

# Minerals, Institutions, Openness, and Growth: An Empirical Analysis

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**ABSTRACT.** *Competing explanations of the resource curse are tested using panel data. The data support the existence of a mineral resource curse for developing countries with weak institutions, consistent with the hypothesis that owners of mineral resources use weak institutions and openness to trade to stifle the development of human capital, to the detriment of growth in other sectors of the economy. Manufacturing imports substitute for the development of domestic production, so openness to trade correlates with lower growth in mineral dependent economies. The “Dutch disease” and debt overhang explanations of the resource curse are not supported. (JEL O11, Q32)*

## I. INTRODUCTION

Are countries that suffer from the “original sin” of abundant natural resources cursed to lower rates of economic growth?<sup>1</sup> If a resource curse exists, are all natural resources equally cursed, or are only specific resources, particularly minerals, cursed? Why would countries that are endowed with abundant resources suffer lower growth than less favorably endowed nations?

Explanations of the resource curse fall into several categories: the “Dutch disease,” poor institutions that are susceptible to rent seeking and corruption, debt overhang, and low investment in human capital. The Dutch

disease explanation is that resource exports cause real exchange rate appreciation that crowds out other exports, usually manufacturing. For this effect to lower growth, the declining sector (manufacturing) must have increasing returns or externalities that would result in more rapid growth than the expansion of the resource sector.

Rent seeking lowers growth by diverting resources away from productive activities. The potential rewards from development of natural resources, especially mineral resources, provide incentives for corruption of existing political institutions. While weak institutions foster corruption and lower rates of growth, if existing institutions are strong, development of natural resources may promote growth.

The debt overhang problem results from heavy borrowing followed by a resource price decline. Resource-abundant countries benefited from rising resource prices in the 1970s, and some borrowed heavily based on anticipated future revenue. A price decline in the 1980s resulted in debt crises and revenue shortfalls that retarded growth in the heavily indebted countries.

Finally, resource-abundant economies may invest less in the development of other resources, particularly human capital. Lower levels of human capital hinder development of the nonresource sectors of the economy, thereby reducing the overall growth rate of these economies.

These explanations are not mutually exclusive. For example, Falkinger and

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<sup>1</sup> Lederman and Maloney (2003) cite a passage from Adam Smith stating that mining is detrimental to growth. However, the cited passage (1937, 529–30) refers to the mining of precious metals (gold and silver). Elsewhere Smith argues that other types of mining are more profitable than precious metal mining (167–69). Smith believed that agriculture was the greatest source of wealth (392). Smith viewed open ports and British institutions as conducive to higher rates of growth (537–39).

Grossmann (2005) argue that resource owners may wield their political power to minimize mass education in order to maintain a low-cost labor force, particularly if their country is open to trade, providing access to foreign manufactures. Thus, resource abundance, weak institutions, and openness to trade combine to reduce the growth of these economies.

Numerous empirical studies, discussed below, present varying evidence both for and against the existence of a resource curse. This paper reports the results of a new, expanded study of the resource curse. Competing explanations of the curse are tested against a data set that includes a larger number of countries and a longer time span than most previous studies. While many studies examine averages for a cross section of countries, the data here are a panel for three decades. The cross-section studies generally report evidence of a resource curse, but Manzano and Rigobon (2001) report that evidence of a curse disappears in panel estimates.<sup>2</sup>

The first important result is that there is a mineral curse for developing countries only.<sup>3</sup> This curse appears to result from poor institutions that are susceptible to rent seeking behavior by the owners of mineral resources. Rent seeking is likely more lucrative when resource ownership is concentrated, as is typical with minerals, than when ownership is diffused, as is often the case in agriculture.

Importantly, these results support Falkinger and Grossmann's (2005) contention that openness to trade reduces growth in mineral dependent economies. They develop a model where owners of concentrated resources use weak institutions and openness to trade to limit the development of

human capital. Trade openness allows importation of manufactured goods rather than development of domestic production, with negative consequences for growth.

Other explanations of the resource curse are investigated. The data fail to support the Dutch disease and debt overhang explanations of the curse.

## II. LITERATURE REVIEW

Both Auty (1994, 1997, 2001) and Sachs and Warner (1997, 1999, 2001) find evidence of a natural resource curse. Both sets of studies attribute the curse to all resources. While Sachs and Warner attribute the curse primarily to Dutch disease effects, and to a lesser extent rent seeking, Auty also cites less openness to trade and slower development of physical and human capital in resource abundant economies.

Papyrakis and Gerlagh (2007) find evidence of a resource curse within regions of the United States. They find that resource abundance reduces investment, schooling, and research and development and fosters corruption (similar to poor institutions).

Sala-i-Martin and Subramanian (2003) find that a resource curse exists for mineral resources, but the curse is due to negative effects on institutional quality. Controlling for the indirect effect of resources on institutional quality, they find no evidence of an independent effect of resources on growth. Isham et al. (2005) show that export concentration in minerals, fuels, and plantation crops is strongly associated with weak public institutions, which are, in turn, strongly associated with slower growth. They find that the main channel through which export structure affects growth is via institutions.

Easterly and Levine (2002) similarly find that the effect of resource endowments on development works through institutions. Bulte, Damania, and Deacon (2005) find that high levels of "point resources," resources extracted from a narrow base such as oil and minerals, result in lower levels of various human development indicators. They also find the link is indirect, through

<sup>2</sup> We find that fixed-effect panel estimates fail to support a resource curse using the resource exports/GDP measure used by Manzano and Rigobon. However, using the export concentration measure (resource exports/merchandise exports), fixed-effect panel estimates (not reported) support the existence of a resource curse for developing nations.

<sup>3</sup> Results reported below find that mineral exports foster growth in developed nations when outliers are excluded.

institution quality, rather than directly from resources to human development.

Robinson, Torvik, and Verdier (2006) develop a theoretical model of the impact of resources on institutions. In their model, good institutions avoid rent seeking while weak institutions succumb to rent seeking behavior. Sandbu (2006) proposes a solution to rent seeking by making society aware of the costs of rent seeking. He recommends that governments collect all resource rents and distribute the proceeds to individuals, and then tax back what is needed for government spending as a method of limiting wasteful government consumption.

Rather than assuming that institutional quality responds endogenously to resources, Lane and Tornell (1996) and Mehlum, Moene, and Torvik (2006a, 2006b) argue that existing institutional quality determines whether resources are a blessing or a curse. Mehlum, Moene, and Torvik present evidence (2006a) that the effect of resources varies from a curse to a blessing as institutional quality improves. Focusing on government behavior, Atkinson and Hamilton (2003) find that the curse varies with an appropriately computed measure of saving adjusted for resource (energy, minerals, and timber) depletion. When governments consume resource rents, a curse exists, but it disappears if governments invest (save) resource rents.

Birdsall, Pinckney, and Sabot (2001) find that resource abundant countries invest less in human capital, with negative implications for growth. Bravo-Ortega and Gregorio (2005) find that natural resources are damaging for economic growth in countries with low levels of human capital. Hence, the negative impact of natural resources could be offset through the accumulation of human capital. Manzano and Rigobon (2001) argue that resource abundant countries borrowed heavily based on future revenue. Falling resource prices in the 1980s created a debt overhang problem that slowed growth. Hausmann and Rigobon (2002) suggest that the curse results from financial market imperfections. Papyrakis and Gerlagh (2004) report that the

most important negative effect of natural resource abundance on growth is that resource abundance lowers (the need for) physical investment.

Birdsall and Hamoudi (2002) argue that Dollar and Kraay's (2001) finding that openness promotes growth is due, at least in part, to commodity dependent countries. The collapse of commodity prices in the 1980s forced many commodity exporters to limit imports to reduce trade deficits. Thus, openness measures of trade to GDP declined. They find that controlling for commodity dependent countries reduces the effect of openness on growth by at least half.

Other studies present evidence against the existence of a resource curse. Davis (1995) finds that 22 mineral economies compare favorably to nonmineral economies in terms of GDP per capita and a variety of human development indicators. Stijns (2006) presents similar results that there is a positive correlation between mineral wealth and human capital indicators.

Resource dependence is typically measured by resource exports as a percentage of GDP or of merchandise exports. Wright and Czelusta (2004) and Ding and Field (2005) distinguish between exports and endowments. Wright and Czelusta discuss various cases demonstrating that mineral extraction is knowledge based and high tech, arguing that there is no curse. Ding and Field find a curse for dependence (exports) but not for endowments. Estimating a recursive model they find that the negative effects of dependence (exports) and endowments disappear. They find a negative relationship between human capital and export dependence, that is, increases in human capital reduce export dependence and increase growth. Thus, the curse may be due to a high level of resource dependence that is due to poor development of human capital.

Lederman and Maloney (2003) find that resource abundance positively affects growth, but export concentration in resources hurts growth. They find that the negative effect is due to reduced accumulation of physical and human capital and deterioration of the terms of trade.

Most of the studies discussed above investigate measures of economic development at a point in time or use the average growth rate over some period of time for a cross section of countries. Manzano and Rigobon (2001) find that the cross-section evidence of a resource curse disappears in panel (fixed-effects) estimates. Only Birdsall and Hamoudi (2002), who find evidence of a commodity curse, and Lederman and Maloney (2003), who find that resources are positively related to growth, use panel data in their estimates. Their contradictory findings leave in doubt the existence of a resource curse.

Thus the existence of a resource curse, the resources that are cursed, and the mechanism through which the curse reduces growth are all subject to dispute. This paper presents additional evidence on the existence of a resource curse, using an expanded data set and econometric specifications that improve upon previous studies. New variables that are included in the study provide new insights into policies that can foster economic development.

### III. MODEL, DATA, AND ESTIMATION TECHNIQUE

An empirical growth model is used to analyze the effect of resources on growth. The model has the form

$$\gamma_{yt} = F(y_t, \mathbf{X}_t, \mathbf{Z}_t), \quad [1]$$

where  $\gamma_{yt}$  is a country's per capita growth rate in period  $t$ ,  $y_t$  is initial GDP per capita,  $\mathbf{X}_t$  is a vector of conditioning variables that have found to be key determinants of growth, and the variable  $\mathbf{Z}_t$  represents a vector of variables related to the resource curse.

The conditioning variables in the vector  $\mathbf{X}_t$  are those commonly used in the literature. The lagged logarithm of life expectancy is used as a measure of human capital, and current gross capital formation as a percentage of GDP is the measure of physical capital. Since the population growth rate reduces growth in the neoclassical growth model, current population growth enters as an independent variable.

Institutional quality is measured by the Kaufmann, Kraay, and Mastruzzi (2003) index of the rule of law. Dummy variables are included for landlocked countries and for three geographic regions: Sub-Saharan Africa, Latin America, and East Asia (coefficients not reported).<sup>4</sup>

The resource measures in  $\mathbf{Z}_t$  are real resource exports as a percentage of real GDP (resource dependence) and real resource exports as a percentage of real merchandise exports (export concentration). Following the recommendations of Dollar and Kraay (2001) and Birdsall and Hamoudi (2002), the trade/GDP measures are deflated by their respective price indices to obtain ratios of real magnitudes. This is especially important if resource prices are more volatile than prices in general.<sup>5</sup>

Other variables in  $\mathbf{Z}_t$  include four categories of resource exports (agricultural products, food, fuel, and minerals); the ratio of central government debt to GDP; the volatility of the terms of trade; the growth of the terms of trade; and growth of real effective exchange rate index. Contemporaneous and five-year lags of import and of export duties are used in some specifications. Another trade measure used is the ratio of real trade to real GDP, each deflated by the appropriate price index. Other measures of openness include the Sachs and Warner index of openness, the share of trade in GDP from the Penn World Table Version 6.1 (Heston, Summers, and Aten 2002)—which is a ratio of nominal values—the constant dollar values of imports and exports to GDP, and trade shares with Organisation for Economic Cooperation and Development (OECD) and non-OECD nations.<sup>6</sup>

<sup>4</sup> Of the regional dummies, only East Asia has a significant (positive) coefficient.

<sup>5</sup> Separate price indices do not exist for export components, so nominal ratios are used for commodity exports/merchandise exports.

<sup>6</sup> Unless otherwise noted, all variables are taken from *World Development Indicators*, 2004 (World Bank 2004); trade shares with OECD and non-OECD nations and landlocked dummy are from Easterly and Sewadeh (2002); and initial GDP per capita is from *Penn World Table 6.1* (Heston, Summers, and Aten 2002).

Lederman and Maloney (2003) point out that Sachs and Warner changed the measure used for resource exports for two countries and that this adjustment was crucial to their results. No such adjustments are made to the data used here.

The data set includes over 100 developed and developing nations.<sup>7</sup> Decade averaged growth rates are computed for the periods 1970–1979, 1980–1989, and 1990–1999 to form a panel of data that is the basis of the analysis. The use of a panel is important because Manzano and Rigobon (2001) reported that the evidence of a curse found in a simple cross-section regression disappeared in panel estimates.

Summary statistics for the panel are reported in Table 1. While the growth of real GDP per capita declined for both developed and developing nations, the decline was particularly severe in the most commodity dependent countries, with growth becoming negative in the 1980s and 1990s. At the same time, government debt grew and natural resource and mineral exports declined relative to their 1970s values. These raw data comparisons suggest a debt overhang problem rather than a resource curse.

Life expectancy increased on average in all country groups during the three decades. Population growth rates were lower in the 1990s than in the 1970s in all country groups, although the decrease was the smallest in the most commodity dependent countries. Capital formation declined in developed and in the most commodity dependent developing countries. Finally, the most commodity dependent countries had the weakest institutions.

The model is estimated using the seemingly unrelated regression (SUR) technique. While the constant term for each decade is allowed to vary, coefficients for other variables are constrained to have the same value for all decades. As Barro and Lee (2005) argue, panel estimates are preferred to fixed-effect and first-differenced general-

ized method of moments estimates, because the latter techniques eliminate time-persistent cross-section information.<sup>8</sup>

#### IV. RESULTS

Estimates of the base model are reported in Table 1. The estimated coefficients for initial GDP indicate rates of convergence typically obtained in empirical studies. The measures of human and physical capital are both significant with the correct sign. Being landlocked reduces growth, although the effect is significant only for developing nations when the sample is split into developing and developed nations.

Population growth rates have a positive and (marginally) significant effect on growth in developing countries. While this result is inconsistent with the basic neoclassical growth model, in models of knowledge accumulation and research and development, population growth can have a positive effect on growth (Strulik 2005).

Having high-quality institutions as measured by the rule-of-law index significantly enhances growth. Again, the effect is important only for developing nations when the sample is split.<sup>9</sup>

##### *Minerals and Growth*

Previous studies typically find evidence of a resource curse for cross-section estimates, but not for panel estimates. We find exactly the opposite. Using averages over all three decades, cross-section estimates (not reported) obtain insignificant results for resource exports as a percentage of GDP and of exports, while the panel estimates discussed below do obtain evidence of a resource curse.

The panel estimates reported in Table 2 do support the existence of a resource curse,

<sup>8</sup> Fixed-effect estimates also obtain very large convergence coefficients.

<sup>9</sup> The standard deviation for the rule of law index over the entire sample is 0.44 for developed nations and 0.67 for developing nations, an increase of 50%. The insignificance of the rule-of-law measure for developed nations may be due to a lack of variation in the data.

<sup>7</sup> A list of countries is available from the authors upon request.

TABLE 1  
SUMMARY STATISTICS: MEAN VALUES

| Variables   | Developed Countries |       |       | Developing Countries |       |       | Developing Countries     |       |       |                         |       |       |
|---|---------------------|-------|-------|----------------------|-------|-------|--------------------------|-------|-------|-------------------------|-------|-------|
|   |                     |       |       |                      |       |       | Least Resource Dependent |       |       | Most Resource Dependent |       |       |
|   | 1970s               | 1980s | 1990s | 1970s                | 1980s | 1990s | 1970s                    | 1980s | 1990s | 1970s                   | 1980s | 1990s |
| GDP per capita growth rates (%)                     | 3.71                | 2.40  | 2.41  | 2.92                 | 0.50  | 0.58  | 3.21                     | 0.80  | 1.97  | 1.63                    | -0.38 | -0.37 |
| Initial GDP per capita (log)                        | 4.02                | 4.15  | 4.25  | 3.31                 | 3.39  | 3.46  | 3.59                     | 3.69  | 3.72  | 3.22                    | 3.23  | 3.31  |
| Life expectancy rates (log, lagged)                 | 1.83                | 1.85  | 1.87  | 1.68                 | 1.72  | 1.76  | 1.75                     | 1.78  | 1.80  | 1.62                    | 1.66  | 1.70  |
| Population growth rates (%)                         | 1.31                | 1.17  | 0.93  | 2.13                 | 2.15  | 1.76  | 1.85                     | 1.66  | 1.48  | 2.74                    | 2.91  | 2.52  |
| Gross capital formation (% of GDP)                  | 26.33               | 24.52 | 22.88 | 22.19                | 23.14 | 22.89 | 24.00                    | 23.33 | 22.60 | 20.06                   | 18.53 | 17.94 |
| Rule of law (-2.5; +2.5)                            | 1.43                | 1.43  | 1.43  | -0.37                | -0.37 | -0.37 | 0.30                     | 0.30  | 0.30  | -0.70                   | -0.70 | -0.70 |
| Landlocked dummy (0-1)                              | 0.08                | 0.08  | 0.08  | 0.26                 | 0.26  | 0.26  | 0.11                     | 0.11  | 0.11  | 0.30                    | 0.30  | 0.30  |
| Natural resource exports (% of GDP)                 | 8.60                | 12.40 | 6.19  | 19.06                | 16.27 | 14.30 | 13.04                    | 11.16 | 9.76  | 27.12                   | 27.49 | 21.45 |
| Natural resource exports (% of merchandise exports) | 43.88               | 35.95 | 31.28 | 82.40                | 71.77 | 62.65 | 63.82                    | 54.14 | 45.41 | 92.33                   | 89.47 | 89.62 |
| Mineral exports (% of GDP)                          | 0.80                | 0.91  | 0.85  | 3.65                 | 2.25  | 2.21  | 1.76                     | 1.37  | 1.30  | 6.91                    | 3.16  | 4.16  |
| Mineral exports (% merchandise exports)             | 4.53                | 3.94  | 4.20  | 11.93                | 8.27  | 8.72  | 7.89                     | 6.00  | 5.16  | 18.19                   | 9.81  | 15.07 |
| Central government debt (% of GDP)                  | 30.22               | 44.18 | 49.08 | 25.83                | 44.85 | 50.40 | 27.88                    | 49.48 | 48.41 | 25.10                   | 39.31 | 76.44 |
| Terms of trade volatility                           | 9.40                | 6.97  | 2.65  | 17.58                | 23.16 | 10.83 | 10.95                    | 13.53 | 6.61  | N/A                     | 36.40 | 15.70 |
| Growth of terms of trade                            | -0.87               | 0.10  | -0.10 | -3.19                | -0.59 | 0.25  | -1.10                    | -0.64 | 0.61  | N/A                     | -0.26 | -0.45 |
| Growth of real effective exchange rate index        | N/A                 | 0.07  | -0.13 | 0.09                 | 0.10  | 1.05  | 0.09                     | 1.06  | 1.04  | N/A                     | -1.74 | -0.25 |
| Import duties (% of imports)                        | 5.37                | 3.60  | 2.36  | 14.54                | 13.50 | 10.97 | 10.42                    | 10.00 | 7.99  | 15.82                   | 14.21 | 14.47 |
| Export duties (% of exports)                        | 0.11                | 0.05  | 0.01  | 4.78                 | 4.19  | 1.06  | 2.81                     | 1.90  | 0.38  | 7.41                    | 8.54  | 2.91  |
| Trade (% of GDP in constant prices)                 | 63.45               | 77.13 | 89.06 | 67.30                | 69.73 | 74.36 | 56.81                    | 65.31 | 73.80 | 74.60                   | 63.30 | 56.05 |
| Exports (% of GDP in constant prices)               | 31.65               | 39.09 | 44.71 | 28.37                | 29.11 | 33.21 | 26.17                    | 29.83 | 34.60 | 34.00                   | 27.86 | 27.93 |
| Imports (% of GDP in constant prices)               | 31.80               | 38.04 | 44.35 | 38.93                | 40.63 | 41.15 | 30.64                    | 35.49 | 39.20 | 40.59                   | 35.43 | 28.12 |
| Sachs and Warner openness index                     | 0.92                | 0.95  | 1.00  | 0.14                 | 0.18  | 0.49  | 0.41                     | 0.44  | 0.70  | 0.08                    | 0.09  | 0.33  |

Note: See text for sources and definitions. N/A, not available.

TABLE 2  
BASIC GROWTH MODEL AND RESOURCE CURSE

| Variable  | All Countries             | Developing Countries      | Developed Countries      | All Countries                                | Developing Countries                        | Developed Countries                      |
|---|---------------------------|---------------------------|--------------------------|--|---|--|
| Independent variable: GDP per capita growth rates   |                           |                           |                          |  |   |  |
| Log (initial GDP per capita)                        | -3.63*** (6.67)           | -3.69*** (5.84)           | -4.79** (2.15)           | -3.26*** (6.14)                              | -3.37*** (5.45)                             | -3.26* (1.72)                            |
| Log (life expectancy, lagged)                       | 9.00*** (2.62)            | 10.87*** (2.90)           | -51.05*** (2.76)         | 7.11** (2.15)                                | 9.01*** (2.46)                              | -59.17*** (3.68)                         |
| Population growth rates                             | 0.20 (1.29)               | 0.30* (1.63)              | 0.10 (0.38)              | 0.20 (1.31)                                  | 0.38** (2.02)                               | -0.03 (0.11)                             |
| Gross capital formation                             | 0.15*** (7.18)            | 0.15*** (6.12)            | 0.12** (2.17)            | 0.12*** (6.07)                               | 0.12*** (5.13)                              | 0.12** (2.47)                            |
| Rule of law   | 1.30*** (5.91)            | 1.21*** (4.40)            | 0.36 (0.58)              | 1.22*** (5.64)                               | 1.22*** (4.55)                              | 0.19 (0.41)                              |
| Landlocked dummy                                    | -0.77** (2.22)            | -0.69* (1.73)             | 0.13 (0.19)              | -0.81** (2.34)                               | -0.66* (1.68)                               | -0.13 (0.19)                             |
| Natural resource exports (% of GDP)                 | -0.031*** (3.03)          | -0.031*** (2.82)          | 0.049 (1.29)             |  |   |  |
| Natural resource exports (% of merchandise exports) |                           |                           |                          |  |   |  |
| For each equation, $R^2$ (N)                        | 0.24, 0.64<br>0.31, (297) | 0.32, 0.60<br>0.34, (220) | 0.48, 0.45<br>0.42, (77) | -0.012** (2.33)<br>0.30, 0.59<br>0.26, (321) | -0.012* (1.78)<br>0.33, 0.51<br>0.30, (237) | 0.007 (1.05)<br>0.47, 0.49<br>0.43, (84) |

Note: Each system of equations is estimated by the seemingly unrelated regression method. The systems have three equations, where the dependent variables are the per capita growth rate over each decade. Each equation has a different constant term (not reported here). Other coefficients are restricted to be the same for all periods.  $t$ -Statistics are in parentheses. Three regional dummies (Sub-Saharan Africa, Latin America, and East Asia) are also included.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

TABLE 3  
EFFECTS OF RESOURCE TYPES ON GROWTH

| Variable   | % of GDP in Constant Prices |                      |                     | % of Merchandise Exports |                      |                     |
|--|-----------------------------|----------------------|---------------------|--------------------------|----------------------|---------------------|
|  | All Countries               | Developing Countries | Developed Countries | All Countries            | Developing Countries | Developed Countries |
| Natural resource exports                           | -0.031*** (3.03)            | -0.031*** (2.82)     | 0.049 (1.29)        | -0.012** (2.33)          | -0.012* (1.78)       | 0.007 (1.05)        |
| Agricultural exports                               | -0.13** (2.29)              | -0.11* (1.91)        | -0.50*** (2.57)     | -0.013 (1.18)            | -0.005 (0.45)        | -0.12*** (3.30)     |
| Food exports                                       | 0.006 (0.37)                | -0.010 (0.52)        | 0.056 (1.27)        | 0.003 (0.59)             | 0.005 (0.96)         | 0.0005 (0.04)       |
| Fuel exports                                       | -0.011 (0.66)               | -0.0009 (0.05)       | 0.069 (0.93)        | 0.0003 (0.06)            | 0.002 (0.32)         | 0.024** (2.24)      |
| Mineral exports                                    | -0.084*** (3.90)            | -0.085*** (4.12)     | 0.19 (0.74)         | -0.024*** (3.20)         | -0.027*** (3.50)     | 0.069 (1.50)        |
| <i>Without 15 Most Mineral Dependent Countries</i> |                             |                      |                     |                          |                      |                     |
| Natural resource exports                           | -0.026** (1.97)             | -0.021 (1.47)        | 0.052 (0.88)        | -0.010* (1.69)           | -0.009 (1.22)        | 0.04 (0.43)         |
| Agricultural exports                               | -0.18*** (2.60)             | -0.16** (2.13)       | -0.65** (2.56)      | -0.017 (1.43)            | -0.011 (0.85)        | -0.13*** (3.00)     |
| Food exports                                       | -0.004 (0.18)               | -0.006 (0.29)        | 0.16** (2.04)       | 0.0006 (0.10)            | 0.002 (0.26)         | -0.005 (0.27)       |
| Fuel exports                                       | -0.015 (0.88)               | -0.005 (0.28)        | 0.031 (0.15)        | -0.0007 (0.12)           | 0.0008 (0.11)        | 0.024 (1.65)        |
| Mineral exports                                    | -0.15*** (2.58)             | -0.15*** (2.52)      | 0.07 (0.14)         | -0.02* (1.71)            | -0.024** (2.00)      | 0.28*** (2.93)      |

Note: See Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

even controlling for two possible channels through which the resource curse hinders growth: poor institutional quality and low human capital.<sup>10</sup> However, when the sample is divided between developing and developed countries, the resource curse exists only for developing countries.<sup>11</sup> For developing countries, while a 10% increase in resource dependence (exports as a percentage of GDP) is estimated to reduce growth by approximately 0.3% annually, a 10% increase in export concentration (resource exports as a percentage of merchandise exports) reduces growth by 0.1% annually.

To further understand the resource curse, exports are separated into the component categories. Table 3 reports the results for each type of resource export. The results indicate the curse applies to mineral exports for developing nations and agricultural exports for developed nations. Since the resource curse exists for mineral exports, the 15 most mineral dependent countries (as measured by mineral exports as a percentage of GDP) are excluded from the sample, and the model is reestimated.<sup>12</sup> The results reported in the second panel of Table 3

indicate that the mineral resource curse is not exclusive to the most important mineral dependent exporters.<sup>13</sup>

The next set of results examines the debt overhang argument of Manzano and Rigobon (2001), that the curse is the result of extensive borrowing and declining terms of trade in the 1980s.<sup>14</sup> The estimates in Table 4 are for developing countries only. Columns 1 and 2 report results indicating that a resource curse exists for either measure of mineral dependence. Controlling for the level of central government debt to GDP (Columns 3 and 4), the results indicate that the mineral resource curse still exists. Countries with a high debt ratio do experience lower growth, but including the debt ratio does not render either mineral resource measure insignificant. Thus, the mineral resource curse exists independent of a country's nation debt.<sup>15</sup>

The next four columns of Table 4 examine whether the resource curse results from declining terms of trade, the Dutch disease. One limitation is that neither resource measure is significant in the smaller sample for which terms of trade data are available, making these results less conclusive than those from larger samples.<sup>16</sup> While the terms of trade volatility measure is insignificant, the growth of the terms of trade variable is marginally significant in both specifications. Thus, there is some evidence that declining terms of trade do reduce growth. However, these results are based on a limit data sample.

The last two columns of Table 4 examine whether the mineral curse results from

<sup>10</sup> Using educational variables instead of life expectancy does not affect the significance of the natural resource exports, and also most of the educational variables are statistically insignificant.

<sup>11</sup> *F*-tests for overall models for the various subgroups of countries do not reveal any significant difference for any of the groupings. However, the individual *t*-statistics for the divided sample indicate that there are statistically significant differences between the coefficients on the variables of interest for the country subgroups. Hineline (2008) shows that pooling data samples may obscure parameter heterogeneity. He finds that when he divides his sample into OECD and non-OECD countries, the distributions of some coefficients have no points in common. The practice of testing for parameter heterogeneity in growth regressions is widely accepted.

<sup>12</sup> The 10 most mineral dependent developing and 5 most mineral dependent developed countries are excluded. The developing countries are Bolivia, Chile, Guyana, Malaysia, Mauritania, Morocco, Papua New Guinea, Sierra Leone, Togo, and Zambia. Their share of mineral exports (% of GDP) exceeds 10%. The developed countries are Australia, Canada, Iceland, Norway, and Sweden. These are the only developed countries appearing in the upper one-third when countries are sorted by their shares of mineral exports in 1970–1975.

<sup>13</sup> OLS estimates for 30-year averages obtain a robust, significant negative effect only for mineral exports as a percentage of merchandise exports (mineral dependence) for developing countries.

<sup>14</sup> Note that the sample used here includes the 1990s and well as the 1970s and 1980s.

<sup>15</sup> Cross-section estimates including mineral export measures and the debt percentage obtain a significant negative effect only for mineral exports as a percentage of merchandise exports. The debt variable is insignificant in both specifications. Thus, cross-section estimates fail to support the debt overhang hypothesis.

<sup>16</sup> That is, excluding the terms of trade measures and reestimating the model for the same sample, both resource measures are still insignificant (results not reported).

currency revaluation. Both mineral export measures and real effective exchange rate index are highly significant and negative, but the sample size is extremely small. Note that there are no changes in the magnitudes of the coefficients of the mineral exports variables. The data limitations render this evidence less compelling than evidence obtained for the full sample. Still, based on the limited data available, the mineral curse exists independent of any exchange rate effects from the Dutch disease.

#### *Minerals, Institutions, and Growth*

Table 5 reports the results when the developing countries are divided into good and bad institution cohorts using the Kaufmann, Kraay, and Mastruzzi (2003) measure of institutional quality.<sup>17</sup> Countries with a rule-of-law score greater than zero are assigned to the good institutions group. Consistent with previous findings, a mineral resource curse exists when institutions are bad, but not when they are good. The results for nonmineral resources indicate that these other types of resources neither enhance nor deter growth.

The estimated coefficient for mineral exports as a percentage of GDP is about three times as large in absolute value as the coefficient for mineral exports as a percentage of merchandise exports. The averages for mineral exports as a percentage of merchandise exports in Table 1 for the most commodity dependent countries are about three times the average of mineral exports as a percentage of GDP. Using the average for the 1990s, 15 times the coefficient  $-0.022$ , a mineral resource dependent country with weak institutions suffers reduced annual growth of real GDP per capita of  $-0.33\%$ , which approximately equals the 1990s decade average growth rate for the most commodity dependent countries.

<sup>17</sup> Dividing countries into two groups according to the quality of their institutions based on other measures such as Gastil indices or regime durability dummy taken Polity IV data set does not change the pattern of results. The mineral resource curse exists only for countries having poor institutions.

Table 6 highlights the difference obtained from panel and cross-section estimates. The cross-section estimates obtain evidence of a mineral resource curse for developing nations with both weak and strong institutions. For developing nations with weak institutions, the curse exists only for export concentration (mineral exports as a percentage of merchandise exports).

Many previous cross-section studies also find evidence that weak institutions cause the resource curse. The data sample used here includes the full sample of developing nations over a longer time span than any previous study. The one result that is consistent across techniques is that mineral dependent developing nations with weak institutions suffer reduced growth. This is yet another way that weak institutions hinder the growth of developing nations.

#### *Minerals, Trade Openness, and Growth*

The sample of developing countries is divided into two groups of the most and least resource dependent, as in Birdsall and Hamoudi's study (2002).<sup>18</sup> The reported results in Table 7 indicate that developing countries that are not resource dependent benefit from tariffs, while resource dependent countries benefit from export duties.<sup>19</sup> Generally trade taxes are expected to have negative effects on trade-driven development, but Yanikkaya (2003) previously found that tariffs increase the growth rates of developing nations. Developing nations that are not resource dependent are developing export sectors that may benefit from tariff protection. Export duties may increase export diver-

<sup>18</sup> Using the ratio of commodity exports to total merchandise exports, they classify as "most commodity dependent" countries in their sample that rank in the top one-third of countries in four years of a five-year sample. "Least commodity dependent" countries are in the top one-third for zero or one year of the five-year sample.

<sup>19</sup> Using the five-year lagged values of import and export duty variables obtains identical results. For cross-section estimates for the combined 30-year period, the only significant effects are a positive effect for export duties and a negative effect of exports as a percentage of GDP, both for the most commodity dependent countries.

TABLE 4  
ALTERNATIVE EXPLANATIONS OF RESOURCE CURSE

| Variable   | 1                | 2                | 3                | 4                |
|--|------------------|------------------|------------------|------------------|
| Independent variable: GDP per capita growth rates, developing countries only |                  |                  |                  |                  |
| Log (initial GDP per capita)   | -3.69*** (5.95)  | -3.14*** (5.14)  | -4.30*** (4.63)  | -3.98*** (4.58)  |
| Log (life expectancy, lagged)  | 8.92*** (2.41)   | 6.57* (1.76)     | 4.82 (0.90)      | 4.29 (0.81)      |
| Population growth rates  | 0.24 (1.29)      | 0.29* (1.64)     | 0.19 (0.76)      | 0.38* (1.67)     |
| Gross capital formation  | 0.15*** (6.19)   | 0.12*** (5.32)   | 0.16*** (4.06)   | 0.15*** (4.12)   |
| Rule of law  | 1.31*** (4.85)   | 1.32*** (4.97)   | 1.58*** (4.54)   | 1.64*** (5.18)   |
| Landlocked dummy   | -0.38 (0.97)     | -0.43 (1.11)     | -0.87 (1.523)    | -0.84 (1.63)     |
| Mineral exports (% of GDP)   | -0.085*** (4.12) |                  | -0.077*** (3.12) |                  |
| Mineral exports (% of merchandise exports)                                   |                  | -0.026*** (3.50) |                  | -0.030*** (2.87) |
| Central government debt (% of GDP)   |                  |                  | -0.009* (2.03)   | -0.010** (2.27)  |
| Terms of trade volatility  |                  |                  |                  |                  |
| Growth of terms of trade   |                  |                  |                  |                  |
| Growth of real effective exchange rate index                                 |                  |                  |                  |                  |
| For each equation, $R^2$   | 0.41, 0.59       | 0.43, 0.50       | 0.58, 0.48       | 0.64, 0.44       |
| ( $N$ )  | 0.35, (220)      | 0.31, (234)      | 0.45, (126)      | 0.46, (135)      |

Note: See Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

sification in resource dependent countries, and diversification may enhance growth. For example, export taxes have been effective instruments for promoting domestic processing activities for cashew nuts in Mozambique and for agroprocessing in Thailand, and have facilitated diversifying exports beyond coffee in Colombia (UNCTAD 1997).

The results reported in Table 8 indicate that trade shares are negatively associated with growth in both least and most resource dependent developing countries.<sup>20</sup> However, these results by no means imply that the overall effects of trade volumes on growth are negative. When investment shares are excluded from the regressions, trade shares have no negative impact on the growth rates of either least or most resource dependent developing countries.<sup>21</sup> Excluding investment shares from the growth regressions can be justified by both the potential existence of reverse causality

between growth and investment, and because investment is the most likely channel through which trade affects growth. These results imply that trade affects growth mainly through higher capital accumulation. These results are consistent with those of Levine and Renelt (1992) who suggest that the linkage between trade and output growth may occur through investment, rather than through better resource allocation.

A recent model developed by Falkinger and Grossmann (2005) demonstrates how owners of concentrated resources use weak institutions and openness to trade to limit development of human capital, with negative consequences for growth. The results in Table 9 provide evidence in support of their model.<sup>22</sup> Since the resource curse in the developing countries is driven mainly by the mineral exports, the sample of developing countries is divided into the two groups of most and least mineral dependent, using Birdsall and Hamoudi's (2002) criteria.

<sup>20</sup> The estimated effect is larger (in absolute value) for the most commodity dependent countries.

<sup>21</sup> The estimation results without gross capital formation (not reported) are available from authors.

<sup>22</sup> Papyrakis and Gerlagh (2007) find evidence of similar results within the United States. Resource rich states have less educational attainment and weaker institutions as proxied by their corruption variable.

TABLE 4  
ALTERNATIVE EXPLANATIONS OF RESOURCE CURSE *Extended*

| 5                   | 6                   | 7                   | 8                   | 9                  | 10                 |
|---------------------|---------------------|---------------------|---------------------|--------------------|--------------------|
| -2.63*** (3.63)     | -2.40*** (3.32)     | -2.71*** (3.76)     | -2.77*** (3.86)     | -5.22*** (6.11)    | -5.02*** (5.99)    |
| 7.25* (1.75)        | 7.44* (1.73)        | 7.19* (1.73)        | 9.56** (2.24)       | 4.97 (0.77)        | 3.55 (0.53)        |
| 0.57** (2.25)       | -0.70*** (2.81)     | -0.49* (1.92)       | -0.58** (2.33)      | 0.40 (1.53)        | 0.51** (1.96)      |
| 0.15*** (4.54)      | 0.13*** (4.09)      | 0.14*** (4.52)      | 0.13*** (4.28)      | 0.12*** (3.66)     | 0.11*** (3.33)     |
| 0.89*** (2.82)      | 0.67** (2.13)       | 1.017*** (3.27)     | 0.83*** (2.74)      | 2.12*** (5.78)     | 2.26*** (6.06)     |
| -0.47 (1.12)        | -0.69 (1.58)        | -0.47 (1.12)        | -0.60 (1.40)        | -0.36 (0.68)       | -0.22 (0.42)       |
| -0.017 (0.45)       |                     | -0.012 (0.34)       |                     | -0.091*** (2.65)   |                    |
|                     | 0.001 (0.13)        |                     | 0.05 (0.54)         |                    | -0.028** (2.23)    |
| -0.014 (1.37)       | -0.012 (1.20)       |                     |                     |                    |                    |
|                     |                     | 0.069* (1.65)       | 0.079* (1.93)       |                    |                    |
|                     |                     |                     |                     | -0.047*** (2.99)   | -0.047*** (2.85)   |
| 0.54, 0.49<br>(133) | 0.51, 0.44<br>(138) | 0.56, 0.48<br>(133) | 0.59, 0.43<br>(137) | 0.65, 0.63<br>(83) | 0.60, 0.65<br>(85) |

Results for import and exports duties in the first two rows are generally consistent with the results reported in Table 7.

The coefficients for the real trade share variable in Row 3 indicate that openness to trade in mineral dependent countries reduces growth, consistent with the Falkinger-Grossmann prediction. When the openness measure is divided into exports and imports, the negative effect is due to imports, again consistent with Falkinger and Grossman's prediction. The results obtained using the Penn World Table trade share data in Row 6 are also consistent with this hypothesis. The negative effect of trade with OECD countries while trade with non-OECD countries has no significant effect supports their contention that powerful groups will limit development of domestic manufacturing if manufactured goods are readily imported.<sup>23</sup> It is in this sense that openness to trade hinders growth.

For the first six trade openness measures reported in Table 9, 29 estimated coefficients are negative and 1 is positive. All of the statistically significant coefficients are negative. A conflicting result is obtained using the

<sup>23</sup> Imports from developed nations are more likely finished products such as manufactures.

Sachs and Warner index of openness. The estimated coefficients obtained using this measure of openness are positive and statistically significant for all developing countries and for the most mineral dependent countries.

The results using the Sachs and Warner openness index indicate a positive effect on growth. However, this index is (negatively) determined in part by black market exchange rate premium data. If the black market premium measure is substituted for the openness index, a significant negative effect is obtained. Thus, a higher black market premium, or market/price distortion, deters growth.

Rodriguez and Rodrik (2001) provide a possible reconciliation of these divergent results. They argue that the Sachs and Warner openness index is not a good proxy for openness or trade policies but more likely measures a wide range of policy and institutional differences, likely reflected by the black market exchange rate premium. Thus, resource rich countries with good institutions and sound policies grow faster, consistent with the evidence presented above on the effect of institutions on growth in mineral and resource dependent countries.

The Pearson correlation coefficient between the institutional quality index and the

TABLE 5  
DEVELOPING NATION INSTITUTIONAL QUALITY AND THE RESOURCE CURSE

|                          | GDP Per Capita Growth Rates, Developing Countries Only |                            |                     |                             |                          |                            |                     |                             |
|--------------------------|--|----------------------------|---------------------|-----------------------------|--------------------------|----------------------------|---------------------|-----------------------------|
|                          | % of GDP in Constant Prices                            |                            |                     |                             | % of Merchandise Exports |                            |                     |                             |
|                          | Good Institutions                                      |                            | Poor Institutions   |                             | Good Institutions        |                            | Poor Institutions   |                             |
| Natural resource exports | -0.004<br>(0.15)                                       | 0.58, 0.47<br>(0.31, (67)) | -0.034***<br>(2.65) | 0.30, 0.55<br>(0.22, (153)) | -0.004<br>(0.39)         | 0.59, 0.47<br>(0.33, (73)) | -0.018*<br>(1.86)   | 0.26, 0.47<br>(0.17, (164)) |
| Agricultural exports     | -0.15*<br>(1.90)                                       | 0.34, 0.51<br>(0.43, (67)) | -0.071<br>(0.85)    | 0.28, 0.46<br>(0.23, (153)) | -0.036<br>(1.44)         | 0.48, 0.51<br>(0.38, (73)) | -0.0008<br>(0.06)   | 0.27, 0.39<br>(0.18, (163)) |
| Food exports             | 0.048<br>(1.14)  | 0.58, 0.55<br>(0.28, (67)) | -0.020<br>(0.93)    | 0.28, 0.49<br>(0.22, (153)) | 0.003<br>(0.25)          | 0.60, 0.48<br>(0.31, (73)) | 0.003<br>(0.38)     | 0.28, 0.38<br>(0.19, (164)) |
| Fuel exports             | 0.013<br>(0.38)  | 0.61, 0.47<br>(0.30, (67)) | -0.010<br>(0.51)    | 0.27, 0.46<br>(0.23, (153)) | 0.010<br>(0.95)          | 0.64, 0.46<br>(0.31, (71)) | 0.003<br>(0.03)     | 0.32, 0.40<br>(0.20, (156)) |
| Mineral exports          | -0.11<br>(1.57)  | 0.58, 0.39<br>(0.40, (67)) | -0.068***<br>(2.92) | 0.38, 0.51<br>(0.21, (153)) | -0.020<br>(1.42)         | 0.62, 0.40<br>(0.38, (73)) | -0.022***<br>(2.51) | 0.37, 0.44<br>(0.17, (164)) |

Note: See Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

Sachs-Warner openness index is 0.66, a statistically significant correlation. The correlation between the trade share variable, imports plus exports as a percentage of GDP, and the Sachs-Warner openness index is 0.03, statistically insignificant. Similar correlations are obtained between other quantitative trade measures and the Sachs-Warner index. These correlations indicate that the Sachs-Warner index better measures the quality of overall economic policies and institutions than it does openness to trade.

## V. CONCLUSION

Previous studies have provided contradictory evidence regarding the existence of a resource curse that slows economic growth. Also, the evidence has been shown to be sensitive to the statistical method employed; cross-section evidence of a resource curse disappears in panel estimates.

This paper reports new evidence about the natural resource curse. A sample of developed and developing countries is studied in a 30-year panel data set. The

TABLE 6  
DEVELOPING NATION INSTITUTIONAL QUALITY AND THE RESOURCE CURSE, OLS CROSS-SECTION ESTIMATES

| Variable                 | GDP Per Capita Growth Rates, Developing Countries Only (1970-1999) |            |                   |            |                          |            |                    |            |
|--------------------------|--|------------|-------------------|------------|--------------------------|------------|--------------------|------------|
|                          | % of GDP in Constant Prices  |            |                   |            | % of Merchandise Exports |            |                    |            |
|                          | Good Institutions  |            | Poor Institutions |            | Good Institutions        |            | Poor Institutions  |            |
|                          | OLS  | OLS        | OLS               | OLS        | OLS                      | OLS        | OLS                | OLS        |
| Natural resource exports | -0.017<br>(0.42)   | 0.51<br>34 | 0.004<br>(0.13)   | 0.27<br>65 | -0.004<br>(0.23)         | 0.50<br>34 | 0.018<br>(0.95)    | 0.28<br>71 |
| Agricultural exports     | -0.25**<br>(2.37)  | 0.60<br>34 | 0.04<br>(0.19)    | 0.27<br>65 | -0.072**<br>(2.03)       | 0.58<br>34 | 0.02<br>(0.85)     | 0.27<br>73 |
| Food exports             | 0.077<br>(1.47)  | 0.54<br>34 | -0.02<br>(0.42)   | 0.27<br>65 | 0.063<br>(1.62)          | 0.55<br>34 | 0.011<br>(0.81)    | 0.27<br>73 |
| Fuel exports             | 0.017<br>(0.36)  | 0.51<br>34 | 0.053<br>(1.32)   | 0.29<br>65 | 0.002<br>(0.18)          | 0.50<br>34 | 0.029**<br>(1.93)  | 0.30<br>70 |
| Mineral exports          | -0.19***<br>(2.52)   | 0.61<br>34 | -0.044<br>(0.93)  | 0.28<br>65 | -0.033*<br>(1.69)        | 0.56<br>34 | -0.033**<br>(1.98) | 0.31<br>73 |

Note: See Table 2 for details. OLS, ordinary least squares.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

TABLE 7  
TRADE TAXES, RESOURCES, AND GROWTH

| Variable                      | All Developing Countries | Least Resource Dependent Countries | Most Resource Dependent Countries | All Developing Countries | Least Resource Dependent Countries | Most Resource Dependent Countries |
|-------------------------------|--------------------------|------------------------------------|-----------------------------------|--------------------------|------------------------------------|-----------------------------------|
| Independent variable: none    |                          |                                    |                                   |                          |                                    |                                   |
| Log (initial GDP per capita)  | -3.56*** (5.37)          | -2.42*** (2.46)                    | -1.39 (0.86)                      | -3.30*** (4.92)          | -2.52*** (2.54)                    | -0.74 (0.61)                      |
| Log (life expectancy, lagged) | 10.34*** (2.74)          | 9.88* (1.86)                       | 4.10 (0.69)                       | 8.13** (2.16)            | 6.32 (1.21)                        | 0.15 (0.03)                       |
| Population growth rates       | 0.38** (1.98)            | 0.22 (0.91)                        | -0.57 (0.82)                      | 0.44** (2.34)            | 0.24 (1.02)                        | 0.049 (0.08)                      |
| Gross capital formation       | 0.13*** (5.66)           | 0.14*** (4.28)                     | 0.16*** (2.78)                    | 0.13*** (5.63)           | 0.13*** (3.84)                     | 0.20*** (4.23)                    |
| Rule of law                   | 1.48*** (5.11)           | 0.75* (1.81)                       | 1.22* (1.78)                      | 1.62*** (5.65)           | 0.99*** (2.52)                     | 0.70 (1.34)                       |
| Landlocked dummy              | -0.11 (0.27)             | -0.19 (0.27)                       | -0.21 (0.30)                      | -0.18 (0.46)             | -0.51 (0.76)                       | -0.40 (0.77)                      |
| Import duties                 | 0.042* (1.91)            | 0.058** (2.04)                     | -0.0025 (0.06)                    |                          |                                    |                                   |
| Export duties                 |                          |                                    |                                   | 0.033 (1.11)             | -0.003 (0.06)                      | 0.11*** (3.75)                    |
| For each equation, $R^2$      | 0.42, 0.42               | 0.55, 0.41                         | -0.38, 0.36                       | 0.39, 0.39               | 0.52, 0.39                         | -0.20, 0.54                       |
| ( $N$ )                       | 0.39, (222)              | 0.25, (131)                        | 0.29, (53)                        | 0.41, (219)              | 0.25, (129)                        | 0.34, (52)                        |

Note: See Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

time span is longer than previous studies, including the commodity price boom of the 1970s, the decline of the 1980s, and the 1990s as a comparison to both.

The results indicate that a mineral resource curse exists for developing countries only. Other types of resources are not similarly cursed. Investigation of various possible causes of the resource curse finds the strongest evidence supporting the weak institution–rent seeking explanation. The Dutch disease and debt overhang explanations are not strongly supported by the data. A mineral resource curse exists for developing nations with weak institutions, but not for those with strong institutions.

Further examination of the data finds evidence supporting the explanation of Falkinger and Grossmann. Powerful groups who control resources also control weak institutions and use their power to limit education for the general population, especially if openness to trade provides access to manufactured imports. Openness to trade in this case can also increase the returns to the owners of the resources, and a poorly educated labor force with limited alternatives is a source of cheap labor for development of domestic resources. The evidence indicates that increased imports do reduce growth in mineral dependent economies.

TABLE 8  
EFFECTS OF TRADE TAXES AND OPENNESS ON GROWTH

| Variable                              | All Developing Countries | Least Resource Dependent Countries | Most Resource Dependent Countries |
|---------------------------------------|--------------------------|------------------------------------|-----------------------------------|
| Import duties                         | 0.042* (1.91)            | 0.058** (2.04)                     | -0.0025 (0.06)                    |
| Export duties                         | 0.033 (1.11)             | -0.003 (0.06)                      | 0.11*** (3.75)                    |
| Trade (% of GDP in constant prices)   | -0.005 (1.03)            | -0.010** (2.03)                    | -0.019* (1.84)                    |
| Exports (% of GDP in constant prices) | -0.012 (1.16)            | -0.022** (2.08)                    | -0.044* (1.81)                    |
| Imports (% of GDP in constant prices) | -0.006 (0.82)            | -0.015* (1.80)                     | -0.029* (1.75)                    |

Note: See Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

TABLE 9  
EFFECTS OF TRADE TAXES AND OPENNESS ON GROWTH BY RESOURCE DEPENDENCY

| Variable                               | All Developing Countries | Based on Mineral Exports (% of Merchandise Exports) |                                  | Based on Mineral Exports (% of GDP) |                                  |
|--|--------------------------|---|----------------------------------|-------------------------------------|----------------------------------|
|  |                          | Least Mineral Dependent Countries                   | Most Mineral Dependent Countries | Least Mineral Dependent Countries   | Most Mineral Dependent Countries |
| Import Duties                          | 0.042* (1.91)            | 0.031 (1.15)  | 0.01 (0.18)                      | 0.056** (2.13)                      | 0.016 (0.26)                     |
| Export Duties                          | 0.034 (1.11)             | -0.034 (0.54)                                       | 0.24** (2.31)                    | 0.011 (0.17)                        | 0.21* (1.74)                     |
| Trade (% of GDP, in constant prices)   | -0.005 (1.03)            | -0.002 (0.26)                                       | -0.017** (2.41)                  | -0.007 (0.81)                       | -0.015** (2.50)                  |
| Exports (% of GDP, in constant prices) | -0.012 (1.16)            | -0.024* (1.65)                                      | -0.017 (1.00)                    | -0.032* (1.86)                      | -0.017 (1.25)                    |
| Imports (% of GDP, in constant prices) | -0.006 (0.82)            | 0.08 (0.76)   | -0.039*** (3.42)                 | -0.0007 (0.05)                      | -0.034*** (3.39)                 |
| Trade PWT (% of GDP)                   | -0.006 (1.06)            | -0.012 (1.58)                                       | -0.015 (1.67)                    | -0.020*** (2.43)                    | -0.013* (1.76)                   |
| Trade shares with OECD Nations         | -0.009 (0.96)            | -0.016 (1.36)                                       | -0.024* (1.72)                   | -0.028** (2.09)                     | -0.028** (2.44)                  |
| Trade shares with non-OECD Nations     | -0.029* (1.75)           | -0.005 (0.22)                                       | -0.028 (1.20)                    | -0.029 (1.21)                       | -0.027 (1.16)                    |
| Sachs and Warner openness index        | 0.99*** (2.44)           | 0.45 (0.88)   | 2.07*** (2.69)                   | 0.42 (0.71)                         | 3.20*** (5.35)                   |

Note: Least mineral-commodity dependent countries and most mineral-commodity dependent countries are classified as by Birdsall and Hamoudi (2002) but using average mineral export shares for 1970–1974. PWT, Penn World Table. See also Table 2 for details.

\* Significant at the 10% level; \*\* significant at the 5% level; \*\*\* significant at the 1% level.

The policy implications are clear. Mineral dependent economies need to develop stronger institutions that encourage the development of human capital, diversified trade, and broadly based growth. Improvement of institutional quality is a topic for further research.

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