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Trade Structure and Growth

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Abstract

Lederman and Maloney examine the empirical relationships between trade structure and economic growth, particularly the influence of natural resource abundance, export concentration, and intra-industry trade. They test the robustness of these relationships across proxies, control variables, and estimation techniques. The authors find trade variables to be important determinants of growth, especially natural resource abundance and export concentration. In contrast with much of the recent literature, natural resource abundance appears to have a *positive* effect on growth, whereas export concentration hampers growth, even after controlling for physical and human capital accumulation, among other factors.

This paper—a product of the Regional Studies Program, Office of the Chief Economist, Latin America and the Caribbean Region—is part of a larger effort in the region to understand the causes of economic growth. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Patricia Soto, room I8-018, telephone 202-473-7892, fax 202-522-7528, email address psoto@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at dlederman@worldbank.org or wmaloney@worldbank.org. April 2003. (26 pages)

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1. Introduction

In recent years, a vast literature has studied the impact of trade openness or magnitude of trade flows on income levels (e.g., Frankel and Romer 1999, Ferreira and Trejos 2002, Wacziarg and Welch 2002) and on the rate of economic growth (e.g., Rodrik and Rodriguez 2000, Jones 2000, Wacziarg 2001, Wacziarg and Welch 2002). This paper investigates a far less studied issue, namely the impact of trade *structure*, particularly natural resource specialization, export concentration, and intra-industry trade on growth. Though these variables clearly do not exhaust the possible interesting dimensions of trade structure, they have received extensive attention in the recent literature.

In spirit and approach the paper can be seen as the trade analogue to recent empirical work for instance, looking at the impact of a set of financial development proxies on growth (Levine et al. 2000). We follow what has become standard practice of assessing the robustness of econometric results by examining how they change as the set of control variables (Levine and Renelt 1992, Xala-I-Martin 1997, among many others) and the estimation techniques (Caselli et al. 1996, Levine et al. 2000) are modified.

We find that regardless of estimation technique, trade structure variables are important determinants of growth rates and hence probably should be in the conditioning set of growth regressions. But we also find that many of the stylized facts, particularly those surrounding natural resource specialization, are not robust to estimation technique or conditioning variables. In particular our preferred measure of natural resource abundance appears to be *positively* correlated with economic growth, and this effect plausibly arises from a greater potential for productivity growth. We also find that concentration of export revenues reduces growth by hampering productivity. The incidence of intra-industry trade is generally associated with good growth performance but the channel may be largely through its correlation with export concentration.

2. Trade Variables and Growth

Natural Resource Abundance

We begin with those variables relating to natural resource abundance which, from Adam Smith to more recently Auty (1998) and Sachs and Warner (2001a, 2001b) have been viewed as having detrimental impacts on growth. Numerous channels through which this might occur have been offered and here we offer an incomplete list.

First, beginning with Smith[1] observers have argued that natural resources are associated with lower human and physical capital accumulation, productivity growth, and spillovers although the case is far from proven. Martin and Mitra (2001) find total factor productivity growth to be higher in agriculture than in manufactures in a large sample of advanced and developing countries. Wright (2001) and Irwin (2000) have argued that, contrary to Smith's prejudice, mining is a dynamic and knowledge intensive industry critical to US development. Blomstrom and Kokko (2001) have argued the same for forestry in Scandinavia.

Second, Prebisch (1959), among others, popularized the idea that terms of trade of natural resource exporters would experience a secular decline over time relative to those of exporters of manufactures. However, Cuddington, Ludema and Jayasuriya (2001) find that they cannot be reject that relative commodity prices follow a random walk across the 20th century with a single break in 1929. Third, either reasons of history or Dutch disease may result in high levels of export concentration which may lead to higher export price volatility and hence greater macro volatility.[2] Fourth, an extensive literature (see, for example Easterly and Levine 2002) examines how the rents arising from resource

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[1] Over two hundred years ago, Adam Smith wrote: "Projects of mining, instead of replacing capital employed in them, together with ordinary profits of stock, commonly absorb both capital and stock. They are the projects, therefore, to which of all others a prudent law-giver, who desired to increase the capital of his nation, would least choose to give any extraordinary encouragement ..." More recently, Auty (1998) wrote that "since the 1960s the resource-rich developing countries have under-performed compared with the resource-deficient economies" (1998, viii).

[2] Sachs and Warner (1995b) argue that Dutch disease leads to concentration in resource exports which they assume to have fewer possibilities for productivity growth.

extraction may lead to institutional failures. Finally, Manzano and Rigobon(2001) argue that imperfect international capital markets allow countries experiencing commodity price booms to over borrow, eventually requiring policies that restrict growth when credit dries up during the inevitable downturns.

There is as yet limited consensus on the appropriate empirical proxy for measuring resource abundance. Leamer (1984) argues that standard Heckscher-Ohlin trade theory dictates that the appropriate measure is net exports of resources per worker. Though this measure has been the basis for extensive research on the determinants of trade patterns (e.g., Trefler 1995, Antweiler and Trefler 2002, Estevadeordal and Taylor 2002)[3] to date there has been essentially no empirical work testing its impact on growth.[4] A look at the unconditional correlation in figure 1a suggests that the most resource abundant country is Norway, followed by New Zealand, Trinidad and Tobago, Canada, Finland and Australia. Though these countries are mostly well-off, there is overall no obvious relationship between the Leamer measure and growth.

In fact, the only formal empirical tests for the resource curse are found in the work of Sachs and Warner (1995a, 1997a, 1997b, 1999, 2001a,b) who employ natural resource exports as a share of GDP as their proxy. Using cross sectional data employed previously by Barro (1991); Mankiew, Romer and Weil (1992); and DeLong and Summers (1991) across the period 1970-1990, they persistently find a negative correlation with growth, much to the alarm of many resource abundant developing countries.[5] Figure 1b suggests that with this proxy the most natural-resource "abundant"

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[3] Assuming identical preferences, a country will show positive net exports of resource intensive goods if if its share of productivity-adjusted world endowments exceeds its share of world consumption. Usually, the net exports are then measured with respect to the quantity of other factors of production, such as the labor force.

[4] It is worth mentioning that the cited references show that the HO model of factor endowments performs relatively well for natural resources net exports, but it performs less well for manufactures. The current debate in the trade literature revolves around the question of how the HO model might be amended (by considering, for example, technological differences across countries, or economies of scale) to help predict better the observed patterns of net exports across countries. But there is not debate about the use of net exports as a proxy for revealed comparative advantage in this literature.

[5] The other papers by Sachs and Warner (1995b, 1997b, 1999, 2001a, 2001b) contain the basic results of 1997a, at times using a slightly longer time span (1965-1990 instead of 1970-1989), and often including

country by far is the Congo and Papua New Guinea with Finland, Norway, Canada nowhere to be found.

This variable is of intrinsic interest, although, as Sachs and Warner suggest, it leads to counterintuitive results as a measure of resource abundance. Figure 1b shows that Singapore, due to its substantial re-exports of raw materials, appears very resource abundant and given its high growth rates, even seems to impart a positive relationship between resource abundance e and growth. Because this gross measure is clearly not capturing the country's true factor endowments, Sachs and Warner replaced the values of Singapore and Trinidad and Tobago with net resource exports as a share of GDP (see data appendix in Sachs and Warner 1997a). This measure, in fact, approximates Leamer's and it is not clear why net values should only be used for these two cases. Numerous countries in Asia and Latin America have a large presence of export processing zones that would, using the gross measure, overstate their true abundance in manufacturing related factors. The variable also shows substantial volatility over time reflecting terms of trade movements and hence the average for the period is probably a better measure than the initial period value that was used by Sachs and Warner in several of their papers.

Export concentration

The next set of variables focuses on export concentration. Clearly, dependence on any one export, be it copper in Chile or potentially micro-chips in Costa Rica, can leave a country vulnerable to sharp declines in terms of trade. The presence of a single, very visible export may also give rise to a variety of political economy effects deleterious to growth. On the other hand, specialization is often associated with scale economies and hence higher productivity.

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additional time-invariant explanatory variables such as dummies identifying tropical and landlocked countries, plus some additional social variables.

We employ two measures that capture different dimensions of concentration. First, we construct a Herfindahl index using export data disaggregated at 4-digit SITC. The index ranges from zero and one and increases with concentration.[6] This index is widely used in studies that focus on general indicators of economic concentration (e.g., Antweiler and Trefler 2002). Figure 1c suggests a downward sloping relationship with growth.

Second, we employ the share of natural resources exports in total exports. This was employed by Sachs and Vial (2002), again, as a measure of resource abundance and found to be very robustly negatively related to growth in a panel specification in differences. Again, we would argue that this measure has intrinsic interest, but as a specific measure of concentration of exports in one particular industry. Figure 1d also suggests a negative relationship with respect to economic growth. But it also shows a significant re-ranking of countries compared to the previous resource measures. Papua New Guinea, Malawi, Nicaragua, Togo, among others, now appear as high value cases while Finland and Singapore have fallen among the lower value cases.

Intra-Industry Trade

The final trade measure we employ is the Grubel-Lloyd (1975) index of intra-industry trade (IIT).[7] The scale economies arising from IIT are thought to lead to more rapid productivity gains and hence faster growth (see for example, Krugman 1979). Because

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[6] The index is defined as: $H = \sum_{i}^{n}\left(\frac{x_i}{\sum_{i}^{n} x_i}\right)^2$, where subscript 'i' stands for a particular product and 'n' is the total number of products. When a single export product produces all the revenues, H=1; when export revenues are evenly distributed over a large number of products, H approaches 0.

[7] The index is defined as: $IIT = 1 - \frac{\sum_{i}^{n} | X_i - M_i |}{\sum_{i}^{n}(X_i + M_i)}$, where "i" indicates a product category and "n" is the total number of products. This index varies between 0 and 1, and it shows the share of total trade that is conducted among identical products (i.e., imports and exports of the same product category).

the incidence of IIT is high among manufactures, there is a sense in which this measure is a broad complement to those above. No obvious unconditional relationship appears in figure 1e.

Each of these variables is of interest in itself. However each also may represent a channel through which the other variables of interest affect growth. For instance, resource abundance may also imply a high level of export concentration or low level of intra-industry trade. We attempt to disentangle these effects as well.

3. Estimation Techniques

We begin with a basic specification that can nest much of the existing work on the empirics of economic growth:

$$\dot{y}_{i,t} = \gamma \ln y_{i,t-1} + \beta' X_{i,t} + \alpha \tau_{i,t} + \mu_i + \mu_t + \varepsilon_{i,t} \qquad (1)$$

Where y_{it} dot is the log difference of per capita GDP of country i in period t, $y_{i,t-1}$ log income per capita at the beginning of the period, X_{it} the matrix of conditioning variables and τ the particular trade variable of interest. μ_i is an individual country fixed effect, μ_t is a sample wide time effect and ε_{it} a country and time specific effect.

Most of the previous work discussed above, and in fact much of the growth literature until recently has been based on estimations of an equation similar to (1) using cross sectional regressions data which lack any time dimension, although the drawbacks are well known.[8] As Levine and Renelt (1992) first pointed out in the growth context, cross-country growth regressions are sensitive to the variables included in the specification. Further, substantial bias may be induced by the correlation of unobserved country-specific factors and the variables of interest; $E(\mu_i, \tau_{it})$, may be large. Casselli, Esquivel and Lefort (1996), for instance, pointed out that the difference with respect to

[8] More recently, distinguished economists have raised serious concerns about the general practice of testing a plethora of hypotheses about economic growth by relying exclusively on cross-country growth regressions. See for example, Solow (2001).

the highest level of income in the sample of countries (i.e., the level to which the other countries are converging) acts as a proxy for country-specific effects in cross sectional regressions, and thus the resulting estimates are inconsistent. Closer to the present paper, Manzano and Rigobón (2001) found in a 1980-1990 cross section that Sachs-Warner's negative correlation of natural resources with growth disappears when they control for the initial ratio of foreign debt to GDP.

Cross sectional regressions clearly suffer from endogeneity problems as well. In the growth context, Knight, Loayza and Villanueva (1993) point out that, by construction, the initial level of income is correlated with the growth variable. But the problem is much larger, as Caselli, Esquivel and Lefort (1996) note, extending as is often the case in macroeconomic studies to the interdependence of virtually all of the relevant growth related variables. Other papers on economic growth attempting to deal with both unobserved country-specific effects and endogenous explanatory variables include Easterly et al. (1997), Levine et al. (2000), and Bond et al. (2001).

Panel data offer a potential solution to the endogeneity problem through the use of lagged values as instruments for endogenous variables. The issue of unobserved country specific effects can also be addressed although the standard fixed or variable effects estimators are not consistent in the present context where we implicitly include a lagged dependent variable -- the initial level of GDP per capita. The assumption of a lack of correlation between μ_i and the explanatory variables required for variable effects estimators is not defensible in this context since both y_{it} dot and y_{t-1} are a function of μ_i. On the other hand, OLS is clearly inconsistent and FGLS is also should the errors show either heteroskedasticity or serial correlation (Sevestre and Trognon 1996). Further, the usual elimination of μ_i by subtracting off the time mean induces a negative correlation between the transformed error and the lagged dependent variables of order 1/T, which, in short panels such as those used here remains substantial.

Following Anderson and Hsiao (1982), Arellano and Bond (1991) and Caselli et. al (1996) in the growth literature, we therefore difference the data to eliminate μ_i, yielding:

$$\Delta\dot{y}_{i,t} = \gamma\Delta \ln y_{i,t-1} + \beta' \Delta X_{i,t} + \alpha\Delta\tau_{i,t} + \Delta\mu_t + \Delta\varepsilon_{i,t}, \qquad (2)$$

Any unobserved country fixed effects disappear in the differenced errors. However, unless the idiosyncratic error followed a random walk, this differencing necessarily gives the transformed error a moving-average, MA(n), structure that is correlated with the differenced lagged dependent variable. This can be overcome by using instruments dated t-n and earlier and Arellano and Bond (1991) employ lagged levels as a proxy for differences in a Generalized Method of Moments (GMM) context. However, in growth regressions where the explanatory variables (eg. schooling, natural resource endowments) show little variation across time, levels are often poor instruments. For this reason, Levine, Loayza, and Beck (2000) in their examination of the impact of financial variables on growth follow Blundell and Bond (1998) and Arellano and Bover (1995) in employing a system estimator that rescues some of the cross-sectional variance that is lost in the differences GMM estimator by estimating a system of equations that also includes equation (1) in levels, but with the lagged differences of the endogenous variables as instruments. Bond et al. (2001) show that the "weak instruments" problem can be severe in cross-country growth regressions with panel data. Therefore we follow them, as well as Levine et al. (2000) in applying the GMM system estimator to our growth models.

That said, working in the differenced panel context raises other concerns. Griliches and Hausman (1986) pointed out that differencing decreases the signal to noise ratio in the data, increasing the de facto measurement error and potentially biasing coefficients toward zero. More recently, Prichett (2000) argued that moving to higher frequency growth data, as we move for example from 20-year averages with cross-sectional data to 5-year averages in the panel data set, highlights the short run relationships (i.e., cyclical elements) among variables relative to the long run (growth). The GMM systems estimator, in theory, addresses these problems. However, to err on the side of caution and to be comparable with previous work, we present both the OLS cross sectional results along with the system estimates.

4. Estimation and Results

The empirical strategy is to introduce the trade variable of interest first to a set of core conditioning variables, and then to progressively add new variables, many now standard in the literature, to examine both robustness and suggestive channels of influence. The basic conditioning set includes initial income of the period and a policy-based index of openness provided by Sachs and Warner (1995a). Although the literature has been highly critical of virtually all such measures of openness (Pritchett 1996, Rodrik and Rodríguez 2000), to ensure consistency with the natural resource literature of Sachs and Warner, we use their measure. Nevertheless it is worth pointing out that Wacziarg (2001) shows that the estimated effects of the trade-to-GDP ratio are virtually identical when the ratio is instrumented by the Sach-Warner index as when it is instrumented by other policy indicators such as average tariffs and the non-tariff barrier coverage ratio.

The second conditioning set adds the average ratio of investment/GDP and log of years of schooling of the adult population, which is the preferred measure of the stock of human capital (e.g., Barro 2001). Next, we add growth in the terms of trade as a possible channel through which natural resources variables may affect growth. As a measure of macro stability of particular importance to the trade sector we then include the standard deviation of the real effective exchange rate (REER) over the period, calculated from monthly data. As numerous authors (see for example, Servén 1998) suggest, macroeconomic volatility reduces investment and thus growth. However, other studies show that macroeconomic factors that are likely to be associated with REER volatility, such as episodes of high inflation, are related to both the level of investment and the rate of productivity growth (e.g., Fischer 1993; Bruno and Easterly 1997). This may also prove a channel through which our trade variables work. Time dummies are included in all the regressions that rely on panel data.

Data

The core data set is that of Summers and Heston (1991), updated to 2000 and the trade variables were constructed as in table 1. We construct panels of five year periods extending from 1975 to 1999. We lose one observation to instruments leaving a twenty year span to estimate from 1980 to 1999. Because we are interested in seeing how sensitive the results are to estimating technique, we use the same sample for both the cross section and panel exercises. Table 2 presents the summary statistics of both the cross section and panel data sets.

Tables 3a and 3b present the cross sectional and panel results respectively. The tables report the coefficient and significance level on the particular trade variable in a regression containing the control variables listed in the first column. Hence, the next column reports the coefficient on the Leamer measure first for the basic conditioning variables, then with human capital and investment, then with terms of trade, and so on. This is done for each variable as we move across the top of the table. Below the double line (under section labeled "Additional Controls"), we combine the variables of interest along with the full conditioning set as tests of possible channels through which the principal variable of interest works. For instance, we add the export Herfindahl to the Leamer regression as a test of whether whatever effect resource abundance has on growth may work through export concentration.

The diagnostics for the panel are those suggested by Blundell and Bond (1998): the Sargan test for overidentifying restrictions, implicitly a test of specification, and tests for second order serial correlation.[9]

In both the OLS and panel exercises, the key conditioning variables entered either with the expected sign or statistically insignificantly (results available on request). For instance, in most specifications initial GDP per capita enters negatively and significantly;

[9] With regressions in differences, however, first-order serial correlation is to be found by construction, so the relevant specification test is that of second-order serial correlation, which does support the reported results.

the stock of human capital enters positively and significantly; and the Sachs-Warner measure of openness enters positively and significantly.

Natural Resource Abundance

In cross section, the Leamer measure is never significant until the introduction of the IIT and Herfindahl in the final exercise, and then it is positive at the 10% level. The panel results are dramatically different suggesting the presence of the omitted variables and simultaneity biases discussed above. Net natural resource exports appear positively and significantly at the 10% level with the core conditioning variables. Including the capital accumulation variable increases the significance and magnitude somewhat, suggesting that there may be some depressing effect on human and physical capital accumulation. The terms of trade and macro stability variables have no important additional effect. Taken together, it is difficult to argue that these are important channels through which resources affect growth. Consistent with the cross sectional results, a larger increase does appear when the export Herfindahl or the IIT variable or both are added, suggesting that resource abundant countries may have more concentrated export structures, or have a lower incidence of IIT. Teasing out the implications of this must wait until these variables are examined on their own below. But the mystery now is no longer what the channels are through which resources reduce growth, but rather why, once we have controlled for these channels, resource abundance continues to have such a positive impact on growth. One possibility is through high rates of productivity growth which would be consistent with Martin and Mitra (2001).

The results are not very different with the Sachs and Warner proxy, resource exports over GDP. Resources never appear significantly with any conditioning set in cross section. This is not due to the shifting of the sample period forward ten years. When we replace Singapore's value with *net* exports, as they do, we again find Sachs and Warner's negative and significant impact of resources. Simply put, whatever the conceptual appeal of this measure, used in its unadjusted form in cross section it shows no impact.[10]

This conclusion changes in the panel context. Natural resource exports have no significance with the basic conditioning set, but adding the capital accumulation variables makes their impact *positive* and significant at the 10% level. This again suggests some depressing impact of resource exports on physical and human capital accumulation. Controlling for terms of trade variations increases both the magnitude and significance of the variable, suggesting that the fall in resource prices across this period did predictably have a depressing impact on growth. Adding the macro stability variables renders the resource variable again insignificant, however, suggesting that it is the association with unstable macro policies, rather than natural resources themselves which is driving the observed correlation. The export Herfindahl has little effect here, but the intra-industry trade variable again makes the resource variable significant and positive.

Export Concentration

For both measures of concentration, the cross section and panel results are somewhat more consistent. With the basic conditioning set, the export Herfindahl is of the same order of magnitude and negative in both regressions although only significant in cross section. Adding the capital accumulation variables increases the magnitude and makes concentration significant at the 1% level. In cross section the addition of new conditioning variables has limited effect on the coefficient value or significance. There is a marginally significant change in value of the OLS estimate with the introduction of the resource exports/exports variable. The panel findings, on the other hand, suggest a marginally significant positive impact of concentration on capital accumulation. Arguably, the largest impact of concentration, predictably, is through the terms of trade variable, whose inclusion reduces the magnitude and significance of the Herfindahl.

[10] With the Sach-Warner 1997b data, our sample of countries yields their results. Hence, the difference in findings is not due to the sample of countries.

The natural resources exports over total exports variable shows less similarity between the two estimation techniques. In cross section, it is uniformly negative and appears insensitive to the addition of any of the controls, or concentration measures or IIT measures. This would seem to suggest some intrinsic effect of a high natural resource concentration in exports that is not accounted for by any of the usual channels. However, again, the panel results cast some doubt on this conclusion. The variable enters negatively and significantly with the basic conditioning variables, however in both cases the Sargan statistic rejects the adequacy of the instruments, casting some doubt on the estimates. Giving the results the benefit of the doubt, the influence of natural resource exports over exports, as well as the evidence of misspecification, weakens with the introduction of the second conditioning set and it is difficult to know whether this reflects a previously unreliable result, or that a high resource concentration in exports has a deleterious effect on capital accumulation. The effect, and evidence of questionable instruments, disappears completely with the addition of the terms of trade variable and never reappears, thus suggesting that it is not so much natural resources per se, but the fact that their terms of trade fell during this period. Including macro stability, the Herfindahl index of export concentration and IIT variables do not substantially alter the finding that resource exports/exports is not a statistically significant variable. Finally, although we do not show this specification in Table 3b, it is worth noting that with the basic controls, plus factor accumulation, the inclusion of the export Herfindahl index alone eliminates the negative effect of export concentration in natural resources, but the Sargan test for that model remains unsatisfactory. Arguably concentration per se is negatively correlated with growth, but concentration in natural resources in particular, is not.

The broadly similar pattern of the coefficients across conditioning sets to that of the export Herfindahl raises the question of whether resource exports over exports is, in fact, simply a weak proxy for export concentration more generally. This is supported by the complete disappearance of the variable when the Herfindahl is added to the basic conditioning set. In the absolute most generous interpretation, the negative impact of natural resources is not happening through productivity growth as Sachs and Warner

(1995, 1999) among others argue, but through some combination of capital accumulation and terms of trade deterioration during 1980-2000.

Intra-industry trade

Both regression techniques suggest a positive impact of IIT as the literature suggests, although beyond this, they suggest somewhat different stories. In cross section, IIT has a positive and generally marginally significant impact that is relatively insensitive to the inclusion of additional control variables. The introduction of the export Herfindahl does push it across the 10% line into insignificance, but it is the resource exports/exports variable which renders it completely insignificant.

The panel results, however, find IIT significant with the basic conditioning variables, but it becomes insignificant with the introduction of the capital accumulation and terms of trade variables. This suggests that it is not IIT per se, but rather that the industries where it is high have enjoyed more capital accumulation. The introduction of the macro-stability proxy brings the significance of IIT back to the 1% level where it remains relatively insensitive to the resource variables. However, consistent with the OLS regressions, its true impact seems largely channeled through export concentration whose introduction obliterates any significance of IIT. This suggests that the importance of IIT in the Leamer regression arises more from it being a proxy for concentration than for economies of scale associated with product differentiation. This may also explain why the addition of all of the NR related variables increases both the magnitude and significance of IIT in the regression.

5. Conclusions

This paper suggests that trade variables related to natural resource abundance, export concentration and intra-industry trade affect growth. Further, many of its findings are sharply at odds with some of the conventional wisdom.

In the case of natural resources, Sachs and Warner's assertion that resource abundance adversely affects growth is found not to be robust to the chosen measure of resource abundance or estimation technique. The measure with the strongest theoretical foundation, Leamer's net natural resource exports per worker, is slightly significant in one specification in cross section, and strongly significant in the systems panel estimator, but always *positive*. This remains the case after controlling for several channels through which natural resources have been postulated to affect growth. Strikingly, broadly similar findings emerge using Sachs and Warner's measure of resource exports over GDP once enforcing a consistent processing of the data: there is no evidence in cross section of a negative impact of this variable on growth and in the panel systems estimator again it enters positively always, if not always significantly. At very least we should probably abandon the stylized fact that natural resource abundance is somehow bad for growth and even perhaps consider a research agenda on the channels through which they may have a positive effect, possibly, through inducing higher productivity growth.

Export concentration, both measured as a Herfindahl index and as natural resource exports as a share of exports has a predicted negative effect that is extremely robust in cross section but less so in the panel. The Herfindahl remains significant and negative with most control sets. However, the only specifications for which the resource export measure remains significant are poorly specified and the result disappears when the Herfindahl measure of overall concentration is included Arguably it is concentration per se, and not in natural resources in particular that is negatively correlated with growth.

Intra-industry trade shows positive impacts on growth as predicted by theory although the preferred specifications leave some doubt about whether the effect is really through the increased productivity effects postulated in the literature, or simply that countries with more IIT also tend to be more diversified.

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Figure 1a: Growth vs NR Net Exports/Labor Force: Period 1980-1999

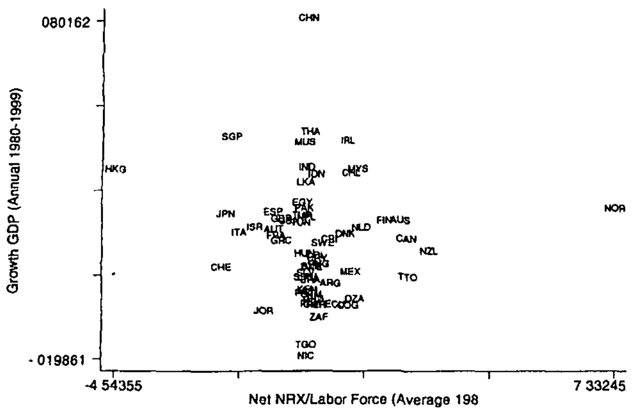

Figure 1b: Growth vs NR Exports/GDP: Period 1980-1999

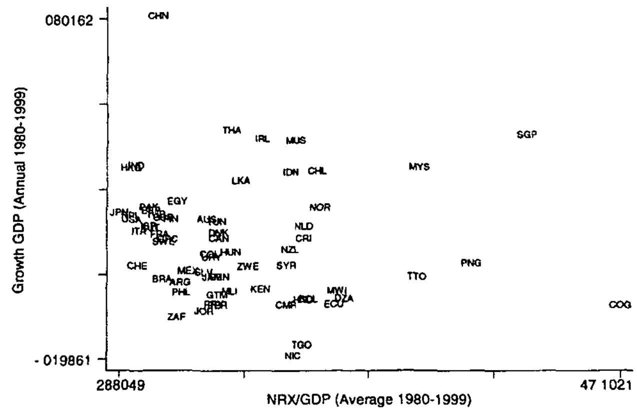

Figure 1c: Growth vs Export Herfindahl: Period 1980-1999

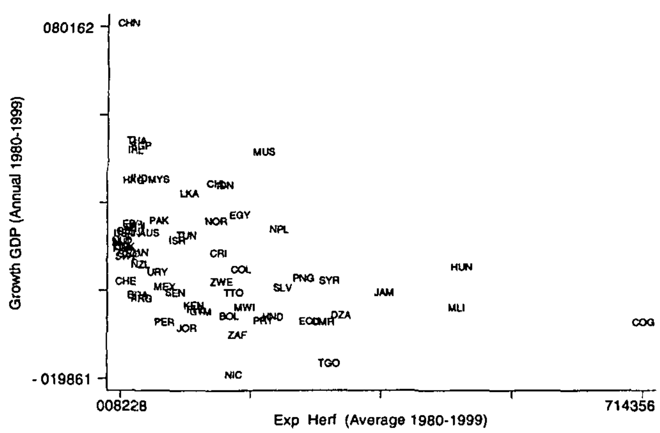

Figure 1d: Growth vs NR Exports/Total Merchandise Exports: Period 1980-1999

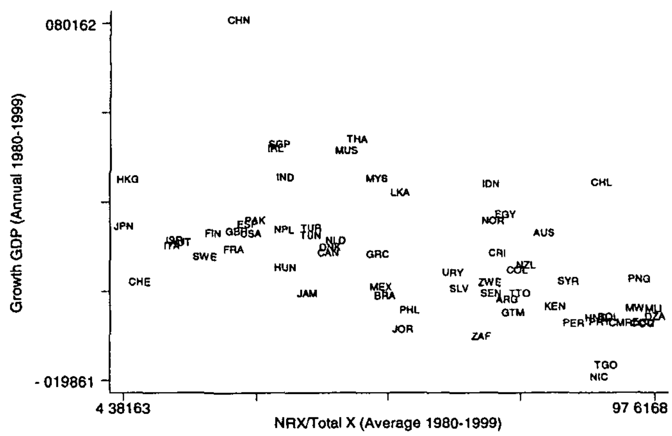

Figure 1e: Growth vs IIT: Period 1980-1999

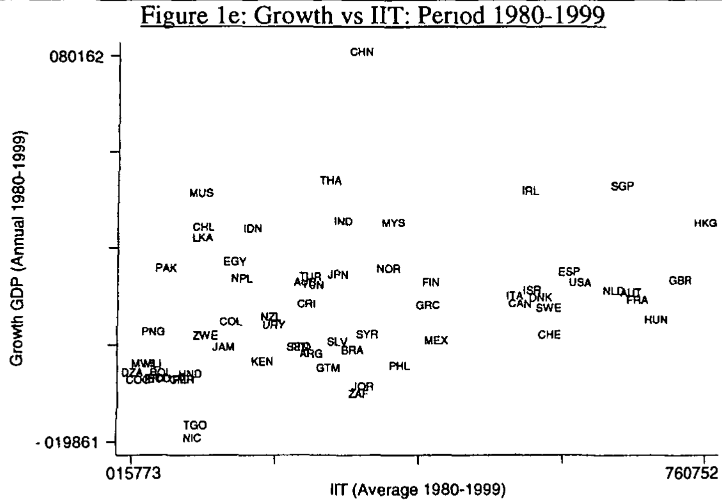

Table 1: Estimated Effect of Trade Structure on Growth
Cross Section, 1980-1999
Countries: 65

	Natural Resource Dependence				Export Concentration				Intra-Industry Trade	
	Net Exports/Labor force		NRX/GDP		Export Herfindahl		NRX/Total Exports		Grubel-Lloyd Index	
Basic Conditioning	-0.38		-0.89		-4.98	**	-3.66	***	3.26	*
+	(-0.20)		(-0 31)		(-2.02)		(-3 12)		((1.79)	
Capital Accumulation	-0.12		-3.66		-5.80	***	-3.10	***	3.09	**
+	(-0 47)		(-1 44)		(-3.72)		(-3.65)		(2.12)	
Growth in Terms of Trade	-0.35		-3.01		-5.62	***	-3.09	***	2.85	*
+	(-0.15)		(-1.29)		(-3.28)		(-3 51)		(1.99)	
Macro Stability	-0.09		-3.40		-6.50	***	-2.99	***	2.67	*
	(-0.878)		(-1.37)		(-3 92)		(-4 37)		(1.90)	
Additional Controls										
NRX/GDP					-6.52	***			2.23	*
					(-3.93)				(1.67)	
Leamer Index					-6.56	***			3.76	*
					(-3.85)				(1.88)	
Export Herfindahl	0.45		0.05				-2.10	***	1.86	
	(0.81)		(0.03)				(-2 69)		(1.63)	
NRX/Total Exports					-4.93	***			-0.20	
					(-3.91)				(-0.14)	
Intra-Industry Trade	1.40		-2.23		-6.03	***	-3.07	***		
	(1.43)		(-1 02)		(-4 68)		(-3.11)			
IIT+Export Herfindahl	1.56	*	0.92				-2.07	**		
	(1.79)		(0 60)				(-2 32)			

The dependent variable is the GDP per capita growth rate. Basic conditioning set includes the log of initial income of the period and a measure of openness (S&W). Capital accumulation includes average ratio of investment/GDP and log of years of schooling. Growth of terms of trade refers to the growth of the ratio of exports price index to import price index over the period. Macro stability includes the standard deviation of the real exchange rate over the period.
T-statistics shown in parenthesis.* significant at 10%, ** significant at 5%, *** significant at 1%

Table 2: Estimated Effect of Trade Structure on Growth
Panel Data (System Estimator), 1980-1999
Countries, Observations:65, 143

	Natural Resource Dependence						Export Concentration						Intra-Industry Trade		
	Net NRX/Labor Force			NRX/GDP			Export Herfindahl			NRX/Total Exports			Grubel-Lloyd Index		
		Sargan	Serial Corr		Sargan	Serial Corr		Sargan	Serial Corr.		Sargan	Serial Corr		Sargan	Serial Corr
Basic Conditioning	1.74 *	0.20	0.27	2.77	0.34	0.27	-4.57	0.18	0.31	-2.67 ***	0.04	0.22	10.49 ***	0.21	0.41
+	(1.84)			(0.89)			(-1.35)			(-3.77)			(2.87)		
Capital Accumulation	2.22 **	0.39	0.53	4.00 *	0.29	0.49	-6.08 ***	0.14	0.66	-1.65 *	0.06	0.41	2.09	0.22	0.57
+	(2 05)			(1 86)			(-3.72)			(-1 94)			(0 72)		
Growth of Terms of Trade	2.16 **	0.45	0.48	5.01 **	0.45	0.48	-2.93 *	0.19	0.61	-1.03	0.18	0.52	2.91	0.15	0.54
+	(2 13)			(2 44)			(-1 85)			(-1.46)			(1 11)		
Macro Stability	2.11 **	0.50	0.56	2.78	0.42	0.56	-5.59 ***	0.38	0.51	-0.59	0.32	0.56	6.76 ***	0.21	0.71
	(2 42)			(1 61)			(-3 85)			(-0 90)			(3 32)		
Additional Controls															
NRX/GDP							-6.00 ***	0.43	0.61				8.08 ***	0.39	0.72
							(-5 14)						(4 78)		
Leamer Index							-5.42 ***	0.42	0.61				8.33 ***	0.33	0.71
							(-4 31)						(5 80)		
Export Herfindahl	3.49 ***	0.42	0.61	1.88	0.43	0.61				-0.36	0.21	0.62	0.08	0.37	0.69
	(3 63)			(1 18)						(-0 72)			(0 39)		
NRX/Total Exports							-5.91 ***	0.21	0.62				10.55 ***	0.15	0.68
							(-5 50)						(5 6)		
Intra-Industry Trade	3.25 ***	0.33	0.71	4.47 **	0.39	0.72	-3.47 **	0.37	0.69	-0.57	0.15	0.68			
	(4 40)			(2 48)			(-2 22)			(-0 87)					
IIT+Export Herfindahl	3.07 ***	0.32	0.66	2.04	0.51	0.69				-0.34	0.14	0.65			
	(4.47)			(1 52)						(-0 62)					

The dependent variable is the GDP per capita growth rate. Basic conditioning set includes log of initial income of the period and a measure of openness (S&W) Capital accumulation includes average ratio of investment/GDP and log of years of schooling. Growth of terms of trade refers to the growth of the ratio of exports price index to import price index over the period. Macro stability includes the standard deviation of the real exchange rate over the period. Sargan refers to the p-value of the Sargan test for the validity of instruments, where the null hypothesis is the no-correlation between the instruments and the errors. Serial Corr. refers to the p-value of a second order serial correlation test, where the null hypothesis is the non-existence of second order serial correlation. Time dummies are included in all the regressions
T-statistics shown in parenthesis * significant at 10%, ** significant at 5%, *** significant at 1%.

APPENDIX

Definitions and Sources

Variables	Definition	Sources
Real Per Capita GDP and Growth Rates (1985 US$ PPP)	Ratio of total GDP to total population. GDP is in 1985 PPP-adjusted US$. Post 1990 GDP per capita growth rates are obtained from constant 1995 US$ per capita GDP series. Post 1990 GDP per capita levels were calculated applying growth rates to 1985 PPP-adjusted series.	Data provided by Loayza, Fajnzylber and Calderon (2002). Based on Summers and Heston (1991) and World Bank (2002)
NRX/Total Exports	Primary exports* divided by total merchandise exports	WDI and UN COMTRADE
NRX/GDP	Primary Exports* divided by GDP	WDI and UN COMTRADE
Net NRX/Labor Force	Net Primary Exports** divided by the labor force	WDI and UN COMTRADE
Openness(S&W)	Percentage of years with open economic regime	Sachs and Warner (1995)
Investment	Natural Log of the ratio of gross domestic investment (in 1995 US$) to GDP(in 1995 US$).	From Loayza, Fajnzylber and Calderon (2002)
Growth of Terms of Trade	Growth of the external terms of trade, defined as the ratio of an export price index to an import price index	WDI
Log Years of Schooling	Natural log of years of schooling	Barro and Lee (2000)
Real Exchange Rate Volatility	Standard deviation of monthly inter-annual changes in real effective exchange rates	Authors' construction using IMF and JP Morgan databases
Export Herfindahl	Herfindahl index of export value.	WDI and UN COMTRADE
Grubel-Lloyd IIT index.	Grubel and Lloyd intra industry trade index.	WDI and UN COMTRADE

* Primary Exports comprise the commodities in SITC sections 0,1,2 (excluding 22), 3,4 and 68.

**Net Primary Exports also include sections 63, 64 and 94

Descriptive Statistics

Panel Data

Variable	Countries	Obs.	Mean	Std Dev	Min	Max
Growth real GDP per capita	65	143	1.81	2.43	-4.69	10 19
Log of real GDP per capita	65	143	8.39	0.99	6.19	9.83
NRX/Total Exports	65	143	0.49	0.29	0.04	0.99
NRX/GDP	65	143	0.11	0 10	0.00	0.62
Net NRX/Labor Force	65	143	0.23	1 18	-7.30	11.11
Openness(S&W)	65	143	0.81	0.38	0.00	1.00
Investment	65	143	3.10	0.23	2.62	3.71
Growth of Terms of Trade	65	143	0.00	0.03	-0.13	0.06
Log Years of Schooling	65	143	1.68	0.58	-0.63	2.48
Real Exchange Rate Volatility	65	143	0.08	0.08	0.01	0.66
Export Herfindahl	65	143	0.11	0.13	0.01	0.74
Grubel-Lloyd IIT index.	65	143	0.30	0.21	0.01	0.83

Cross Section

Variable	Countries	Mean	Std Dev	Min	Max
Growth real GDP per capita	65	1.38	1.74	-1.99	8.02
Log of real GDP per capita	65	8.17	0.95	6.30	9.61
NRX/Total Exports	65	0.55	0.28	0.04	0.98
NRX/GDP	65	0.12	0.09	0.00	0.47
Net NRX/Labor Force	65	0.22	1.42	-4.54	7.33
Openness(S&W)	65	0.62	0.37	0.00	1.00
Investment	65	3.09	0.21	2.64	3.65
Growth of Terms of Trade	65	0.00	0.02	-0.07	0.02
Log Years of Schooling	65	1.47	0.67	-0.73	2.47
Real Exchange Rate Volatility	65	0.12	0.23	0.02	1.91
Export Herfindahl	65	0.13	0.13	0.01	0.71
Grubel-Lloyd IIT index.	65	0.30	0.21	0.02	0.76

List of Countries

	Country	Code		Country	Code
1	Argentina	ARG	33	Jordan	JOR
2	Australia	AUS	34	Japan	JPN
3	Austria	AUT	35	Kenya	KEN
4	Bolivia	BOL	36	Sri Lanka	LKA
5	Brazil	BRA	37	Mexico	MEX
6	Canada	CAN	38	Mali	MLI
7	Switzerland	CHE	39	Mauritius	MUS
8	Chile	CHL	40	Malawi	MWI
9	China	CHN	41	Malaysia	MYS
10	Cameroon	CMR	42	Nicaragua	NIC
11	Congo, Rep.	COG	43	Netherlands	NLD
12	Colombia	COL	44	Norway	NOR
13	Costa Rica	CRI	45	Nepal	NPL
14	Denmark	DNK	46	New Zealand	NZL
15	Algeria	DZA	47	Pakistan	PAK
16	Ecuador	ECU	48	Peru	PER
17	Egypt, Arab Rep.	EGY	49	Philippines	PHL
18	Spain	ESP	50	Papua New Guinea	PNG
19	Finland	FIN	51	Paraguay	PRY
20	France	FRA	52	Senegal	SEN
21	United Kingdom	GBR	53	Singapore	SGP
22	Greece	GRC	54	El Salvador	SLV
23	Guatemala	GTM	55	Sweden	SWE
24	Hong Kong, China	HKG	56	Syrian Arab Republic	SYR
25	Honduras	HND	57	Togo	TGO
26	Hungary	HUN	58	Thailand	THA
27	Indonesia	IDN	59	Trinidad and Tobago	TTO
28	India	IND	60	Tunisia	TUN
29	Ireland	IRL	61	Turkey	TUR
30	Israel	ISR	62	Uruguay	URY
31	Italy	ITA	63	United States	USA
32	Jamaica	JAM	64	South Africa	ZAF
			65	Zimbabwe	ZWE

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