resource abundance increases corruption. The main idea is that the increase in government revenues, and spending, makes it easier for politicians to grab rents without disappointing voters. Thus, corrupt incumbents can still be reelected.<sup>5</sup> Furthermore, the increase in rent-grabbing possibilities attracts other corrupt individuals to a political career, so the quality of the political elite deteriorates. In this view, resource booms can exacerbate the political agency problem and deteriorate political selection. Similar arguments have been proposed by political scientists. For example, Ross (2001) discusses several reasons why some natural resources, such as oil, may undermine democratic institutions.

Fourth, resource rents can fuel armed conflict. The key idea is that resource windfalls increase the “war chest” that organized groups can appropriate by fighting. This increases the returns to predation and promotes rapacity over these resources (Collier and Hoeffler 2005; Grossman 1999; Hirshleifer 1991). Resource booms, however, do not necessarily increase violence. In some cases, they could actually reduce it. This can happen if resource booms increase the returns from productive activities and, thus, the opportunity cost of participating in violence (Dal Bó and Dal Bó 2011). This is the so-called opportunity cost effect. For instance, an increase in agricultural prices may lead to higher rural wages, discourage workers from becoming warriors, and reduce the intensity of social conflict.

The role of resources on conflict may be facilitated by ethnic diversity. In this view, ethnic differences allow the formation of stable coalitions necessary to engage in civil conflict (Caselli and Coleman 2013). Resource-fueled conflict can have a negative effect on a country’s income and growth by destroying capital and discouraging investment. It can also have deeper, more damaging effects by reducing the effectiveness of property rights institutions (Hodler 2006), and weakening incentives to invest in state capacities. State capacity refers to the ability of the state to implement a range of policies such as raising taxes, enforcing contracts, and supporting markets through regulation or otherwise. Besley and Persson (2010) propose a model in which dependence on natural resources triggers a higher propensity toward conflict. The resulting political instability discourages political elites from investing in legal and fiscal capacities.

---

<sup>5</sup> This result hinges on the assumption that voters are rational, but imperfectly informed. In that case, voters use spending as a signal of a politician’s quality. With higher revenue, a corrupt politician can disguise himself or herself as honest by increasing public spending.

All these political economy explanations rely on the assumption that institutions are weak. In particular, they assume that institutions are unable to constrain expropriation and discretionary redistribution by interest groups.

## **2.2 Country-level evidence**

This section discusses some of the empirical evidence on the socioeconomic impacts of resource abundance using country-level data. First, we examine the evidence on the resource curse. Then, guided by the analytical framework discussed in the previous section, we explore evidence on the possible explanations. Finally, we discuss the importance of institutions to understand the impact of natural resources.

### **2.2.1 Natural resource curse**

Sachs and Warner (1995, 2001) were among the first to formally explore the relation between resource abundance and economic growth. Using a cross-section of countries, they find that resource abundance (measured as the relative size of primary exports) is negatively correlated to gross domestic product (GDP) growth. Other studies, using similar methodology, also document a similar negative correlation between measures of resource abundance and growth (Gylfason, Herbertsson, and Zoega 1999; Leite and Weidmann 1999; Sala-i-Martin 1997).

The evidence of the natural resource curse is, however, far from conclusive (Lederman and Maloney 2007, 2008). Recent empirical work questions the robustness of the results to alternative specifications and measures of resource abundance. For instance, Alexeev and Conrad (2009) depart from the growth regression approach and use, as an outcome, income per capita. They show that an abundance of oil and mineral resources is associated with higher income per capita. They also fail to find support for a deterioration of institutions due to natural resources.

A fundamental critique is that the measure of resource abundance (usually the relative size of commodity exports) is endogenous. For instance, there may be other confounding factors, such as quality of institutions, which may affect both 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 thus 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. Moreover, they find a positive relation between growth and alternative measures of resource endowment, such as value of natural wealth and subsoil assets. van der Ploeg and Poelhekke (2009, 2010) also find similar results when controlling for measures of output volatility.

A possibility is that the effect of resource abundance on growth may be heterogeneous; in particular, it could depend on the quality of institutions. For instance, the effect could be negative in a country with bad institutions, but positive when institutions are good (Robinson et al., 2006). Failing to account for this heterogeneity may lead to the wrong conclusion that the effect is insignificant.

Most of the country-level literature focuses on the effect of resource abundance on growth. There are, however, some studies focusing on other outcomes, such as inequality. For instance, Fum and Hodler (2010) and Leamer et al. (1999) find that resource abundance is associated with more inequality, especially in ethnically polarized societies. In contrast, Goderis and Malone (2011) find that inequality falls immediately after a resource boom, and returns to its previous level in the long run.

### **2.2.2 Possible explanations for the resource curse**

The debate of why the natural resource curse occurs is not yet settled. Cross-country empirical evidence offers mixed support for the Dutch disease and increase of terms-of-trade volatility as explanations for the resource curse. A more robust body of evidence points instead to the relevance of institutions. This suggests that rent-seeking and deterioration of governance may play an important role.

Several studies find strong evidence that resource booms are associated with the sectoral reallocation predicted by Dutch disease models, that is, reduction of the manufacturing sector and increase of imports (Harding and Venables 2010; Ismail 2010; Stijns 2003). This

evidence provides support to the first part of the Dutch disease argument, that is, that resource windfalls would lead to deindustrialization. These studies, however, fail to show evidence of the second part of the argument, that is, that real appreciation and the subsequent deindustrialization would reduce growth or income. For instance, Sala-i-Martin and Subramanian (2003) do not find a significant relationship between overvaluation of the exchange rate and economic growth.

There is also mixed empirical support for the hypothesis that terms-of-trade volatility is the main culprit. Using cross-sectional and panel regressions, Gylfason et al. (1999) do not find a negative relationship between volatility of the real exchange rate and growth. Sala-i-Martin and Subramanian (2003) document a significant, but not robust, relation. In contrast, van der Ploeg and Poelhekke (2009) find a negative and significant relation and argue that volatility is the key channel for the resource curse. The main differences between these studies are the set of control variables, measures of volatility, and sample of countries used.

Three sets of results point to the importance of institutions to understand the natural resource curse. As previously discussed, with weak institutions, resource windfalls can fuel opportunistic behavior such as rent-seeking. In turn, this may lead to deterioration of governance, corruption, and even armed conflict.

The first set of results suggests that the resource curse seems to be associated with the so-called “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 their rents. For instance, Bulte et al. (2005) and Isham et al. (2005) find that point-resources are associated with worse 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 seems to be 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, using a cross-section of countries, Ades and Di Tella (1999) find that natural resource wealth is correlated with worse subjective measures of

political corruption. Bhattacharyya and Hodler (2010) use a panel data of countries and 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.

Several empirical studies argue that resource abundance hinders democracy, and fosters authoritarian regimes, especially in African countries (Jensen and Wantchekon 2004; Ross 2001; Wantchekon 2002). Early evidence was based on cross-sectional analysis and case studies, and its internal validity is open to debate. A more recent paper (Tsui 2011) uses a more convincing identification strategy exploiting panel data of countries and oil discoveries. Tsui finds that oil discoveries indeed 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 civil war (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 accounts for several time-invariant unobserved omitted variables. In a recent study, Cotet and Tsui (2013) use a panel data of countries and include country fixed effects. In that case, they fail to find a significant effect of oil discoveries on conflict. Using a similar approach, however, Lei and Michaels (2011) do find a positive relation between oil and conflict. The main difference between these studies is that Lei and Michaels focus on large oil fields while Cotet and Tsui examine all fields, including small ones. This evidence is suggestive of nonlinearities in the relation between resource abundance and conflict.

Finally, the negative relation between resource abundance and growth seems to be present only in countries with already bad institutions. In an influential paper, Mehlum, Moene, and Torvik (2006) show that the resource curse is essentially driven by countries with low-quality institutions. In contrast, in countries with high-quality institutions, resource abundance does not affect growth. Using a panel data set of countries, Collier and Hoeffler (2009) find similar results. In particular, the resource curse seems to be avoided in countries with strong democratic checks and balances. Boschini, Pettersson, and Roine (2007) extend these results by adding differences in the type of resources. They find that the curse is present only in

countries with low-quality institutions and easily appropriable resources, such as precious minerals and diamonds.

### **2.3 Lessons, limitations, and policy implications**

The literature examining the impact of natural resource abundance at the national level is ample and quite mature. So, what have we learned? First, natural resources, by themselves, do not seem to be bad for economic growth. But they do become a problem in the absence of good institutions. Second, the problem is bigger for some types of resources whose rents are easier to appropriate (such as oil, minerals, and diamonds). Finally, deindustrialization and price volatility may also matter, but not as much as we initially believed.

What are the policy implications? Resource economists have long been studying how best to use scarce, nonrenewable resources. The key insight is that a fraction of rents from a nonrenewable resource should be saved and invested (Hartwick 1977). This is the so-called Hartwick rule.<sup>6</sup> In this view, the policy recommendation for a resource boom is quite straightforward: invest the resource rents in other forms of productive capital, such as public infrastructure, education and health, or financial assets. In practice, this recommendation has translated into establishing commodity funds or sovereign wealth funds. Originally set by a handful of oil-rich countries such as Kuwait, Norway, Saudi Arabia, and the United Arab Emirates, these funds have been increasingly adopted by other resource-rich countries such as Ghana, Kazakhstan, Nigeria, and Papua New Guinea.<sup>7</sup> An alternative, suboptimal, policy has been simply to accumulate foreign reserves.<sup>8</sup>

Few countries, however, follow this rule (van der Ploeg, 2011, section 4.2). Many resource-rich economies actually have negative rates of genuine saving, that is, they seem to be wasting or consuming their resource rents, rather than reinvesting them. The main challenge does not seem

---

<sup>6</sup> The fraction saved should be such that genuine savings are zero (Asheim, Buchholz, and Withagen 2003). Genuine savings, also known as adjusted net saving, take into account, national savings, investment in human capital, depletion of natural resources, and damage caused by pollution.

<sup>7</sup> Note, however, that having a commodity fund by itself does not guarantee that the country is adhering to an optimal saving policy, or that an interest group will not capture the rents.

<sup>8</sup> There are also several macroeconomic policy alternatives that could mitigate the side effects of commodity price volatility. For instance, producers could reduce their exposure by hedging in commodity future markets, or governments could negotiate debt to be indexed to commodity prices. In terms of monetary policy, a country could reduce the impact of terms-of-trade shocks by adopting a managed floating exchange rate regime or pegged exchange rates within target bands. Countries could also implement countercyclical fiscal rules that would force it to save export earnings during boom years (for instance, in a commodity or stability fund) in order to fuel spending during commodity busts. A good example of such an institutional arrangement is the case of Chile's budget rules (Frankel 2011).

to be finding the right policies, but instead making societies willing (or able) to adopt them. This goes back to having the right institutional environment.

Hence, the main recommendation from this literature is that resource-rich countries should improve their institutions in order to make the best use of a resource boom, and avoid its more 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 echoed by a 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).

This literature, however, suggests that core institutions, such as the ones needed to avoid the resource curse, are in part shaped by profound historical events. Recent theoretical work also points to fundamental factors, such as external threats and distribution of political power, as important drivers of state building (Persson and Besley 2009). Given these antecedents, it is not clear whether, and which, short-term policies could significantly improve the quality of these core institutions. More research in this area is needed.

The use of country-level data has significantly advanced our knowledge on the impact of resource abundance. This literature, however, has several limitations. First, there are still relevant concerns regarding the causal interpretation of results. The presence of omitted variables, reverse causality, and measurement error are important empirical challenges in this literature (van der Ploeg 2011, 381). Scholars have tried to address them by including a richer set of covariates, exploiting panel data sets, and using instrumental variables. These solutions, however, still fall short relative to the experimental and quasi-experimental approaches currently used in applied economics.

Second, the impacts (positive or negative) 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. Distribution of resource rents usually targets certain populations. Similarly, the impact of extractive industries' demand for inputs may be felt more intensively in specific local markets. These local phenomena cannot be studied by looking at cross-country variation.

Finally, while informative on the importance of nationwide institutions, this literature is silent regarding other factors that may also exacerbate the negative effects of resource abundance or

enhance its potential benefits. Understanding these factors can enrich the toolkit of policy makers and other stakeholders. Exploring the local impacts of resource abundance may shed some light on this question.

### **3 Impacts at the local level**

In this section, we examine the potential economic impacts of resource abundance from a local perspective. In contrast to the country-level literature, which focuses on a country as the unit of observation, we focus on subnational units such as states, counties, or municipalities. By exploiting variation *within a country*, this literature is able to improve the empirical strategy and explore novel mechanisms. There are, however, new empirical challenges that need to be taken into account, in particular confounding changes in prices and population that may affect the interpretation of results.

First, we develop an analytical framework for understanding how a resource boom can impact local communities. Second, we present the available empirical evidence using within-country variation. Finally, we discuss whether there is a local resource curse and point out some policy recommendations to mitigate negative effects of resource abundance at the local level.

#### **3.1 Analytical framework<sup>9</sup>**

The existing economic literature highlights at least four possible ways to analyze the local economic impact of natural resources and resource booms.

##### **3.1.1 Resource endowments and specialization**

First, resource abundance can be analyzed as a change in local endowments. If we treat local areas as small open economies, then we can study this change in endowments within the framework of the standard Heckscher-Ohlin model of international trade.

Within this framework, this change in endowments will imply a change in comparative advantages (figure AA.1). This will lead to specialization in primary sectors at the expense of other traded sectors, such as agriculture and manufacturing. The reallocation of inputs toward

---

<sup>9</sup> See diagrams in Appendix A for a graphic representation of the analytical framework.



the primary sector would require an increase in input prices, such as wages. In turn, this would increase the cost and price of nontraded goods relative to traded goods. This argument is basically an application of the Dutch disease models discussed in the cross-country literature.

In a similar way, the link between specialization and long-term outcomes is given by potential learning by doing or human capital spillovers associated with traded sectors. If these sectors experience faster productivity gains, then specialization in natural resources would hinder long-term economic growth and local income (Michaels 2011). Note that this argument assumes that population is fixed, and thus excludes possible migration that could occur as a response to a resource boom. Later we discuss models that relax this assumption.

Models stressing this specialization mechanism have several testable empirical predictions. First, they suggest that resource abundance would be associated with a reduction in the size of industries producing nationally traded goods. At the local level, these industries are usually considered to be manufacturing and agriculture. Some of the measures of industry size used are employment shares, share in wage bills, or share in local income. Second, they suggest that resource abundance could have a negative impact on economic growth and income. Finally, they also predict a change in relative prices. In particular, the price of nontraded goods would increase relative to traded goods. This result is equivalent to the real exchange appreciation predicted by Dutch disease models.

### **3.1.2 Fiscal revenue windfall**

A second way to analyze the local impact of natural resources is to consider them as a source of fiscal revenue to local communities, that is, a fiscal revenue windfall (figure AA.2). This windfall could have both positive and negative effects on economic welfare.

A positive effect can be generated by the increase in the budget constraint of local governments and the subsequent increase in public spending. This could potentially translate into better public good provision and better local infrastructure. In some cases, extractive firms directly improve local infrastructure and provide public services, such as roads, hospitals, schools, and housing, or contribute to local development projects. By improving the quantity or quality of local public goods, these interventions have the potential to improve human welfare outcomes, such as health and education. Moreover, to the extent that these public goods are productive inputs or create positive spillovers (as in the case of transport

infrastructure), a resource boom could also increase local income and growth.

This argument, however, relies on several assumptions. First, it requires that local politicians are responsive to demands from the broad population. In turn, this requires well-functioning local institutions and a healthy degree of political competition (Besley and Burgess 2002). In the absence of good democratic checks and balances, the revenue windfall can fail to significantly improve public good provision (Caselli and Michaels 2013) and lead instead to corruption and worsening of political selection (Brollo et al. 2013). Second, even if local politics made politicians responsive, it requires that local bureaucracies have the technical capacity to provide those public goods and services. This is not necessarily the case (Aragón and Casas 2009). Not surprisingly, practitioners usually highlight the need to develop managerial and planning skills when implementing decentralization processes (Litvack, Ahmed, and Bird 1998).

These two factors—lack of political responsiveness and lack of technical capacities—may undermine the positive effect of revenue windfalls on public good provision, 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 that this targeted redistribution may deteriorate provision of public goods.<sup>10</sup> For instance, in the Philippines, Khemani (2013) documents a negative relation between vote-buying and delivery of primary health services. Using the case of local governments in rural Maharashtra, Anderson, Francois and Kotwal (2014) argue that clientelism may lead to poor governance, even in a context of free and fair elections and active political competition.<sup>11</sup>

A similar negative effect on living conditions can occur due to violent conflict. A resource windfall can foster conflict by increasing the benefit interest groups could obtain with violence. This is the so-called rapacity effect discussed in the country-level literature. Note that this argument relies on the assumption that local governments, in control of the revenue windfall, are unable to commit to redistribute these resources (Lei and Michaels 2011). Resource booms, however, may also reduce conflict if they increase the opportunity cost for participants. This is

---

<sup>10</sup> For a comprehensive review of the literature see Bardhan and Mookherjee (2012) Vicente and Wantchekon (2009), and references therein.

<sup>11</sup> In contexts with weaker democratic institutions, political capture may also be relevant. We discuss this literature in more detail in Section 4.2.

the so-called opportunity cost effect.

In this case, the distribution and type of natural resources can be important. The important distinction is the degree of appropriability of the resource (Boschini, Petterson, and Roine 2007).<sup>12</sup> For instance, booms associated with point resources, such as oil and gold, 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. Booms associated with dispersed agricultural resources, such as coffee, banana, and tobacco, may have a greater effect on local wages, and thus increase the opportunity cost of conflict participants (Dube and Vargas 2013).

An additional source of conflict, complementary to the rent-seeking argument, is the change in land use (Hilson 2002). For instance, some modern open-pit mines may require land or access to water previously used for agriculture. This may create competing claims with existing local populations that may already be using those resources. Change in land use could also displace local populations and disrupt other activities such as hunting, fishing, and gathering. In the absence of adequate reallocation and compensation policies, this competition for resources can have negative redistributive consequences and lead to civil unrest and violence.

This discussion highlights the importance of local institutions. There are two sets of institutions that might be particularly relevant at the local level: political institutions and fiscal decentralization arrangements. In contrast to the institutions studied in the cross-country literature, these institutional arrangements are usually defined by national legislation and thus are, in principle, more susceptible to policy interventions.

Political institutions comprise the rules to select politicians, reelect incumbents, and restrict an incumbent's power. Similarly, they include the procedures citizens may need to take to become eligible voters, the set of electoral rules, among others. 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, or supermajority

---

<sup>12</sup> For analytical purposes, resources are classified as point and dispersed resources, the former being the most easily appropriated. In practice, the degree of appropriability is a continuum and depends on specific technological and institutional features. For instance, in some contexts, artisanal mining is a hybrid with dispersed activity and high labor participation, but with commercial structures that make rents easily appropriable.

requirements affect the degree of political competition and representativeness of elected authorities. In turn, this translates to differences in spending and taxation. In India, Pande (2003) finds that political reservation (wherein some seats in state legislatures are reserved to candidates from minority castes) affects the size of public transfers to some disadvantaged groups. In China, Zhang et al. (2004) find that the use of elections to select local authorities (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 pro-consumer 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. We will discuss in more detail the literature on fiscal decentralization in Section 4.

### **3.1.3 Local demand shocks**

The previous two analytical frameworks are closely related to mechanisms already studied at the country level. A more novel approach relies on thinking of resource booms as an increase in the demand of local goods and inputs, that is, a positive demand shock (Aragón and Rud 2013) (figure AA.3). This is plausible in contexts in which extractive industries use locally supplied inputs, such as labor or intermediate materials—that is, in cases when extractive industries have strong enough backward linkages.<sup>13</sup>

A useful framework to examine the general equilibrium effect of such localized demand shocks is provided by models of spatial equilibrium. These models, originally developed by urban economists, are increasingly used to analyze local housing and labor markets.

The most widely used model is the Rosen-Roback framework. This model considers a country composed of several local economies or cities. Every city produces a single internationally traded good using labor, land, and a local amenity. Workers' utility depends on nominal wages, cost of housing, and local amenities. Labor is homogeneous and perfectly mobile. Land is the only immobile factor, and its supply is fixed.

The key insight of this model is that, due to perfect mobility, the utility of workers in every

---

<sup>13</sup> A similar effect could occur if rents of extractive industries are transferred directly to the local population. Examples of such policies are the impact benefit agreements in Canada and the permanent fund dividend in Alaska.

city should be the same. Thus, any local shock to the demand of labor is fully capitalized into land prices. In equilibrium, shocks to the local economy (such as a resource boom) benefit mostly the owners of immobile factors, such as landowners. In this case, while the national real wage may increase (depending on the relative size of the local shock), there is no difference in real wage between locations. This extreme result, however, is driven by the assumption that the elasticity of housing supply is limited, while local labor supply is infinitely elastic.

Greenstone, Hornbeck, and Moretti (2010) and Moretti (2011) extend this framework by considering a more general case in which the supply of housing is not necessarily fixed and workers' mobility is not necessarily infinite. In this framework, a shock to the demand of labor has more nuanced effects. In particular, a positive shock in the local demand for labor would first increase nominal wages. This would attract workers from other cities. Migration would increase labor supply, push down wages, and increase housing costs. The net effect, however, depends on the elasticity of supply of both labor and housing. In particular, if both supplies are upward sloping (that is, housing supply is not fixed and labor is not perfectly mobile), then the demand shock can lead to an increase in real wages, and welfare, of workers.

This benefit could accrue not only to workers in the affected industry, but to workers in other industries. This can occur to the extent that workers in different industries are substitutable. Similar arguments can be made for workers of different skill level or within commuting distance of the city. Thus, a demand shock can have spillover effects across industries and space.

The increase in real income is driven by the relative inelasticity of supply of factors used in the production of nontraded goods (such as housing and services). In Moretti's model, these two factors are land for housing and labor, which is used to produce a traded manufacturing good and nontraded services. This argument, however, can be easily extended to other inputs used in production of goods that may be costly to trade, such as agricultural land used to produce perishable food.

An interesting prediction of spatial equilibrium models is that local demand shocks would attract workers and increase the local population. Population growth may create increased congestion and additional pressure on local services, such as education and health. However, the additional population could also generate positive effects in the form of agglomeration

economies, that is, gains in productivity associated with the clustering of economic activity. There is a growing body of evidence, mostly from the United States, suggesting that the magnitude of agglomeration economies, in manufacturing and high-tech industries, is not trivial.<sup>14</sup>

There is, however, not yet evidence on the magnitude of agglomeration economies generated by extractive industries. Moretti (2011) also points to heterogeneous effects across tradable and nontradable sectors. In particular, the model predicts that the demand shock would benefit mostly the nontradable sector, such as services. The effect on tradable sectors is ambiguous. On the one hand, it may be negative due to the increase in wages and land rents. On the other, it may benefit from increasing agglomeration economies associated with the larger population. Thus, it is not clear whether a resource boom would encourage or crowd out manufacturing. This prediction contrasts with the standard Dutch disease argument, which would predict deindustrialization.

This framework provides several empirical predictions of the effect of resource booms, such as opening or expansion of mines and oil fields, in the case when *they have strong enough backward linkages*.

1. They suggest that resource booms would have a positive effect on nominal wages and labor outcomes, such as participation rate, number of hours worked, or employment rates.
2. Under plausible assumptions on housing supply and labor mobility, resource booms could increase real wages, and real income, of local populations. This could translate into a reduction of poverty and an increase in welfare. Note, however, that many extractive operations, especially in rural and less developed areas, resemble economic enclaves. They hire few local workers, do not redistribute profits locally, and most of their production is exported. In these cases, we should expect positive economic impacts to be negligible.
3. There may be positive spillovers for workers in several industries not directly linked to the extractive activity, and for surrounding localities within the hinterland of the affected city.

---

<sup>14</sup> See Moretti (2011, section 4.1) for a review of the evidence.

4. Resource booms will be associated to the migration of workers and an increase in the price of nontraded goods, such as housing.

These predictions have important implications for empirical analysis. First, migration induced by the resource boom may change the spatial distribution of a population's productivity. This could happen, for instance, if high-productivity workers are more able to benefit from the boom or face lower migration costs, or if low-productivity workers are displaced away from resource-rich areas. The worry is that an increase in local real income would reflect just the change in population composition, not real improvements in economic well-being. The importance of these compositional effects is case specific. Some empirical strategies to address this concern include using individual panel data, focusing on subpopulations that reside in the locality before and after the resource boom, and examining observable population characteristics (such as measures of human capital) that may be indicative of the importance of compositional changes.

Second, the predicted increase in nontraded prices, and cost of living, implies that changes in nominal variables (such as income, wages, and household expenditure) are not informative of the effect on purchasing power and welfare. Increments of these nominal variables may just reflect local inflation. To address this concern, researchers should deflate nominal variables using local price indexes that take into account possible changes in local housing costs. Moretti (2013) discusses several methodologies to construct such local price indexes.

Similar concern arises when using other measures of well-being based on income or expenditure, such as poverty. The main issue is that in many cases, poverty lines reflect the cost of a minimum consumption basket using prices at the national level. In that case, they may fail to take into account changes in the local cost of living. To avoid this, researchers should adjust poverty lines using measures of local inflation.

While this framework predicts a possible positive impact of resource booms on real income, it is less clear what would be the effect on other measures of human well-being, such as education and health. On the one hand, education and health outcomes could improve due to an income effect. In addition, if the resource boom is biased toward high-skilled workers, it could increase the returns to education. On the other hand, the increase in wages could increase the opportunity cost of education and discourage it (Atkin 2012). A similar effect

can occur if the extractive industry demands low-skilled workers and thus reduces the skill premium. In terms of health, environmental pollution and work-related injuries can reduce, or even offset, the benefits from higher income.

Importantly, the magnitude of these negative effects is likely to depend on the quality of local institutions. For instance, Greenstone and Hanna (2014) find that air and water quality regulations in India had modest to negligible impact on health. This contrasts with much larger impacts of similar environmental regulations in the United States. This study highlights the limitations of environmental regulations in weak institutional settings. In the context of coal mines in China, Fisman and Wang (2013) find that worker injuries and deaths are larger in firms that have political connections, likely because they can use their political relations to circumvent safety oversight and regulations.

#### **3.1.4 Pollution**

Extractive industries, such as mining and oil extraction, have the potential to pollute the environment. For instance, large-scale mining and mineral processing can generate significant amounts of air pollutants such as nitrogen oxides (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), ozone, and particulate matter. The main sources of these air pollutants are gasoline engines of heavy machinery, fumes from smelters and refineries, and dust from blasting and earthmoving operations. These air pollutants can be carried over larger distances. At low concentrations, air pollutants are short-lived; they are dissipated or absorbed by the environment. However, if toxic emissions are relatively large, they can deposit on the ground as acid rain, which contributes to soil degradation and can have cumulative negative effects (Menz and Seip 2004).

Mining activities can also release industry-specific pollutants, such as cyanide, sulfuric acid, mercury, heavy metals, and acidic drainages (Dudka and Adriano 1997; Salomons 1995). These pollutants can have negative, cumulative effects on the quality of soil and water sources. Similarly, small-scale and artisanal mining operations can pollute air and water. The most notorious example is pollution from mercury used in gold amalgamation.

Environmental pollution creates several negative externalities (figure AA.4). The one that has received most of the attention in the biological and social sciences is the negative



effect on human health (Currie et al. 2013; Graff-Zivin and Neidell 2013).<sup>15</sup> There is also evidence that pollution can affect school and cognitive outcomes (Almond, Edlund, and Palme 2009; Lavy, Ebenstein, and Roth 2012), and increase school absenteeism (Currie et al. 2009; Gilliland et al. 2001; Park et al. 2002; Ransom and Pope III 1992).

Recently, scholars have also started to examine other possible health-related effects, such as reduction in labor supply and labor productivity (Graff-Zivin and Neidell 2012; Hanna and Oliva 2011). This literature suggests that, by affecting health and human capital, pollution can deteriorate living conditions and hinder long-term development.

Another possible important pollution externality is the loss of agricultural productivity (Aragón and Rud 2014). The loss of agricultural productivity can have a negative impact on agricultural output, and, through that channel, affect the income of farmers and the rural population. This externality can be particularly relevant when extractive industries are located in the vicinity of rural areas, in which agriculture remains an important source of livelihood.

There are at least three mechanisms by which pollution can affect agricultural productivity. First, pollution can affect crop health and growth (Heck et al. 1982; Marshall, Ashmore, and Hinchcliffe 1997; Miller 1988). This translates into lower yields. Second, pollution can deteriorate the quality of key agricultural inputs, such as soil and water (Menz and Seip 2004; U.S. EPA 2012). 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, like aluminum. Similar effects can be caused by acidic discharges from mining operations. Finally, air pollution can reduce labor productivity (Chang et al. 2014; Graff-Zivin and Neidell 2012).

This framework has several implications for empirical analysis. First, it suggests examining the effect of resource booms on indicators of human health, such as mortality and incidence of illness. This can provide a better picture of the effect on human well-being than simply observing income or poverty outcomes. Second, it points to other possible outcomes affected by resource booms such as workers' productivity, labor supply, and agricultural output. Finally, it highlights another channel, that is, loss of agricultural

---

<sup>15</sup> For example, in the economics literature, there are studies linking pollution to infant mortality (Chay and Greenstone 2003; Currie and Neidell 2005; Jayachandran 2009), children's hospitalizations (Lleras-Muney 2010), low birth weight (Currie and Walker 2011), and incidence of cancer (Ebenstein 2012).

productivity, through which resource booms could negatively affect local income, especially in rural areas.

## **3.2 Empirical evidence<sup>16</sup>**

In this section, we discuss the empirical evidence on the local impact of resource abundance. We focus on quantitative academic studies.<sup>17</sup> In contrast to the country-level literature, the empirical literature exploiting within-country variation is more recent and less developed. There are, however, a growing number of studies already expanding this literature.

### **3.2.1 Impact on growth**

A first group of studies replicates the growth regressions used in the cross-country literature, but with data at the state, province, or county level (table AB.1). Similar to early work suggesting the presence of a resource curse, these papers also document a negative relation between measures of resource abundance and growth. For instance, using a cross-section of state-level data from the United States, Papyrakis and Gerlagh (2007) find a negative relation between income growth and the share of primary sectors in local GDP. James and Aadland (2011) and Douglas and Walker (2013) use more disaggregated data from U.S. counties and find similar results. Outside the United States, Zuo and Jack (2014) document a similar negative relation using data from Chinese provinces.

It is, however, difficult to interpret these results in a causal way. These studies share many of the limitations of the cross-country literature, such as omitted variable bias, reverse causality, and measurement error.

### **3.2.2 Impact on employment and local living standards**

---

<sup>16</sup> See tables in Appendix B for a summary of the papers discussed in this section.

<sup>17</sup> There are, however, several case studies examining the role of extractive industries, such as mining, on local communities. See, for instance, McMahon and Remy (2001) for a review of case studies in Canada, Latin America, and Spain. There is also a growing body of work on local value added in extractives supply chains, which is informative of the potential impact of mining on local economies. This includes industry-sponsored reports (International Council of Mining and Metals [ICMM]) and work funded by the World Bank (Burkina Faso, Central Asia, Ghana, Liberia, Tanzania, Zambia, Zimbabwe). The work funded by the Bank has not yet been assessed, but tentative conclusions are that in weak private sector environments, there tends to be a very low proportion of manufacturing value added in supplying mines and a somewhat higher service value added. This is after excluding supply of locally produced fuel, electricity, and cement.

Black, McKinnish, and Sanders (2005) was one of the earliest studies departing from the cross-country growth regressions (table AB.2). They use county-level data from the coal-rich areas in the Appalachia region of the United States to examine the short-term economic impact of the coal boom in the 1970s and the subsequent bust in the early 1980s. This study treats resource booms and busts as shocks to the local demand for labor. Black, McKinnish, and Sanders find evidence of modest employment spillovers. The boom is associated with an increase in population, especially males in prime age, and in nonmining employment and wages. These effects are reversed during the bust. Their results, however, do not support the hypothesis that the coal boom crowded out other industries.

Using data from western Canada, Marchand (2012) documents similar effects on local labor markets (that is, modest employment spillovers, mostly in construction, services, and retail) associated with the 1970s energy boom and bust. Fleming and Measham (2014) also find positive employment spillovers associated with the recent boom of coal seam gas in Australia.

In a related paper, Michaels (2011) examines the long-term economic impact of oil discoveries in the southern United States. He uses county-level data covering 1940 to 1990 and exploits geological variation in oil abundance. He finds that discovery of oil increases specialization in oil production, but does not seem to have led to deindustrialization. There is, for instance, no change in the employment share of manufacturing. On the contrary, oil discovery increases the overall size of manufacturing (measured as number of manufacturing jobs per square mile). The increase in density of manufacturing employment seems to be associated with the increase in population size. These results are the opposite of what we could expect from the standard Dutch disease argument. Instead, they are suggestive of agglomeration economies. The effect on real income is less clear. Michaels (2011) finds that nominal income increases, but this increase may have been offset by higher housing costs.

Allcott and Keniston (2014) extend the study by Michaels (2011) to rural counties in the entire United States. They find similar results: oil discoveries increase population size, income growth, and wages, but do not seem to negatively affect manufacturing. If anything, oil discoveries have a positive effect on manufacturing employment and output. Using rich data at the firm level, they also evaluate the effect on total factor productivity, but find no significant increase. They interpret this evidence as suggesting that some manufacturing firms benefit from oil booms due to the increase in size of local markets and not due to productivity gains

associated with agglomeration economies. This can happen, for instance, if manufacturing firms produce locally traded goods.

More recently, Jacobsen and Parker (2014) extend Black, McKinnish, and Sanders' (2005) study to the Western United States. They focus on the oil and gas boomtowns created during the 1970s increase in energy prices. They also use county-level data but observe a longer time span, that is, 1969 to 1998. This allows them to explore the effect of a bust after a longer period.

Similar to Black et al. (2005), they also find evidence of improvement in several economic indicators during boom years (such as nominal income and wages, employment, and population). Most of these effects are transitory and disappear after the boom. But, there are some long-lived negative effects after the bust: lower nominal income, lower profits and earnings, and higher unemployment compensation. The authors interpret these results as evidence that the bust created long-lasting economic hardships in the form of joblessness and depressed local income. In contrast to Michaels (2011) and Allcott and Keniston (2014), however, they find no evidence of any effect on manufacturing employment in either the short or long term.

These studies suggest that extractive industries (such as coal mining, oil, and gas) do generate positive employment spillovers: booms seem to increase the number of jobs and wages in other industries.<sup>18</sup> These spillovers are, however, modest in size.

These studies provide a less clear answer regarding the crowding out of manufacturing, which is a necessary condition for Dutch disease arguments. While some studies find a reduction in the relative size of manufacturing, others document an actual increase in manufacturing activity. A possible explanation is that resource booms may generate agglomeration economies that benefit local manufacturing firms. Similarly, part of manufacturing output is actually destined to local markets. Thus, some manufacturers could benefit from the growth of local demand. These factors may offset the increase in input prices associated with the resource boom. There is also not conclusive evidence on the long-term effects, at the local level, of resource booms. This is still an active area of research.

The studies discussed above have two important limitations. First, they are not very informative about the effects on real income or other measures of welfare. In particular, it is

---

<sup>18</sup> Similar employment spillovers have been documented using other sources of demand shocks, such as construction of a pipeline (Carrington 1996), closure of army bases (Hooker and Knetter 2001), or opening of manufacturing plants (Greenstone, Hornbeck, and Moretti 2010).

difficult to assess how much of the increase in nominal income simply reflects the higher cost of living or changes in the composition of the local population. Second, these studies focus on developed economies such as Australia, Canada, and the United States. Thus, they are not very informative of the local economic effects of resource abundance in less developed economies.

As discussed in the analytical framework, the economic effects at the local level depend on several factors, such as the degree of economic linkages of extractive activities (which determine the size of the local demand shock), substitutability of labor between industries, and labor mobility. These factors are likely to be very context specific.

Recent work has started to fill this gap in the literature. Caselli and Michaels (2013) examine the local economic effect of oil-based fiscal windfall in Brazil. Using data at the municipality level, this paper shows that oil production is associated with an increase in oil royalties paid to local governments, and reported public spending. However, the impact on provision of local public services is minimal. There is no significant improvement in housing quality or quantity, supply of educational or health inputs, or welfare receipts.<sup>19</sup> There is also a negligible effect on household income and population size. The authors interpret these findings as evidence that oil production has not been particularly beneficial to the local population. Instead, circumstantial evidence suggests that the oil revenues were used to fund patronage, rent extraction, and embezzlement by officials. Brollo et al. (2013) provide further support to this interpretation. They also use municipality-level data from Brazil, but focus on all municipalities (not only the recipients of oil royalties). They find that fiscal windfalls are indeed associated with an increase in political corruption.

In the Brazilian case, the most important channel linking local economies to natural resources is through the fiscal windfall associated with oil royalties. This happens because in Brazil the extent of economic linkages between oil companies and local economies is very limited.

Aragón and Rud (2013) examine the importance of these economic linkages. They use the case of Yanacocha, a large gold mine in the Peruvian highlands, and exploit a significant increase in the demand for local inputs. Their empirical strategy uses microdata at the household level and a difference-in-differences approach. They find that this increase in backward linkages

---

<sup>19</sup> Using the same case but a different methodology, Monteiro and Ferraz (2010) also document that the oil windfall is associated to reported increases in expenses and size of the public sector, but no improvement in public services to the local population.

had a positive economic impact on real income and poverty reduction. The benefit extends to local population not directly linked to mining, such as farmers and service workers. These results are consistent with the effects of a local shock to demand for labor in the presence of imperfect worker mobility. As suggested by Greenstone, Hornbeck, and Moretti (2010), in this case local shocks are not fully capitalized in land prices but can increase real wages.

Aragón and Rud (2013) also examine the effect of the fiscal revenue windfall associated with mining production. In the Peruvian case, a share of corporate taxes from mining companies is transferred to local authorities. Similar to Caselli and Michaels (2013), they also find that increased local revenue and public spending associated with the resource boom do not translate into higher household income. The authors interpret these results as suggestive evidence that the market mechanism (that is, increase in demand for local inputs) might be more effective in improving local living conditions than the fiscal channel (that is, increase in local governments' revenue and spending). These findings, both in Brazil and Peru, cast some doubts on the effectiveness of revenue sharing schemes as a policy instrument for local communities to benefit from resource booms.

In a related study, Loayza, Mier y Teran, and Rigolini (2013) examine the socioeconomic impact of mining in Peru using a rich data set at the district level that combines census and household surveys. Similar to Aragón and Rud (2013), they find a positive relation between measures of living standards (such as poverty, consumption, and literacy) and mining production, but not with government transfers associated to mining tax revenue. 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.<sup>20</sup>

In one of the few studies focusing on Africa, Kotsadam and Tolonen (2014) 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. This 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 toward service sectors,

---

<sup>20</sup> A similar relation among resource booms, income, and inequality has been reported in the case of Australia (Reeson, Measham, and Hosking 2012). Interestingly, this study suggests that the relation between mining and inequality may have an inverted U-shape.

while men move toward skilled manual jobs. Moreover, women's participation rate decreases with mine openings, while men's participation rate increases. 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 on the local level in Africa, but with permanent (negative) effects on women's labor market participation.

### **3.2.3 Impact on corruption and conflict**

The within-country evidence linking resource booms to corruption and conflict is also quite sparse (table AB.3). As discussed above, evidence from Brazil (Brollo et al. 2013; Caselli and Michaels 2013) suggests that the fiscal revenue windfall, associated with oil royalties, has increased corruption and rent-seeking at the local level.

The revenue windfall is also associated with changes in political outcomes. For instance, Brollo et al. (2013) argue that the increase in public spending (allowed by the resource windfall) allows bad politicians to remain in office, despite extracting more rents. This translates into higher reelection rates of incumbents. Monteiro and Ferraz (2010) also document a similar increase in incumbency advantage, but only in the short term.

These studies examine the effect of a current resource windfall. Political behavior, however, could change in anticipation of a windfall, that is, even before resources are actually extracted. This could happen because anticipated rents (from future resource extraction) increase the value of political positions. Thus, politicians may start competing for office now in order to capture future rents.

Vicente (2010) examines this issue in the context of São Tomé and Príncipe's announcement of oil discoveries. He uses microdata at the individual level with retrospective information on perceived corruption. He finds that oil discovery announcements are associated with an increase in perceived vote buying and corruption across a range of public services, such as customs, public procurement, state jobs, health care, and police.

The empirical study of resource abundance on local conflict has focused on exploring two possible mechanisms: the opportunity cost effect and the rapacity effect. As previously discussed, these mechanisms 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) may decrease conflict, while resources that create appropriable rents (such as oil, diamonds, and minerals) may encourage it.

For instance, Angrist and Kugler (2008) find that an increase in coca prices in Colombia led to modest local economic gains, but increased violence in rural areas. They interpret these findings as evidence that the financial opportunities provided by coca fueled internal conflict. Gawande, Kapur, and Satyanath (2012) examine the Naxalite conflict in India. They find that negative agricultural shocks are associated with an intensification of conflict. This is consistent with the opportunity cost effect.

Dube and Vargas (2013) provide convincing evidence that both the opportunity and rapacity effects are important. They use data at the municipality level from Colombia and exploit variation in commodity prices. The main idea is that some commodities, such as oil, are more likely to generate rents than changes in local wages, and thus affect conflict mostly through a rapacity effect. In contrast, agricultural commodities, like coffee, may have relatively more influence on wages than rents and thus mostly affect the opportunity cost of conflict. This study finds that increases in oil, coal, and gold prices are associated with an intensification of conflict. In contrast, the increase in international prices of agricultural products, such as banana, coffee, palm, sugar, and tobacco, decrease it.

#### **3.2.4 Impact of mining-related pollution**

There is a vast literature highlighting the potential for extractive industries, such as mining, to pollute the environment. Similarly, there are several studies documenting the negative effect of pollution on human health and, through that channel, on labor supply and labor productivity (see references above). Despite these findings, there is little empirical work directly examining the socioeconomic impacts of mining-related pollution (table AB.4).

Rau, Reyes, and Urzúa (2013) examine the impact of mining-related pollution on educational achievement. They focus on a case of environmental negligence in northern Chile in which hundreds of houses were built in the proximity of a deposit of mineral waste, which had hazardous levels of lead and other heavy metals. This study finds that children living in the proximity of the mineral waste had higher concentrations of lead in their blood, and worse academic performance. They estimate that this translates into a significant loss of



earnings in adulthood.<sup>21</sup>

Aragón and Rud (2014) focus instead on the effect of pollution on agriculture, using the case of large-scale gold mining in Ghana. This study is motivated by the existing evidence in biological sciences linking pollution to lower crop yields, and degradation of key agricultural inputs, such as soil and water. They find robust evidence that cumulative gold production (a measure of the stock of pollution) is associated with a significant reduction in agricultural productivity. The effects are concentrated within 20 kilometers of mine sites and decline with distance. This loss of productivity is associated with an increase in rural poverty. Using satellite imagery, they also document an increase in concentration of air pollutants in the proximity of mines. 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. This study highlights 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.

von der Goltz and Barnwal (2014) use a rich microdata set from 44 developing countries and a difference-in-differences approach to examine the effect of mining on human health outcomes. They find suggestive evidence that mining is associated with an increase in stunting among children and anemia among young women. The effects are localized in the vicinity of mines (that is, within 5 kilometers). These effects occur despite an increase in household wealth, which may attenuate the negative effects of mining on health. This paper raises an important debate about the trade-off between economic benefits and health costs that mining communities may face.

### **3.2.5 Input-output analysis**

The studies described above are ex-post analysis of the effect of resource abundance, that is, they observe the change in outcomes that takes place *after* a resource boom/bust takes place. A complementary approach consists of predicting what the effect of a mining project (or other extractive activities) would be. This is useful for ex-ante impact evaluations (that is, when the project has not been implemented yet) or for economic planning and analysis.

Some common tools to perform this type of analysis are input-output (I-O) models and social

---

<sup>21</sup> The estimated figure is around US\$60,000 for the average affected individual.

accounting matrixes (SAMs). The basic idea of these tools is to construct mathematical models of an economy and then calculate the change on economic outcomes associated with changes in some variables, such as the expenditure on a given basket of goods, or the output of an industry. Depending on data availability, these models can be built to describe regional and local economies, and thus inform about impacts at the subnational level.<sup>22</sup>

Some countries, like Canada and the United States, routinely use I-O models to assess the ex-ante economic impact of extractive industries.<sup>23</sup> These models have also been used to assess the impact of mining in a variety of contexts, such as in northern Chile (Aroca 2001), northern Sweden (Ejdemo and Söderholm 2011), South Africa (Stilwell et al. 2000), and Europe (San Cristobal and Biezma 2006), among others.

Analyses based on I-O models and SAMs are useful for economic planning and ex-ante impact evaluation. Their predictions are informative of what the economic effect of a mining project could be. But a main limitation is that they do not tell what the effect actually is.

The actual effect could be different from the predicted one for several reasons. First, by construction, economic models cannot account for all the possible mechanisms through which resource booms affect outcomes, such as pollution spillovers, structural changes, and migration. These mechanisms may be important. Second, I-O models usually do not take into account price-adjusting behavior or substitution effects, and assume that there is no scarcity of resources. Finally, the model parameters (such as multipliers and technical coefficients) may change as a consequence of the resource boom itself and thus render the model predictions inaccurate. This is the standard Lucas critique.

### **3.3 Main lessons**

The literature on the local impact of natural abundance is still at the early stages of development. Despite this, it has already provided some important insights.

First, similar to the country-level literature, it suggests that a local resource curse is not inevitable. On the contrary, there are some examples in which resource abundance does not have

---

<sup>22</sup> I-O models and SAMs are available for several developed and developing countries. For a list of SAMs for developing countries, see <http://www.ifpri.org/category/dataset-type/social-accounting-matrixes>.

<sup>23</sup> In Canada, the I-O analysis at the national and subnational level is performed by Stats Canada and provincial statistical agencies. In the United States, there are commercial I-O models at the national and regional level, such as IMPLAN and RIMS II.

detrimental effects. A provocative idea is that what may matter is the channel through which resource rents reach a local economy. 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 even foster negative side effects such as conflict, rent-seeking, and corruption. In contrast, when the resource rents are distributed through market channels (for instance, as an increase in demand for local workers), resource booms may bring some benefits to the local population, at least in the short 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.

Second, there is no conclusive evidence that resource booms lead to deindustrialization, despite the increase in price of local inputs. On the contrary, in some 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 arguments, and suggests that other effects, such as agglomeration economies, may also be relevant.

Finally, this literature highlights the importance of examining other 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 human well-being such as inequality, education, and health. So far, there is a paucity of empirical studies examining these possible impacts.

## **4 Fiscal decentralization arrangements**

Mining and other extractive activities generate a substantial fiscal windfall from taxes, royalties, and fees. This windfall raises several important policy questions. First, which level of government (local, regional, or national) should collect this revenue? Second, how should this mining revenue be shared with subnational governments? Finally, to what extent do these institutional differences matter for economic performance? These questions relate to fiscal decentralization, which involves shifting some responsibilities for revenue collection and/or expenditure to lower levels of government.

In this section, we focus on fiscal decentralization of mining revenues.<sup>24</sup> We start by

---

<sup>24</sup> The design of expenditure decentralization, that is, which expenditures are the responsibility of each subnational level, does not distinguish the source of revenue. In that sense, some general

discussing the main theoretical arguments addressing the design of fiscal decentralization arrangements. Then we review the empirical literature on the effect of fiscal decentralization on economic outcomes. Finally, we discuss selected international practices.

## **4.1 What is the optimal level of fiscal decentralization?<sup>25</sup>**

### **4.1.1 Revenue decentralization**

Governments rely on several tax tools to collect revenues. In the case of mining, these tools include royalties, direct taxes (income, profit, and property taxes), indirect taxes (such as the value-added tax [VAT], sales and excise taxes, import and export duties, and payroll-based taxes), surtaxes, and licensing and user fees. The policy question is which of these taxes should be assigned to subnational governments. To inform this question, the literature on fiscal decentralization has already identified several principles for the optimal design of tax systems.

1. Economic efficiency: This requires that the tax system does not affect economic decisions such as how much or where to invest, produce, or consume. Decentralized tax systems can interfere with economic efficiency in at least two ways. First, geographic differences in tax systems may distort locational decisions linked to mobile goods and factors, such as capital and tradable goods. For instance, a state imposing a high corporate tax rate may hinder private investment. Second, in the presence of mobile factors, jurisdictions could compete among themselves by reducing taxes to suboptimal levels. This principle has an important implication. It suggests that taxes linked to mobile goods and activities should be decided centrally or at least coordinated among jurisdictions. Similarly, taxes linked to less mobile tax bases (such as property taxes) are more suitable to be assigned to local governments. Given the ex-ante mobility of mining, this principle suggests that mining taxes should be assigned to national- and regional- level governments instead of local governments.
2. Equity: The tax system plays a crucial role in economic redistribution. This redistribution is politically feasible when both net payers and net receivers (the winners and losers of

---

principles can be applied to both mining and nonmining cases. For a discussion on principles for expenditure decentralization, see World Bank (2014).

<sup>25</sup> This section is partially based on Otto (2001) and World Bank (2014). For additional work describing fiscal tools and principles to decentralize resource rents, see also Brosio (2006); Clark (1999); and Morgandi (2008).

redistribution) are represented by the government to whom the tax has been assigned. For that reason, a decentralized tax system can hinder the goal of national equity. For instance, a local government may be less interested than the federal government in using its tax revenue to fund a nationwide welfare program. In addition, local governments could use redistribution policies (such as less progressive taxes and transfers) to attract high-income persons and repel poorer ones. This can exacerbate the geographic differences within a country. Given the unequal distribution of mineral wealth, this equity principle supports assigning mining taxes to the national and regional level.

3. Administrative costs: The design of tax systems should consider the effect on collection and compliance costs. A decentralized tax system can increase these costs for several reasons. First, there are fixed costs associated with collecting taxes. This creates economies of scale, and scope, in tax administration. Second, the complexity of several local tax systems can increase opportunities for tax evasion and avoidance. Finally, local government may also lack the technical capacity to administer some taxes, thus facing higher costs, lower compliance rates, and inefficient use of resources, at least in the short run (Aragón and Casas 2009). These additional administrative costs not only can erode the net tax revenue, but they can also distort local government incentives. In particular, by increasing the cost of collecting taxes, it can reduce the local fiscal effort, leading to suboptimal levels of tax collection (Aragón 2013).

In the case of mining, there are two other factors that may make local tax collection costly. First, in most jurisdictions, there are few mines. Thus, there is limited scope to exploit economies of scale in tax collection. Second, in some cases, mining activities straddle several jurisdictions. This can increase the complexity of assessing tax bases, and create incentives to free-ride on other local governments' monitoring, thus reducing overall monitoring effort.

4. Fiscal revenue should match spending needs: In order to guarantee the accountability of local politicians and the sustainability and quality of local public goods, revenue means should be matched to revenue needs. Mining activities can potentially increase the pressures on local services and infrastructure due, for instance, to inflow of new workers and their families. This increase in revenue needs requires an expansion of fiscal revenue in the form of subnational taxes or intergovernmental transfers.

In addition to these principles, mining has three features that should be taken into account in designing fiscal decentralization arrangements.

5. Mining extracts nonrenewable resources: These resources are usually owned by the state, but in some cases, like in the United States, the owners may be private individuals or corporations. In either case, the owner of these assets has the right to levy a compensatory royalty, in addition to usual income or profit taxes.
6. Mining is a risky and capital-intensive activity: One of the most risky aspects of mining is exploration. This activity involves significant investments, and the rate of success is quite low. Mine development can also be lengthy, thus creating a substantial time gap between expenses and revenues. Finally, once in operation, most of the costs are sunk. This creates the possibility of a hold-up problem: operating mines have less bargaining power to deter expropriation by the state, in the form of exceptional taxes or fees. This risk of expropriation can deter mining investment in the first place. These features provide the rationale for creating tax incentives and guaranteeing stable tax treatment of mining companies (for instance, in the form of tax agreements).
7. Mining can create localized negative effects: Mining has the potential to generate local spillovers, such as pollution, migration, and population displacement. In addition, mining can change land use and affect other economic activities such as agriculture, cattle husbandry, or harvesting of wildlife. These factors can impose significant costs on local communities. These features raise two implications for the design of fiscal decentralization arrangements. First, the tax design should consider the use of Pigouvian taxes to reduce these spillovers to socially efficient levels. These taxes should be defined by the level of government more able to internalize these externalities. This is usually, but not always, the local government. Second, it provides the rationale for some form of compensation to the local population. This compensation can take the form of payments by the mining firm to the community (such as impact benefit agreements or direct community contributions), or targeted intergovernmental transfers.

The above discussion points to a limited scope for 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). There are, however, some tax

tools that could be suitable to local governments, such as property taxes, surtaxes, and land use fees.<sup>26</sup> Importantly, it also points to the importance of intergovernmental transfers to match increased local needs and to compensate local populations.

#### **4.1.2 Intergovernmental transfers and revenue sharing**

In practice, intergovernmental transfers are important tools to redistribute mining revenue among local populations. Transfers can be classified into three types:

1. Nonmatching unconditional transfers: The amount of the transfer does not have to be matched by local funds, and there are no constraints on how it should be spent. Many equalization grants fall within this category.
2. Nonmatching conditional transfers: The transfer does not have to be matched by local funds, but it has to be spent for a particular purpose, such as capital expenditure or specific projects.
3. Selective matching transfers: Also called cost-sharing programs, these require that funds be spent for a specific purpose and that the recipient also match the funds to some degree.

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 with funds from the national budget. Others are linked to a particular source of revenue or tax. This last type of transfer, also called revenue sharing or a tax-sharing scheme, is commonly used to distribute mining revenues. An example of a revenue scheme is the Peruvian *canon minero*. This transfer is funded with 50 percent of corporate taxes paid by mining firms. Revenue sharing schemes usually define the sharing rate and allocation procedure by law, and thus 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.

---

<sup>26</sup> Otto (2001, 8) provides a detailed discussion on the suitability of different tax tools in the context of mining.

Furthermore, they give incentives to local politicians to support mining activities. But they also have several disadvantages. First, if they are based only on certain taxes, they may bias national tax policy. In particular, they may discourage national fiscal efforts to collect those taxes. This argument is related to the problems associated with multitasking studied in contract theory.<sup>27</sup> Second, if they share the revenue from origin-based production (as in the case of mining-related sharing schemes), they can break the link 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. Similar phenomena 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 few taxes (such as mining firms' corporate taxes), then their funding is exposed to industry shocks, such as changes in commodity prices. This can increase the volatility of local fiscal revenue. Finally, 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 effort or underreport tax revenues.

## **4.2 Does fiscal decentralization matter? Empirical evidence**

As previously discussed (Section 3.2), there is some evidence examining the link between mining revenue windfalls and economic outcomes. Overall, this literature suggests that mining-related transfers may fail to improve local living conditions. However, there is a lack of quantitative studies examining how the different fiscal decentralization arrangements used to distribute mining revenues can shape the effect of this windfall.

The current literature on the impact of fiscal decentralization 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 share of subnational governments in tax revenues or public spending. While not aimed at understanding how decentralization of mining revenues affects

---

<sup>27</sup> Multitasking refers to when an agent (such as a worker) is in charge of several tasks but her or his reward is based on the outcome of a few tasks. In that case, the agent can exert more effort on the tasks she or he is rewarded for and neglect the others. For example, consider a teacher who can receive a bonus if her class average grade on a test exceeds a certain score. In that case, the teacher may put more effort into preparing students for that exam and neglect other important aspects of teaching.



local communities, this literature might be informative of the overall impact of fiscal decentralization.<sup>28</sup>

Early studies using cross-country regressions find a negative, or insignificant, relation between spending decentralization and growth (Davoodi and Zou 1998). Similar results have been found using data from Chinese provinces and U.S. states (Xie, Zou, and Davoodi 1999; Zhang and Zou 1998). Woller and Phillips (1998) also fail to find a statistically significant relationship between fiscal decentralization and economic growth for separate panels of developing countries.

This result seems to be sensitive to the measure of decentralization used. In particular, when using measures of revenue decentralization, such as share of revenue collected by subnational governments, the relation becomes positive. For instance, using measures of revenue decentralization, Lin and Liu (2000) and Akai and Sakata (2002) find a positive relation between decentralization and growth in the Chinese and U.S. case, respectively. A concern is that spending decentralization may fail to reflect revenue autonomy of subnational governments. To illustrate this issue, Ebel and Yilmaz (2002) replicate the cross-sectional study of Davoodi and Zou (1998) using measures of revenue decentralization. In contrast to the original study, they find a positive relation.

It is difficult to interpret these results as evidence of a causal effect of fiscal decentralization on economic growth. The positive (or negative) relation could be driven by omitted variables or confounding factors. The available studies do not satisfactorily address these endogeneity concerns. A conservative interpretation is that the evidence linking fiscal decentralization and economic growth is, at best, still inconclusive (Martinez-Vazquez and McNab 2003).

Related work examines the link between decentralization, corruption, and local capture. Based on cross-country regressions, Fisman and Gatti (2002a) find suggestive evidence that spending decentralization may be effective in reducing corruption. However, if there is a mismatch between revenue generation and expenditure, decentralization may not be beneficial (Fisman and Gatti, 2002b). Fan, Lin and Treisman (2009) find a similar result: countries with a larger number of administrative tiers and local workers report more bribery.

---

<sup>28</sup> See Mookherjee (2015) for a more comprehensive review of the literature on the empirical relation between decentralization, corruption and government performance.

These findings complement evidence, mostly from less developed economies, that decentralization can facilitate capture of local governments and collusion between local officers and local elites. For instance, Galasso and Ravallion (2005) find that 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) find evidence of local capture of a social development fund. Local capture was also more likely in villages with greater inequality. In China, Jia and Nie (2015) show how decentralization has facilitated collusion between coal mines and industry regulators. This has translated into poorer safety standards, and increased mortality rate of workers.

An important observation is that the success, or failure, of decentralization may depend on existing institutions that can increase political accountability and safeguard against local capture. For instance, using a cross section of 75 countries, Enikopolov and Zhuravskaya (2007) find that strong political parties substantially improve the effect of decentralization on growth, public goods provision, and government quality.

Some papers examining the effectiveness of community-driven monitoring are consistent with the importance of political accountability. For example, in Uganda, Reinikka and Svensson (2005) show that a newspaper campaign that provided parents information about school revenue reduced diversion of funds. Francken, Minten and Swinnen (2009) document a similar finding in Madagascar. In that case, media significantly reduced the local capture of public education funds, especially among more educated communities that may be more able to use the information to monitor local officers.<sup>29</sup> Björkman and Svensson (2010) also find that community-based monitoring can be effective to improve health services, but this monitoring is less effective in fractionalized, unequal communities.

### **4.3 How are mining revenues distributed? Selected case studies**

In practice, the distribution of mining revenues varies across countries. In this section we discuss selected case studies that fall within four commonly used approaches: no formal redistribution rule, revenue sharing, fiscal decentralization, and direct contributions to communities.<sup>30</sup>

---

<sup>29</sup> See section 3.2. in Mookherjee (2015) for additional information.

<sup>30</sup> This section is based on ICMM (2006) and (2009).

#### **4.3.1 Chile – no formal redistribution rule**

In contrast to most mining countries, Chile does not operate an institutionalized mechanism of redistributing revenue received from mining to subnational governments. Lack of formal redistribution rules, however, does not mean that mining revenues are not shared with local governments. Instead they can flow through the central government budget process. This is the case of Chile, where subnational funding is allocated through the budget process managed at the central government level. In addition, almost all mining taxes and fees are collected by the central government.<sup>31</sup>

An important element of Chile's management of mining windfalls is its structural surplus rule. Under this fiscal rule, introduced in 2000, the government aims to achieve a structural surplus of 1 percent (0.5 percent effective since 2008) of actual GDP. This structural surplus considers, among other things, the copper revenue that could have been obtained using a long-term copper price, instead of the actual price. In practice, this means that the government will save during copper price booms and increase spending during price busts.

#### **4.3.2 Tanzania - no formal redistribution rule**

In Tanzania, the majority of mining revenue (mostly from copper and gold) comes from just 6 of 117 local districts. Similar to Chile, there are no specific arrangements to distribute mining revenue among mining regions. There are also no special mining compensation or development funds targeting these regions. However, these regions can benefit from this revenue through the budget decisions of the central government.

#### **4.3.3 Peru – revenue sharing**

The most important source of mining revenue in Peru comes from corporate income taxes paid by mining companies. These taxes are collected at the central government level. This mining revenue is distributed to mining localities via a revenue sharing mechanism called canon minero. Through this mechanism, part of this revenue (50 percent since 2001) from a given mine is directly distributed to subnational governments (regional governments, provincial and district municipalities) in whose jurisdiction the mine is located. The allocation is based on a

---

<sup>31</sup> The only exception is the mining patent, an annual fee paid to the region to protect the mining title.

formula defined by law. The allocation is done in two stages. First, the canon is allocated between levels of subnational governments using the following participation rates: 10 percent for municipalities where the mine is located, 25 percent for all municipalities in the province where the mine is located, 40 percent for all municipalities in the region where the mine is located, and 25 percent for the regional government and public universities. Second, the amount in each category is distributed among municipalities based on population size and poverty.

Since 2005, mining companies have also been required to pay a royalty tax. Similarly to the canon minero, the revenue from this royalty is distributed among all tiers of subnational governments where a mine is located.<sup>32</sup> The majority of large mining companies, however, do not pay this royalty due to previously signed tax stability contracts. These contracts lock in each firm's tax status and thus protect them from new taxes, royalties, and fees.

In response to this situation, the Peruvian government and mining companies negotiated a voluntary mining fund (VMF) in 2006.<sup>33</sup> Under this arrangement, mining companies contribute to a private fund to implement social development projects in mining localities. This fund is not distributed to local authorities or publicly audited. The use of the fund is decided by a committee composed of representatives of the firm and local authorities.

#### **4.3.4 Ghana – revenue sharing**

The main sources of mining revenues in Ghana are corporate taxes and royalties. Most of this revenue is generated from large-scale gold mines in the Western, Central, Ahafo, and Ashanti regions. Similarly to Tanzania, revenue generation is highly concentrated: in 2004, half of all mining revenue was collected in two (of 160) districts.

This revenue is distributed among mining regions using a revenue sharing mechanism: 20 percent of mining royalties are allocated to a Mineral Development Fund (MDF). The MDF is then distributed among mining sector institutions and local authorities with mines in their jurisdictions. The participation shares, defined in the Constitution, are 50 percent to

---

<sup>32</sup> The participation shares are also predefined by law: 20 percent to the district municipalities (of which 50 percent is given to the communities), 20 percent to the provincial municipalities, 15 percent to the regional government, and 5 percent to national universities of the region. The remaining 40 percent is distributed to the district and provincial municipalities of the departments where exploration has taken place.

<sup>33</sup> These funds are used to support the so-called Programa Minero de Solidaridad con el Pueblo (Solidarity Mining Program).

institutions and agencies that support mining at the national level (such as the Minerals Commission, Department of Mines, and Geological Survey), 30 percent to district assemblies, 10 percent to traditional stools (local chieftaincies), and 10 percent to traditional authorities.

In contrast to the Peruvian case, the participation of local communities in mining revenue is very small. Only 10 percent of mining royalties are distributed to local communities where mines are located. This limits the scope of development projects and mitigation activities that can be implemented at the local level.

Four additional issues may impact the effectiveness of this scheme. First, the amount of revenue is highly volatile. Second, there is a lack of transparency on both the amount of royalties collected and payments made to local authorities. Third, there is no clarity on the purpose of this fund, especially for traditional stools. In this case, the law establishes that the MDF should be used to maintain the stool in keeping with its status. Finally, traditional stools and authorities are not elected, do not need to prepare budgets or financial statements, and are not subject to the oversight of national auditing authorities. This greatly reduces the accountability of local politicians and may facilitate diversion of resources and rent extraction.

#### **4.3.5 Australia and Canada - fiscal decentralization**

Both Australia and Canada have federal systems with a high degree of revenue and spending decentralization. Subnational governments (states and territories in Australia, provinces and territories in Canada) own mineral resources within their territory and have the power to raise mining taxes and royalties, in addition to taxes and fees collected by the federal government.

The high degree of fiscal decentralization guarantees that a large share of mining revenues remains within mining regions. This comes at the cost of the increasing complexity of mining taxation: each province or territory imposes its own mining taxes, and the systems vary significantly.

#### **4.3.6 Impact-benefit agreements – direct contributions to communities<sup>34</sup>**

In the last 20 years, mining companies and Aboriginal communities in Canada and Australia have pioneered a new way to distribute mining benefits directly to communities using so-called Impact Benefit Agreements (IBAs). These agreements are legally binding contracts between

---

<sup>34</sup> This discussion is based on BC First Nations Energy & Mining Council (2010).

mining companies and aboriginal communities that specify the obligations of each party regarding mitigation actions, as well as the benefits to the local community (such as employment opportunities, training, or revenue sharing). These agreements are negotiated in almost all new mining projects in Canada and are regarded as a best practice by the mining industry (Sosa and Keenan 2001).

The rise of this tool has been facilitated by the existence of Aboriginal rights over land. These rights recognize the ancestral occupation of the land. In the Canadian case, aboriginal rights are enshrined in the Constitution and, in many cases, defined and protected by treaties. The existence of these rights creates the duty to consult with aboriginal communities before any mining activity takes place. These features have greatly increased the bargaining power of aboriginal communities.

IBAs usually specify how Aboriginal communities can participate in mining benefits. For instance, they can include provisions to provide education and training to local workers, secure employment in the mine project, and maximize business opportunities to local firms. Importantly, they may also include provisions to set out financial benefits.<sup>35</sup> There are several contractual models to share financial benefits, such as issuing shares or stock options on the mining projects, or giving the community a share of the mine's profits or revenues.

## **5 Ideas for future work**

The research reviewed in this paper is starting to provide new insights into the local impact of natural resources and sharing of resource rents. First, similar to the cross-country literature, some of the research studies find that resource abundance may have negative effects by increasing corruption and conflict, or deteriorating local political processes. This evidence, however, is far from conclusive. Second, this work highlights the importance of studying other local phenomena such as the general equilibrium effects of local demand shocks, migration, and environmental pollution. These mechanisms may also affect living standards and make the impact of natural resources more nuanced. Finally, there is a well-developed literature discussing several tools to distribute resource rents, and the principles

---

<sup>35</sup> The benefits specified in IBAs are in addition to federal and provincial taxes and other compensation and mitigation actions required by environmental agencies.

that guide fiscal decentralization. There are, however, still several limitations and unsolved questions. In this section, we identify some of these issues to suggest strands of future work.

First, a main limitation is the paucity of empirical evidence on the impact of resource abundance on local income, poverty, and employment, especially in less developed countries. The available evidence is sparse and focuses on a few countries, such as Brazil, Canada, Peru, and the United States. Research in other resource-rich contexts, such as Sub-Saharan Africa and Asia, is needed to increase the external validity of these results and to better inform policy makers and practitioners.

Second, there is also a paucity of quantitative studies exploring the effect of extractive industries on other outcomes such as health, education, and pollution externalities. The few existing studies suggest that these impacts (on health and agricultural productivity) can be economically important. However, additional studies are necessary to draw a better picture of the scope and magnitude of these negative spillovers, and to better understand the mitigation actions needed to ameliorate these potential negative effects.

Third, some research highlights the importance of market versus fiscal mechanisms to create positive local impacts. In this view, developing local supply chain linkages may be more effective in improving local living standards than sharing the revenue windfall with local governments when local institutions are weak. More research is needed, however, to confirm these initial findings and to evaluate the effectiveness of different policies in developing these local linkages.

Fourth, more quantitative research is needed to examine the effect of resource abundance on local conflict and political outcomes. The existing evidence, mostly from Latin America, already suggests that the revenue windfall associated with 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. These different institutional arrangements may attenuate, or exacerbate, these negative effects. Similarly, there is a lack of evidence examining the effect of resource abundance on less violent forms of conflict, such as riots and civil unrest.

Fifth, there is a paucity of empirical evidence assessing the political economic impact of different fiscal decentralization arrangements. The existing evidence examines the effect of the overall degree of decentralization, but it is not informative of the importance of the specific

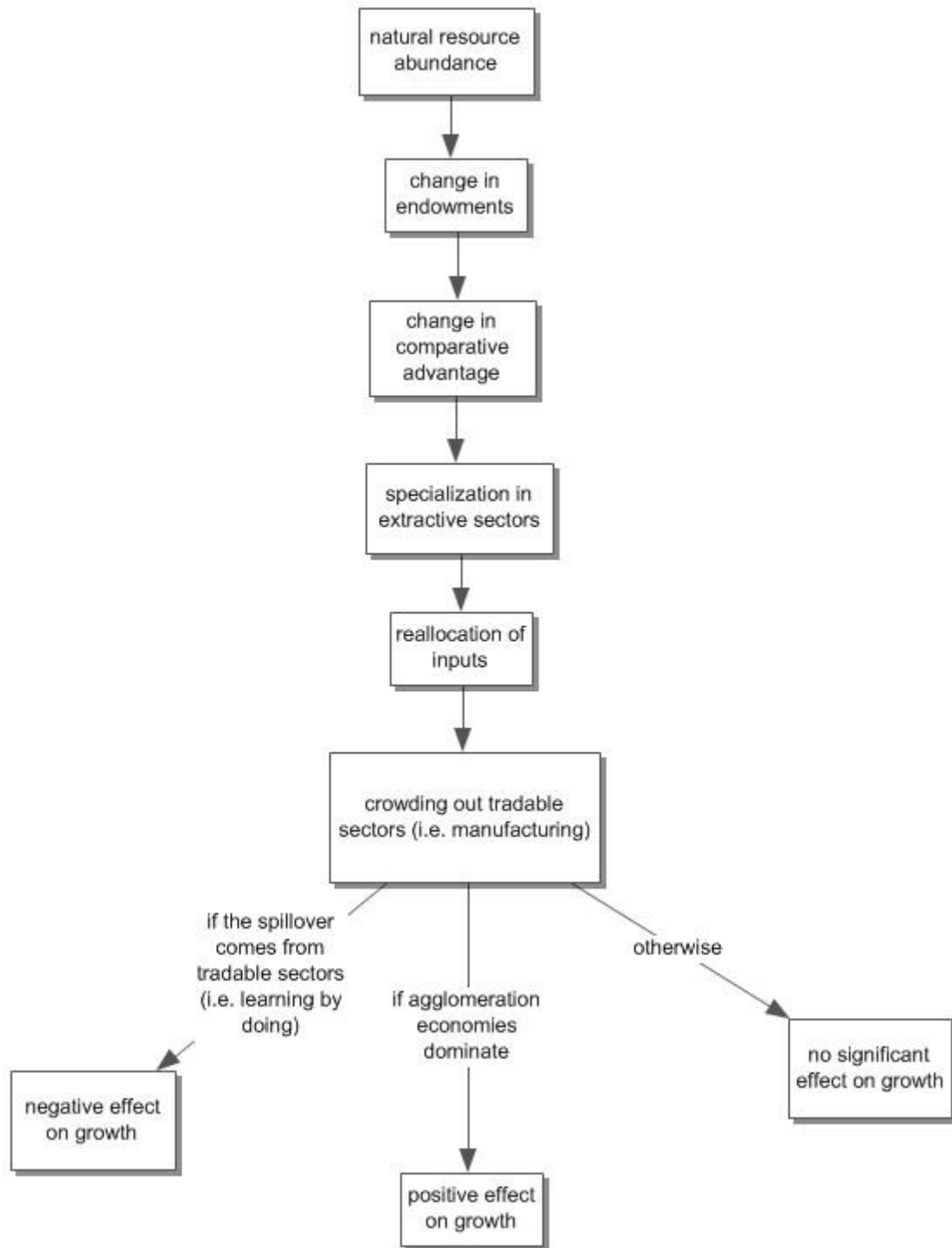
institutional arrangements, such as type of transfers, type of revenue sharing schemes, or type of competences devolved. These features may affect the impact of resource revenues on local income, corruption, or local political responsiveness. Similarly, there is not much evidence on which institutional factors contribute to the success (or failure) of fiscal decentralization. Understanding these questions is crucial to inform the design of fiscal decentralization.

Finally, a related issue is the role of local technical capacities. Even if local governments have the political will to use a revenue windfall to promote local development, they may lack the capacity to identify and implement the necessary projects. Some studies, using the Peruvian case, suggest that lack of capacity may be important and affect local governments' spending ability (Aragón 2013; Aragón and Casas 2009). More research is needed, however, 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.



**Appendix A Graphic representation of the analytical framework**

**Figure A A .1 Change in endowments**



**Figure A A . 2 Revenue windfall**

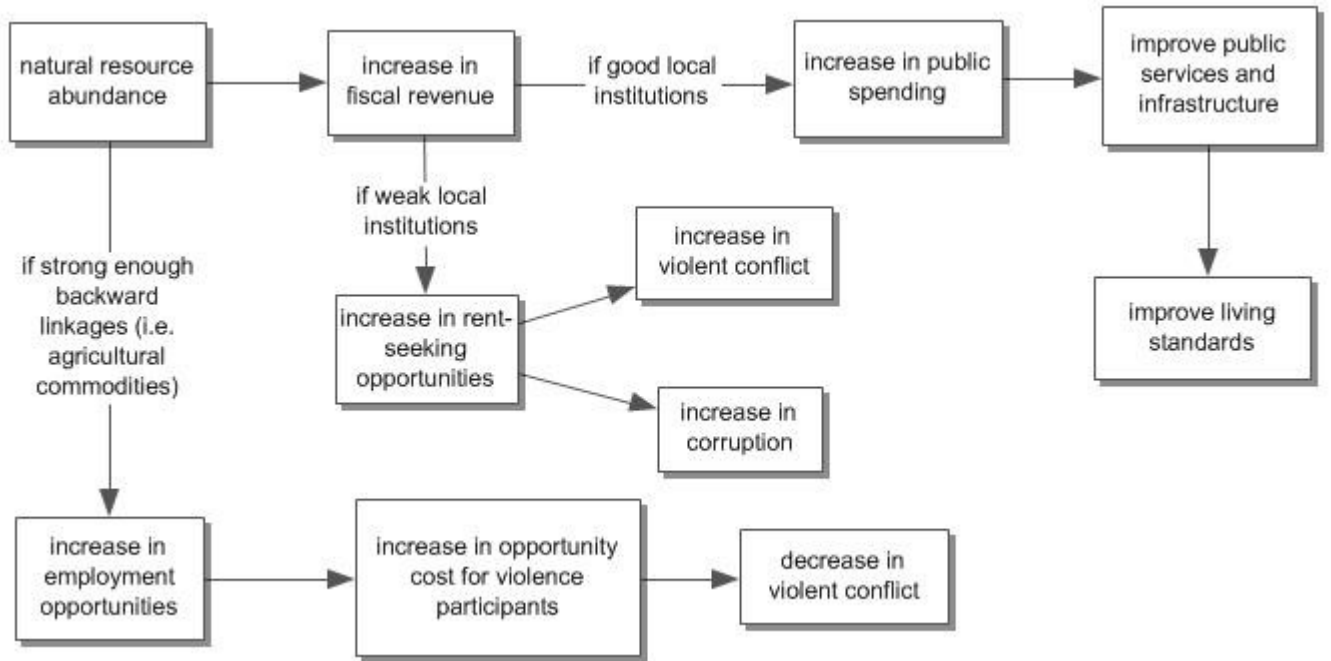
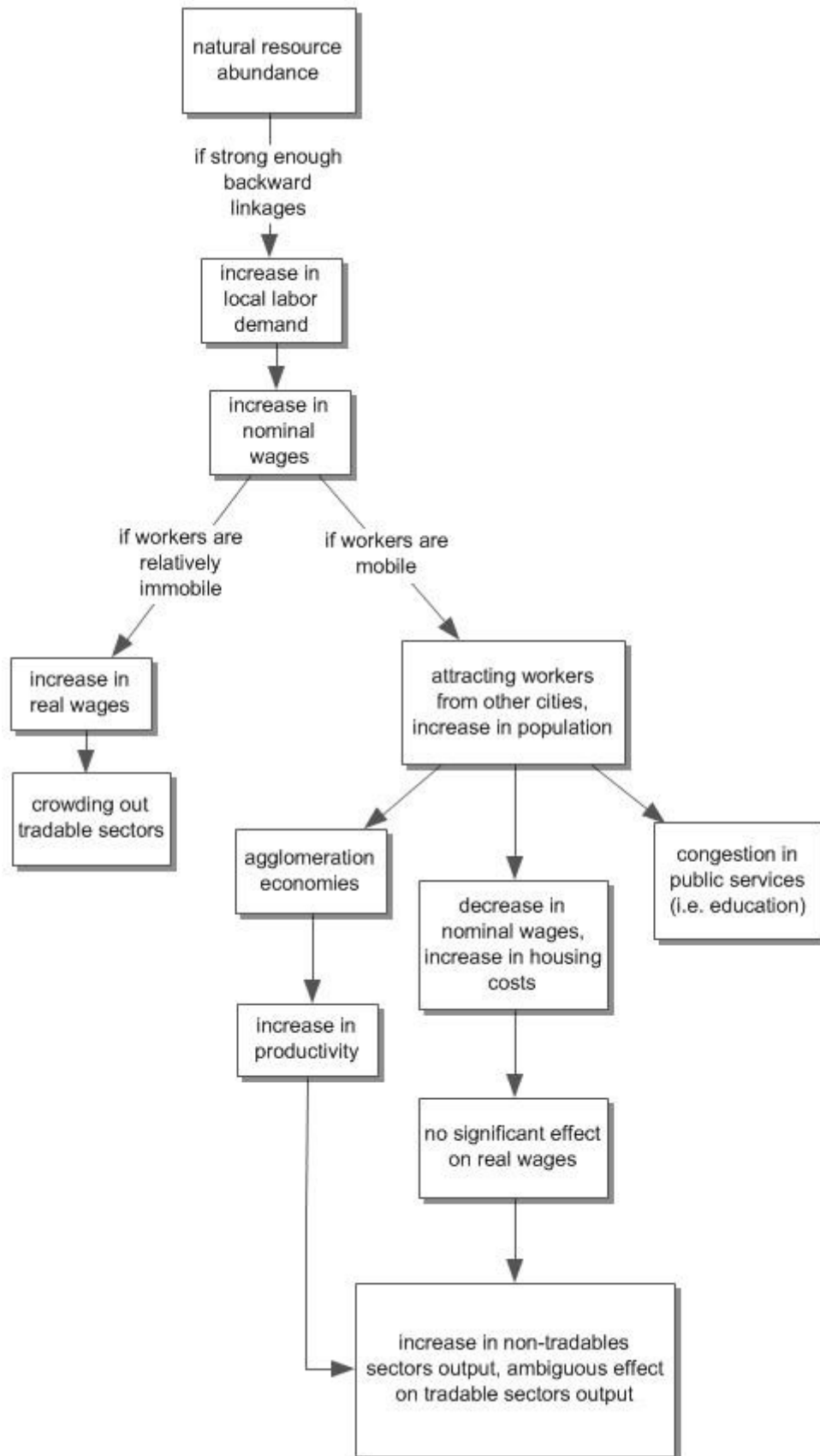
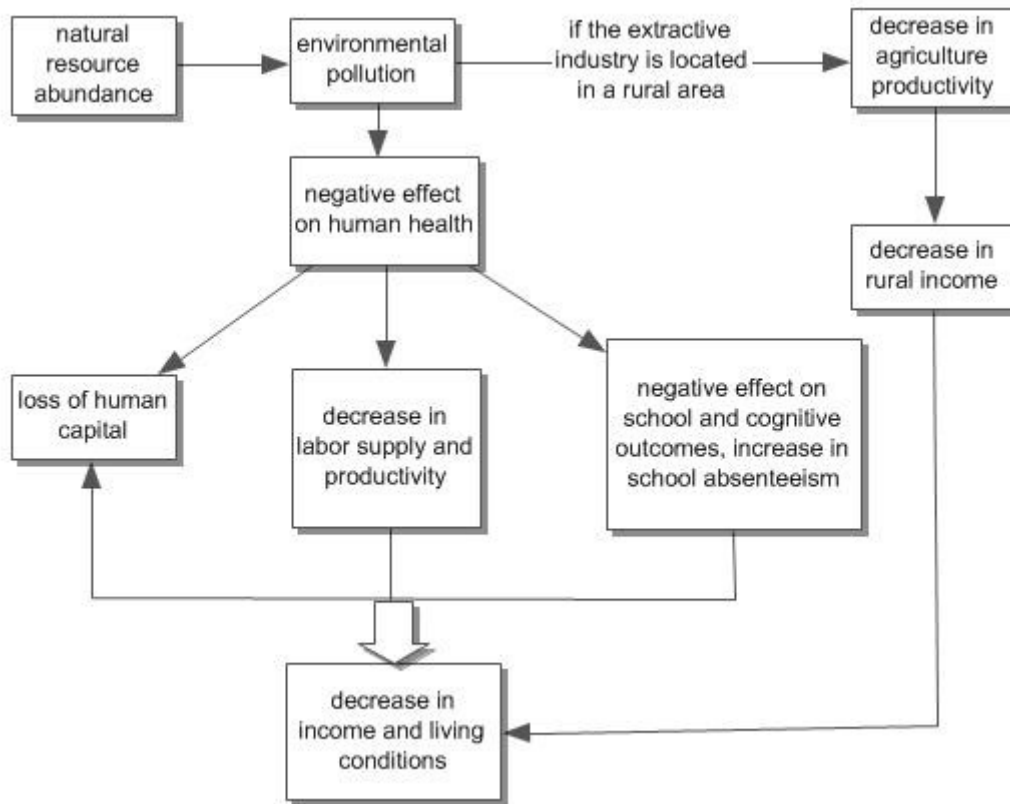


Figure A A.3 Local demand shock



**Figure AA.4 Environmental pollution**



## **Appendix B Summary of empirical studies**

**Table AB.1: Empirical evidence of the impact of resource abundance on local growth**

<b>Paper</b>	<b>Explanatory variable</b>	<b>Outcome variable</b>	<b>Sign</b>	<b>Country, data level</b>	<b>Identification strategy</b>
Douglas & Walker (2013)	Share of coal revenue in total county personal income	Income growth rate	-	U.S., county level	Cross-sectional OLS
James & Aadland (2011)	Share of earnings in resource-extraction industries			U.S., county level	Cross-sectional OLS
Papyrakis & Gerlagh (2007)	Share of primary sector in local GDP			U.S., state level	Cross-sectional OLS
Zuo & Jack (2014)	Provincial annual energy production per capita, or provincial annual energy production, or ratio of the regional energy production over GDP			China, province level	Fixed effect panel model

*Note:* + = positive relation; - = a negative relation; 0 = statistically insignificant. OLS = ordinary least squares.

**Table AB.2 Empirical evidence of the impact of resource abundance on local living standards**

<b>Paper</b>	<b>Explanatory variable</b>	<b>Outcome variable</b>	<b>Sign</b>	<b>Country, data Level</b>	<b>Identification strategy</b>
Allcott & Keniston (2014)	Whether the county produces any oil or gas in any year after 1969	Income growth rate, wages	+	U.S., county level	Difference-in-differences
		Manufacturing employment and output	+		
		Factor productivity	0		
Aragon and Rud (2014)	Gold mine production	Household income	+	Peru, household level	Difference-in-differences
	Mining transfer	Municipality revenue and expenditure	+		
		Household income	0		
Black et al. (2005)	Whether the county is the coal boom county	Employment and wages	+	U.S., county level	Instrumental variables
Caselli & Michaels (2013)	Oil output	Local government revenues	+	Brazil, municipality level	Instrumental variables
		Local government spending	+		
		Local public service	0		
		Household income	0		
Fleming & Measham (2014)	Indicator of having a coal seam gas operation	Income growth, employment	+	Australia, individual level	Cross-sectional OLS
Jacobsen (2013)	Whether the county is the oil and gas boom county	Nominal income, wages, employment and population	+	U.S., county level	Fixed effect panel model
		Manufacturing employment	0		
Kotsadam & Tolonen (2014)	Mine openings	Service sector employment	+	Sub-Saharan Africa, individual level	Difference-in-differences
		Agriculture employment	-		
		Women - service sector employment	+		
		Men - skilled manual jobs employment	+		
	Mine closings	Women - agriculture employment	0		
		Men - agriculture employment	+		



Loayza et al. (2013)	Mining production	Household consumption, literacy	+	Peru, district level	Matching and propensity score
		Poverty rate	-		
		Consumption inequality	+		
Marchand (2012)	Indicator of having 10% or more of their total earnings from the energy extraction sector.	Employment and earnings	+	Canada, province level	Difference-in- differences
Michaels (2011)	Indicator of whether the county is located above an oil field or part of an oil field (or multiple oil fields) that contains at least 100 million barrels of oil before any oil was extracted	Employment share of mining	+	U.S., county level	Fixed effect panel model
		Employment share of agriculture	-		
		Employment share of manufacturing	0		
		Stock of educated workers	+		
		Nominal income	+		

*Note:* + = positive relation; - = negative relation; 0 = statistically insignificant. OLS = ordinary least squares.

**Table AB.3 Empirical evidence of the impact of resource abundance on corruption and conflict**

<b>Paper</b>	<b>Explanatory variable</b>	<b>Outcome variable</b>	<b>Sign</b>	<b>Country, data Level</b>	<b>Identification strategy</b>
Angrist and Kugler (2008)	Coca prices	Violent conflict	+	Colombia, individual level	Difference-in-differences
Brollo et al. (2013)	Oil royalty revenue	Political corruption	+	Brazil, municipality level	Regression discontinuity
		Quality of political candidates	-		
Dube and Vargas (2013)	Oil, coal, and gold prices	Conflict	+	Colombia, municipality level	Difference-in-differences
	International prices of agricultural products		-		
Monteiro and Ferraz (2010)	Oil royalty revenue	Incumbency advantage	+	Brazil, municipality level	Instrumental variables
		Public employment	+		
		Educational and health supply	0		
Vicente (2010)	Oil discovery announcements	Perceived vote buying and corruption on public services	+	Africa, individual level	Difference-in-differences

*Note:* + = positive relation; - = negative relation; 0 = statistically insignificant.

**Table A B.4 Impact of mining-related pollution**

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

*Note:* + = positive relation; - = negative relation; 0 = statistically insignificant.

## References

- Acemoglu, Daron, James A. Robinson, and Dan Woren. 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*, Vol. 4, SciELO Chile.
- Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2005. "Institutions as a Fundamental Cause of Long-run Growth." *Handbook of Economic Growth* 1: 385–472.
- Ades, Alberto, and Rafael Di Tella. 1999. "Rents, Competition, and Corruption." *American Economic Review* 89 (4): 982–993.
- Aghion, Philippe, Philippe Bacchetta, Romain Ranciere, and Kenneth Rogoff. 2009. "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development." *Journal of Monetary Economics* 56 (4): 494–513.
- Akai, Nobuo, and Masayo Sakata. 2002. "Fiscal Decentralization Contributes to Economic Growth: Evidence from State-level Cross-section Data for the United States." *Journal of Urban Economics* 52 (1): 93–108.
- Alexeev, Michael, and Robert Conrad. 2009. "The Elusive Curse of Oil." *The Review of Economics and Statistics* 91 (3): 586–598.
- Allcott, Hunt, and Daniel Keniston. 2014. "Dutch Disease or Agglomeration? The Local Economic Effects of Natural Resource Booms in Modern America." Working Paper No. 20508. National Bureau of Economic Research, 2014.
- Almond, Douglas, Lena Edlund, and Mårten Palme. 2009. "Chernobyl's Subclinical Legacy: Prenatal Exposure to Radioactive Fallout and School Outcomes in Sweden." *The Quarterly Journal of Economics* 124 (4): 1729–1772.
- Anderson, Siwan, Patrick Francois, and Ashok Kotwal. "Clientelism in Indian Villages." (2014), forthcoming in the *American Economic Review*.
- Angrist, Joshua D., and Adriana D. Kugler. 2008. "Rural Windfall or a New Resource Curse? Coca, Income, and Civil Conflict in Colombia." *The Review of Economics and Statistics* 90 (2): 191–215.
- Aragón, Fernando M. 2013. "Local spending, transfers and costly tax collection." *National Tax Journal* 66 (2): 343–370.
- Aragón, Fernando, and Carlos Casas. 2009. "Technical Capacities and Local Spending in Peruvian Municipalities." *Perspectivas* 7 (1): 89–113.
- Aragón, Fernando M., and Juan Pablo Rud. 2013. "Natural Resources and Local Communities: Evidence from a Peruvian Gold Mine." *American Economic Journal: Economic Policy* 5 (2): 1–25.
- . 2014. "Modern Industries, Pollution and Agricultural Productivity: Evidence from Ghana." forthcoming in the *Economic Journal*.
- Araujo, M. Caridad, Francisco H.G. Ferreira, Peter Lanjouw, and Berk Özler. 2008. "Local inequality and project choice: Theory and evidence from Ecuador." *Journal of Public Economics* 92(5): 1022-1046.
- Aroca, Patricio. 2001. "Impacts and Development in Local Economies Based on Mining: The Case of the Chilean II Region." *Resources Policy* 27 (2): 119–134.
- Asheim, Geir B., Wolfgang Buchholz, and Cees Withagen. 2003. "The Hartwick Rule: Myths and Facts." *Environmental and Resource Economics* 25: 129–150.

- Atkin, David. 2012. "Endogenous Skill Acquisition and Export Manufacturing in Mexico," Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Bardhan, Pranab, and Dilip Mookherjee. Political clientelism and capture: Theory and evidence from West Bengal, India. No. 2012/97. WIDER Working Paper, 2012.
- BC First Nations Energy & Mining Council. 2010. "Sharing the Wealth: First Nations Resource Participation Models," Technical Report, BC First Nations Energy & Mining Council, North Vancouver, BC.
- Besley, Timothy, and Anne Case. 2003. "Political Institutions and Policy Choices: Evidence from the United States." *Journal of Economic Literature* 41 (1): 7–73.
- Besley, Timothy, and Robin Burgess. 2002. "The Political Economy of Government Responsiveness: Theory and Evidence from India." *The Quarterly Journal of Economics* 117 (4): 1415–1451.
- Besley, Timothy, and Stephen Coate. 2003. "Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Approach." *Journal of Public Economics* 87 (12): 2611–2637.
- Besley, Timothy, and Torsten Persson. 2010. "State Capacity, Conflict, and Development." *Econometrica* 78 (1): 1–34.
- Bhattacharyya, Sambit, and Roland Hodler. 2010. "Natural Resources, Democracy and Corruption." *European Economic Review* 54 (4): 608–621.
- Björkman, Martina, and Jakob Svensson. 2010. "When is community-based monitoring effective? Evidence from a randomized experiment in primary health in Uganda." *Journal of the European Economic Association* 8(23):571-581.
- Black, Dan, Terra McKinnish, and Seth Sanders. 2005. "The Economic Impact of the Coal Boom and Bust." *The Economic Journal* 115 (503): 449–476.
- Boschini, Anne D., Jan Pettersson, and Jesper Roine. 2007. "Resource Curse or Not: A Question of Appropriability." *The Scandinavian Journal of Economics* 109 (3): 593–617.
- Brollo, Fernanda, Tommaso Nannicini, Roberto Perotti, and Guido Tabellini. 2013. "The Political Resource Curse." *The American Economic Review* 103 (5): 1759–1796.
- Brosio, Giorgio. 2006. "The assignment of revenue from natural resources." In *Handbook of fiscal federalism*, edited by Ehtisham Ahmad and Giorgio Brosio. Cheltenham, UK: Edward Elgar Publishing, chapter 17, pp. 431–458.
- Brunnschweiler, Christa N. 2008. "Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth." *World Development* 36 (3): 399–419.
- Brunnschweiler, Christa N., and Erwin H. Bulte. 2008. "The Resource Curse Revisited and Revised: A Tale of Paradoxes and Red Herrings." *Journal of Environmental Economics and Management* 55 (3): 248–264.
- Bulte, Erwin H., Richard Damania, and Robert T. Deacon. 2005. "Resource Intensity, Institutions, and Development." *World Development* 33 (7): 1029–1044.
- Carrington, William J. 1996. "The Alaskan Labor Market during the Pipeline Era." *Journal of Political Economy* 104 (1): 186–218.
- Caselli, Francesco, and Guy Michaels. 2013. "Do Oil Windfalls Improve Living Standards? Evidence from Brazil." *American Economic Journal: Applied Economics* 5 (1): 208–238.
- Caselli, Francesco, and Wilbur John Coleman. 2013. "On the theory of ethnic conflict."

*Journal of the European Economic Association* 11 (s1): 161–192.

- Chang, Tom, Joshua Graff-Zivin, Tal Gross, and Matthew Neidell. 2014. “Particulate Pollution and the Productivity of Pear Packers.” Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Chay, Kenneth Y., and Michael Greenstone. 2003. “The Impact of Air Pollution on Infant Mortality: Evidence from Geographic Variation in Pollution Shocks Induced by a Recession.” *The Quarterly Journal of Economics* 118 (3): 1121–1167.
- Clark, Allen L. 1999. “Government Decentralization and Resource Rent Revenue Sharing: Issues and Policy.” Occasional Paper, Economics Series, East-West Center, Honolulu, Hawaii, November.
- Collier, Paul, and Anke Hoeffler. 2005. “Resource Rents, Governance, and Conflict.” *Journal of Conflict Resolution* 49 (August): 625–633.
- . 2009. “Testing the Neocon Agenda: Democracy in Resource-rich Societies.” *European Economic Review* 53 (3): 293–308.
- Collier, Paul, Anke Hoeffler, and Måns Söderbom. 2004. “On the Duration of Civil War.” *Journal of Peace Research* 41 (3): 253–273.
- Corden, W. Max. 1984. “Booming Sector and Dutch Disease Economics: Survey and Consolidation.” *Oxford Economic Papers*, New Series 36 (3) (November): 359–380.
- Corden, W. Max, and J. Peter Neary. 1982. “Booming Sector and De-industrialisation in a Small Open Economy.” *The Economic Journal* 92 (368) (December): 825–848.
- Cotet, Anca M., and Kevin K. Tsui. 2013. “Oil and Conflict: What Does the Cross-Country Evidence Really Show?” *American Economic Journal: Macroeconomics* 5 (1): 49–80.
- Currie, Janet, and Matthew Neidell. 2005. “Air Pollution and Infant Health: What Can We Learn from California’s Recent Experience?” *The Quarterly Journal of Economics* 120 (3): 1003–1030.
- Currie, Janet, and Reed Walker. 2011. “Traffic Congestion and Infant Health: Evidence from E-ZPass.” *American Economic Journal: Applied Economics* 3 (January): 65–90.
- Currie, Janet, Eric A. Hanushek, E. Megan Kahn, Matthew Neidell, and Steven G. Rivkin. 2009. “Does Pollution Increase School Absences?” *The Review of Economics and Statistics* 91 (4): 682–694.
- Currie, Janet, Joshua Graff-Zivin, Jamie Mullins, and Matthew J. Neidell. 2013. “What Do We Know About Short and Long Term Effects of Early Life Exposure to Pollution?” Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Dal Bó, Ernesto, and Pedro Dal Bó. 2011. “Workers, Warriors, and Criminals: Social Conflict in General Equilibrium.” *Journal of the European Economic Association* 9 (4): 646–677.
- Davoodi, Hamid, and Heng-fu Zou. 1998. “Fiscal Decentralization and Economic Growth: A Cross-country Study.” *Journal of Urban Economics* 43 (2): 244–257.
- Deacon, Robert T. 2011. “The Political Economy of the Natural Resource Curse: A Survey of Theory and Evidence.” *Foundations and Trends in Microeconomics* 7 (2): 111–208.
- Douglas, Stratford, and Anne Walker. 2013. “Coal Mining and the Resource Curse in the Eastern United States.” [http://papers.ssm.com/sol3/papers.cfm?abstract\\_id=2385560](http://papers.ssm.com/sol3/papers.cfm?abstract_id=2385560).

- Dube, Oeindrila, and Juan F. Vargas. 2013. "Commodity Price Shocks and Civil Conflict: Evidence from Colombia." *The Review of Economic Studies* 80 (4): 1384–1421.
- Dudka, Stanislaw, and Domy C. Adriano. 1997. "Environmental Impacts of Metal Ore Mining and Processing: a Review." *Journal of Environmental Quality* 26 (3): 590–602.
- Ebel, Robert D., and Serdar Yilmaz. 2002. *On the measurement and impact of fiscal decentralization*. World Bank Publications, Vol. 2809. Washington, DC: World Bank.
- Ebenstein, Avraham. 2012. "The Consequences of Industrialization: Evidence from Water Pollution and Digestive Cancers in China." *Review of Economics and Statistics* 94 (1): 186–201.
- Ejdemo, Thomas, and Patrik Söderholm. 2011. "Mining Investment and Regional Development: A Scenario-based Assessment for Northern Sweden." *Resources Policy* 36 (1): 14–21.
- Enikolopov, Ruben, and Ekaterina Zhuravskaya. 2007. "Decentralization and political institutions." *Journal of Public Economics* 91(11): 2261-2290.
- Fan, C. Simon, Chen Lin, and Daniel Treisman. 2009. "Political decentralization and corruption: Evidence from around the world." *Journal of Public Economics* 93(1): 14-34.
- Fearon, James D. 2005. "Primary Commodity Exports and Civil War." *Journal of Conflict Resolution* 49 (4): 483–507.
- Fearon, James D., and David D. Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97 (01): 75–90.
- Fisman, Raymond, and Roberta Gatti. 2002a. "Decentralization and Corruption: Evidence across Countries." *Journal of Public Economics* 83 (3): 325–345.
- . 2002b. "Decentralization and Corruption: Evidence from US federal transfer programs." *Public Choice* 113 (1–2): 25–35.
- Fisman, Raymond, and Yongxiang Wang. 2013. "The mortality cost of political connections." Columbia Business School.
- Fleming, David A., and Thomas G. Measham. 2014. "Local economic impacts of an unconventional energy boom: the coal seam gas industry in Australia." *Australian Journal of Agricultural and Resource Economics*. DOI: 10.1111/1467-8489.12043.
- Francken, Nathalie, Bart Minten, and Johan FM Swinnen. 2009. "Media, monitoring, and capture of public funds: evidence from Madagascar." *World Development* 37(1): 242-255.
- Frankel, Jeffrey A. 2011. "A Solution to Fiscal Procyclicality: The Structural Budget Institutions Pioneered by Chile," Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Fum, Ruikang Marcus, and Roland Hodler. 2010. "Natural Resources and Income Inequality: The Role of Ethnic Divisions." *Economics Letters* 107 (3): 360–363.
- Galasso, Emanuela, and Martin Ravallion. 2005. "Decentralized targeting of an antipoverty program." *Journal of Public Economics* 89(4): 705-727.
- Gawande, Kishore, Devesh Kapur, and Shanker Satyanath. 2012. "Renewable Resource Shocks and Conflict in Indian's Maoist Belt," Working Paper No. 302, Center for Global Development, Washington, DC.
- Gilliland, Frank D., Kiros Berhane, Edward B. Rappaport, Duncan C. Thomas, Edward

- Avol, W. James Gauderman, Stephanie J. London, Helene G. Margolis, Rob McConnell, K. Talat Islam et al. 2001. "The Effects of Ambient Air Pollution on School Absenteeism Due to Respiratory Illnesses." *Epidemiology* 12 (1): 43–54.
- Goderis, Benedikt, and Samuel W. Malone. 2011. "Natural Resource Booms and Inequality: Theory and Evidence." *The Scandinavian Journal of Economics* 113 (2): 388–417.
- Graff-Zivin, Joshua, and Matthew Neidell. 2012. "The Impact of Pollution on Worker Productivity." *American Economic Review* 102: 3652–3673.
- . 2013. "Environment, Health, and Human Capital." *Journal of Economic Literature* 51: 689–730.
- Greenstone, Michael, and Rema Hanna. 2014. "Environmental Regulations, Air and Water Pollution, and Infant Mortality in India." *American Economic Review* 104(10):3038-72.
- Greenstone, Michael, Richard Hornbeck, and Enrico Moretti. 2010. "Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings." *Journal of Political Economy* 118(3):536–598.
- Grossman, Herschel I. 1999. "Kleptocracy and Revolutions." *Oxford Economic Papers* 51 (2): 267–283.
- Gylfason, Thorvaldur, Tryggvi Thor Herbertsson, and Gylfi Zoega. 1999. "A Mixed Blessing." *Macroeconomic Dynamics* 3 (02): 204–225.
- Hanna, Rema, and Paulina Oliva. 2011. "The Effect of Pollution on Labor Supply: Evidence from a Natural Experiment in Mexico City." Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Harding, Torfinn, and Anthony J. Venables. 2010. "Exports, Imports and Foreign Exchange Windfalls." Oxcarre Research Paper, University of Oxford.
- Hartwick, John M. 1977. "Intergenerational Equity and the Investing of Rents from Exhaustible Resources." *American Economic Review* 67 (5): 972–974.
- Heck, Walter W., O. C. Taylor, Richard Adams, Gail Bingham, Joseph Miller, Eric Preston, and Leonard Weinstein. 1982. "Assessment of Crop Loss from Ozone." *Journal of the Air Pollution Control Association* 32 (4): 353–361.
- Hilson, Gavin. 2002. "An Overview of Land Use Conflicts in Mining Communities." *Land Use Policy* 19 (1): 65–73.
- Hirshleifer, Jack. 1991. "The Paradox of Power." *Economics & Politics* 3 (3): 177–200.
- Hodler, Roland. 2006. "The Curse of Natural Resources in Fractionalized Countries." *European Economic Review* 50 (6), 1367–1386.
- Hooker, Mark A., and Michael M. Knetter. 2001. "Measuring the Economic Effects of Military Base Closures." *Economic Inquiry* 39 (4): 583–598.
- Humphreys, Macartan. 2005. "Natural Resources, Conflict, and Conflict Resolution Uncovering the Mechanisms." *Journal of Conflict Resolution* 49 (4): 508–537.
- ICMM (International Council of Mining and Metals). 2006. "Synthesis of Four Country Case Studies," Technical Report, International Council of Mining and Metals, London.
- . 2009. "Minerals Taxation Regimes." Technical Report, International Council of Mining and Metals, London.
- Isham, Jonathan, Michael Woolcock, Lant Pritchett, and Gwen Busby. 2005. "The Varieties of Resource Experience: Natural Resource Export Structures and the



- Political Economy of Economic Growth.” *The World Bank Economic Review* 19 (2): 141–174.
- Ismail, Kareem. 2010. *The Structural Manifestation of the Dutch Disease: The Case of Oil Exporting Countries*. Washington, DC: International Monetary Fund.
- Jacobsen, Grant, and Dominic Parker. 2014. “The Economic Aftermath of Resource Booms: Evidence from Boomtowns in the American West.” *Economic Journal*.
- James, Alex, and David Aadland. 2011. “The Curse of Natural Resources: An Empirical Investigation of U.S. Counties.” *Resource and Energy Economics* 33 (2): 440–453.
- Jayachandran, Seema. 2009. “Air Quality and Early-life Mortality Evidence from Indonesia’s Wildfires.” *Journal of Human Resources* 44 (4): 916–954.
- Jensen, Nathan, and Leonard Wantchekon. 2004. “Resource Wealth and Political Regimes in Africa.” *Comparative Political Studies* 37 (7): 816–841.
- Khemani, Stuti. “Buying votes vs. supplying public services: political incentives to under-invest in pro-poor policies.” World Bank Policy Research Working Paper 6339 (2013).
- Kotsadam, Andreas, and Anja Tolonen. 2014. “African Mining, Gender, and Local Employment.” Department of Economics, OxCarre Oxford Centre for the Analysis of Resource Rich Economies, Oxford.
- Krugman, Paul. 1987. “The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies.” *Journal of Development Economics* 27 (1): 41–55.
- Lane, Philip R., and Aaron Tornell. 1996. “Power, Growth, and the Voracity Effect.” *Journal of Economic Growth* 1 (2): 213–241.
- Lavy, Victor, Avraham Ebenstein, and Sefi Roth. 2012. “The Impact of Air Pollution on Cognitive Performance and Human Capital Formation.” unpublished mimeo.
- Leamer, Edward E., Hugo Maul, Sergio Rodriguez, and Peter K. Schott. 1999. “Does Natural Resource Abundance Increase Latin American Income Inequality?” *Journal of Development Economics* 59 (1): 3–42.
- Lederman, Daniel, and William F. Maloney. 2007. *Natural Resources, Neither Curse nor Destiny*. Washington, DC: World Bank Publications.
- . 2008. “In Search of the Missing Resource Curse.” *Economía* 9 (1): 1–56.
- Lei, Yu-Hsiang, and Guy Michaels. 2011. “Do Giant Oilfield Discoveries Fuel Internal Armed Conflicts?” Technical Report 6934, CEPR Discussion Paper Series, Center for Economic and Policy Research, Washington, DC.
- Leite, Carlos A., and Jens Weidmann. 1999. “Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth.” IMF Working Paper, International Monetary Fund, Washington, DC, June.
- Lin, Justin Yifu, and Zhiqiang Liu. 2000. “Fiscal Decentralization and Economic Growth in China.” *Economic Development and Cultural Change* 49 (1): 1–21.
- Litvack, Jennie, Junaid Ahmad, and Richard Bird. 1998. *Rethinking Decentralization in Developing Countries*. Sector Studies Series. Washington DC: World Bank.
- Lizzeri, Alessandro, and Nicola Persico. 2001. “The Provision of Public Goods under Alternative Electoral Incentives.” *American Economic Review* 91 (1): 225–239.
- Lleras-Muney, Adriana. 2010. “The Needs of the Army Using Compulsory Relocation in the Military to Estimate the Effect of Air Pollutants on Children’s Health.” *Journal*

- of *Human Resources* 45 (3): 549–590.
- Loayza, Norman, Alfredo Mier y Teran, and Jamele Rigolini. 2013. “Poverty, Inequality, and the Local Natural Resource Curse.” Technical Report, World Bank, Washington, DC.
- Lujala, Päivi. 2010. “The Spoils of Nature: Armed Civil Conflict and Rebel Access to Natural Resources.” *Journal of Peace Research* 47 (1): 15–28.
- Manzano, Osmel, and Roberto Rigobon. 2001. “Resource Curse or Debt Overhang?” Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Marchand, Joseph. 2012. “Local Labor Market Impacts of Energy Boom-bust-boom in Western Canada.” *Journal of Urban Economics* 71 (1): 165–174.
- Marshall, Fiona, Mike Ashmore, and Fiona Hinchcliffe. 1997. *A Hidden Threat to Food Production: Air Pollution and Agriculture in the Developing World*. London: International Institute for Environment and Development.
- Martinez-Vazquez, Jorge, and Robert M. McNab. 2003. “Fiscal decentralization and economic growth.” *World Development* 31 (9): 1597–1616.
- Matsuyama, Kiminori. 1992. “Agricultural Productivity, Comparative Advantage, and Economic Growth.” *Journal of Economic Theory* 58 (2): 317–334.
- McMahon, Gary, and Felix Remy, eds. 2001. *Large Mines and the Community: Socioeconomic and Environmental Effects in Latin America, Canada and Spain*. Washington, DC: World Bank.
- Mehlum, Halvor, Karl Moene, and Ragnar Torvik. 2006. “Institutions and the Resource Curse.” *The Economic Journal* 116 (508): 1–20.
- Menz, Fredric C., and Hans M. Seip. 2004. “Acid Rain in Europe and the United States: An Update.” *Environmental Science & Policy* 7 (4): 253–265.
- Michaels, Guy. 2011. “The Long Term Consequences of Resource-Based Specialisation.” *The Economic Journal* 121 (551): 31–57.
- Miller, Joseph E. 1988. “Effects on Photosynthesis, Carbon Allocation, and Plant Growth Associated with Air Pollutant Stress.” In *Assessment of Crop Loss from Air Pollutants*. New York: Springer, pp. 287–314.
- Monteiro, Joana, and Claudio Ferraz. 2010. “Does Oil Make Leaders Unaccountable? Evidence from Brazil’s Offshore Oil Boom.” Unpublished, PUC Rio.
- Moretti, Enrico. 2011. “Local Labor Markets.” *Handbook of Labor Economics* 4: 1237–1313.
- . “Real Wage Inequality.” *American Economic Journal: Applied Economics* 5 (1): 65–103.
- Mookherjee, Dilip. 2015. “Political Decentralization,” *Annual Review of Economics* 7: 231–49.
- Morgandi, Matteo. 2008. “Extractive Industries Revenues Distribution at the Sub-National Level: The experience in seven resource-rich countries,” Technical Report, Revenue Watch Institute, New York.
- Murphy, Kevin M., Andrei Shleifer, and Robert W. Vishny. 1989. “Industrialization and the Big Push.” *The Journal of Political Economy* 97 (5): 1003–1026.
- Nunn, Nathan. 2009. “The Importance of History for Economic Development.” *Annual Review of Economics* 1: 65–92.
- Otto, James M. 2001. “Fiscal decentralization and mining taxation.” Technical Report, The World Bank Group Mining Department, Washington, DC.

- Pande, Rohini. 2003. "Can Mandated Political Representation Increase Policy Influence for Disadvantaged Minorities? Theory and Evidence from India." *The American Economic Review* 93 (4): 1132–1151.
- Papyrakis, Elissaios, and Reyer Gerlagh. 2007. "Resource Abundance and Economic Growth in the United States." *European Economic Review* 51 (4): 1011–1039.
- Park, Hyesook, Boeun Lee, Eun-Hee Ha, Jong-Tae Lee, Ho Kim, and Yun-Chul Hong. 2002. "Association of Air Pollution with School Absenteeism Due to Illness." *Archives of Pediatrics & Adolescent Medicine* 156 (12): 1235–1239.
- Persson, Torsten. 2002. "Do Political Institutions Shape Economic Policy?" *Econometrica* 70 (3): 883–905.
- Persson, Torsten, and Timothy Besley. 2009. "The Origins of State Capacity: Property Rights, Taxation and Policy." *The American Economic Review* 99 (4): 1218–1244.
- Ransom, Michael R., and C. Arden Pope III. 1992. "Elementary school absences and PM-10 pollution in Utah Valley." *Environmental Research* 58 (1): 204–219.
- Rau, Tomás, Loreto Reyes, and Sergio S. Urzúa. 2013. "The Long-term Effects of Early Lead Exposure: Evidence from a Case of Environmental Negligence." Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Reeson, Andrew F., Thomas G. Measham, and Karin Hosking. 2012. "Mining Activity, Income Inequality and Gender in Regional Australia." *Australian Journal of Agricultural and Resource Economics* 56 (2): 302–313.
- Robinson, James A., Ragnar Torvik, and Thierry Verdier. 2006. "Political Foundations of the Resource Curse." *Journal of Development Economics* 79 (2): 447–468.
- Ross, Michael L. 2001. "Does Oil Hinder Democracy?" *World Politics* 53 (3): 325–361.
- . 2004. "What Do We Know about Natural Resources and Civil War?" *Journal of Peace Research* 41 (3): 337–356.
- Rosser, Andrew. 2006. *The Political Economy of the Resource Curse: A Literature Survey*. Vol. 268. Brighton, UK: Institute of Development Studies.
- Jia, Ruixue, and Huihua Nie. 2015. "Decentralization, Collusion and Coalmine Deaths." Forthcoming in the *Review of Economics and Statistics*.
- Sachs, Jeffrey D., and Andrew M. Warner. 1995. "Natural Resource Abundance and Economic Growth," Technical Report, National Bureau of Economic Research, Cambridge, MA.
- . 1999. "The Big Push, Natural Resource Booms and Growth." *Journal of Development Economics* 59 (1): 43–76.
- . 2001. "The Curse of Natural Resources." *European Economic Review* 45 (4), 827–838.
- Sala-i-Martin, Xavier, and Arvind Subramanian. 2003. "Addressing the Natural Resource Curse: An Illustration from Nigeria," Technical Report, National Bureau of Economic Research, Cambridge, MA.
- Sala-i-Martin, Xavier X. 1997. "I Just Ran Two Million Regressions." *The American Economic Review* 87 (2): 178–183.
- Salomons, W. 1995. "Environmental Impact of Metals Derived from Mining Activities: Processes, Predictions, Prevention." *Journal of Geochemical Exploration* 52 (1): 5–23.
- San Cristobal, J. R., and M. V. Biezma. 2006. "The Mining Industry in the European Union: Analysis of Inter-industry Linkages Using Input-output Analysis." *Resources*

- Policy* 31 (1): 1–6.
- Sosa, Irene, and Karyn Keenan. 2001. *Impact benefit agreements between aboriginal communities and mining companies: Their use in Canada*. Ottawa: Canadian Environmental Law Association.
- Stevens, Paul. 2003. "Resource Impact: Curse or Blessing? A Literature Survey." *Journal of Energy Literature* 9 (1): 1–42.
- Stijns, Jean-Philippe. 2003. "An Empirical Test of the Dutch Disease Hypothesis Using a Gravity Model of Trade." *International Trade* 305001.
- Stilwell, L. C., R. C. A. Minnitt, T. D. Monson, and G. Kuhn. 2000. "An Input-output Analysis of the Impact of Mining on the South African Economy." *Resources Policy* 26 (1): 17–30.
- Tornell, Aaron, and Philip R. Lane. 1999. "The Voracity Effect." *American Economic Review* 89 (1): 22–46.
- Torvik, Ragnar. 2001. "Learning by Doing and the Dutch Disease." *European Economic Review* 45 (2): 285–306.
- Tsui, Kevin K. 2011. "More Oil, Less Democracy: Evidence from Worldwide Crude Oil Discoveries." *The Economic Journal* 121 (551): 89–115.
- U.S. EPA (U.S. Environmental Protection Agency). 2012. "Acid Rain." U.S. Environmental Protection Agency, Washington, DC. <http://www.epa.gov/acidrain/effects/forests.html>.
- von der Goltz, Jan, and Prabhat Barnwal. 2014. "Mines: The Local Welfare Effects of Mineral Mining in Developing Countries." Department of Economics Discussion Paper Series, Columbia University, New York.
- van der Ploeg, Frederick. 2011. "Natural Resources: Curse or Blessing?" *Journal of Economic Literature* 49 (2): 366–420.
- van der Ploeg, Frederick, and Steven Poelhekke. 2009. "Volatility and the Natural Resource Curse." *Oxford Economic Papers* 61 (4): 727–760.
- . 2010. "The Pungent Smell of 'Red Herrings': Subsoil Assets, Rents, Volatility and the Resource Curse" *Journal of Environmental Economics and Management* 60 (1): 44–55.
- Vicente, Pedro C. 2010. "Does Oil Corrupt? Evidence from a Natural Experiment in West Africa." *Journal of Development Economics* 92 (1): 28–38.
- Vicente, Pedro C., and Leonard Wantchekon. "Clientelism and vote buying: lessons from field experiments in African elections." *Oxford Review of Economic Policy* 25.2 (2009): 292-305.
- Wantchekon, Leonard. 2002. "Why Do Resource Dependent Countries Have Authoritarian Governments?" *Journal of African Finance and Economic Development* 5 (2): 57–77.
- Woller, Gary M., and Kerk Phillips. 1998. "Fiscal decentralisation and IDC economic growth: An empirical investigation." *The Journal of Development Studies* 34 (4): 139–148.
- World Bank. 2014. "Intergovernmental Fiscal Relations." <http://www1.worldbank.org/publicsector/decentralization/fiscal.htm>
- Xie, Danyang, Heng-fu Zou, and Hamid Davoodi. 1999. "Fiscal decentralization and economic growth in the United States." *Journal of Urban Economics* 45 (2): 228–239.
- Zhang, Tao, and Heng-fu Zou. 1998. "Fiscal Decentralization, Public Spending, and

Economic Growth in China.” *Journal of Public Economics* 67 (2): 221–240.

Zhang, Xiaobo, Shenggen Fan, Linxiu Zhang, and Jikun Huang. 2004. “Local Governance and Public Goods Provision in Rural China.” *Journal of Public Economics* 88 (12): 2857–2871.

Zuo, Na, and Schieffer Jack. 2014. “Are Resources a Curse? An Investigation of Chinese Provinces.” Paper presented at the Southern Agricultural Economics Association 2014 Annual Meeting, Dallas, Texas, February 1–4.