Studies in
Mining Policy

35 YEARS 1974-2009
FRASER INSTITUTE

October 2009

Economic Freedom and the "Resource Curse"

An Empirical Analysis

by Louis-Philippe Béland and Raaj Tiagi

Series Editor: Fred McMahon

Studies in
Mining Policy
Series editor: Fred McMahon

October 2009

Economic Freedom and the "Resource Curse"

An Empirical Analysis

by Louis-Philippe Béland and Raaj Tiagi

Contents

Executive summary

This paper explores the question of whether mineral resource wealth is an economic blessing or curse, particularly for developing nations where growth and reduction of poverty are vital. It does this by examining the relationship between natural resources and economic growth and the interaction between institutions and natural resources. We consider four categories of natural resources: [1] agricultural raw materials, [2] fuel, [3] food, and [4] ores and metals. Resource wealth was significant in our testing on economic growth but only the last category turned out to be significant on its own as the effect upon economic growth of agricultural raw materials, fuel, and food, when tested independently, did not reach a level of statistical significance.

Historically, natural resources were considered beneficial to economic growth. This changed recently, mainly due to Sachs and Warner's seminal paper (1995) that found that natural resources lead to negative economic growth, or what is termed as a "resource curse." These findings are controversial not only because they were not in line with the literature at the time but also because economic theory suggests that natural resources, like physical or human capital, should have a positive impact on growth. While earlier research following Sachs and Warner's paper supported the conclusions that natural resources had a negative effect on economic growth, recent studies have challenged these findings. This recent research indicates that the choice of the measure of natural resources can change the results: if one uses a more precise measure of natural resources, the resource curse may disappear and natural resources lead to *positive* economic growth. The recent research also indicates that institutions may play a decisive role in determining if natural resources are channeled into positive economic growth: a high level of institutional quality in a country with abundant resources can turn the "resource curse" into a "resource blessing."

In this paper we test for the resource curse using the latest data from the World Bank, for the period 1970 to 2006, and the role of institutions using Fraser Institute's Economic Freedom of the World (EFW) index, which has become a broadly accepted measure of the quality of institutions. For example, IMF's key recent investigation of institutions, its 2005 report *World Economic Outlook: Building Institutions*, uses the EFW index as its key measure of the quality of institutions. A major advantage of the EFW index is that it is a better proxy for institutional quality than others used earlier in research. In addition to measuring the rule of law and the level of red tape—measures that have been used in earlier research—the economic

freedom index also measures additional aspects of economic institutions and policies: size of government; legal structure and security of property rights; access to sound money; freedom to trade internationally; and regulation of credit, labor, and business. This index allows us to get a more precise estimate of the impact of institutions on economic growth and how institutions interact with natural resources.

For our analysis, we use the most commonly used measure of natural resources in this literature, including Sachs and Warner's study, and we also look at minerals and ores specifically. We use the ratio of primary exports to GDP in 1970 and find evidence of a resource curse. That is, countries that are highly dependent on primary product exports are more likely, according to our data, to experience slower economic growth.

To test for the role of institutions, we use the Fraser Institute's EFW index in two different ways. First, we include the index as an independent variable in our regression specification to measure whether institutions matter for economic growth. Second, we introduce an interaction term, the EFW index interacting with our measure of natural resources, to measure whether institutions matter for countries that are highly dependent on natural resources. Regression results indicate that institutions do matter for economic growth: the coefficient on the EFW index variable is positive and statistically significant. More importantly, however, we get a positive and significant coefficient on the interaction term. This implies that the quality of economic institutions is crucial in determining how natural resources affect economic growth. Using our regression specification, we also compute the level of economic freedom necessary for countries to turn the resource curse into a blessing.

Metals and ores

Metals and ores bring a stronger resource curse than natural resources in general: the negative coefficient on the variable representing metals and ores has a greater absolute value than the coefficient for resources in general. However, this curse is turned into an economic blessing even at relatively low levels of institutional development. The regressions show that nations with a score above 5.43 (out of 10) for economic freedom benefit from possessing metals-and-ores resources. This is lower than the world average of 5.89 and means that a large majority of nations will benefit economically from mineral resources. Among the 26 resource-dependent nations we examine, 22 have a score high enough to benefit from mining development.

Resource wealth overall

Resource wealth in general carries a weaker curse: the negative coefficient on the variable representing natural resources in general has a lower absolute value than the coefficient for metals and ores. However, although resource wealth in general has less negative effect on growth than metals and ores (other things being held equal), it only becomes a blessing at a relatively high level of economic freedom. An economic freedom score of 6.89 is required for nations to benefit from resource wealth in general. Among our resource-dependent countries, only nine have an economic freedom score higher than 6.89, a necessary level of economic freedom: Costa Rica, Honduras, Ireland, Netherlands, New Zealand, Nicaragua, Singapore, Trinidad, and Zambia.

How to benefit from resources

All nations have the potential to benefit from both abundant metals and ores and natural-resource wealth in general by improving the quality of their institutions. Fortunately, the level of economic freedom on a worldwide basis has risen consistently for the last quarter century, so more and more countries are benefiting from their resource wealth. This publication presents a number of sensitivity tests made to examine the robustness of the results. The regression results and various robustness checks support the existence of a resource curse. More importantly, however, our empirical analysis suggests that institutions matter for economic growth and that nations with better economic and political institutions are more capable of managing their resource revenue and lessening, then eliminating, the adverse economic and political consequences of a natural-resource boom.

Strong institutions in countries with natural resources can turn a resource curse into a resource blessing. The policy implication from these results is that leaders in various countries should focus on building strong, well-designed institutions: rule of law, property rights, independent judiciary and impartial judges, low taxation, low levels of tariffs and import barriers, and low levels of red tape, all key elements of economic freedom. This will increase their prosperity and enable them to benefit from their natural resources.

Economic freedom and the "resource curse"

An empirical analysis

1 Introduction

The relationship between the abundance of natural resources and economic growth has been a subject of debate for decades and a renewed interest in this subject emerged in the 1990s. There is no consensus at this point on whether natural resources are beneficial or not for economic growth. For example, Australia, Canada, the United States, New Zealand, Iceland, and some Scandinavian countries are clear examples of countries where natural resource abundance has induced preliminary economic development (Mehlum et al., 2006).[1] However, a majority of research, starting with the work of Sachs and Warner (1995), suggests that natural resources have a negative effect (often called the "resource curse") on economic growth (Mikesell, 1997). The evidence of a curse of natural resources is puzzling since standard economic theory suggests that, like physical and human capital, natural resources should induce economic growth.

While a number of studies have tested for the existence of a resource curse, recent research has added an interesting dimension to the literature. According to this research, the negative association between resource abundance and economic growth can be explained by the quality of institutions in a country. That is, developing nations with a great abundance of natural resources are not doomed to failure or poor economic performance if they have strong institutions (the institutions effect). In this paper, we add to current literature in two ways. First, we investigate the impact of natural resources on economic growth, using latest data from the World Bank, for the period from 1970 to 2006. Second, we use a more comprehensive proxy for institutions to test for the effect of institutions mentioned above.

While previous research has proxied for institutions using political indicators—for example rule of law or quality of bureaucracy (Sala-i-Martin and Subramanian, 2003; Brunnschweiler and Bulte, 2006), or the democracy index (Kolstad, 2007)—we will follow *World Economic Outlook: Building Institutions* (International Monetary Fund, 2005) in using the index published in *Economic Freedom of the World* as the key measure of the quality

1 Note however that some countries such as the Republic of Korea, Taiwan, Hong Kong, and Singapore have had successful and rapid economic growth in the past few decades although they are not rich in resources (Sachs and Warner 1995). Japan, Luxembourg, and Switzerland, some of the world's richest states, also have few natural resources (Gylfason and Zoega, 2006).

of institutions.[2] This measure has been frequently used as a measure of good institutions and, in our opinion, is a better proxy for institutions than the measures that have been used in earlier papers. This is because, in addition to measuring the rule of law and the level of red tape, this index also measures additional aspects of economic institutions and policies such as size of the government (as measured by government expenditures, taxes and enterprises); legal structure and security of property rights (which includes the rule of law); access to sound money; freedom to trade internationally; and regulation of credit, labor and business.

Our regression results show that for nations with weak institutions, natural resources are a curse and for nations with strong institutions, natural resources are a blessing. That is, a high level of economic freedom (stronger institutions) turns this resource curse into a blessing. Also, results indicate that this "curse" has a strong effect upon countries with higher levels of metals and ores exports but that it turns into a blessing when such a country adopts a relatively low level of economic freedom. The results of our study suggest that, regardless of their natural-resource endowments, nations should focus on increasing their level of economic freedom by establishing better institutions, which in turn will increases their prosperity.

In the following section, we briefly summarize the literature on the subject. In section 3, we discuss our measures of resource abundance and institutions. In section 4, we present empirical evidence, control for endogeneity of institutions using instrument variables, and conduct various robustness checks. Finally, in section 5 we give a summary, our conclusions, and policy recommendations.

2 The index published annually in *Economic Freedom of the World* is compiled by the Fraser Institute. The economic freedom index (EFW index) is designed to measure the consistency of a nation's institutions and policies with economic freedom. In this study, we use data from *Economic Freedom of the World: 2008 Annual Report* (Gwartney and Lawson, 2008).

2 Literature review

2.1 Resource abundance and economic growth

Literature on the "curse of natural resources can be seen as an extension of the standard endogenous growth theory where natural resource abundance is one of the main drivers of economic growth.[3] Research on endogenous growth theory was in part motivated by the availability of cross-country data sets such as the Penn World Table (CICUP, 2009) and various World Bank statistics. These data allowed researchers to analyze the elements of economic growth in more depth (Romer, 1994). For example, Sachs and Warner (1995) empirically analyze the association between resource abundance and economic growth using World Bank data (for a number of indicators), leading to a vast amount of subsequent research in this area. These studies point to the existence of a resource curse, a negative relation between an abundance of natural resources and economic growth (Papyrakis and Gerlagh, 2004; Leite and Weidmann, 1999).

The existence of a resource curse, although puzzling, has two common explanations in this literature: economic and political and institutional. A prominent economic explanation of the resource curse is that diagnosing the "Dutch disease." Under this explanation, the expansion of the natural-resources sector (due to increases in prices or the discovery of new stocks of resources) leads to the manufacturing sector's having decreased importance or a decreased share of GDP.[4] According to Matsuyama (1992) and Sachs & Warner (1995), positive externalities (in the form of learning by doing[5]) are mainly present in the manufacturing sector. This implies that the larger the natural-resource sector gets, the fewer the positive externalities from the manufacturing sector due to its shrinkage, leading to a negative impact on overall economic growth.

3 "In endogenous growth models, economic growth is determined within a model by factors such as economic institutions and policies and the accumulation of human capital. In exogenous growth models, on the other hand, the long-run economic growth is determined by factors outside of the model such as the rate of technological progress" (Karabegović, 2009: 10, fn 6). For an exhaustive review of the literature on the "curse" of natural resources and a detailed explanation of many of the theories about the topic, see Karabegović, 2009.

4 An expansion of the natural-resource sector in a country leads to increased revenues for the country, followed by currency appreciation, thereby making the manufacturing sector less competitive internationally.

5 That is, the improvement in methods, tools, and products that is acquired through performing the work.

The other popular explanation of why natural resources have a negative effect on growth is the political and institutional explanation. This literature suggests a number of channels through which natural resources could affect the functioning of a political system. One such channel is rent-seeking.[6] This has been explored in depth by a number of authors: for example, in their papers, Lane and Tornell (1999) and Torvik (2002) have developed theoretical models of rent seeking. Their main argument is that a high level of resource abundance creates incentives for rent-seeking behavior. Further, Ross (2001) points out that nations that obtain significant revenue from natural resources may tax their populations less heavily and that the population may in turn be less likely to demand greater accountability and representation. Also, Isham et al. (2005) argue that natural resources can affect a country's social structure by creating a wealthy elite who are less likely to support economic and political reforms. Such rentier effects may undermine economic development in a country. There are, thus, three consequences when revenues from resources are extracted easily. First, the need for taxation decreases for any given revenue target. Therefore, citizens have less incentive to develop mechanisms of accountability and to develop deep civil society and social associations that are arguably preconditions of democracy (see, among others, Inglehart, 1997; Lipset, 1959; Moore, 1966; Putnam, 1993). Second, the large exogenous revenues from resources allow the government to appease the population through a diversity of instruments (buying off critics, giving benefits to the population, infrastructure project, patronage, etc.). Third, the revenue from the resource allows the state to pursue direct repression and violence against dissenters. In this framework, the role of good institutions and laws that prevent rent-seeking behavior is crucial.

In their initial paper, Sachs and Warner (1995) developed a model of the Dutch disease to explain why a resource curse may exist in resource-rich nations. This influential, seminal paper restarted the debate on the effect of natural resources on economic growth. Sachs and Warner examined the impact of natural resources on economic growth using data for a large number of nations (varying from 40 to 95 depending on the specific regression) from 1970 to 1989. To measure resource abundance, they used primary-product exports as a percentage of GDP or GNP (which they term SXP). Their results indicate that, after controlling for a number of factors, natural resources have a negative impact on economic growth.[7] This negative

6 Rent-seeking usually implies an "expenditure of scarce resources to capture an artificially created transfer" (Tollison, 1982: 578).

7 Sachs and Warner's initial paper (1995) measures natural resources as primary-product exports as a percentage of GDP in 1971. Their revised version (1997a), from which data are available online, measures natural resources as primary-product exports as a percentage of GNP in 1970. Later in our study, we use their revised measure as a robustness check.

impact, according to them, is likely due to the effects of the Dutch disease on the manufacturing sector, as explained above.[8]

Several papers following Sachs and Warner's work distinguish between different categories of resources—as we do in this paper—and point out their differing effects upon growth (see, for example, Auty, 1997; Woolcook et al., 2001; Isham et al., 2005, Brunnschweiler, 2006; Boschini et al., 2007). The general argument is that "point source" resources such as minerals are more likely to have a negative effect upon economic growth than "diffuse" natural resources such as rice and wheat.[9] This is because "point source" resources are more likely to attract appropriation and rent seeking: in the literature, abundant point resources are often associated with higher risk of conflict (see, for example, Addison et al., 2001; Addison and Murshed, 2001). Point resources cannot escape expropriation by moving. With a more inelastic supply, they are taxed more heavily and are more subject to expropriation.

A study by Boschini et al. (2007) tests for the impact of natural resources on economic growth, by using different measures of natural resources. These include the value of primary exports; value of exports of ores and metals plus fuels; value of mineral production (not including fuels); and value of production of gold, silver, and diamonds; all as a percentage of GNP or GDP for 80 nations from 1975 to 1998. Their results indicate that gold, silver, and diamonds have the strongest negative impact on economic growth.

More recently, papers have questioned the use of SXP as an appropriate measure of resource abundance. For example, a paper by Ding and Field (2005) distinguishes between resource abundance and resource dependence and argues that primary exports as a proportion of GDP (SXP) measures resource dependence rather than resource abundance. Therefore, instead of using SXP as a measure of resource abundance, the authors construct two new measures. Their measures of natural resource capital are based on the World Bank's estimates of agricultural land, pasture land, forests, protected areas, metals, coal, oil, and natural gas. *Resource dependence* is then measured as a ratio of natural-resource capital to total capital while r*esource abundance*

The main controls used by Sachs and Warner are the following: initial per-capita income; trade policy; government efficiency (measured as an average of three indices: efficiency of the judiciary, lack of red tape, and lack of corruption); investment rates (measured as average investment to GDP).

8 Sachs and Warner's results were also robust to different measures of natural-resource abundance, such as share of mineral production to GDP, primary exports intensity (measured as fraction of primary exports to total exports), the log (natural logarithm) of land area per person, and natural resource wealth in total wealth.

9 Whether a natural resource is "point" or "diffuse" depends on its geographical concentration. For example, forests are considered diffuse resources since they cover a significant area on a map. Minerals, on the other hand, occur in small areas and are therefore considered point resources (Lujala, 2003).

is measured as natural-resource capital per population. After controlling for income, investment rate, openness, and rule of law, the authors find that resource abundance has a positive impact on economic growth whereas resource dependence has a negative impact on economic growth.

In summary, although one cannot reach a definitive conclusion about the impact of natural resources on a country's economic growth, recent evidence suggests that the choice of the measure of natural resources can change the results. For example, when we distinguish between resource abundance and resource dependence and proxy for a country's resource endowment using either of these two measures, it is dependence upon resources that seems to generate a resource curse.

Although recent research suggests that Sachs and Warner's measure of resource endowment may be an imperfect measure of resource abundance, we use this as our preferred measure of natural resource endowment. One reason is that this measure is widely used in this literature: recent papers (e.g., Kolstad, 2007) continue to use this as a measure of "resource abundance." Moreover, data is available on this measure since 1970. However, in keeping with literature that distinguishes between resource abundance and resource dependence, we shall henceforth refer to our measure of resources, SXP´, as a proxy for resource *dependence*, while reminding the reader that resource abundance (as defined by Ding and Field, 2005) has not been shown to have negative consequences.

2.2 Institutions and economic growth

There is substantial research on the association between institutions and economic growth in a country. By creating an environment that encourages voluntary transactions, risk-taking, and engaging in productive activities in general, institutions spur economic growth (North, 1990). In a recent paper, Acemoglu and Robinson (2008) argue that institutions are the fundamental cause of economic growth and, therefore, of the differences in different levels of economic development across countries. Further, the differences in institutions across countries may help explain differences in human capital, physical capital. and technology across countries—all of which bring about economic growth.

A large body of empirical research has found that economic freedom is a key to increasing prosperity. Fact-based studies in top academic journals have shown that economic freedom in a country promotes growth, prosperity, and other positive outcomes. For example, using the EFW index published annually in *Economic Freedom of the World*, De Haan and Sturm (2000) show empirically that positive (negative) change in economic freedom leads to positive (negative) change in rates of economic growth.

Another paper by Gwartney et. al (2006) examines the impact of economic freedom on economic growth but with a specific focus on investment and productivity. They find that economic freedom promotes investment and growth for a country.[10]

Recent research on the resource curse has highlighted the crucial role of institutions for countries with an abundance of natural resources. For example, Mehlum et al. (2006) argue that countries with abundant natural resources need not be affected by a resource curse if they have strong institutions. Using Sachs and Warner's measure of natural-resource abundance (SXP), they find that the resource-curse effect depends on the quality of the institutions: for countries with weak institutions, natural resources are a curse but, for countries with strong institutions, resources are actually a "blessing," so that their economic growth is greater than that of resource-poor nations.

Further, research on countries that have abundant natural resources, such as Botswana (Iimi, 2006) and Norway (Larsen, 2006), point to the same conclusion: strong institutions in these countries helped them escape the resource curse. For example, Iimi shows that for Botswana, the coexistence of good governance and abundant diamonds helped the country's economic growth. For developing countries in general, good governance (specifically, a strong public voice with accountability, high government effectiveness, good regulation, and powerful anticorruption policies) tends to link natural resources with high economic growth (Iimi, 2006). Similarly, Larsen shows that a major factor that accounted for Norway's rapid growth after the discovery of oil in 1969 was the management of its oil revenues: it was Norway's arrangement of political and economic institutions, a strong judicial system, and social norms that contributed to its escaping the resource curse and the Dutch disease.

This study adds to the literature cited above by using a more comprehensive measure of institutions. Earlier research has used either the rule-of-law index (Sachs and Warner, 1995; Brunnschweiler, 2006) or the democracy index (Kolstad, 2007), as a proxy for institutions. Our proxy, the EFW index from the Fraser Institute's *Economic Freedom of the World* (Gwartney and Lawson, 2008), is more precise and a more comprehensive estimate of economic institutions; it is based on a broader range of components (see next section). Using this index will allow us to get a more precise estimate of the impact of institutions on economic growth and how institutions interact with natural resources.

10 For a sample of the literature on economic freedom, see <http://www.freetheworld.com>.

3 Measuring natural resources and institutions

3.1 Measuring natural resources

While there are a number of measures that attempt to capture resource abundance or dependence in a country, the share of primary product exports to GDP or GNP (SXP) seems to be the most commonly used measure. Starting with the seminal work of Sachs & Warner in 1995, this measure has been used by more recent papers as well (e.g., Mehlum et al., 2006; Kolstad, 2007). Another estimate of a country's wealth in natural resources is natural-resource capital as a percentage of total capital or as a percentage of the population. This estimate of resource abundance is based on the World Bank's estimation of natural capital (Ding and Field, 2005).

Although used widely, these measures are not without their shortcomings. Brunnschweiler (2006), for example, points out that there is no strong correlation between resource abundance and natural-resources exports given the existence of counter-examples of resource-rich countries such as Germany with relatively low primary exports. Further, according to Ding and Field (2005), SXP mainly captures the importance of primary industries in terms of exports. In other words, an economy with a large primary sector would be classified as a resource-abundant country when using SXP. Ding and Field argue that it is possible for a resource-abundant country like the United States not to depend heavily on exports of primary products and for countries like Tanzania and Burundi that do not have abundant natural resources to depend heavily on primary sectors. Also, the World Bank's estimates of natural capital are not available prior to 1994, which makes it less attractive for use in empirical analysis.

While we agree that SXP is not without its shortcomings as a measure of resource abundance, it still is the most commonly used measure in this literature. Therefore, in this paper, we use SXP as our preferred measure of resource abundance in a country. However, as mentioned previously, we will refer to this as measuring resource *dependence* (SXP′) rather than resource abundance.

World Bank data from the *World Development Indicators 2008* (World Bank, 2008a) was used to create our measure: primary product exports as a proportion of GDP in 1970, or SXP′. This measure includes the share of exports to GDP of agricultural raw materials, fuel, food, and ores and metals

and has a correlation of 0.84 with the original measure of Sachs and Warner.[11] Further, we disaggregate our updated measure of primary export to GDP in 1970 by the above categories and find that the share of ores and metals exports in GDP in 1970 is the only category significant on its own. We shall, therefore, give it special consideration in the sections that follow.

3.2 Measuring institutions

For our measure of institutions, we use a score for economic freedom between 1970 and 2006 averaged from scores in *Economic Freedom of the World: 2008 Annual Report* (Gwartney and Lawson, 2008). The main hypothesis here is that countries with better scores for economic freedom have better institutions that facilitate such freedom.

In *Economic Freedom of the World*, economic freedom is rated on a scale of zero to 10, where a higher score indicates a higher level of economic freedom. The index is comprehensive and includes: (1) size of government; (2) legal structure and security of property rights; (3) access to sound money; (4) freedom to trade internationally; and (5) regulation of credit, labor and business. Data on the economic freedom index are available from 1970 to 2000 on a five-year basis, and from 2000 to 2006 on an annual basis. Our average score includes the economic freedom score for the years 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2006. Only countries with a score for economic freedom in 1995 and subsequent years have been included, as countries with data for only 2000 and 2006 would have significantly higher average scores because, on average, the level of economic freedom shown in the index trends upwards over time.

In this study, we test for economic freedom during different time periods and decompose economic freedom by areas as part of our checks for robustness. Further, we rerun our tests with an alternative measure of institutions, the institutional quality index in 1980 (Mehlum et al., 2006).

11 Note that we did not get a perfect correlation with Sachs and Warner's measure, SXP. Sachs and Warner made a number of modifications to their data (Sachs and Warner, 1997a: 29) that may account for the less-than-perfect correlation observed here. Also, Sachs and Warner (1997a) used the share of primary exports as a percentage of *GNP* in 1970. In this paper, we use share of primary exports as a percentage of *GDP* in 1970.

4 Empirical evidence

We use the World Bank's data set from the *World Development Indicators, 2008,* which has information on all the relevant variables used in our analysis and the Fraser Institute's EFW index from Gwartney and Lawson, 2008 as our proxy for institutions for the countries in the World Bank's data set.[12] In order to get a better understanding of the association between resource dependence and economic growth, and the association between institutions and economic growth for resource-dependent countries, we take the following steps.

1 *We divide our list of countries into two groups,* those highly dependent upon natural resources and those not highly dependent upon natural resources, and calculate the (logged) average, per-capita growth rates for each of these groups of countries. If the (average) growth rate in highly dependent countries is lower than the growth rate in countries not highly dependent upon natural resources, then this is suggestive evidence of a resource curse.

2 *We sort the countries by their level of economic freedom,*[13] averaged over 1970 to 2006, and compute the (logged) average, per-capita growth rates for each of these groups. If the (average) growth rate in countries with stronger institutions (as measured by the EFW index) is greater than the growth rate in countries with weaker institutions, then this is suggestive evidence that institutions matter for growth.

3 *We look at resource-dependent countries only and sort them by their level of economic freedom.* A positive relationship between economic growth and economic freedom is suggestive evidence that institutions matter for resource-dependent countries. Later in the study, we use econometric techniques to investigate more formally the link between resource dependence and economic growth and the association between institutions and economic growth for resource-dependent countries.

12 For a description of the variables, see Data appendix, page 61.

13 In figures 3 and 4, we divide the countries into three categories by their level of economic freedom. The top-third consists of countries with the highest level of economic freedom while the bottom third have the lowest. This classification allows us to have the same number of countries in each category and enough observations to compute our summary statistics. The level of economic freedom necessary for a country to be classified in the top, middle, or bottom third in figure 3 differs from levels needed in figure 4.

4.1 Descriptive statistics

Note that resource dependence in the following paragraphs refers to a country's dependence upon metals and ores, our area of particular focus, calculated as the share of exports of ores and metals in GDP in 1970. As mentioned previously, exports of ores and metals as a fraction of a country's GDP is a subset of the share of exports of primary products in GDP, originally used by Sachs and Warner (1995) and in subsequent literature. We chose this category since results for our aggregate measure, primary product exports as a proportion of GDP, are mainly driven by ores and metals exports. This can be seen more clearly in figure 1 where the trend line for ores and minerals exports is much steeper than the trend line for exports of primary products. Also note that the trend lines for both the share of primary product exports in GDP as well as the share of ores and metals exports in GDP are negatively sloped. Thus, raw data used in our analysis suggests a negative association between our different measures of resource dependence and the average (log) per-capita growth of GDP.[14]

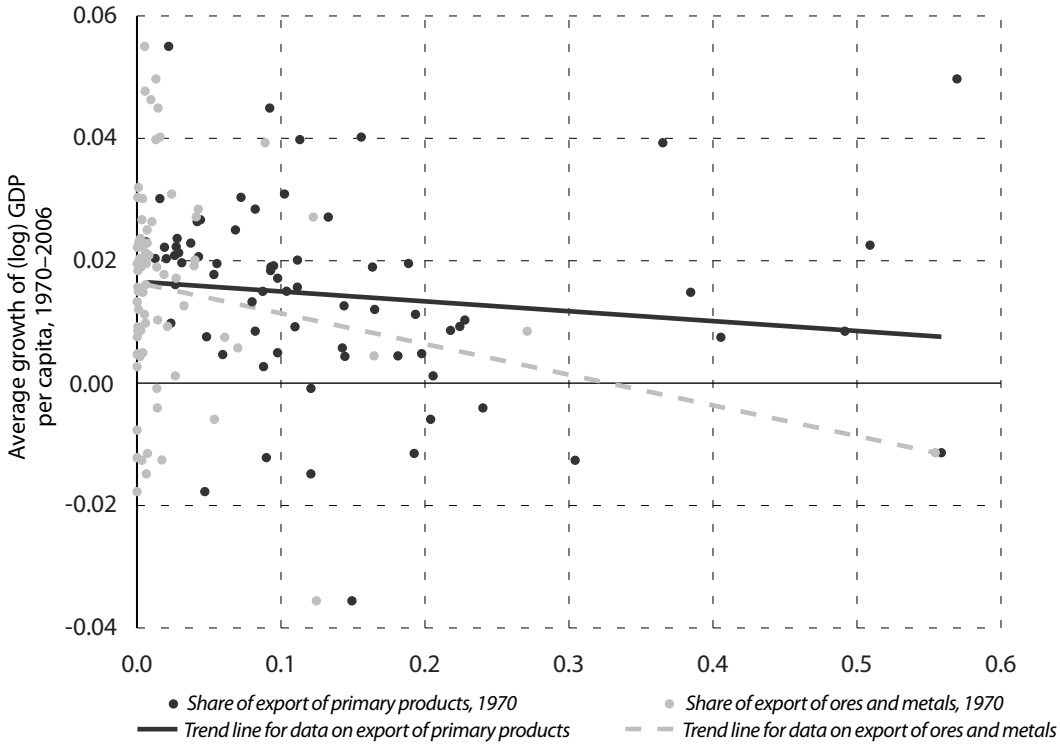
Figure 2 shows the average growth rates for countries grouped by resource dependence. Countries highly dependent upon natural resources are the top-third of the observed countries in the data set in terms of their share of metal and ores exports in GDP in 1970 (see column 3, table A1). Countries not highly dependent upon natural resources are the remaining countries. Note that growth is defined as average growth in GDP per capita between 1970 and 2006. As figure 2 illustrates, countries that had a higher proportion of ores-and-metal exports to GDP grew slower, on average, over the period from 1970 to 2006 relative to countries that had a lower proportion of ores-and-metal exports.[15] Although we have not controlled for other factors that may account for the above results, this is evidence suggestive of a resource curse.[16]

14 Note that the trend lines were robust to the exclusion of outliers: Bolivia, Chile, Gabon, Malaysia, Peru and Togo. The figures, however, include these countries.

15 The correlation between metal-and-ores exports and growth rates for all countries in our data set was –0.22. On dividing these countries into those that are highly dependent upon natural resources and those not highly resource dependent, we found a strong negative correlation (–0.32) with growth for highly resource dependent countries and a positive correlation (0.45) for not highly resource dependent countries. Note that these correlation coefficients were significantly different from each other.

16 The average growth in GDP per capita for resource-dependent *developing* countries was 0.80% over the period from 1970 to 2006, while it was 1.10% for developing countries less dependent upon natural resources. We also looked at correlations between resource dependence and economic growth for developing countries. The correlation coefficient between resource dependence and economic growth was –0.20 for all developing countries, –0.25 for developing countries highly dependent upon natural resources, and 0.25

Figure 1: Association between average growth of (log) GDP per capita, 1970–2006, and share of exports of primary products; and ores and metals, 1970



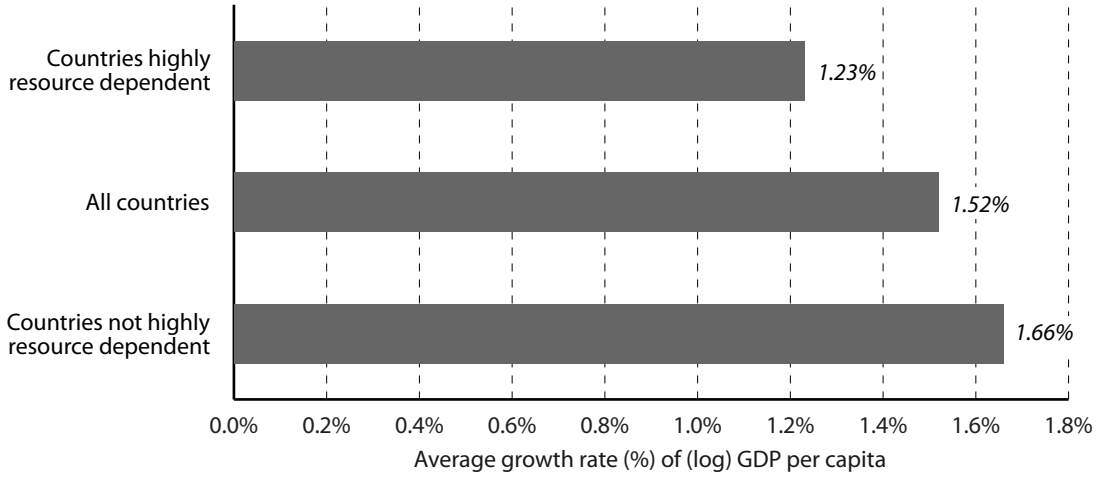
Notes: [1] The data set consisted of 77 countries. [2] Primary products include agricultural raw materials, fuel, food, and ores and metals.

Source: World Bank, 2008a; calculations by the authors.

In figure 3, we look at the association between economic institutions (as proxied by the EFW index) and growth. As expected, there is a positive association between the two variables: countries with high economic-freedom scores (the top-third group of countries) grew faster (at 2.4%), on average, than countries with lower economic-freedom scores, which grew at a rate of only 0.3%. One concern with figure 3 may be that the top third group of countries are not resource-dependent countries. To resolve this, we restrict our data set to resource-dependent countries in figure 4. Once again, the most economically free nations (top third, which correspond to an EFW score higher that 6.36) have a higher growth rate, on average, over the period from 1970 to 2006 (at 2.62%) than countries in the group with the lowest economic-freedom

for the developing countries less dependent upon natural resources. Note that developed countries were defined by the IMF's (2008) classification of advanced economies. The remaining countries were classified as developing countries.

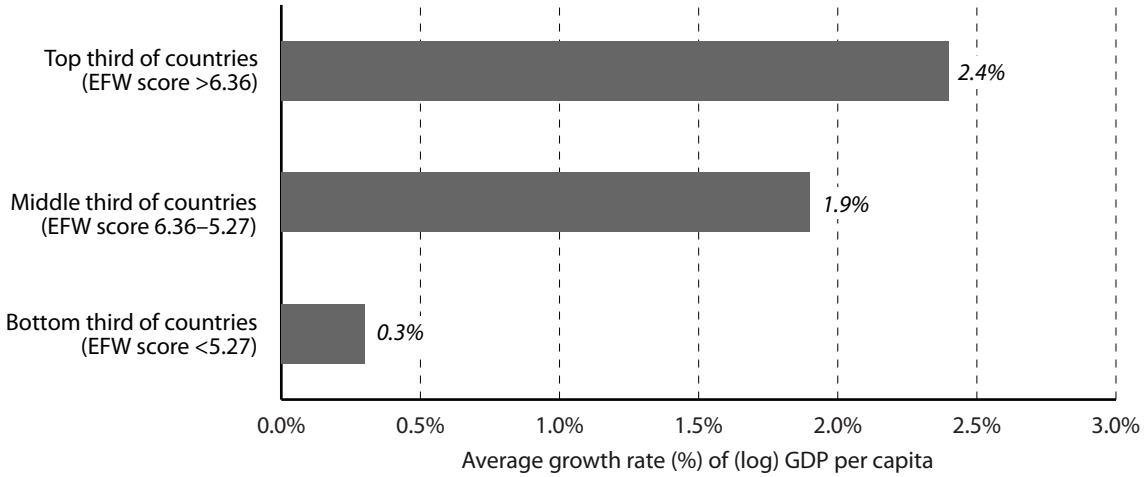
Figure 2: Average growth of (log) GDP per capita, by dependence upon natural resources, 1970–2006



Notes: [1] The data set consisted of 77 countries. The 26 countries in the top third in terms of metal -and-ores exports as a share of GDP were grouped as highly resource dependent; the remaining 51 were grouped as not highly resource dependent. [2] The last country included in the group of highly resource-dependent countries is the Netherlands, where metal-and-ores exports as a share of GDP is 1.38%. [3] Resource dependence is measured as exports of ores and metals to GDP.

Source: World Bank, 2008a; calculations by the authors.

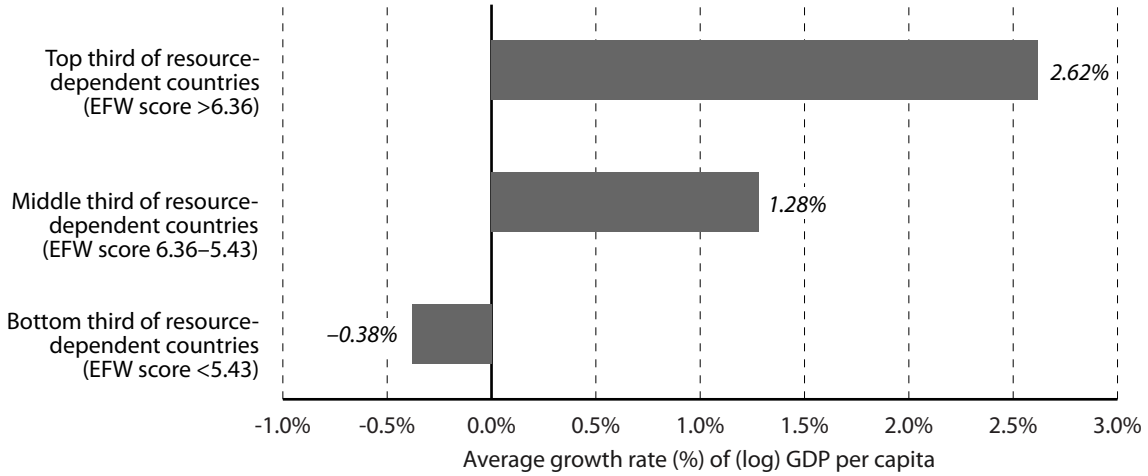
Figure 3: Average growth rate of (log) GDP per capita, by level of economic freedom, 1970–2006



Note: We divide the countries into three categories by their level of economic freedom: countries in the top-third have the highest level of economic freedom; those in the bottom third have the lowest. This classification allows us to have the same number of countries in each category and enough observations to compute our summary statistics. The level of economic freedom necessary for a country to be classified in the top, middle, or bottom third in figure 3 differs from that in figure 4. The data set consisted of 77 countries. Of these, in figure 3, 25 were in the top third (EFW score greater than 6.36); 26 in the middle third (EFW score from 6.36 to 5.27); and 26 in the bottom third (EFW score lower than 5.27).

Source: World Bank, 2008a; Gwartney and Lawson, 2008; calculations by the authors.

Figure 4: Average growth rate of (log) GDP per capita of the 26 highly resource-dependent countries, by level of economic freedom, 1970–2006



Notes: [1] There were 26 resource-dependent countries. Of these, in figure 4, 9 were in the top third by level of economic freedom (EFW score greater than 6.36); 26 were in the middle third (EFW score from 6.36 to 5.43); 8 were in the bottom third (EFW score lower than 5.43). [2] The last country included in the group of highly resource-dependent countries is the Netherlands, where metal-and-ores exports as a proportion of GDP is 1.38%.

Source: World Bank, 2008a; Gwartney and Lawson, 2008; calculations by the authors.

scores (which has a growth rate of –0.38%).[17] As mentioned previously, this suggests that institutions matter for resource-dependent countries.[18]

Figures 2, 3, and 4 present evidence on the negative relation between natural resources and economic growth and the importance of economic institutions for resource dependent countries. However, in these figures,

17 The most economically free nations (top third, which correspond to an EFW score higher that 6.36), had a positive correlation (0.27) between resource dependence and economic growth while the least economically free (bottom third, with an EFW score lower than 5.43) had a negative correlation (–0.28). Note that these coefficients are not significantly different from each other due to the small number of observations (8 or 9 countries).

18 A concern with figure 4 may be that the countries in the top third for economic freedom in the data set may primarily be developed countries. For this reason, we also looked at the association between average growth rates and resource dependence for developing countries only, ranked by economic-freedom scores. The average growth in GDP per capita for developing countries in the top third for economic freedom was 1.89% over the period from 1970 to 2006, while it was 0.01% for developing countries in the bottom third for economic freedom over the same period. Correlations obtained for these countries point to the same conclusion: the most economically free countries (top third, which correspond to an EFW score higher that 5.73), have a positive correlation (0.39) between resource dependence and economic growth while the least economically free nations (bottom third, which correspond to an EFW score lower than 5.135) have a negative correlation (–0.26).

we have not controlled for any country-specific factors that might generate growth, which could in turn affect the relationship between natural resources and economic growth. With the help of econometric techniques, we can take those considerations into account. The following section presents our econometric analysis as well as various sensitivity tests.

4.2 Econometric analysis

The goal of econometric techniques is to estimate economic relationships and test economic theory using a range of statistical methods. Our model for estimating economic growth is presented in the section below. The main results and the analysis follow.

Model

This is a single equation model of the following form:

$$\Delta GDP_i = \beta_0 + \beta_1 (RD_i) + \beta_2 (EFW_i) + \beta_3 (RD_i) \times (EFW_i) + \beta_4 (X_i) + \mu_i \quad [1]$$

where i indexes the country, μ_i is the error term, and X_i is a vector of controls, viz., $X_i = (GDP_0, \Delta EDUC, \Delta POP, REVCOUP, INV, REG1, REG2, REG3)$;

- ΔGDP is average annual growth in (logged) GDP per capita, from 1970 to 2006;
- RD is the natural-resource dependence in 1970, measured either as the ratio of exports of primary products to a country's GDP or as the ratio of exports of ores and metals to a country's GDP;
- EFW is the average level of economic freedom (institutional quality) between 1970 and 2006;
- GDP_0 is log of initial GDP in 1970;
- ΔEDUC is the difference in the average schooling (years) in the total population over 25, from 1970 to 1999;[19]
- ΔPOP is the average rate of growth of total population between 1970 and 2006;
- REVCOUP is the number of revolutions and coups per year, averaged over the period from 1970 to 1985[20]
- INV is the ratio of investment to GDP averaged over the period from 1970 to 2006
- REG1, REG2, REG3 are regional dummies, measuring if the country is in sub-Saharan Africa [REG1], the Middle East [REG2], or East-Asia and Pacific [REG3].

19 International data on educational attainment (from Center of International Development, Harvard University) was available only until 1999 (see Barro and Lee, 2000).

20 This is the same measure used in Sachs and Warner, 1997a. Note that data on this measure is available only until 1985.

In equation [1], β_1 measures the resource curse. If $\beta_1 < 0$, then this implies that (controlling for other factors) resource dependence in a country is associated with a decline in economic growth. Further, if $\beta_2 > 0$, then this implies that institutions matter for economic growth: stronger institutions lead to higher economic growth. Finally, the coefficient on the interaction term, β_3, measures whether better institutions in resource-dependent countries leads to higher economic growth. If $\beta_3 > 0$, then this will be true.

Choice of controls[21]

In addition to dependence upon natural resources and economic freedom (EFW), there are additional variables that have been shown to affect growth and therefore need to be included in our model so that we can capture the effect of natural resources on economic growth more precisely. These variables include education, initial GDP, population, a measure of civil conflicts, investment, and regional dummies. We find similar controls in other empirical papers on institutions and the natural-resource curse. Below is a brief explanation of these variables.

The variable for the initial level of GDP per capita (GDP_0) allows us to account for a possible convergence or conditional convergence effect. If the coefficient on this variable is negative, then the conditional convergence hypothesis is supported. The neoclassical growth model predicts that the income levels of developing countries will tend to converge (catch up) to the income level of developed countries if countries are similar in terms of structural parameters such as preferences and technology. In other words, developing countries should grow at a faster rate than developed countries that are closer to the steady-state level of their economy. The main element behind this convergence effect is the diminishing returns to capital. Since poor countries have low rates of capital to labor, they tend towards growth at higher rates with any increase in capital (Barro, 1991).

The difference in the average schooling in years (ΔEDUC) serves as a proxy for human capital across countries.[22] We also use a control for the growth in population between 1970 and 2006 (ΔPOP). A large growth in population can prevent economic development. Since Malthus, it has been argued that unrestrained population growth could negatively affect economic growth through its impact on key determinants of economic growth such as capital formation, environment, saving rates, and natural resources (Ukpolo, 2002). The variable REVCOUP measures the number of revolutions or coups

21 See Data appendix (page 61) for more details.

22 Literature on human capital identifies two ways in which education can generate growth. Human capital can directly generate growth of output by participation as a factor of production and indirectly (exogenously) through an increase in innovation, diffusion, and adoption of new technologies by a more educated population (Freire-Seren, 2001).

per year, averaged over the period 1970 and 1985. The intuition is that internal conflict in a country might possibly block growth as well as delaying the development of good institutions.

The control variable INV measures the ratio of investment to GDP averaged over the period from 1970 to 2006 (as used in Sachs and Warner, 1995). The neoclassical growth model predicts that investment in capital can increase productivity of labor and generate growth. Higher level of investment can lead to lower cost of doing business (transaction costs) and increase economic growth. We also include regional dummies for countries in sub-Saharan Africa [REG1], the Middle East [REG2], or East-Asia and Pacific [REG3] to capture some characteristics of particular regions that might alter the growth patterns.

A matrix showing correlations among the variables used in the model is presented in table 1a. Note the high correlation between average growth rates (ΔGDP) and economic freedom (EFW). A matrix showing correlations among our different measures of natural resources is presented in table 1b.

Regression results

Regression results are presented in tables 2 and 3.[23] In table 2, we use the share of primary exports in GDP in 1970 as the measure of natural-resource dependence (SXP′) while in table 3 we decompose primary exports and report results for the only category significant on its own, share of exports of ores and metals in GDP. Tables 2 and 3 show the results for four regressions, each column adding more controls. For example, column 1 in tables 2 and 3 uses only natural resources to predict growth, while column 2 adds the impact of the level of economic freedom. Column 3 is the regression for the model presented above with additional controls (variation in education, initial GDP, variation in population, a measure of conflicts, investment and some regional dummy variables). Finally, column 4 adds a term for the interaction between resource dependence and the level of economic freedom. The interaction term captures the link between resource dependence and economic freedom. Note that a positive interaction term suggests that higher levels of economic freedom decreases the resource curse and eventually turns the resource curse into a blessing for a given threshold in the level of economic freedom (see below for the calculation and interpretation). For higher levels of economic freedom, resource dependence generates growth.

Ordinary least squares (OLS) regression

The coefficient on natural-resource dependence is negative in the third and fourth column in table 2. The coefficient on natural-resource dependence in column 1 indicates that an increase of 1% in the share of primary product exports in GDP in 1970 would lead to a decrease of 3.4% in the average growth

23 All results presented have robust standard errors.

Table 1a: Correlations between variables used in the regression model

	Average growth in GDP per capita (1970–2006)	Primary exports to GDP (RA)	Ores and Metals exports to GDP (RA)	Economic Freedom (EFW) (1970–2006)	Δ Education (1970–1999)	GDP initial (1970–)	Δ Population (1970–2006)	Revolution and Coup	Investment (1970–1989)	Sub-Saharan Africa	Middle East	East Asia
Average growth in GDP per capita (1970–2006)	1.00											
Primary exports to GDP	–0.11	1.00										
Ores and Metals exports to GDP	–0.27	0.55	1.00									
Economic Freedom (EFW) (1970–2006)	0.52	–0.09	–0.21	1.00								
Δ Education (1970–1999)	0.41	0.24	0.12	0.15	1.00							
GDP initial (1970–)	0.33	–0.23	–0.19	0.69	0.19	1.00						
Δ Population (1970–2006)	–0.47	0.24	0.12	–0.55	–0.10	–0.75	1.00					
Revolution and Coup	–0.20	–0.08	0.04	–0.31	–0.02	–0.31	0.29	1.00				
Investment (1970–1989)	0.62	0.19	–0.03	0.32	0.51	0.31	–0.34	–0.26	1.00			
Sub-Saharan Africa	–0.61	0.15	0.24	–0.45	–0.34	–0.61	0.57	0.02	–0.50	1.00		
Middle East	0.02	–0.07	–0.08	–0.23	0.04	0.04	0.15	0.01	0.07	–0.10	1.00	
East Asia	0.47	0.22	–0.04	0.23	0.41	–0.10	0.00	0.04	0.43	–0.18	–0.09	1.00

Observations = 63

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 1b: Correlations between various measures of resource abundance or dependence

	SXP (Sach's and Warner's original measure of resource abundance)	Primary exports to GDP (our aggregate measure of resource abundance)	Agricultural raw materials to GDP	Fuel to GDP	Ores and Metals exports to GDP	Food to GDP
SXP (Sach's and Warner's original measure of resource abundance)	1.00					
Primary exports to GDP (our aggregate measure of resource abundance)	0.79	1.00				
Agricultural raw materials to GDP	0.16	0.41	1.00			
Fuel to GDP	0.52	0.55	0.04	1.00		
Ores & Metals exports to GDP	0.53	0.47	0.13	–0.09	1.00	
Food to GDP	0.24	0.24	0.07	–0.17	–0.06	1.00

Observations = 76

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

in GDP per capita between 1970 and 2006. As indicated by column 2, economic freedom has a positive impact on growth. It reduces the negative coefficient on natural resources. An increase of one point in the level of economic freedom would increase the average economic growth by nearly 1% over the period.

The coefficient on natural resources is still negative when we add all the controls (variation in education, initial GDP, variation in population, measure of conflicts, investment and regional dummy variables) in column 3.[24] The signs of the controls are correct according to the standard economic intuition.[25] Economic freedom level is still positive and significant.

24 Lederman and Maloney (2003) claim that, if Sachs and Warner (1995) did not replace Singapore's value with "net exports," the coefficient on natural resources would not be significant. We used the same computation for Singapore (share of exports of primary products in GDP in 1970 using the share of exports in GDP of agricultural raw materials, fuel, food, and ores and metals) as the other countries and we get significant results for the coefficient on natural resources in column 3 and 4, as well as the interaction term.

25 Note the weakness of the contribution of the investment variable to growth. One reason may be that some of the investment effect is "picked up" by the institutions variable in the regression, the EFW index. Economic theory indicates that private investment will tend to flow towards economic environments that are more attractive to productive activities. Free economies tend to attract more investment, which in turn promotes growth. On the other hand, excessive taxes, excessive regulation, lack of legal resources, monetary instability, and so on deter investment and growth (Gwartney and Lawson, 2004).

Table 2: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (primary exports to GDP, 1970); and economic freedom (1970–2006)

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP, 1970	–0.034	–0.012	–0.024 **	–0.193 ***
	(0.021)	(0.014)	(0.012)	(0.046)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.008 **	0.003
		(0.002)	(0.003)	(0.003)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			–0.007 ***	–0.007 ***
			(0.002)	(0.001)
Variation in population (1970–2006)			–0.553 **	–0.767 ***
			(0.203)	(0.166)
Investment (1970–2006)			0.001 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			–0.007	–0.007 *
			(0.004)	(0.004)
Sub-Saharan Africa			–0.014 **	–0.012 **
			(0.005)	(0.004)
Middle East			0.011	0.009
			(0.009)	(0.007)
East Asia			0.005	0.003
			(0.005)	(0.004)
(Economic freedom) * (Primary exports to GDP)				0.028 ***
				(0.007)
Constant	0.019 ***	–0.036 **	0.012	0.046 ***
	(0.003)	(0.013)	(0.018)	(0.017)
R-squared	0.084	0.275	0.732	0.783
Observations	75	71	63	63

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 3: Ordinary least squares (OLS) regressions—Economic growth (1970–2006); resource dependence (ores and metals to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP , 1970	−0.081 **	−0.031 **	−0.035 **	−0.614 **
	(0.029)	(0.012)	(0.015)	(0.175)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.007 **	0.005 **
		(0.002)	(0.002)	(0.002)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.006 **	−0.006 **
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.722 **	−0.833 ***
			(0.204)	(0.197)
Investment (1970–2006)			0.001 *	0.001 **
			(0.000)	(0.000)
Revolution and Coup			−0.004	−0.006
			(0.005)	(0.005)
Sub-Saharan Africa			−0.010 *	−0.008
			(0.006)	(0.006)
Middle East			0.011	0.012
			(0.010)	(0.009)
East Asia			0.004	0.004
			(0.005)	(0.005)
(Economic freedom) * (Ores and Metals exports to GDP)				0.113 **
				(0.034)
Constant	0.017 ***	−0.038 ***	0.008	0.023
	(0.002)	(0.010)	(0.018)	(0.018)
R-squared	0.150	0.316	0.700	0.736
Observations	81	77	68	68

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

The coefficient on natural resources is still negative in column 4. The interaction term in column 4 is positive and significant, which means that good institutions matter for resource-dependent countries. That is, resource-dependent countries are not doomed to failure and poor economic performance. The interaction terms capture the positive effect of good institutions on the economic growth of countries dependent upon natural resources. With a high level of economic freedom, natural resources become a blessing.[26] The isolated negative effect of resource dependence (without the positive effect of high level of economic freedom captured by the interaction term) is higher in column 4 than the other three regressions at −0.19.

Decomposing primary exports

As mentioned above, our updated measure of primary exports in GDP is composed of four different categories: agriculture raw materials, fuel, food, and ores and metals. The share of ores-and-metals exports in GDP in 1970 was the only category significant on its own when we tested the different categories individually. Thus, it is an important factor in the resource curse observed in table 2 for the aggregate measure. Therefore, table 3 presents the same regressions using ores-and-metals exports in GDP in 1970 as the measure of natural resources.[27]

Results in table 3 are similar to results to table 2. The sign and significance of economic freedom and the controls are almost identical. The coefficient on the share of metals-and-ores exports is negative and significant in all four regressions, which indicates that there is indeed a resource curse and that the metals-and-ores category is responsible for it. The coefficient on the share of metals-and-ores exports is higher for all columns compared to exports of primary products in table 2. Once again, the interaction term in column 4 is positive and significant, which indicates that strong institutions matter for growth.

26 The positive coefficient on the interaction term also implies that the effect of economic freedom on growth varies directly with natural-resource dependence. To see this more formally, suppose we have $g = aE - bN + cEN$ where g is growth, E is economic freedom and N is natural-resource dependence; a and b are positive parameters and c can be either positive or negative. Then, if $c > 0$, this implies that $dg/dE = a + cN$, or that the effect of economic freedom on growth varies directly with natural-resource dependence. However, recent literature (Collier and Hoeffler, 2009) has shown that in developing countries, the combination of high natural-resource rents and open democratic systems (a proxy for economic freedom) reduces growth.

27 We ran regressions for each of the four categories of primary-product exports individually (results not shown): the share of exports in GDP of agricultural raw materials, fuel, food, and ores and metals. The coefficients on all categories of natural resources are negative and the interaction terms are positive. However, only the fuel and ores-and-metals categories and the economic-freedom interaction term are statistically significant and only the ores-and-metals category is statistically significant on its own.

Note that the coefficient on metals-and-ores exports is higher in column 4 than in the other three regressions. In fact, the coefficient is quite high at –0.61, which indicates the crucial importance of a high level of economic freedom for countries that are dependent upon metals and ores.[28] Without high institutional quality, the resource curse is very detrimental. This suggests that metals and ores may be particular group of natural resources, more prone to appropriation and rent-seeking.

Institutions can turn resource curse into a blessing

As shown in the graphs and tables above, the resource curse appears weaker, the higher the level of economic freedom until it turns into a blessing. Using the information in column 4 of the tables 2 and 3, it is possible to predict when economic freedom turns natural-resource dependence into a blessing. From regression equation 1, the growth impact of a marginal increase in resources is given by:

$$d(\Delta GDP\ i) \div d(RD_i) = \beta_1 + \beta_3\ (EFW_i) \qquad [2]$$

The right side of equation [2] measures the increase (or decrease) in growth that results from an increase in resource dependence, keeping other factors (variation in education, initial GDP, variation in population, the measure of conflicts, investment and regional dummies) constant. Given that $\beta_1 < 0$ and $\beta_3 > 0$, the threshold at which the resource curse no longer applies is when the left side of equation [2] is equal to 0.

Column 4 in tables 2 and 3 provide the coefficients for RD and the interaction term. Manipulating equation [2],[29] we find that the level of EFW where resource dependence turns the resource curse into a blessing is equal to the following values.

For table 2 (share of exports of primary products in GDP in 1970):

$$\frac{\text{Coefficient on resource dependence}}{\text{Coefficient on interaction term}} = \frac{0.193}{0.028} = 6.89$$

Therefore, countries with an economic-freedom score higher than 6.89 benefit (show an increase in economic growth) from having a higher share of exports of primary products in GDP. Among our 23 resource-dependent

28 The size of the coefficient on the resource-dependence term (–0.61) is similar to that found by Brunnschweiler (2006) when she uses SXP as a measure of resource dependence (at –0.65).

29 Equation (2) can be rewritten as $0 = \beta 1 + \beta 3\ (EFW_i)$. This equation gives us the level of economic freedom at which the negative impact of resource dependence and the positive impact of strong institutions balance out. This occurs at a level where $EFW_i = -\beta 1/\beta 3$.

countries,[30] nine have an economic-freedom score higher than 6.89: Costa Rica, Honduras, Ireland, Netherlands, New Zealand, Nicaragua, Singapore, Trinidad & Tobago, and Zambia. An average economic-freedom score of 6.89 is high and similar to those of developed countries such as Finland (6.92) and the United Kingdom (7.10). This suggests that countries with high level of economic freedom benefit from exporting primary products.[31]

For table 3 (share of exports of metals and ores in GDP in 1970), the threshold is considerably lower:

$$\frac{\text{Coefficient on resource dependence}}{\text{Coefficient on interaction term}} = \frac{0.614}{0.113} = 5.43$$

Among our 26 resource-dependent countries, 22 have an economic-freedom score above the threshold of 5.43: Australia, Bolivia, Cameroon, Canada, Chile, Ghana, Guyana, Haiti, Honduras, Iceland, Ireland, Malaysia, Morocco, Netherlands, Norway, Peru, Philippines, Sweden, Thailand, Tunisia, Senegal and Zambia.[32] These countries benefit from their dependence on metals and ores because their level of economic freedom is higher than 5.43. An average economic score of 5.43 corresponds to some basic level of freedom. It is lower than the average of all countries (5.89) and the average of resource-dependent countries (5.88). It is also lower than the average of the resource dependent developing countries (5.50).

Two stage least squares (2SLS) regressions

One concern in the resource-curse literature is that the "quality of institutions" variable used in the ordinary least squares (OLS) regressions may itself be endogenous.[33] To correct for this possible bias, we instrument for institu-

30 These 23 countries are Algeria, Bolivia, Cameroon, Congo (Democratic Republic), Costa Rica, Fiji, Gabon, Ghana, Guyana, Honduras, Iran, Ireland, Ivory Coast, Malawi, Malaysia, Netherlands, New Zealand, Nicaragua, Singapore, Togo, Trinidad & Tobago, Venezuela, and Zambia. They are defined as the countries in the top third in terms of the share of exports of primary products in GDP in 1970.

31 The average economic-freedom scores between 1970 and 2006 and the economic-freedom scores for 2006 for the countries in our data set are available in table A1 (page 64).

32 Note that EFW score for Venezuela has declined recently. Other resource-dependent countries that had lower scores were Congo, Gabon, and Togo.

33 There may exist a problem of reverse causality (that is, the possibility that growth affects institutions) and the possibility that resource dependence may negatively affect institutions. As pointed out by Brunnschweiler (2006), the negative correlation between dependence upon natural resources and institutions may outweigh the positive direct growth influence. These factors are not adequately captured in OLS regressions and thus require instrumentation of the institutional quality variable.

tions (i.e., use a variable that is correlated with Institutions and is not independently correlated with economic growth) using a two-stage least squares (2SLS) regression framework.

In a 2SLS set-up, regression is carried out in two stages. The first stage requires modeling the endogenous variable (institutions) as a function of other variables that influence institutional quality. More importantly, an instrumental variable (IV) is included in the equation. This variable must be correlated with the explanatory variable (institutional quality), and uncorrelated with the dependent variable (growth) other than through the explanatory variable. In the second stage, the dependent variable (growth) is regressed on the instrument and other variables. The 2SLS regression equations are described below:

$$\text{Stage 1: } EFW_i = \alpha_0 + \alpha_1 (IV_1) + \alpha_2 (IV_2) + \alpha_3 (X_i) + \eta_i$$

$$\text{Stage 2: } \Delta GDP_i = \beta_0 + \beta_1 (X_i) + \beta_2 (EFW_i) + \xi_i$$

In these equations, IV refers to the (two) instrumental variables used in our regression to correct for endogeneity bias prevalent in an OLS set-up; X_i includes controls similar to those used in specification (1) as well as the resource dependence and the interaction terms.[34]

Table 4a presents regression results for natural resources using two instruments for quality of institutions: "colony," and "ethno-linguistic fractionalization." The first instrument, "colony," is a dummy variable indicating whether a country was a former European colony.[35] Our main hypothesis here is that countries that were former colonies should have weaker institutions.[36] Our second instrument, "'ethnolinguistic fractionalization," is a measure of ethnic diversity (based on language) in a country. More technically, it measures the probability that two randomly selected people from a country will not belong to the same linguistic group. Our choice of this instrument rests on Easterly and Levine's (1997) study that shows that ethnic diversity leads to poor public-policy choices and hence to weaker institutions. However, this argument is more directly applicable to developing countries.

34 Note that in Stage 2, the endogenous variable EFW is replaced with the predicted values from its first-stage model.

35 One problem of using "colony" as an instrument is that it could arguably be endogenous to having resources (countries set up colonies in places with resources). However, in our data, we find that "colony" and our measure of resource dependence are not strongly correlated, with a correlation coefficient of 0.37. We, therefore, choose to use it as our instrument for institutions.

36 A paper by North (1990) suggests that it was the colonial heritage that accounted for weaker institutions in former colonies. For example, North argues that Latin America inherited weaker institutions due to its colonization by Spain.

Table 4a: Two stage least squares (2SLS) regressions—resource dependence (primary exports to GDP), institutions and economic growth

First Stage	Coefficient	Standard Error
Primary exports to GDP	−12.042 ***	(2.057)
Variation in Education (1970–1999)	−0.102	(0.064)
Initial GDP (1970)	0.244 ***	(0.076)
Variation in population (1970–2006)	−13.176	(9.961)
Investment (1970–2006)	0.008	(0.016)
Revolution and Coup	−0.774 ***	(0.274)
Sub-Saharan Africa	0.138	(0.227)
Middle East	−0.725 ***	(0.259)
East Asia	0.509 **	(0.230)
(Economic freedom) * (Primary exports to GDP)	2.063 ***	(0.329)
Ethno-Linguistic fractionalization	0.011 ***	(0.003)
Colony	−0.764 ***	(0.195)
Constant	4.301 ***	(0.803)

Second Stage	Coefficient	Standard Error
Primary exports to GDP	−0.289 ***	(0.064)
Economic freedom (EFW, 1970–2006)	−0.005	(0.004)
Variation in Education (1970–1999)	0.002	(0.001)
Initial GDP (1970)	−0.005 ***	(0.002)
Variation in population (1970–2006)	−0.931 ***	(0.207)
Investment (1970–2006)	0.001 **	(0.000)
Revolution and Coup	−0.010 *	(0.005)
Sub-Saharan Africa	−0.012 ***	(0.004)
Middle East	0.004	(0.006)
East Asia	0.008	(0.005)
(Economic freedom) * (Primary exports to GDP)	0.045 ***	(0.011)
Constant	0.086 ***	(0.023)
Observations	61	
Sargan statistic (over identification test of all instruments)	0.101	
Chi-sq(1) P-val	0.751	
F-Statistics: 1st stage IV	12.11	

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Similarly, table 4b presents regression results for metals and ores using two instruments. The first instrument, "colony" was discussed above. For the second instrument, we follow Brunnschweiler and Bulte (2008) and use "openness" as our instrument. This is a measure of historic trade openness (in nominal terms), defined as the sum of imports and exports over GDP for the earliest period between 1950 and 1960 for which data were available for a particular country.[37]

The first stage results from the 2SLS are presented in the top panel in Table 4a. For this regression, both our instruments are statistically significant and pass the test for "instrument relevance."[38] As hypothesized, the coefficient for "colony" is negative, indicating that former colonies have poorer institutions. However, it is surprising that, although small, the coefficient on ethnolinguistic fractionalization is positive and significant. A possible reason, as mentioned in Anderson and Francois (2008), may be that the interaction between groups of different ethnicities can increase the need to develop formal (better) institutions to prevent being "cheated on" while interaction between groups of the same ethnicity decreases this need (emergence of informal institutions). Similarly, in table 4b, both instruments are statistically significant, although they are substantially weaker. Note that the historic openness indicator is positive and significant, implying that countries that were more open to trade, historically, have stronger institutions.

The second stage results for natural resources are presented in the bottom panel of table 4a and for ores and minerals in the bottom panel of table 4b. Note that for natural resources, although the "institutional quality" variable is negative (but not significant), the positive and significant coefficient on the interaction term (between resource dependence and institutional quality) indicates that better institutions in resource-dependent countries leads to higher growth. Similarly, for metals and ores, although the "institutional quality" variable is not significant, the interaction term between resource dependence and institutional quality is positive and significant. Moreover, these results support our earlier conclusion based on the OLS regression of a negative association between resource dependence and economic growth. The second stage results presented here highlight the existence of a resource curse, even after instrumenting for institutions. However, again, similar to the OLS results, the interaction term between our instrument and resource dependence is positive, suggesting that stronger institutions in resource dependent countries leads to higher economic growth.

37 Data was taken from the Penn World Tables (CICUP, 2009: table 6.1).

38 Instrument relevance is tested using an F-test. An F-test <10 indicates "weak instruments" (Staiger and Stock, 1997). In our first stage results, the F-test is 12.

Table 4b: Two stage least squares (2SLS) regressions—resource dependence (ores and metals to GDP), institutions and economic growth

First Stage	Coefficient	Standard Error
Ores and metals exports to GDP	−32.989 **	12.229
Variation in Education (1970–1999)	−0.114	0.080
Initial GDP (1970)	0.273 **	0.086
Variation in population (1970–2006)	−4.290	11.802
Investment (1970–2006)	−0.016	0.020
Revolution and Coup	−0.695 **	0.332
Sub-Saharan Africa	0.144	0.286
Middle East	−0.655 *	0.336
East Asia	0.858 ***	0.251
(Economic freedom) * (Ores and metals exports to GDP)	6.317 **	2.370
Trade Openness	0.003 **	0.001
Colony	−0.553 **	0.226
Constant	4.582 ***	0.911

Second Stage	Coefficient	Standard Error
Ores and metals exports to GDP	−0.597 **	0.268
Economic freedom (EFW, 1970–2006)	0.002	0.005
Variation in Education (1970–1999)	0.003 *	0.001
Initial GDP (1970)	−0.005 *	0.002
Variation in population (1970–2006)	−0.744 ***	0.190
Investment (1970–2006)	0.001 **	0.000
Revolution and Coup	−0.007	0.006
Sub-Saharan Africa	−0.009 *	0.004
Middle East	0.008	0.007
East Asia	0.007	0.006
(Economic freedom) * (Ores and metals exports to GDP)	0.110 **	0.052
Constant	0.030	0.022
Observations	64	
Sargan statistic (over identification test of all instruments)	0.980	
Chi-sq(1) P-val	0.322	
F-Statistics: 1st stage IV	4.79	

Notes: All standard errors are in parentheses; Significance: *** p <.001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

4.3 Sensitivity analysis and robustness checks

In addition to the analysis above, we used alternative measures of resource dependence and a number of other controls to check for the robustness of our results in tables 2 and 3. These checks, typically separately testing both resources generally and ores and metals, are presented in the following tables. Note that when possible, we decompose primary exports and present results for ores and metal exports in GDP as in table 3. The pattern across the testing is highly consistent. Metals and ores are consistently found to have a stronger curse than resource wealth in general but also a greater coefficient on the interactive term, meaning that the curse turns into a blessing at a lower level of economic freedom.

1 SXP

In table 5, we run the same regression as in table 2 using the original Sachs & Warner (1997a) measure of natural resources, SXP. Table 5 shows that our updated measure and the original SXP have similar outcomes and interpretation.[39] More specifically, the coefficient for SXP is negative and in the same range as our measure of resource dependence in table 2.[40] The interaction term is positive and significant and has a slightly larger coefficient compared to table 2. Economic freedom is positive and significant in models (2) and (3). The sign of the other controls conform to standard economic intuition.

2 Natural resources averaged over the period

Ledermann and Maloney (2003) argue that, in order to measure resource dependence, using an average of natural resources over the period is more adequate and more stable to different specifications than using the initial resource values. Therefore, we computed an average share of primary-product exports in GDP between 1970 and 2006; we did the same for the share of ores and metals in GDP.[41] We re-ran the regressions as in tables 2 and 3 with the average measure of natural resources and found similar results.

39 Our measure was created using the *World Development Indicators 2008* and the share of exports in GDP of agriculture raw materials, fuel, food, and ores and metals. Sachs and Warner's measure, SXP, measures the share of primary products in GNP in 1970. Note that Sachs' measure has been used as a robustness check for our measure of natural resources since both of these are aggregate measures. We did not use Sachs measure to check for the robustness of our ores-and-metals measure.

40 Note however that the coefficient on SXP is significant in all the four columns in table 5.

41 Similarly, we compute an average share for the other categories (agricultural raw materials, fuel, and food). Ores-and-metal exports in GDP was the only significant category on its own.

Table 5: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (Sachs and Warner's original measure: primary exports to GNP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary Exports to GNP, 1970	−0.053 **	−0.038 **	−0.039 **	−0.277 ***
	(0.017)	(0.018)	(0.012)	(0.073)
Economic freedom (EFW, 1970–2006)		0.008 ***	0.009 ***	0.004
		(0.002)	(0.002)	(0.003)
Variation in Education (1970–1999)			0.003 ***	0.003 ***
			(0.001)	(0.001)
Initial GDP (1970)			−0.008 ***	−0.007 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.661 ***	−0.800 ***
			(0.180)	(0.159)
Investment (1970–2006)			0.001 ***	0.002 ***
			(0.000)	(0.000)
Revolution and Coup			−0.003	−0.002
			(0.004)	(0.004)
Sub-Saharan Africa			−0.007	−0.003
			(0.005)	(0.005)
Middle East			0.011	0.010
			(0.008)	(0.008)
East Asia			0.000	0.000
			(0.005)	(0.004)
(Economic freedom) * (Primary exports to GNP)				0.042 **
				(0.013)
Constant	0.022 ***	−0.026 **	0.003	0.025
	(0.003)	(0.012)	(0.016)	(0.015)
R-squared	0.135	0.251	0.697	0.735
Observations	94	89	78	78

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; Sachs and Warner's original measure (SXP, the share of primary exports to GNP) was used to proxy for resource abundance in these regressions; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Using natural resources averaged over the period does not alter our earlier interpretation. This can be seen in tables 6 and 7. Note however that, while the interaction term is positive and significant for primary product exports in table 6, it is positive but no longer significant in specification (4) in table 7.[42]

3 Terms of trade

Some papers (for example Sachs and Warner, 1995) include a measure of terms of trade. This measure captures the effect of any variation in prices of natural resources that might affect the economic growth of a resource -exporting country.[43] However, when we incorporate this measure as a control, we find that it is never significant. More importantly, the measure does not change our main results (tables 8 and 9). Therefore, we decided to exclude it from our main regressions in tables 2 and 3.

4 Climate (tropics)

According to certain studies (Gallup et al., 1999), climate is another variable that should be controlled for.[44] The sign, significance, and size on our coefficient of natural resources, economic freedom, and the interaction terms are similar to the ones presented above when we (re-) ran the regressions in table 2 and 3 with climate as an additional control (tables 10 and 11).

5 Another measure of institutions

We re-ran our regressions as in table 2 and 3 with an alternative measure of institutions, as used by Mehlum et al. (2006): institutional quality index in 1980. This index is an unweighted average of five indexes based on data from Political Risk Services for [1] rule-of-law, [2] bureaucratic quality, [3] corruption in government, [4] risk of expropriation, and [5] government repudiation of contracts. The correlation between the institutional quality index and the economic freedom score is high at 0.74.

Once again, the results are very similar. The coefficients on institutional quality and the interaction term (between natural resources and the new measure of institutions) are positive, while the coefficient on natural resources is negative. The other controls also have signs that conform to standard economic intuition (tables 12 and 13).

42 The correlation between the initial measure of primary-products export in GDP in 1970 and its average share between 1970 and 2006 is 0.88; the correlation between the metals-and-ores exports in GDP in 1970 and its average share between 1970 and 2006 is 0.94.

43 As used in Sachs and Warner's paper, this measure is the average annual growth in the log of the external terms of trade between 1970 and 1990.

44 The climate variable used in our regression is similar to the one used by Gallup et al. (1999). It measures the proportion of the country's land area within the geographical tropics.

Table 6: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (average of primary product exports to GDP), 1970–2006; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Average Primary Exports to GDP (1970–2006)	–0.039 **	–0.015	–0.033 **	–0.201 ***
	(0.017)	(0.014)	(0.014)	(0.051)
Economic freedom (EFW, 1970–2006)		0.008 ***	0.009 ***	0.005 *
		(0.002)	(0.002)	(0.003)
Variation in Education (1970–1999)			0.003 ***	0.004 **
			(0.001)	(0.001)
Initial GDP (1970)			–0.007 ***	–0.007 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			–0.664 ***	–0.796 ***
			(0.182)	(0.155)
Investment (1970–2006)			0.001 ***	0.002 ***
			(0.000)	(0.000)
Revolution and Coup			0.001	0.002
			(0.004)	(0.004)
Sub-Saharan Africa			–0.005	–0.004
			(0.005)	(0.004)
Middle East			0.012	0.012
			(0.008)	(0.008)
East Asia			–0.001	–0.003
			(0.005)	(0.004)
(Economic freedom) * (Average Primary exports to GDP)				0.029 **
				(0.002)
Constant	0.021 ***	–0.031 **	–0.009	0.014
	(0.003)	(0.012)	(0.016)	(0.017)
R-squared	0.079	0.217	0.674	0.727
Observations	102	94	81	81

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 7: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (average of ores and metals exports to GDP), 1970–2006; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Average Ores & Metals Exports to GDP (1970–2006)	−0.127 ***	−0.085 **	−0.080 **	−0.514 *
	(0.021)	(0.024)	(0.023)	(0.308)
Economic freedom (EFW, 1970–2006)		0.008 ***	0.009 **	0.008 **
		(0.002)	(0.002)	(0.002)
Variation in Education (1970–1999)			0.004 **	0.004 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.007 ***	−0.007 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.746 ***	−0.831 ***
			(0.190)	(0.191)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
Revolution and Coup			0.001	−0.001
			(0.004)	(0.004)
Sub-Saharan Africa			−0.003	−0.002
			(0.005)	(0.005)
Middle East			0.012	0.012
			(0.009)	(0.009)
East Asia			−0.001	−0.002
			(0.005)	(0.005)
(Economic freedom) * (Average Ores & Metals exports to GDP)				0.080
				(0.058)
Constant	0.018 ***	−0.032 **	−0.007	0.003
	(0.002)	(0.010)	(0.016)	(0.016)
R-squared	0.185	0.265	0.684	0.697
Observations	104	95	81	81

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 8: Ordinary least squares (OLS) regressions with controls for terms of trade—economic growth (1970–2006); resource dependence (primary product exports to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary Exports to GDP, 1970	−0.034	−0.012	−0.021 *	−0.188 ***
	(0.0213)	(0.0138)	(0.0123)	(0.0464)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.008 **	0.003
		(0.0021)	(0.0027)	(0.003)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.0013)	(0.0013)
Initial GDP (1970)			−0.007 ***	−0.007 ***
			(0.0018)	(0.0015)
Variation in population (1970–2006)			−0.573 **	−0.777 ***
			(0.2128)	(0.1738)
Investment (1970–2006)			0.001 *	0.001 *
			(0.0003)	(0.0003)
External Terms of Trade			−0.000	−0.000
			(0.0005)	(0.0005)
Revolution and Coup			−0.008 *	−0.007 *
			(0.0046)	(0.0040)
Sub-Saharan Africa			−0.015 **	−0.013 **
			(0.0050)	(0.0045)
Middle East			0.011	0.010
			(0.0077)	(0.0065)
East Asia			0.007	0.004
			(0.0063)	(0.0050)
(Economic freedom) * (Primary exports to GDP)				0.028 **
				(0.008)
Constant	0.019 ***	−0.036 **	0.016	0.048 **
	(0.0030)	(0.0134)	(0.0190)	(0.0184)
R-squared	0.084	0.275	0.738	0.787
Observations	75	71	62	62

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 9: Ordinary least squares (OLS) regressions with controls for terms of trade—economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals Exports to GDP, 1970	−0.081 ***	−0.031 **	−0.038 **	−0.619 **
	(0.029)	(0.012)	(0.014)	(0.190)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.007 **	0.004 *
		(0.002)	(0.003)	(0.002)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.006 **	−0.006 **
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.670 **	−0.779 ***
			(0.185)	(0.178)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
External Terms of Trade			0.000	−0.001
			(0.001)	(0.001)
Revolution and Coup			−0.005	−0.007
			(0.005)	(0.005)
Sub-Saharan Africa			−0.011 *	−0.009
			(0.006)	(0.006)
Middle East			0.011	0.012
			(0.008)	(0.008)
East Asia			0.007	0.007
			(0.006)	(0.006)
(Economic freedom) * (Ores and Metals exports to GDP)				0.113 **
				(0.037)
Constant	0.017 ***	−0.038 ***	0.010	0.024
	(0.002)	(0.010)	(0.018)	(0.018)
R-squared	0.150	0.316	0.716	0.754
Observations	81	77	66	66

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 10: Ordinary least squares (OLS) regressions with controls for climate–economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary Exports to GDP, 1970	–0.034	–0.012	–0.003	–0.154 **
	(0.021)	(0.014)	(0.013)	(0.045)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.007 **	0.003
		(0.002)	(0.003)	(0.003)
Variation in Education (1970–1999)			0.002	0.002 *
			(0.001)	(0.001)
Initial GDP (1970)			–0.008 ***	–0.008 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			–0.668 ***	–0.757 **
			(0.195)	(0.205)
Investment (1970–2006)			0.001	0.001
			(0.000)	(0.000)
Revolution and Coup			–0.008 *	–0.008 *
			(0.005)	(0.004)
Sub-Saharan Africa			–0.017 ***	–0.014 **
			(0.005)	(0.004)
Middle East			0.008	0.007
			(0.009)	(0.008)
East Asia			0.009	0.006
			(0.006)	(0.005)
Tropics			–0.005	–0.005
			(0.004)	(0.004)
(Economic freedom) * (Primary exports to GDP)				0.024 **
				(0.007)
Constant	0.019 ***	–0.036 **	0.037 **	0.058 **
	(0.003)	(0.013)	(0.018)	(0.019)
R-squared	0.084	0.275	0.763	0.797
Observations	75	71	61	61

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p<= 0.10; economic growth refers to the average (logged) growth in GDP per capita; climate is controlled for by "tropics" in models 3 and 4.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 11: Ordinary least squares (OLS) regressions with controls for climate–economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals Exports to GDP, 1970	−0.081 ***	−0.031 **	−0.021 **	−0.478 **
	(0.029)	(0.012)	(0.008)	(0.199)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.007 **	0.005 *
		(0.002)	(0.003)	(0.003)
Variation in Education (1970–1999)			0.002 *	0.003 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.007 ***	−0.007 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.621 **	−0.697 **
			(0.193)	(0.211)
Investment (1970–2006)			0.001 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			−0.006	−0.007
			(0.005)	(0.005)
Sub-Saharan Africa			−0.013 **	−0.011 **
			(0.005)	(0.005)
Middle East			0.008	0.008
			(0.010)	(0.009)
East Asia			0.009	0.009
			(0.006)	(0.006)
Tropics			−0.006	−0.005
			(0.004)	(0.004)
(Economic freedom) * (Ores and Metals exports to GDP)				0.088 **
				(0.038)
Constant	0.017 ***	−0.038 ***	0.027	0.035 *
	(0.002)	(0.010)	(0.018)	(0.018)
R-squared	0.150	0.316	0.747	0.768
Observations	81	77	64	64

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita; climate is controlled for by "tropics'" in models 3 and 4.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 12: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and Mehlum's measure of institutions (institutional quality index in 1980)

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP, 1970	−0.034	−0.028	−0.018	−0.119 ***
	(0.021)	(0.025)	(0.014)	(0.021)
Institutional Quality Index (1980-PRS)		0.003 ***	0.004 ***	0.001
		(0.001)	(0.001)	(0.001)
Variation in Education (1970–1999)			0.002 **	0.002 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.008 ***	−0.008 ***
			(0.002)	(0.001)
Variation in population (1970–2006)			−0.387 *	−0.817 ***
			(0.220)	(0.195)
Investment (1970–2006)			0.001 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			0.006	0.003
			(0.006)	(0.006)
Sub-Saharan Africa			−0.020 ***	−0.015 **
			(0.006)	(0.006)
Middle East			0.012 **	0.013 *
			(0.006)	(0.006)
East Asia			0.007	0.006 *
			(0.005)	(0.003)
(Economic freedom) * (Primary exports to GDP)				0.019 ***
				(0.004)
Constant	0.019 ***	0.003	0.041 **	0.069 ***
	(0.003)	(0.007)	(0.016)	(0.013)
R-squared	0.084	0.221	0.742	0.817
Observations	75	68	61	61

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 13: Ordinary least squares (OLS) regressions —economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and Mehlum's measure of institutions (institutional quality index in 1980)

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP, 1970	−0.081 **	−0.069 **	−0.049 **	−0.199 ***
	(0.029)	(0.027)	(0.018)	(0.041)
Institutional Quality Index (1980-PRS)		0.003 ***	0.004 **	0.002 *
		(0.001)	(0.001)	(0.001)
Variation in Education (1970–1999)			0.003 **	0.002 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.008 ***	−0.007 ***
			(0.002)	(0.001)
Variation in population (1970–2006)			−0.629 **	−0.792 **
			(0.221)	(0.227)
Investment (1970–2006)			0.001 *	0.001 **
			(0.000)	(0.000)
Revolution and Coup			0.005	0.006
			(0.006)	(0.007)
Sub-Saharan Africa			−0.015 **	−0.013 **
			(0.006)	(0.005)
Middle East			0.014 **	0.015 **
			(0.006)	(0.006)
East Asia			0.008	0.010 **
			(0.005)	(0.005)
(Economic freedom)*(Ores and Metals exports to GDP)				0.041 ***
				(0.010)
Constant	0.017 ***	0.002	0.043 **	0.051 ***
	(0.002)	(0.004)	(0.015)	(0.015)
R-squared	0.150	0.293	0.752	0.784
Observations	81	74	66	66

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

6 Other measures of EFW

We tried different measures of economic freedom, all of which gave similar results. For example, we looked at the level of economic freedom in 1995,[45] the average level of economic freedom between 1970 and 2006 for area 2 (legal structure and security of property rights) only, or all the areas of economic freedom except Area 1 (size of government). Once again, all those alternatives do not alter the results and interpretations (tables 14 and 15; 16 and 17; 18 and 19, respectively). In all cases, the full index has a larger coefficient than partial measures.

7 The World Bank's measure of natural capital

An alternative measure of natural resources used in the literature is the World Bank's estimation of natural capital, used by Ding and Field (2005) and others. This measure is available only since 1994 and thus it cannot be used in long-term, historical analysis.[46] However, Ding and Field argue that this measure does not change extensively over time and is therefore a good proxy for earlier estimates of natural resources.

We use the Word Bank's measure as an alternative measure of natural resources and replicate the regressions of table 2. The coefficient of natural capital/total capital is negative and significant for the first and third columns of our regressions. However, for the model with the interaction term, neither the measure of natural resources nor the interaction terms are significant (table 20).[47]

45 The sample size of countries prior to 1995 is quite small; we therefore use 1995 instead of prior years. All areas of economic freedom are highly correlated except area 1; therefore we tried excluding it and reproduced the regressions of tables 2 and 3.

46 Natural capital or natural-resources abundance is composed of the estimates of agricultural land, pasture land, forests, protected areas, metals and materials, and coal, oil and natural gas. For more details, see *World Bank Environment: A Guide to Valuing Natural Resources Wealth* (World Bank, 2008b).

47 However, if we use logged values for natural-capital-to-total capital, both the terms become statistically significant. Note that in Ding and Field's (2005) paper, resource dependence was measured as natural-resource capital as a percentage of total capital while resource abundance was measured as natural-resource capital per population. They argue that resource dependence measures the extent to which an economy relies on natural resources and resource abundance gauges natural-resources abundance or supply of natural resources per capita. When we use natural capital per population as a proxy for natural-resource abundance, the coefficient on natural capital per capita is negative (although not statistically significant) for specification 3, but is negative and statistically significant for specification 4. Also, as before, better institutions turn this curse into a blessing (coefficient on the interaction term in specification 4 is positive and statistically significant). However, when we use logged values for the variable, natural resources per capita, the coefficient on this measure of resource abundance although negative, is no longer statistically significant (for specification 4) while the interaction term is positive,

As a further step, we disaggregated this measure; the category minerals/total capital is the only category significant on its own. For column 4 in table 21, the sign of the coefficient of minerals/total capital is negative and significant while the interaction term (between EFW and minerals/total capital) is positive and significant. Once more, a higher level of economic freedom decrease the resource curse effect and turns it eventually into a blessing.

8 Developing compared to developed countries

One could argue that the positive effect of institution and the positive interaction term is mainly due to developed countries. We therefore include a dummy variable for developed countries and ran the same regression as in tables 2 and 3. The results are similar, the coefficients have the same sign and significance and the coefficients are comparable. The dummy for developed countries is positive for all our specifications, but significant only for ores and metal exports (tables 22 and 23).

The above results fortify our confidence in our recommendation below of increasing economic freedom to generate growth and to eliminate the negative impact of natural resources. Moreover, this illustrates the importance of high levels of economic freedom for countries that export metals and ores.

but not statistically significant. Finally, the coefficient on the institutions term is positive and significant on its own, for the same specification. Thus, the World Bank measure of natural-resource abundance seems to be sensitive to the specification that we use. Note, however, that Ding and Field's analysis is slightly different: in their paper, they use both resource abundance and resource dependence as separate independent variables. Accounting for the endogeneity of resource dependence and human capital in a three-equation model, they find that the adverse effects of natural resources disappear.

Table 14: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and economic freedom in 1995

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP, 1970	−0.034	−0.009	−0.021 *	−0.122 ***
	(0.021)	(0.013)	(0.011)	(0.032)
Economic Freedom (1995)		0.007 ***	0.006 **	0.003
		(0.001)	(0.002)	(0.002)
Variation in Education (1970–1999)			0.002 *	0.003 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.008 ***	−0.007 ***
			(0.001)	(0.001)
Variation in population (1970–2006)			−0.447 **	−0.607 ***
			(0.186)	(0.172)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
Revolution and Coup			−0.014 ***	−0.013 **
			(0.004)	(0.003)
Sub-Saharan Africa			−0.013 **	−0.012 **
			(0.005)	(0.005)
Middle East			0.009 *	0.008 *
			(0.005)	(0.005)
East Asia			0.007	0.005
			(0.005)	(0.005)
(Economic freedom) * (Primary exports to GDP)				0.016 **
				(0.005)
Constant	0.019 ***	−0.029 ***	0.034 ***	0.057 ***
	(0.003)	(0.010)	(0.012)	(0.019)
R-squared	0.084	0.342	0.734	0.763
Observations	75	71	63	63

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 15: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and economic freedom in 1995

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP, 1970	−0.081 **	−0.032 **	−0.042 **	−0.178 **
	(0.029)	(0.012)	(0.013)	(0.085)
Economic Freedom (1995)		0.008 ***	0.006 ***	0.005 **
		(0.001)	(0.002)	(0.002)
Variation in Education (1970–1999)			0.003 *	0.003 *
			(0.001)	(0.001)
Initial GDP (1970)			−0.009 ***	−0.008 ***
			(0.001)	(0.001)
Variation in population (1970–2006)			−0.615 **	−0.660 **
			(0.181)	(0.188)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
Revolution and Coup			−0.011 **	−0.013 **
			(0.004)	(0.005)
Sub-Saharan Africa			−0.009	−0.008
			(0.006)	(0.005)
Middle East			0.009	0.010 *
			(0.006)	(0.006)
East Asia			0.004	0.005
			(0.005)	(0.005)
(Economic freedom)*(Ores and Metals exports to GDP)				0.027 *
				(0.015)
Constant	0.017	−0.031 ***	0.034 **	0.038 **
	(0.002)	(0.008)	(0.017)	(0.012)
R-squared	0.150	0.384	0.734	0.757
Observations	81	77	68	68

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 16: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and economic freedom (Legal structure and security of property rights), 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP. 1970	−0.034	−0.007	−0.018	−0.143 ***
	(0.021)	(0.017)	(0.011)	(0.026)
Economic Freedom (1970–2006) (Area 2 only)		0.004 ***	0.007 ***	0.003 *
		(0.001)	(0.001)	(0.002)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.009 ***	−0.008 ***
			(0.002)	(0.001)
Variation in population (1970–2006)			−0.127	−0.439 **
			(0.171)	(0.161)
Investment (1970–2006)			0.000	0.001 **
			(0.000)	(0.000)
Revolution and Coup			0.001	−0.000
			(0.004)	(0.004)
Sub-Saharan Africa			−0.025 ***	−0.021 ***
			(0.005)	(0.005)
Middle East			0.003	0.004
			(0.005)	(0.005)
East Asia			0.006	0.004
			(0.004)	(0.004)
(Economic freedom) * (Primary exports to GDP)				0.022 ***
				(0.005)
Constant	0.019 ***	−0.008	0.034 **	0.058 ***
	(0.003)	(0.008)	(0.013)	(0.012)
R-squared	0.084	0.244	0.775	0.822
Observations	75	71	63	63

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05: * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 17: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and economic freedom (Legal structure and security of property rights), 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP, 1970	−0.081 **	−0.038 **	−0.036 ***	−0.187 **
	(0.029)	(0.014)	(0.008)	(0.071)
Economic Freedom (1970–2006) (Area 2 only)		0.005 ***	0.008 ***	0.007 ***
		(0.001)	(0.001)	(0.002)
Variation in Education (1970–1999)			0.004 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.010 ***	−0.009 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.269	−0.381 **
			(0.168)	(0.182)
Investment (1970–2006)			0.000 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			0.003	0.004
			(0.005)	(0.005)
Sub-Saharan Africa			−0.023 ***	−0.021 ***
			(0.005)	(0.005)
Middle East			0.004	0.004
			(0.006)	(0.007)
East Asia			0.004	0.005
			(0.004)	(0.004)
(Economic freedom) * (Ores and Metals exports to GDP)				0.031 **
				(0.014)
Constant	0.017 ***	−0.010 *	0.036 **	0.041 ***
	(0.002)	(0.006)	(0.013)	(0.014)
R-squared	0.150	0.296	0.769	0.780
Observations	81	77	68	68

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05 and * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita

Sources: World Bank, 2008a; Gwartney & Lawson (2008); calculations by the authors.

Table 18: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and economic freedom (excluding Size of government), 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP, 1970	−0.034	−0.012	−0.025 **	−0.197 ***
	(0.021)	(0.014)	(0.012)	(0.047)
Economic Freedom (1970–2006) (Area 1 excluded)		0.002 ***	0.002 **	0.001
		(0.000)	(0.001)	(0.001)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.007 ***	−0.007 ***
			(0.002)	(0.001)
Variation in population (1970–2006)			−0.555 **	−0.761 ***
			(0.206)	(0.168)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
Revolution and Coup			−0.007	−0.006 *
			(0.004)	(0.004)
Sub-Saharan Africa			−0.014 **	−0.012 **
			(0.005)	(0.005)
Middle East			0.011	0.010
			(0.008)	(0.007)
East Asia			0.005	0.003
			(0.005)	(0.004)
(Economic freedom)*(Primary exports to GDP)				0.006 ***
				(0.002)
Constant	0.019 ***	−0.036 ***	0.011	0.044 **
	(0.003)	(0.013)	(0.018)	(0.017)
R-squared	0.084	0.281	0.731	0.784
Observations	75	71	63	63

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 19: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (ores and metals exports to GDP), 1970; and economic freedom (excluding Size of government), 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP, 1970	−0.081 **	−0.032 **	−0.036 **	−0.573 **
	(0.029)	(0.012)	(0.015)	(0.163)
Economic Freedom (1970–2006) (Area 1 excluded)		0.002 ***	0.002 **	0.001 **
		(0.000)	(0.000)	(0.000)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.006 **	−0.006 **
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.732 **	−0.810 ***
			(0.208)	(0.207)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.000)
Revolution and Coup			−0.004	−0.006
			(0.005)	(0.005)
Sub-Saharan Africa			−0.010 *	−0.008
			(0.006)	(0.006)
Middle East			0.012	0.012
			(0.010)	(0.009)
East Asia			0.004	0.004
			(0.005)	(0.005)
(Economic freedom)*(Ores and Metals exports to GDP)				0.021 **
				(0.006)
Constant	0.017 ***	−0.038 ***	0.008	0.022
	(0.002)	(0.010)	(0.018)	(0.018)
R-squared	0.150	0.318	0.699	0.731
Observations	81	77	68	68

Notes: All standard errors are in parentheses; Significance: *** p <.001; ** p <= .05 and * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 20: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (natural capital/total capital), 1995; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Natural capital/total capital (1995)	−0.010 **	−0.005	−0.015 ***	−0.003
	(0.004)	(0.003)	(0.003)	(0.022)
Economic Freedom (1970–2006)		0.007 ***	0.008 **	0.008 ***
		(0.002)	(0.002)	(0.002)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.009 ***	−0.009 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			0.001 ***	0.001 ***
			(0.000)	(0.000)
Investment (1970–2006)			0.001	0.001
			(0.004)	(0.004)
Revolution and Coup			−0.899 ***	−0.875 ***
			(0.155)	(0.167)
Sub-Saharan Africa			−0.002	−0.002
			(0.005)	(0.005)
Middle East			0.014 *	0.014 *
			(0.007)	(0.008)
East Asia			−0.001	0.000
			(0.004)	(0.004)
(Economic freedom) * (Natural capital / total capital)				−0.002
				(0.004)
Constant	0.020 ***	−0.024 *	0.020	0.019
	(0.002)	(0.012)	(0.015)	(0.015)
R-squared	0.130	0.246	0.721	0.722
Observations	101	95	81	81

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 21: Ordinary least squares (OLS) regressions—economic growth (1970–2006); resource dependence (minerals/total capital), 1995; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Minerals in Total Wealth (1995)	−0.089 **	−0.087 **	−0.113 **	−2.536 **
	(0.040)	(0.037)	(0.054)	(0.751)
Economic Freedom (1970–2006)		0.008 ***	0.010 **	0.009 **
		(0.002)	(0.003)	(0.003)
Variation in Education (1970–1999)			0.003 **	0.004 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.007 **	−0.007 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.625 **	−0.783 ***
			(0.228)	(0.192)
Investment (1970–2006)			0.001 **	0.001 **
			(0.000)	(0.005)
Revolution and Coup			−0.000	−0.000
			(0.005)	(0.005)
Sub-Saharan Africa			−0.007	−0.005
			(0.006)	(0.006)
Middle East			0.014	0.013
			(0.009)	(0.009)
East Asia			0.000	−0.001
			(0.006)	(0.005)
(Economic freedom) * (minerals / total capital)				0.399 **
				(0.122)
Constant	0.016 ***	−0.031 **	−0.014	−0.002
	(0.002)	(0.012)	(0.022)	(0.019)
R-squared	0.031	0.186	0.637	0.660
Observations	81	79	71	71

Notes: All standard errors are in parentheses; Significance: *** p <.001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 22: Ordinary least squares (OLS) regressions with a dummy for developed countries—economic growth (1970–2006); resource dependence (primary exports to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Primary exports to GDP, 1970	–0.034	–0.012	–0.018	–0.180 ***
	(0.021)	(0.014)	(0.012)	(0.046)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.007 **	0.003
		(0.002)	(0.003)	(0.003)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			–0.009 ***	–0.008 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			–0.473 **	–0.702 ***
			(0.215)	(0.178)
Investment (1970–2006)			0.001 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			–0.007	–0.007 *
			(0.005)	(0.004)
Sub-Saharan Africa			–0.019 ***	–0.015 **
			(0.006)	(0.005)
Middle East			0.009	0.009
			(0.008)	(0.007)
East Asia			0.005	0.002
			(0.005)	(0.004)
Developed			0.008	0.005
			(0.005)	(0.005)
(Economic freedom) * (Primary exports to GDP)				0.027 **
				(0.007)
Constant	0.019 ***	–0.036 **	0.030	0.056 ***
	(0.003)	(0.013)	(0.022)	(0.020)
R-squared	0.084	0.275	0.743	0.788
Observations	75	71	63	63

Notes: All standard errors are in parentheses; Significance: *** p <.001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

Table 23: Ordinary least squares (OLS) regressions with a dummy for developed countries—conomic growth (1970–2006); resource dependence (ores and metals to GDP), 1970; and economic freedom, 1970–2006

	Model 1	Model 2	Model 3	Model 4
	Coeff.	Coeff.	Coeff.	Coeff.
Ores and Metals to GDP, 1970	−0.081 **	−0.031 **	−0.030 **	−0.633 **
	(0.029)	(0.012)	(0.014)	(0.182)
Economic freedom (EFW, 1970–2006)		0.009 ***	0.006 **	0.004
		(0.002)	(0.003)	(0.002)
Variation in Education (1970–1999)			0.003 **	0.003 **
			(0.001)	(0.001)
Initial GDP (1970)			−0.008 ***	−0.009 ***
			(0.002)	(0.002)
Variation in population (1970–2006)			−0.554 **	−0.660 **
			(0.201)	(0.191)
Investment (1970–2006)			0.001 *	0.001 *
			(0.000)	(0.000)
Revolution and Coup			−0.004	−0.006
			(0.005)	(0.005)
Sub-Saharan Africa			−0.016 **	−0.014 **
			(0.006)	(0.006)
Middle East			0.009	0.009
			(0.009)	(0.008)
East Asia			0.004	0.004
			(0.005)	(0.004)
Developed			0.011 **	0.012 **
			(0.005)	(0.005)
(Economic freedom) * (Primary exports to GDP)				0.117 **
				(0.035)
Constant	0.017 ***	−0.038 ***	0.032	0.049
	(0.002)	(0.010)	(0.022)	(0.021)
R-squared	0.150	0.316	0.726	0.765
Observations	81	77	68	68

Notes: All standard errors are in parentheses; Significance: *** p < .001; ** p <= .05; * p <= 0.10; economic growth refers to the average (logged) growth in GDP per capita.

Sources: World Bank, 2008a; Gwartney & Lawson, 2008; calculations by the authors.

5 Diagnostic of resource-dependent countries and recommendations

The evidence presented above is a compelling argument in favor of increasing the level of economic freedom to generate economic growth. Many other empirical studies conclude that a high level of economic freedom is a key factor in the growth and prosperity of nations. This publication illustrates that economic freedom is particularly important for both resource-dependent countries and resource-dependent developing countries.

A society that encourages mutually beneficial agreements differs dramatically from a society without economic freedom, where rent seeking is the path to increased wealth and power. The first dynamic promotes the development of a stable and productive society marked by freedom, while the latter leads to stagnation or a decline in prosperity. Resource-dependent countries need to focus on increasing economic freedom to promote growth.

In order to do so, it is crucial to investigate which areas of economic freedom resource-dependent and resource-dependent developing countries should focus on. Table 24 presents the average economic freedom scores, by area, for 2006 (Gwartney and Lawson, 2008) for all countries, developing countries, resource-dependent, and resource-dependent developing countries in our data set.[48]

Economic freedom is measured in five different areas: Area 1: Size of government; Area 2: Legal structure and security of property rights; Area 3: Access to sound money; Area 4: Freedom to trade internationally; and Area 5: Regulation of credit, labor, and business. Compared to Area 3 (Access to sound money), which has the highest EFW scores across all country types, the economic freedom score for Area 2 (Legal structure and security of property rights) is particularly low. The average score for Area 2 is 5.78 out of 10 for all the countries in our data set, compared to 4.71 for the developing countries, 5.73 for the resource-dependent countries, and 4.71 for the resource-dependent developing countries. The rule of law—the enforcement

48 Resource-dependent countries here refer to countries dependent upon ores and metals. Note that economic freedom scores for resource-dependent countries in table 24 are similar to the scores for all countries This is because resource-dependent countries include (in addition to resource-dependent developing countries) developed countries such as Australia and Canada that have high economic freedom scores. Table A1 presents the economic freedom scores (by area) for all countries in 2006, as well as the proportion of exports of primary products and export of ores and metals in GDP.

Table 24: Average economic freedom scores, by area, 2006

	All areas	Area 1	Area 2	Area 3	Area 4	Area5
All countries	6.72	6.39	5.78	8.03	6.81	6.59
Developing	6.25	6.54	4.71	7.37	6.50	6.11
Resource-dependent	6.71	6.31	5.73	8.01	6.85	6.66
Resource-dependent developing	6.32	6.49	4.71	7.52	6.68	6.22

Notes: All scores are out of 10. Area 1 represents size of government; Area 2 represents legal structure and security of property rights; Area 3 represents access to sound money; Area 4 represents freedom to trade internationally; and Area 5 represents regulation of credit, labor and business. For the list of countries, developing, resource-dependent, and resource-dependent developing countries, refer to table A1.

Source: Gwartney & Lawson, 2008; calculations by the authors.

of contracts, an impartial court system, and an independent judicial system—is essential for the protection of property and security of contracts, both of which are cornerstones of a market economy. If the powerful can steal property or violate contracts at will, no one but the powerful can build businesses or extract resources; thus, the powerful can deprive the masses of economic freedom. Without the rule of law, economic growth and prosperity are not possible. Indeed, the legal system is the most important internal function of a government. Security of property rights, protected by the rule of law, is essential to economic freedom.

Two additional areas of importance for resource-dependent and resource-dependent developing countries are the Size of the government (Area 1) and Freedom to trade internationally (Area 4). For Area 1, all countries have an EFW score of approximately 6.40, while resource-dependent countries score lower at 6.31. Clearly, when government consumption is a larger share of the total or when governments impose higher taxes, political choice is substituted for personal choice and freedom of individuals is reduced, resulting in low scores in this area. For Area 4, the economic freedom score is 6.85 for resource-dependent countries and 6.68 for resource-dependent developing countries. This makes sense since almost any nation with natural resources should have at least the freedom to export, since few will be able to absorb the resources themselves. Closed markets limit the investment opportunities that the resources can create since businesses can serve only a local market. Moreover, closed markets promote political power over economic efficiency since local power can dominate a market without fear of competition and this feeds into the cronyism and corruption that may promote the resource curse. It can also lead to rent-seeking behavior. In a world of high technology and low costs for communication and transportation, freedom of exchange across national boundaries is a key element of economic freedom. Individuals and businesses in resource-dependent countries should have the right to buy and sell from each other, as well as from everyone

and anywhere in the world. In other words, consumers should be able to buy the products they want regardless of origin and producers should be able to sell freely to the world market.

Another crucial area is the 'Regulation of credit, business, and labor' (Area 5). The average score for Area 5 for resource-dependent countries is 6.66, and for resource-dependent developing countries, 6.22. When regulation restricts entry into markets and interferes with the freedom to engage in voluntary exchange, it reduces economic freedom. Red tape can strangle the expansion of business, entrepreneurship, and job creation. Government must allow free markets to determine credit. Individuals should be able to work for whom they wish and employers should be able to hire whom they wish. Individuals should be able to open the business they wish when they wish and close it when they choose. Bureaucratic procedures must not limit the capacity of establishing a business, operating a business, and closing a business. Eliminating unnecessary regulatory barriers would reduce corruption and, therefore, decrease the administrative costs on businesses for resource-dependent countries. Once again, the limitations of the regulations of credit, business, and labor can limit rent-seeking behavior and decrease the resource curse.

Policy recommendations

Our results show that the negative effect of resource dependence on growth is particularly evident for countries with high levels of metals-and-ores exports (the only significant category on its own and our focus). Moreover, the findings of this paper suggest that the level of economic freedom is crucial for economic growth for resource-dependent countries. A substantial degree of economic freedom eventually turns this resource curse into a blessing. Although the resource curse associated with metals and ores is particularly strong, the curse turns into a blessing at a relatively low level of economic freedom, emphasizing the importance of policies that will increase economic freedom in these nations.

Resource-dependent countries and, especially, resource-dependent developing countries should focus on improving three main aspects that would increase considerably their level of economic freedom and their gain from exporting primary products as well as metals and ores.

1 *The rule of law should be improved* to protect property rights, encourage investment, and reduce corruption. Without proper mechanisms of settlement of disputes and security of property rights, many mutually beneficial exchanges are prevented, thus undermining the market-exchange system. Although crucial for prosperity, improving the legal system is a complex task that cannot be achieved overnight. Developing countries must be patient and look at success stories among similar countries and follow their path.

2 *Trade barriers should be removed.* Developing nations tend to have smaller domestic markets and therefore could benefit from opening their markets to international trade while gaining access to bigger markets.

3 *Business regulations should be simplified* to encourage investment and business creation by eliminating unnecessary regulatory barriers, reducing corruption, and therefore decreasing the administrative costs on businesses.

Transformations and improvements in policies are possible. Resource dependent nations have the capacity to improve their level of economic freedom and thus effectively improve their economic growth and prosperity.

Data appendix

Dependent variables

Average growth in GDP per capita(1970–2006) = Δ GDPi Natural logarithm of the average GDP per capita growth. *World Development Indicators 2008* (World Bank, 2008a) and calculation by authors: GDP per capita (2000 constant US$). Formula: $Gi = (1/(T-t)) \ln (Y_{Ti}/y_{ti})$, where T = 2006 and t = 1970 (all tables)

Measures of natural resources

SXP (Sachs and Warner's original measure of resource abundance) Share of exports of primary products in GNP in 1970. Variable from Sachs and Warner, 1997a; 1997b.

Primary exports to GDP (1970) Share of exports of primary products (agriculture raw materials, fuel, food, and ores and metal) in GDP in 1970. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Ores & Metals exports to GDP (1970) Share of exports of ores and metals in GDP in 1970. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Fuel to GDP (1970) Share of exports of fuel in GDP in 1970. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Agricultural raw materials to GDP (1970) Share of exports of agricultural raw materials in GDP in 1970. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Food to GDP (1970) Share of exports of food in GDP in 1970. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Primary exports to GDP Simple average of share of exports of primary products (agriculture raw materials, fuel, food, and ores and metal) in GDP between 1970 and 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Ores & Metals exports to GDP Simple average of share of exports of Ores and Metals in GDP between 1970 and 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Fuel to GDP Simple average of share of exports of fuel in GDP between 1970 and 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Agriculture to GDP Simple average of share of exports of agricultural raw materials in GDP between 1970 and 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Food to GDP Simple average of share of exports of food in GDP between 1970 and 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Measure of Natural Resources (1995) Natural capital / total wealth 1995. *World Bank Environment* (World Bank, 2008b); calculations by authors.

Minerals in Total Wealth (1994) Mineral capital /Total wealth 1995. *World Bank Environment* (World Bank, 2008b); calculations by authors.

Natural Resources per capita (1994) Natural capital/ population 1995. *World Bank Environment* (World Bank, 2008b); calculations by authors.

Institutions

Institutional quality index (1980-PRS) Unweighted average of five sub-indexes developed from data by PRS (rule of law index, bureaucratic quality index, corruption in government, risk of expropriation index, government repudiation of contracts index). Data from Sachs and Warner, 1997; calculations by authors.

Other controls

Variation in Education (1970–2006) Difference in the average schooling years in the total population over 25 between 1970 and 1999. From Barro and Lee, 2000; calculations by authors.

Initial GDP (1970) Natural logarithm of GDP per capita 70 (2000 constant US$. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors.

Growth in population (1970–2006) Average growth in total population from 1970 to 2006. *World Development Indicators 2008* (World Bank, 2008a); calculations by authors. Formula: $Gi = (1/(T-t)) \ln (Y_{Ti}/y_{ti})$, where $T = 2006$ and $t = 1970$.

Revolution and Coup Number of revolutions and coups per year, averaged over the period from 1970 to 1985. Data from Sachs and Warner, 1995; calculations by authors.

Sub-Saharan Africa Dummy variable equal to 1 for sub-Saharan African countries, 0 otherwise. Data from Sachs and Warner, 1997; calculations by authors.

Middle East Dummy variable equal to 1 for Middle-East countries. Calculations by authors.

East Asia Dummy variable equal to 1 for East-Asia and Pacific countries. Calculations by authors.

Tropics Dummy variable equal to 1 for countries located in the Tropics. Calculations by authors.

External Terms of Trade Average annual growth in the log of the external terms of trade between 1970 and 1990. Data from Sachs and Warner, 1995; calculations by authors.

Investment Ratio of investment to GDP averaged over the period from 1970 to 2006. Calculations by authors

Developed Dummy variable equal to 1 for a country that is classified as developed. Classification of advanced economies from Country Composition of WEO Groups, *World Economic Outlook* (International Monetary Fund, 2008; calculations by authors.

Instrumental variables

Colony Dummy equal to 1 if the country used to be a colony. Data from Sachs and Warner, 1997; calculations by authors.

Ethnolinguistic fractionalization Measure of ethnolinguistic fractionalization used in Easterly and Levine (1997). Data from Sachs and Warner, 1997. This variable measures the probability that two randomly-selected people from a country will not belong to the same ethnic or linguistic group.

Openness Measure of historic trade openness (in nominal terms), defined as the sum of imports and exports over GDP for the earliest period between 1950 and 1960 for which data was available for a particular country. From *Penn World Tables* 6.1 (CICUP, 2009); calculations by authors.

Table A1: Economic growth, resource dependence, and economic freedom scores

	(1) Economic Growth (1970–2006)	(2) Primary exports to GDP, 1970 (SXP′)	(3) Ores and Metal exports to GDP, 1970	(4) Average Economic Freedom (1970–2006)	(5) Average (across all areas), Economic Freedom, 2006	(6) Economic Freedom (Area 1), 2006	(7) Economic Freedom (Area 2), 2006	(8) Economic Freedom (Area 3), 2006	(9) Economic Freedom (Area 4), 2006	(10) Economic Freedom (Area 5), 2006
Algeria	0.011	0.193	0.005	4.223	5.57	4.93	5.15	6.33	6.30	5.15
Argentina	0.008	0.048	0.000	5.216	5.85	7.48	4.35	6.17	6.32	4.94
Australia (d, RD)	0.017	0.098	0.027	7.306	8.04	6.77	8.68	9.46	7.17	8.12
Austria (d)	0.023	0.037	0.007	6.755	7.66	5.18	8.67	9.54	7.68	7.22
Benin	0.003	0.088	0.000	5.115	5.88	7.20	4.33	6.86	5.25	5.78
Bolivia (RD)	0.004	0.181	0.165	5.582	6.38	6.20	4.11	8.66	7.29	5.63
Brazil	0.020	0.056	0.007	4.883	6.16	6.65	5.19	7.77	6.51	4.69
Cameroon (RD)	0.009	0.224	0.021	5.670	5.76	6.52	3.69	7.07	5.80	5.71
Canada (d, RD)	0.019	0.095	0.040	7.505	8.05	6.88	8.39	9.60	7.14	8.22
Central African Republic	–0.012	0.090	0.000	4.765	5.01	6.32	2.99	6.80	4.03	4.91
Chad	0.005	0.060	0.000	5.136	5.12	6.45	2.28	6.12	5.93	4.81
Chile (RD)	0.027	0.133	0.122	5.980	8.06	7.50	6.99	9.14	8.40	8.24
Columbia	0.018	0.093	0.001	5.150	5.78	4.44	4.49	7.85	6.05	6.05
Congo, Democratic Republic (RD)	–0.036	0.149	0.125	4.184	5.25	7.24	2.06	7.25	5.43	4.26
Congo, Republic	0.013	0.080	0.000	4.708	4.64	3.90	2.35	5.71	6.02	5.22
Costa Rica	0.020	0.189	0.000	6.654	7.58	8.01	6.79	8.89	7.62	6.59
Denmark (d)	0.019	0.093	0.003	6.764	7.78	4.39	8.96	9.36	7.77	8.44
Ecuador	0.016	0.111	0.001	5.508	5.87	8.03	4.06	5.06	6.58	5.60
Egypt	0.030	0.072	0.001	5.469	6.65	7.29	5.66	8.74	6.63	4.93
El Salvador	0.004	0.144	0.002	5.950	7.51	8.96	4.83	9.37	7.18	7.23
Fiji	0.015	0.385	0.004	5.963	6.42	6.08	5.61	6.56	5.45	8.40
Finland (d)	0.025	0.068	0.007	6.915	7.69	5.03	9.01	9.52	7.43	7.47
France (d)	0.020	0.031	0.005	6.429	7.19	4.11	7.53	9.51	7.38	7.40
Gabon (RD)	0.007	0.406	0.061	5.215	5.37	4.26	4.27	6.03	5.48	6.82
Ghana (RD)	0.001	0.206	0.027	4.763	6.84	6.60	5.74	8.21	6.79	6.85
Greece (d)	0.021	0.029	0.006	6.118	7.03	6.82	6.56	9.53	6.21	6.05
Guatemala	0.009	0.110	0.001	6.500	7.06	7.77	5.22	9.17	6.84	6.27
Guinea-Bissau	–0.008	NA	0.000	3.818	5.01	3.09	3.68	6.67	5.67	5.94
Guyana (RD)	0.008	0.492	0.271	4.920	5.89	3.06	4.56	7.79	7.67	6.39
Haiti (RD)	–0.013	NA	0.017	5.685	6.16	7.26	2.59	8.28	6.49	6.16
Honduras (RD)	0.010	0.228	0.014	6.403	7.35	8.94	4.85	8.94	7.23	6.79
Hong Kong (d)	0.046	NA	0.010	8.610	8.94	9.13	8.19	9.36	9.50	8.54
Hungary	0.026	0.042	0.010	5.845	7.46	5.70	6.68	9.48	8.24	7.18
Iceland (d, RD)	0.027	NA	0.041	6.368	7.80	6.94	8.80	8.62	5.90	8.76
India	0.030	0.016	0.004	5.373	6.59	7.14	6.12	6.70	6.82	6.17
Indonesia	0.040	0.113	0.013	5.751	6.12	6.36	3.93	7.18	7.29	5.83

Table A1 continued: Economic growth, resource dependence, and economic freedom scores

	(1) Economic Growth (1970–2006)	(2) Primary exports to GDP, 1970 (SXP′)	(3) Ores and Metal exports to GDP, 1970	(4) Average Economic Freedom (1970–2006)	(5) Average (across all areas), Economic Freedom, 2006	(6) Economic Freedom (Area 1), 2006	(7) Economic Freedom (Area 2), 2006	(8) Economic Freedom (Area 3), 2006	(9) Economic Freedom (Area 4), 2006	(10) Economic Freedom (Area 5), 2006
Iran	0.009	0.218	0.003	5.261	6.46	6.79	6.11	8.24	6.42	4.76
Ireland (d, RD)	0.040	0.156	0.016	7.006	7.92	6.38	7.89	9.52	8.31	7.49
Israel (d)	0.021	0.043	0.005	5.009	6.63	3.83	6.22	9.14	7.56	6.38
Italy (d)	0.020	0.020	0.002	6.204	7.15	5.99	6.26	9.42	7.24	6.84
Ivory Coast	–0.012	0.304	0.003	5.573	5.95	7.35	3.36	6.88	5.97	6.21
Japan (d)	0.023	0.006	0.001	7.135	7.48	6.23	7.90	9.72	5.87	7.69
Korea, Republic (South) (d)	0.055	0.022	0.005	6.200	7.42	6.62	7.45	9.34	6.89	6.81
Madagascar	–0.015	0.121	0.007	5.134	5.96	6.92	3.32	7.33	6.46	5.77
Malawi	0.005	0.198	0.001	5.061	5.42	5.41	5.25	5.31	4.96	6.18
Malaysia (RD)	0.039	0.365	0.089	6.826	6.72	5.50	6.85	6.02	7.55	7.66
Mali	0.008	0.082	0.001	5.779	6.13	7.33	4.51	6.47	6.25	6.09
Malta (d)	0.048	NA	0.006	6.155	7.53	5.91	7.75	9.53	7.43	7.02
Mexico	0.016	0.027	0.006	6.013	6.98	7.33	5.45	8.24	7.14	6.72
Morocco (RD)	0.020	0.111	0.040	5.430	6.24	6.68	6.10	6.89	5.87	5.64
Netherlands (d, RD)	0.019	0.164	0.014	7.296	7.65	4.06	8.49	9.69	8.33	7.69
New Zealand (d)	0.012	0.165	0.001	7.091	8.28	6.70	8.90	9.35	7.79	8.65
Nicaragua	–0.011	0.193	0.007	4.785	6.99	7.52	4.32	9.06	7.09	6.98
Nigeria	–0.018	0.047	0.000	5.227	4.67	3.04	4.32	6.55	4.46	4.98
Nigeria	0.005	0.098	0.004	4.550	5.88	3.97	3.98	7.38	7.22	6.86
Norway (d, RD)	0.028	0.082	0.043	6.566	7.54	5.80	8.91	8.90	6.62	7.48
Pakistan	0.022	0.019	0.000	5.043	6.05	7.01	4.31	6.45	5.91	6.56
Panama	0.015	0.104	0.002	6.937	7.41	8.37	5.21	9.11	7.41	6.98
Peru (RD)	0.006	0.143	0.070	5.015	7.16	8.27	5.00	8.76	7.31	6.44
Philippines (RD)	0.013	0.144	0.033	5.998	6.72	7.12	4.90	8.13	7.17	6.28
Portugal (d)	0.027	0.044	0.003	6.089	7.16	5.71	7.21	9.32	7.33	6.22
Senegal (RD)	–0.001	0.121	0.014	5.267	5.65	6.07	3.55	6.94	6.13	5.57
Singapore (d)	0.050	0.569	0.013	7.913	8.57	7.86	8.43	8.99	9.35	8.22
Spain (d)	0.024	0.028	0.002	6.466	7.38	6.69	6.71	9.49	7.16	6.86
Sri Lanka	0.032	NA	0.001	5.567	6.11	7.03	4.92	6.10	6.35	6.17
Sweden (d, RD)	0.018	0.053	0.019	6.369	7.35	3.73	8.41	9.61	7.72	7.26
Switzerland (d)	0.010	0.024	0.006	7.880	8.20	7.89	8.66	9.56	6.79	8.12
Thailand (RD)	0.045	0.092	0.015	6.456	7.00	7.33	6.20	6.61	7.51	7.37
Togo (RD)	–0.006	0.204	0.054	4.955	5.33	6.36	2.46	6.90	6.17	4.77
Trinidad & Tobago	0.023	0.509	0.004	5.910	7.07	7.24	5.04	8.53	7.16	7.38
Tunisia (RD)	0.031	0.102	0.024	5.396	6.44	5.31	6.90	6.98	6.14	6.85

Table A1 continued: Economic growth, resource dependence, and economic freedom scores

	(1) Economic Growth (1970–2006)	(2) Primary exports to GDP, 1970 (SXP′)	(3) Ores and Metal exports to GDP, 1970	(4) Average Economic Freedom (1970–2006)	(5) Average (across all areas), Economic Freedom, 2006	(6) Economic Freedom (Area 1), 2006	(7) Economic Freedom (Area 2), 2006	(8) Economic Freedom (Area 3), 2006	(9) Economic Freedom (Area 4), 2006	(10) Economic Freedom (Area 5), 2006
Turkey	0.022	0.027	0.002	4.889	6.35	7.82	6.29	5.42	6.77	5.47
United Kingdom (d)	0.021	0.026	0.008	7.088	8.07	6.64	8.33	9.40	7.76	8.25
United States (d)	0.020	0.013	0.002	7.771	8.04	7.13	7.58	9.66	7.53	8.31
Uruguay	0.015	0.087	0.001	6.313	6.93	7.52	5.57	7.98	6.99	6.58
Venezuela (RD)	–0.004	0.240	0.014	5.735	4.76	4.99	3.08	5.64	5.35	4.75
Zambia (RD)	–0.011	0.559	0.554	5.071	7.09	8.19	5.58	8.57	7.11	6.00
Averages										
All countries	0.015	0.139	0.027	5.891	6.719	6.393	5.780	8.032	6.806	6.585
Developing	0.010	0.164	0.035	5.435	6.246	6.536	4.714	7.371	6.503	6.107
Resource dependent	0.012	0.198	0.074	5.883	6.712	6.306	5.733	8.008	6.849	6.662
Resource-dependent developing	0.008	0.228	0.091	5.503	6.325	6.495	4.709	7.516	6.678	6.220

Notes: Countries marked (d) are developed countries; those not marked (d) are developing countries. Countries marked (RD) are resource-dependent countries. Columns (2) and (3) represent the two measures of resource abundance used in this publication, exports of primary products to GDP and exports of ores and metals to GDP, respectively; columns (4) to (10) represent various measures of economic freedom. Countries were grouped into developed countries using IMF's (2008) classification of advanced economies.

Source: Gwartney & Lawson, 2008; calculations by the authors.

References

Acemoglu, D. and James Robinson (2008) The Role of Institutions in Growth and Development Commission on Growth and Development Working Paper No. 10

Addison, Tony, Philippe le Billon, and S. Mansoob Murshed (2001). *Conflict in Africa: The Cost of Peaceful Behaviour*. Wider Discussion Paper No. 2001/51. World Institute for Development Economics Research of the UN University (UNU/WIDER).

Addison, Tony, and S. Mansoob Murshed (2001). From Conflict to Reconstruction: Reviving the Social Contract. WIDER Discussion Paper 2001/48. World Institute for Development Economics Research of the UN University (UNU/WIDER).

Anderson, Siwan, and Patrick Francois (2008). Formalizing Informal Institutions: Theory and Evidence from a Kenyan Slum. In Elhanan Helpman, ed., *Institutions and Economic Performance* (Harvard University Press): 409–51.

Auty, R. M. (1997). Natural Resource Endowment, the State and Development Strategy. *Journal of International Development* 9: 651–63.

Barro, R.J. (1991). Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics* 106, 2: 407–44.

Barro, Robert J., and Jong-Wha Lee (2000). *International Data on Educational Attainment: Updates and Implications*. CID Working Paper No. 42 (April)—Human Capital updated files. <http://www.cid.harvard.edu/ciddata/>.

Boschini, Anne D., Jan Pettersson, and Jesper Roine (2007) Resource Curse or Not: A Question of Appropriability. *Scandinavian Journal of Economics* 109, 3: 593–617.

Brunnschweiler, Christa N. (2006). *Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth*. Economics Working Paper Series No. 06/51. Center of Economic Research (CER-ETH), at ETH Zurich.

Brunnschweiler, Christa N., and Erwin H. Bulte (2006). *The Resource Curse Revisited and Revisited: A Tale of Paradoxes and Red Herrings*. Economics Working Paper Series No. 06/61. Swiss Federal Institute of Technology Zurich.

Brunnschweiler, Christa N., and Erwin H. Bulte (2008). The Resource Curse Revisited and Revisited: A Tale of Paradoxes and Red Herrings. *Journal of Environmental Economics and Management* 55: 248–64.

Center for International Comparisons at the University of Pennsylvania [CICUP] (2009). *Penn World Tables*. <http://pwt.econ.upenn.edu/>.

Collier, Paul, and Anke Hoeffler (2009). Testing the Neocon Agenda: Democracy in Resource-Rich Societies. *European Economic Review* 53, 3: 293–308.

De Haan, Jakob, and Jan-Egbert Strum (2000). On the Relationship between Economic Freedom and Economic Growth. *European Journal of Political Economy* 16: 215–41

Ding, Ning, and Barry C. Field (2005). Natural Resource Abundance and Economic Growth. *Land Economics* 81, 4: 496–502.

Easterly, W., and R. Levine (1997). Africa's Growth Tragedy: Policies and Ethnic Divisions. *Quarterly Journal of Economics* 112: 1203–50.

Freire-Seren, Maria Jesus (2001). Human Capital Accumulation and Economic Growth. *Investigaciones Economicas* 25, 3: 585–602

Gallup, John L., and Jeffrey D. Sachs, with Andrew Mellinger (1999). *Geography and Economic Development*. CID Working Paper No. 1 (March). <http://www.cid.harvard.edu/ciddata/>.

Gylfason, T. (2001). Natural Resources, Education, and Economic Development. *European Economic Review* 45: 847–59.

Gylfason, Thorvaldur, and Gylfi Zoega (2006). Natural Resources and Economic Growth: The Role of Investment. *World Economy* 29, 8 (August): 1091–115.

Gwartney, James, and Robert Lawson (2004). *Economic Freedom of the World: 2004 Annual Report*. Fraser Institute. <http://www.freetheworld.com>.

Gwartney, James, and Robert Lawson, with Seth Norton (2008). *Economic Freedom of the World: 2008 Annual Report.* Fraser Institute. <http://www.freetheworld.com>.

Gwartney, James, R. Holcombe, and Robert Lawson, with Seth Norton (2006). Institutions and the Impact of Investment on Growth. *Kyklos* 59, 2: 255–73

Iimi, A. (2006). *Did Botswana Escape from the Resource Curse?* IMF Working Paper WP/06/138. International Monetary Fund.

Inglehart, Ronald (1997). *Modernization and Post Modernization: Cultural, Economic, and Political Change in 43 Societies.* Princeton University Press.

International Monetary Fund (2005). *World Economic Outlook: Building Institutions*. <http://www.imf.org/external/pubs/ft/weo/2005/02/index.htm>.

International Monetary Fund (2008). Country Composition of WEO Groups. *World Economic Outlook*. <http://www.imf.org/external/pubs/ft/weo/2008/02/weodata/groups.htm>.

Isham, Jonathan, Micheal Woolcock, Lant Pritchett, and Gwen Busby (2005). The Varieties of Resource Experience: Natural Resource Export Structures and the Political Economy of Economic Growth. *World Bank Economic Review* 19, 2: 141–74.

Karabegović, Amela (2009). *Institutions, Economic Growth, and the "Curse" of Natural Resources*. Studies in Mining Policy. Fraser Institute.

Kolstad, I. (2007). *The Resource Curse: Which Institutions Matter?* CMI Working Paper WP 2007, 2. CHR Michelsen Institute. <http://www.cmi.no/publications/publication/?2678=the-resource-curse-which-institutions-matter>.

Lane, P.R., and A. Tornell (1999). The Voracity Effect. *American Economic Review* 89: 22–46.

Larsen, Erling R. (2006). Escaping the Resource Curse and the Dutch Disease? When and Why Norway Caught Up with and Forged Ahead of Its Neighbors. *American Journal of Economics and Sociology* 65, 3 (July): 605–40.

Ledermann, Daniel, and William F. Maloney (2003). *Trade Structure and Growth*. World Bank Policy Research Working Paper No. 3025.

Leite, C., and J. Weidmann (1999). *Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth.* IMF Working paper 99/85.

Lipset, Seymour M. (1959). Some Social Requisites of Democracy: Economic Development and Political Legitimacy. *American Political Science Review* 53, 1: 69–105.

Lujala, Päivi (2003). Classification of Natural Resources for Conflict and Growth Research. Presented at the 2003 European Consortium for Political Research (ECPR) Joint Session, Workshop #9 on Geography, Conflict, and Cooperation, Edinburgh (March 28–April 2).

Matsuyama, K. (1992). Agricultural Productivity, Comparative Advantage and Economic Growth. *Journal of Economic Theory* 58: 317–34.

Mehlum, Halvor, Karl Moene, and Ragnar Torvik (2006). Institutions and the Resource Curse. *Economic Journal* 116 (January): 1–20.

Mikesell, F. Raymond (1997). Explaining the Resource Curse, with Special Reference to Mineral-Exporting Countries. *Resource Policy* 23, 4: 191–99.

Moore, B. (1966). *Social Origins of Dictatorship and Democracy*. Beacon.

North, Douglass C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press

Papyrakis, E., and R. Gerlagh (2004). The Resource Curse Hypothesis and Its Transmissions Channels. *Journal of Comparative Economics* 32: 181–93.

Putnam, R. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton University Press.

Romer, M. Paul (1994). The Origins of Endogenous Growth. *Journal of Economic Perspectives* 8, 1 (Winter): 3–22.

Ross, Michael (2001). Does Oil Hinder Democracy? *World Politics* 53, 3: 325–61.

Sachs, D. Jeffrey, and Andrew M. Warner (1995). *Natural Resource Abundance and Economic Growth*. NBER Working Paper Series No. 5398. National Bureau of Economic Research.

Sachs, D. Jeffrey, and Andrew M. Warner (1997a). Natural Resource Abundance and Economic Growth. <http://www.cid.harvard.edu/ciddata/warner_files/natresf5.pdf>.

Sachs, D. Jeffrey, and Andrew M. Warner (1997b). Sources of Slow Growth in African Economies. *Journal of African Economies* 6, 3: 335–76. <http://www.cid.harvard.edu/ciddata/>.

Sachs, D. Jeffrey, and Andrew M. Warner (1999). The Big Push, Natural Resource Booms and Growth. *Journal of Development Economics* 59: 43–76.

Sachs, D. Jeffrey, and Andrew M. Warner (2001). Natural Resources and Economic Development: The Curse of Natural Resources. *European Economic Review* 45: 827–38.

Sala-i-Martin, X. Xavier (1997). I Just Ran Two Million Regressions. *American Economic Review* 87, 2: 178–83.

Sala-i-Martin, Xavier, and Arvind Subramanian (2003). *Addressing the Natural Resource Curse: An Illustration from Nigeria*. IMF Working Paper No. WP/03. International Monetary Fund.

Staiger, D., and James Stock (1997) Instrumental Variables Regression with Weak Instruments. *Econometrica* 65, 3: 557–86.

Solow, Robert M. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics* 70, 1: 65–94.

Stijns, Jean-Philippe C. (2001). Natural Resource Abundance and Human Capital Accumulation. *World Development* 34, 6 (June): 1060–83 .

Tollison, D. Robert (1982). Rent Seeking: A Survey. *Kyklos* 35, 4: 575–602.

Torvik, R. (2002). Natural Resources, Rent Seeking and Welfare. *Journal of Development Economics* 67: 455–70.

Ukpolo, Victor (2002). Population Growth and Economic Growth in Africa. *Journal of Developing Societies* 18: 315–29.

Woolcook, M., L. Pritchett, and J. Isham (2001). The Social Foundations of Poor Economic Growth in Resource Rich Economies. In R.M. Auty (ed.), *Resource Abundance and Economic Development* (Oxford University Press): 76–92.

World Bank (2008a). *World Development indicators*. World Bank.

World Bank (2008b). *World Bank Environment: A Guide to Valuing Natural Resources Wealth*. <http://siteresources.worldbank.org/INTEEI/1105643-1116228574659/21003722/NaturalWealth_EstMethods.pdf>.

About this publication

About the authors

Louis-Philippe Béland
Louis-Philippe Béland was a Policy Analyst in the Centre for Globalization Studies at the Fraser Institute during 2008 and 2009. He holds a Bachelor of Business Administration with a major in applied economics from HEC Montréal and an M.A. in economics from the University of British Columbia (UBC). He is the lead author of *La liberté économique dans la Francophonie* (2008).

Raaj Tiagi
Raaj Tiagi is a Senior Economist in the Fraser Institute's R.J. Addington Center for the Study of Measurement. He has an M.A. and a Ph.D. in Economics from the University of California, Irvine. His research has focused on migrants in the United States in the early twentieth century. His publications for the Fraser Institute include *Canada's Economic Relations with China* (2009) and Canada's Growing Economic Relations with China (*Fraser Forum*, May 2009).

Acknowledgments

We would like to thank Amela Karabegović, Fred McMahon and two anonymous referees for their comments on an earlier version of this paper. We are also grateful to Carlos Murillo for his excellent research assistance. Any errors, omissions, or mistakes remain the sole responsibility of the authors.

Publishing information

Periodically, the Fraser Institute publishes timely and comprehensive studies of current issues in economics and public policy. This study is one such example belonging to a series of related publications.

Distribution

These publications are available from <http://www.fraserinstitute.org> and <http://www.fraseramerica.org> in Portable Document Format (PDF) and can be read with Adobe Acrobat® 7 or later or with Adobe Reader® 7 or later. Adobe Reader® 9, the most recent version, is available free of charge from Adobe Systems Inc. and may be down-loaded from: <http://get.adobe.com/reader/>. We encourage you to install the most recent version.

Ordering publications

For information about ordering the printed publications of the Fraser Institute, please contact the publications coordinator

- e-mail: sales@fraserinstitute.org
- telephone: 604.688.0221 ext. 580 or, toll free, 1.800.665.3558 ext. 580
- fax: 604.688.8539.

Media

For media inquiries, please contact our Communications Department

- 604.714.4582
- e-mail: communications@fraserinstitute.org.

Disclaimer

The authors of this publication have worked independently and opinions expressed by them are, therefore, their own, and do not necessarily reflect the opinions of the supporters, trustees, or other staff of the Fraser Institute. This publication in no way implies that the Fraser Institute, its trustees, or staff are in favor of, or oppose the passage of, any bill; or that they support or oppose any particular political party or candidate.

ISSN
ISSN 1920-3314 Studies in Mining Policy (print version)
ISSN 1920-3322 Studies in Mining Policy (online version)

Date of issue
October 2009

Editing and design
Lindsey Thomas Martin.

Cover design
Bill Ray

Images for cover
Mining for copper © Arno Massee, iStockphoto

High resolution gold nuggets © Bill Noll, iStockphoto

Precious stones © weim, Fotolia

Coal-heap © Sally Wallis, Fotolia

Salt mine © radarreklama, Fotolia

Gold seeker © TMAX, Fotolia

Supporting the Fraser Institute

To learn how to support the Fraser Institute, please contact

- Development Department, Fraser Institute
  Fourth Floor, 1770 Burrard Street
  Vancouver, British Columbia, V6J 3G7 Canada
- telephone, toll-free: 1.800.665.3558 ext. 586
- e-mail: development@fraserinstitute.org.

About the Fraser Institute

Our vision is a free and prosperous world where individuals benefit from greater choice, competitive markets, and personal responsibility. Our mission is to measure, study, and communicate the impact of competitive markets and government interventions on the welfare of individuals.

Founded in 1974, we are an independent research and educational organization with locations throughout North America and international partners in over 70 countries. Our work is financed by tax-deductible contributions from thousands of individuals, organizations, and foundations. In order to protect its independence, the Institute does not accept grants from government or contracts for research.

菲沙研究所的願景乃一自由而昌盛的世界，當中每個人得以從更豐富的選擇、具競爭性的市場及自我承擔責任而獲益。我們的使命在於量度、研究並使人知悉競爭市場及政府干預對個人福祉的影響。

Nous envisageons un monde libre et prospère, où chaque personne bénéficie d'un plus grand choix, de marchés concurrentiels et de responsabilités individuelles. Notre mission consiste à mesurer, à étudier et à communiquer l'effet des marchés concurrentiels et des interventions gouvernementales sur le bien-être des individus.

تتمثل رؤيتنا في وجود عالم حر ومزدهر يستفيد فيه الأفراد من القدرة على الاختيار بشكل أكبر، والأسواق التنافسية، والمسؤولية الشخصية. أما رسالتنا فهي قياس، ودراسة، وتوصيل تأثير الأسواق التنافسية والتدخلات الحكومية

Nuestra visión es un mundo libre y próspero donde los individuos se beneficien de una mayor oferta, la competencia en los mercados y la responsabilidad individual. Nuestra misión es medir, estudiar y comunicar el impacto de la competencia en los mercados y la intervención gubernamental en el bienestar de los individuos.

Editorial Advisory Board