Re-testing the Resource Curse Hypothesis
Using Panel Data and an Improved Measure of Resource Intensity

Alicia N. Rambaldi*, Greg Hall, Richard P.C Brown

School of Economics
University of Queensland
Brisbane 4072
Australia
*Email: a.rambaldi@uq.edu.au

Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

Re-testing the Resource Curse Hypothesis
Using Panel Data and an Improved Measure of Resource Intensity

1. Introduction

While it might be expected that natural resource rich countries have an advantage, in practice many have experienced poor growth performances (Auty 1993, 1994; Auty and Mikesell, 1998; Davis and Tilton 2002). Such countries are believed to suffer the 'Resource Curse'. Recent empirical studies testing the Resource Curse Hypothesis (RCH) find evidence of significant negative impacts of natural resource abundance on economic growth. The most common explanations rely on Dutch Disease-type crowding-out mechanisms. We question the reliability of past empirical studies on two grounds. First, we question their measures of resource-intensity arguing the need to devise a measure that does not include renewable resources and is independent of the effects of past economic growth and structural change. Second, almost all existing studies use cross-sectional data with the dependent variable, economic growth, measured by a single, mean annual rate over a given period, usually twenty years. We favour econometric modeling using annual panel data. To our knowledge this has not been done previously.

In Section 2 we review a number of empirical studies of the RCH, and critically discuss their measures of resource intensity and econometric modeling. In Section 3 we develop an alternative measure of resource intensity and allocate countries to like-clusters based on their income and resource intensity position. Section 4 presents the results of a multivariate analysis based on our measure of resource intensity and compares the results using the same model with measures of resource intensity used in other studies. Section 5 summarizes our main findings and draws conclusions.

2. Shortcomings of existing empirical studies of the Resource Curse Hypothesis

Testing the RCH has been conducted in a growth modeling framework (Sachs and Warner (1995) (SW); Gylfason and Zoega (2002) (GZ); Manzano and Rigobon (2003) (MR); Atkinson & Hamilton (2003) (AH); Neumayer (2004) (NM); Stijns (2001) (ST); Papyrakis and Gerlagh (2004) (PG)). Most of these studies include as explanatory variables a measure of resource intensity, variables to capture 'transmission mechanisms' such as governance, export performance, openness and terms of trade effects, and controls to capture geography, crowding-out of savings, investment and human capital. In almost all cases a statistically significant negative relationship between resource intensity and growth was found. We believe these studies suffer two main shortcomings; the measurement of resource abundance and the modeling framework.

Measurement issues

Almost all the studies surveyed here measure resource intensity in relation to GDP, exports or, in the case of GZ, total capital stock.[1] In all except one, growth is measured using a single, period average annual growth rate, which is modeled in a cross-sectional regression framework. MR (2003) use panel data, but, unlike our study, they derive a number of period average annual growth rates. Interestingly this is the only study surveyed here that found neither direct nor indirect support for the RCH.

The main theoretical argument underpinning the RCH is the Dutch Disease which posits that windfall gains from a resource boom have a negative impact on productivity and competitiveness in other tradeable goods sectors (Sachs and Larrain, 1993). Dutch Disease effects most frequently occur in non-renewable industries where supply shocks are more frequent. This is because a country's supply of these products can change abruptly with the discovery of new deposits. In addition, inelastic demand for some some non-renewable commodities, energy products are a good example, mean their price is more volatile. Large price increases, by raising rents, can also create a boom in these industries. Including renewable resources in the measure of natural resource intensity, and particularly, agricultural production is questionable. During a Dutch Disease episode, the boom industry crowds out other export industries. If such effects were in operation a broad measure of resource intensity would be obscured by the very process it is trying to capture. SW (2001; p. 831) defend their adherence to a measure of resource intensity that includes both non-renewable and renewable industries, arguing that the variation across countries in non-renewable mineral exports explains most of the variation in primary exports. In Section 3 we question the validity of this assertion on empirical grounds when we compare country classifications with and without agriculture included in the measure.

As an economy develops it undergoes structural change, including a decline in the share of primary output in GDP and exports (Chenery, 1960; Chenery and Syrquin, 1975; Chenery and Watanabe, 1958; Syrquin, 1988). With the accumulation of manufactured capital a given stock of natural capital will decline as a proportion of total capital. Countries that were once, by these measures, resource rich and successful in avoiding the resource curse

[1] The one exception is Stijns (2001) who measures resource intensity in terms of natural capital per capita.

would cease to be classified resource-intensive. It was only because of vast ore and coal deposits that countries like Great Britain and Germany were able to industrialize. By contrast, resource rich countries that have performed badly will continue to appear as resource-intensive. SW (2001; p. 832-33) defend their adherence to a GDP-based measure arguing that currently rich countries that successfully reinvested their natural resource rents did not enjoy the same degree of resource-intensity as the most highly resource-intensive in the mid-to-late 20th century. Even if this assertion is empirically correct, the point of the econometric analysis is to test the relationship between countries' degree of resource-intensity and economic growth. If the measure of the independent variable (resource intensity) is affected by historical changes in the dependent variable (economic growth), circularity and bias are inevitable. In Section 4 we devise a measure which avoids this problem.

Use of period averages vs. panel data

The major econometric deficiency of studies using single period mean growth rates as the dependent variable is the information lost as there can only be one observation for each country in the cross-sectional analysis. Using a single, average growth rate from a highly turbulent, two-decade period; mostly, 1970-1990 effectively assumes that the economy has experienced a steady rate of growth (Maloney 2001; Neumayer 2004). One exception is MR (2003) who replicate SW's (1995) cross-sectional analysis using panel data. However, they calculate two to four period-averages from the panel. In their model a Fixed Effects estimator is used which removes any time invariant factors such as geography variables from the estimation. Splitting the panel into such large time periods may again fail to capture the effects of expansions and contractions in the resource sector adequately. In our econometric analysis in Section 4, we use a panel of 47 countries with annual data spanning the period 1983-2000.

3. A measure of resource intensity based on non-renewable resource rents

This study uses non-renewable resource rents per capita as the measure of resource intensity, which we label PCRENTS. This is similar to the measure of Stijns (2001) who also uses a per capita measure of resource intensity, except, we use the World Bank's estimates of resource rents (Bolt, Malete *et al*. 2002). The World Bank's (2003) estimates include mineral, energy and forestry resources but exclude other, non-forestry land resources. As we are concerned with non-renewable resources we exclude forestry rents. To avoid the problem of circularity we express rents on a per capita basis. Our data set contains 102 countries[2]. As we seek to compare our results to previous studies, the comparisons are based on a reduced number of countries.

Comparing country rankings using alternative resource intensity measures

This section compares the grouping of countries according to the three measures of resource-intensity; ie. those used by SW (1995), GZ (2002) and ours. Through *Cluster Analysis*[3] we classify countries in terms of two criteria, GDP per capita and resource intensity. The sample of countries and time period studied differ slightly across the three studies and measures of resource intensity. In each case eight distinct groupings were identified (excluding the single outlier country in each case). Figures 1, 2 and 3 show the clusters identified within each data set.

[Figures 1, 2 and 3]

To compare the results across the three resource intensity measures countries are classified into four resource-intensity categories, labeled *Least Dependent* through to *Very Highly Dependent*; and three per capita income levels, labeled *Low Income, Middle Income,* and *High Income*. This produces 12 clusters (shown in Table 1) to be matched to the clusters found by the analysis.

[Table 1]

Table 2 shows the category into which each country was allocated using Cluster Analysis (cluster numbers are those in Table 1). Eight of the 12 possible categories were populated, with categories 5, 9, 11 and 12 unpopulated.

[Table 2]

Although the Cluster Analysis generated a similar typology of country categories for the three different measures, there is considerable divergence in terms of country classifications. The same countries are often allocated to a different cluster-group, sometimes ranging from one extreme to the other. This confirms our concern that alternative measures result in considerable differences in resource-intensity classifications. The next section tests in an econometric framework the RCH using the three resource-intensity measures.

---

[2] List available from authors
[3] The average annual rent earned in each country over the sample period is used.

4 Re-Testing the Resource Curse Hypothesis

In this study we use a panel (1983-2000) of 47 countries (largest sample given data availability) and regress GDP growth on resource intensity using the three alternative measures of resource intensity (GZ, SW and our PCRENTS) and several control variables, namely, the growth rates of: *income terms of trade* (INCTOT), *Domestic Credit available to the Private Sector as a percentage of GDP* (DCREDTOGDP), *Education Expenditure as a proportion of GDP* (EDUEXPTOGDP), and *Inflation* (measured by the GDP Deflator); other variables included are: *Net Accumulation of Physical Capital per capita (in constant 1994 $US)* (NETCAPITAL), *latitude* (LATITUTE), *GDP per capita at the beginning of the sample period* (GDP83), and *Governance* (GOV, explained below).

We favour using the income terms of trade since it measures changes in the country's capacity to import with given export earnings. The measure of *Governance* is an index we have constructed from several indicators of government corruption and social cohesion (Knack, no date)[4]. A lower score on this index indicates the country has better Governance. The index accounts for 67 percent of the variation amongst the original six indicators. These two variables are included to control for indirect sources of the Resource Curse.

Variables relating to physical capital and education control for productivity of the workforce. How efficiently funds are allocated between competing investments will also have a bearing on a country's development. The credit variable is intended to gauge the quality of a country's financial system. Empirical evidence has shown that geographic characteristics of a country have a bearing on development. In particular, tropical regions appear to have a lower standard of living (Bloom, Sachs *et al.* 1998; Sachs and Warner 2001). The latitude of a country is included as a proxy for environmental hardship. With latitude increasing with the distance from the equator there should be a positive relationship with economic growth.

Three alternative measures of resource intensity are used for the analysis, SW, GZ and Ours. As SW and GZ were cross-sectional studies, there are no panel data available for the resource intensity variable. We have created four dummy variables for their measures using a quartile based resource intensity classification[5]. For instance $D1_{ij}$ (*j*= SW, GZ) takes the value of 1 if country *i* has resource intensity 1 for the *jth* measure and zero otherwise, $D2_{ij}$ (*j*= SW, GZ) takes the value of 1 if country *i* has resource intensity 2 for the *jth* measure and

[4] Data and results available from the authors.
[5] We rank the countries common to the three studies in terms of their relative resource intensity. Using the rankings we group the countries by quartiles, labeled as 'Least Dependent' (lowest quartile) to 'Most Dependent' (highest quartile). Full results available from the authors.

zero otherwise, and so forth. As PCRENTS, is available for all countries and years, we use it for the estimation of the model and those estimates are labeled "Ours" in Table 3. In the reported results, D1 is the omitted category. Thus, the estimates on the three remaining dummies are estimates of the difference between the coefficient of the low resource dependence group (captured by the constant term, 'C' in the equation) and each of the other resource dependence levels.

If the RCH holds we would expect the constant and the dummy variables to be significant and the coefficients on the three dummies should be negative with D2>D3>D4, indicating a negative relationship between higher resource intensity and growth.

The model is estimated with some of the explanatory variables lagged one period to account for possible endogeneity of some of the regressors[6]. Since several variables included are time invariant, ie LATITUDE, GOV, GDP83 and the resource intensity dummies, a fixed effects estimator was not suitable. A random effects estimator is consistent if the regressors are uncorrelated with the random effects[7]. Further, under both a pooled estimation and the random effects estimation the residuals show substantial signs of heteroskedasticity and autocorrelation[8]. Thus, after weighing the alternatives, the model was estimated using a pooled panel estimation with first order autocorrelated errors and white robust standard errors. Two sets of results are presented in Table 3.

[Table 3]

The first set (M1) shows the estimates for the model under the three alternative resource intensity measures, without allowing for interaction between resource intensity and the indirect channels, terms of trade and institutional quality. The second set (M2) presents the estimation including interaction terms between the resource intensity variable and indirect channels, allowing us to test for the joint, indirect effect of for example "bad governance" and "resource intensity".

Models without interaction terms (M1)

For the GZ and SW specifications, the intercept captures the effect of being in the "Least Dependent" (LD) category and the coefficients of D2, D3 and D4 will add or subtract

---

[6] Endogeneity arguments can be made for variables such us education expenditures, inflation, and domestic credit.

[7] A Hausman test rejected the null hypothesis of consistency of the random effects estimator (28.43, p-value=0.0008). This test compares the random effects to the fixed effects, and thus removes time invariant variables.

[8] Results available from the authors.

to the intercept the effect of being in the "moderately dependent" (MD), "Highly Dependent" (HD) and "Very Highly Dependent" (VHD) categories respectively.

With GZ's resource intensity measure we find the intercept to be significant and positive, MD to be not significantly different from LD, HD to be significant and positive (estimated intercept for this group is 0.015838), and VHD to be significant and negative (with the intercept for this group estimated at -0.004038). Thus, the results are mixed and therefore do not provide unambiguous support for the RCH.

For SW's resource intensity measure, the intercept is positive and significant, the three dummies have the expected negative coefficients but the intercepts for the MD and HD groups are not significantly different from the LD group, while the VHD group has a significant, positive but lower intercept than that of the other groups (the coefficient of D4 is negative, thus the estimated intercept for this group is 0.000765). This result is consistent with SW's original findings.

Our resource intensity measure (PCRENTS) is found to be significant and positively related to growth, although the value of the estimated coefficient is very small with an increase in per capita rents of one thousand dollars increasing annual growth by around 0.0057 per cent.

We find the estimates for the rest of the variables in the model to be robust to the resource measure chosen. In all three cases, an increase in the income terms of trade or the accumulation of physical capital per capita are positively related to growth, while increases in inflation or the (poor) governance index have a negative effect on growth. As indicated the model was estimated with first order autocorrelated errors. The autocorrelation parameter is statistically significant in all three cases.

We further discuss the findings after presenting the results for the models with interacted terms.

Model with the interacted terms (M2)

We interacted our terms of trade and governance variables with the resource-intensity grouping to test whether terms of trade and/or poor governance (these are in effect our 'transmission variables') affected resource intensive countries differently. Our results indicate that the interacted terms of trade are not significantly different across resource intensity groupings. This result is consistent across measures of resource intensity. Our governance variable (GOV) was also interacted with the country groupings to test whether the resource intensive countries are more vulnerable to the presence of poor governance than the others.

We do not find however, a uniform effect indicating poor governance differs across resource-intensity. For SW measure, there is only one significant coefficient (interaction with the HD group, see M2). For GZ none of the interaction dummies are significant. Our measure finds a negative effect of GOV and a significant but less negative coefficient for the interacted VHD group, contrary to other studies.

Using model M2 direct evidence of Resource Curse is found only for the SW measure.

Discussion:

In this paper we have employed a different modelling technique and sample from those used by SW and GZ. What also differs across studies is the definition of resource-intensity. The studies of SW and GZ based on cross-sectional modelling using a single, period-average measure of economic growth, found direct evidence of the Resource Curse. Using annual panel data and our PCRENTS measure of resource-intensity we do not find direct or indirect evidence of the Resource Curse. These results also show that the original findings of SW in support of the RCH appear to still hold, suggesting that their results are relatively robust in relation to the measure of economic growth (GNP or GDP) and econometric model used. However, they are not robust to the measure of resource-intensity as the same model with PCRENTS does not give similar results, indicating that their findings are dependent on the measure of resource intensity.

The same is not true for the GZ's measure. The results show no support for the RCH when we use panel data and a different modelling technique. This indicates that their findings in support of the RCH are dependent on the measurement and modelling of economic growth.

5. Conclusions

Most empirical studies of the RCH find evidence of a strong negative relationship between a country's natural resource abundance and economic growth. We question the reliability of these findings in relation to the definitions and measures used for both resource intensity and economic growth, and the econometric testing which we consider deficient. We used an alternative, per capita resource rents measure of resource intensity that excludes renewable resources and avoids the circularity and bias of other output-related measures. The important difference between our measure and those used previously is that only non-renewable resources are included in our measure and that it is expressed on a per capita basis.

Using a different measure of resource intensity, we compare the sensitivity of the results across alternative measures of resource intensity. Using three different definitions of resource intensity, we showed, first, using Cluster Analysis, different measures yield different groupings of countries in terms of resource intensity. Second, this is confirmed by econometrically re-testing the RCH. We used panel data as opposed to a single, period-average measure of economic growth and an estimate of the same model under the three alternative resource intensity measures. We found that the negative relationship between resource intensity and economic growth still holds for the SW measure, but the same was not true for GZ. When using our measure, evidence of a positive relationship between natural resource abundance and growth is found. We conclude that testing the RCH can be strongly dependent on the definition of resource-intensity and the measurement and modeling of economic growth.

References

Atkinson, G. and K. Hamilton (2003) 'Savings, growth and the Resource Curse Hypothesis' World Development 31(11) 1793-1807.

Auty, R. M. (1993). Sustaining Development in Mineral Economies. London, Routledge.

Auty, R.M. (1994) 'Industrial policy reform in six large newly industrializing countries' World Development, 22, 11-26.

Auty, R.M. and R.F. Mikesell (1988) Sustainable development in mineral economies. Oxford: Clarendon Press.

Bloom, D., Sachs, J., et al. (1998). "Geography, Demography and Economic Growth in Africa." Brookings Papers on Economic Activity 1998(2): 207-295.

Bolt, K., Matete, M., and Clemens, M. (2002) Manual for Calculating Adjusted Net Savings. Environment Department, World Bank: Washington DC.

Chenery, H. (1960) 'Patterns of industrial growth', American Economic Review, 50(4):624–54.

Chenery, H.B. and Syrquin, M. (1975), Patterns of Development, 1950-1970, London, Oxford University Press.

Chenery, H.B. and Watanabe, T. (1958) "International Comparisons of the Structure of Production" Econometrica, 26: 487-521.

Davis, G. A. and Tilton, J. E. (2002). Should Developing Countries Renounce Mining? A Perspective on the Debate, Colorado School of Mines: 1-61.

Gylfason, T. and Zoega, G. (2002). "Natural Resources and Economic Growth: The Role of Investment." Central Bank of Chile Working Paper. Santiago de Chile: Central Bank of Chile.

Knack, S. (no date). File of International Country Risk Guide (ICRG) Data, IRIS Center University of Maryland.

Maloney, W.F. (2001) 'Innovation and growth in resource rich countries'. Central Bank of Chile Working Paper 148. Santiago de Chile: Central Bank of Chile.

Manzano, O. and Rigobon, R. (2003). "Resource Curse or Debt Overhang?" National Bureau of Economic Research Working Paper Series (No. 8390).

Neumayer, E. (2004) 'Does the "Resource Curse" Hold for Growth in Genuine Income as Well?' World Development 32 (10): 1627-1640.

Papyrakis, E. and R. Gerlagh (2004) 'The resource curse hypothesis and its transmission channels' Journal of Comparative Economics 32: 181-193.

Sachs, J. and Larrain, F. (1993). Macroeconomics in the global economy. New Jersey, Prentice Hall.

Sachs, J. and Warner, M. (1995). "Natural Resource Abundance and Economic Growth." NBER Working Paper Series (5398).

Sachs, J. and Warner, M. (2001). "The Curse of Natural Resources." European Economic Review 45(4-6): 827-838

Stijns, J-P.C. (2001) 'Natural resource Abundance and Economic Growth Revisited' Unpublished mimeo, Department of Economics, University of California, Berkeley.

Syrquin, M. (1988), "Patterns of Structural Change" Chapter 7 in Cherney, H.B. and Srinivasan, T.N. (eds.), Handbook of Development Economics, Volume I, Amsterdam, Elsevier Science Publishers.

World Bank (2003) Environmental Economics and Indicators

http://lnweb18.worldbank.org/ESSD/essdext.nsf/44ByDocName/GreenAccountingAjusteNet Savings

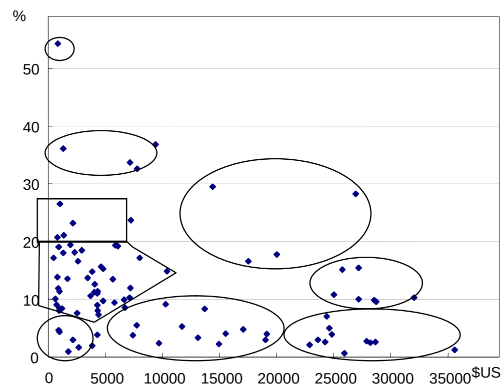

Figure 1: Cluster Analysis Using SW Measure of Resource Intensity[9]

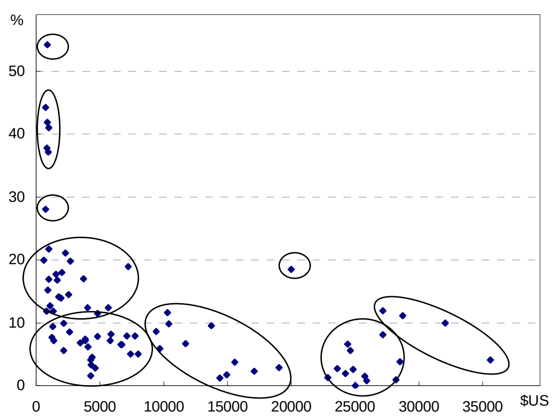

Figure 2: Cluster Analysis Using GZ Measure of Resource Intensity [10]

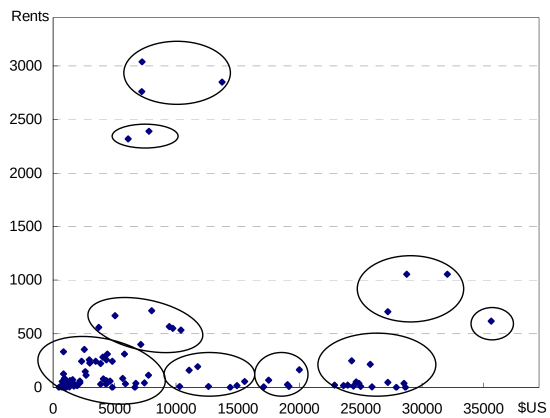

Figure 3: Cluster Analysis Using PCRENTS Measure of Resource Intensity[11]

---

[9] Primary Products as a share of total exports
[10] Natural capital as a fraction of total wealth.
[11] Rents per capita, averaged from 1983-2000.

Table 1 Two-Way Classification of Cluster Groups by Resource Intensity and Income Level

		Resource Intensity Category			
		Least Dependent	Moderately Dependent	Highly Dependent	Very Highly Dependent
Income Category	Low Income	1	4	7	10
	Middle Income	2	5	8	11
	High Income	3	6	9	12

Table 2 Cluster Analysis Classification Using Different Measures of Resource Intensity

	Cluster				Cluster		
Country	GZ	SW	Ours	Country	GZ	SW	Ours
Algeria	-	-	7	Jordan	1	4	1
Argentina	2	2	2	Kenya	4	4	1
Australia	6	6	6	Korea, Rep.	2	2	2
Austria	3	3	3	Lesotho	-	-	1
Bangladesh	4	1	1	Madagascar	10	4	1
Barbados	-	8	8	Malawi	4	4	1
Belgium	3	6	3	Malaysia	2	10	4
Belize	-	10	-	Mali	10	4	1
Benin	4	4	1	Malta	-	2	-
Bolivia	-	4	1	Mauritius	2	8	2
Brazil	1	2	1	Mexico	2	2	4
Burkina Faso	4	1	1	Morocco	1	4	1
Burundi	4	4	1	Mozambique	4	-	1
Cameroon	1	4	1	Nepal	4	-	1
Canada	6	6	6	Netherlands	3	6	3
Cape Verde	-	1	-	New Zealand	8	8	8
Chad	10	4	1	Nicaragua	4	4	1
Chile	2	4	4	Niger	**	1	1
China	1	1	1	Nigeria	-	4	1
Colombia	1	4	1	Norway	6	6	6
Congo, Rep.	1	4	1	Pakistan	4	1	1
Costa Rica	1	4	1	Panama	1	4	1
Cote d'Ivoire	4	-	1	Paraguay	1	4	1
Denmark	3	6	3	Peru	1	4	1
Dom. Republic	1	4	1	Philippines	1	4	1
Ecuador	1	4	4	Portugal	2	2	8
Egypt	1	4	1	Romania	-	-	4
El Salvador	1	4	1	Rwanda	4	4	1
Ethiopia	-	-	1	Senegal	4	4	1
Finland	3	3	3	Sierra Leone	7	4	-
France	3	3	3	Singapore	-	3	3
Gabon	-	10	7	Slovak Republic	-	-	2
Gambia	10	10	1	South Africa	1	4	4
Germany	-	-	3	Spain	2	2	8
Ghana	4	7	1	Sri Lanka	1	4	1
Greece	2	2	2	Sweden	3	3	3
Guatemala	1	4	1	Switzerland	3	3	-
Guinea	-	-	1	Syria	-	4	1
Guinea-Bissau	4	-	1	Tanzania	-	4	1
Honduras	4	7	1	Thailand	1	4	1
Hong Kong	-	3	3	Togo	4	4	1
Hungary	-	-	2	Trinidad & Tobago	2	2	10
Iceland	-	8	-	Tunisia	1	4	4
India	1	1	1	Turkey	1	2	1
Indonesia	1	4	1	Uganda	-	7	1
Iran	-	4	10	United Kingdom	3	3	3
Ireland	3	6	3	United States	6	3	**
Israel	-	2	8	Uruguay	2	2	2
Italy	3	3	3	Venezuela	1	7	10
Jamaica	1	4	1	Zambia	10	**	1

- not in sample   ** non-classifiable outlier

Table 3. Model Estimates Under Three Measures of Resource Intensity

Variable	Without Interaction Terms (M1)			With Interaction Terms (M2)		
	GZ	SW	Ours	GZ	SW	Ours[a]
C	**0.008384*** (0.004731)	**0.015457***** (0.003119)	**0.008080***** (0.003954)	0.008347 (0.005118)	**0.024518***** (0.003771)	**0.009085**** (0.003687)
PCRENTS_RATE(-1)			**5.70E-06***** (6.18E-07)			**5.51E-06***** (6.44E-07)
D2	0.005083 (0.003744)	-0.003136 (0.003584)		0.009476 (0.007012)	-0.012570 (0.008978)	
D3	**0.007454**** (0.003756)	-0.004226 (0.003113)		0.010049 (0.007951)	**-0.01461***** (0.005068)	
D4	**-0.012422***** (0.003307)	**-0.014692***** (0.005286)		**-0.019775*** (0.010233)	**-0.026724**** (0.011887)	
DCREDTOGDP_RATE(-1)	7.75E-07 (5.68E-07)	7.16E-07 (6.42E-07)	7.05E-07 (6.23E-07)	7.16E-07 (5.53E-07)	4.47E-07 (5.49E-07)	4.98E-07 (7.55E-07)
EDUEXPTOGDP_RATE(-1)	0.000201 (0.000224)	0.000203 (0.000232)	0.000219 (0.000230)	0.000200 (0.000230)	0.000200 (0.000230)	0.000211 (0.000232)
INCTOT_RATE(-1)	**0.000531**** (0.000214)	**0.000529**** (0.000213)	**0.000539**** (0.000212)	0.000129 (0.000388)	0.000115 (0.000232)	0.000290 (0.000427)
INCTOT_RATE(-1)*D2				0.000162 (0.000398)	0.000568 (0.000477)	5.66E-05 (0.000462)
INCTOT_RATE(-1)*D3				0.000440 (0.000519)	0.000203 (0.000204)	2.15E-05 (0.000464)
INCTOT_RATE(-1)*D4				0.000766 (0.000546)	0.000609 (0.000410)	0.000581 (0.000440)
INFLATION_RATE(-1)	**-5.22E-06***** (2.01E-06)	**-5.01E-06***** (1.92E-06)	**-3.75E-06**** (1.80E-06)	**-4.72E-06**** (2.41E-06)	**-4.37E-06**** (2.19E-06)	-3.39E-06 (2.20E-06)
NETCAPITAL(-1)	**2.68E-14**** (1.08E-14)	**2.28E-14*** (1.19E-14)	**3.08E-14***** (1.16E-14)	**2.98E-14***** (1.09E-14)	**2.80E-14**** (1.25E-14)	**3.61E-14***** (1.20E-14)
GOV	**-2.422579**** (1.109281)	**-2.112778**** (1.033639)	**-1.945461*** (1.126589)	**-2.73583**** (1.388281)	-0.688926 (1.375969)	**-2.614763*** (1.529477)
GOV*GD2				1.359904 (0.961828)	-0.890425 (1.330270)	0.083308 (0.683772)
GOV*GD3				0.983644 (0.970405)	**-1.825014**** (0.872828)	1.037253 (0.751787)
GOV*GD4				-1.426050 (2.183620)	-1.720252 (2.121753)	**1.696092**** (0.752749)
LATITUDE	0.000124 (8.49E-05)	4.94E-05 (7.53E-05)	0.000127 (8.89E-05)	**0.000173*** (9.28E-05)	5.89E-05 (7.93E-05)	9.27E-05 (9.42E-05)
GDP83	**-1.02E-06**** (5.60E-07)	-7.59E-07 (4.81E-07)	-6.41E-07 (5.39E-07)	**-1.10E-06*** (5.76E-07)	-6.24E-07 (5.88E-07)	-5.93E-07 (5.85E-07)
Autoregressive Parameter	**0.150947**** (0.074060)	**0.166578**** (0.074572)	**0.177188**** (0.074462)	**0.148391**** (0.075005)	**0.172482**** (0.075287)	**0.197420**** (0.078499)
Log-Likelihood	1379.362	1374.874	1372.882	1382.837	1377.671	1376.717

Standard Errors in brackets. ***, **, * Significant at 1%, 5% and 10%, respectively

[a] Dummy variables for the interaction terms were created using the classification in a similar fashion as those defined for the other two authors'