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ABSTRACT

While openness to trade is a well-recognized hallmark of many successful emerging market economies known as "growth miracles," another component of the growth model is a leapfrogging strategy – the use of policies to guide the industrial structural transformation ahead of a country's factor endowment. Does the leapfrogging strategy work? Opinions vary but the evidence is scarce in part because it is more difficult to measure the degree of leapfrogging than the extent of trade openness. We undertake a systematic look at the evidence across countries to assess the efficacy of such a strategy. So far, there is no strong and robust evidence that this strategy works reliably. Future research can explore a number of refinements.

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1. Introduction

All countries want to grow fast on a sustained basis. In East Asia, for example, many economies excel in this area. Following Japan after World War II, the “four little dragons” – Korea, Singapore, Taiwan and Hong Kong – are by now familiar success stories. Many more economies in the region, including Malaysia, Thailand, and Indonesia, quickly followed, achieving higher growth rates than most other developing countries that had a comparable level of development in the 1960s. Since 2000, China, India and Vietnam are the new “growth miracles” – achieving the same high growth rates as their neighbors for 2-3 decades in a row.[1] Naturally, this record invites admiration and scrutiny. What is the Asian growth model? Is it something that can be transplanted to Latin America, Africa, or elsewhere, and have the same magic effect?

While the growth records of these economies are (almost) uncontroversial, what is responsible for the growth results is subject to debate. At the risk of over-simplification, we suggest that two aspects of these economies’ growth model merit particular attention. First, almost all high-growing emerging market economies since the 1970s embrace trade openness. Trade barriers are taken down or progressively reduced either at the start of the growth process or not long after the start of the process. Trade liberalization doesn’t have to take the narrow form of reducing tariff rates on imported goods, although that is often part of the process. It can take the form of de-monopolizing and de-licensing. While the right to import and export used to be concentrated in a small number of firms by government regulations, trade liberalization broadens the set of firms that could directly participate in international trade. Even holding tariff rates constant, such “democratization” of trading rights could dramatically increase a country’s trade openness. This was a significant part of the Chinese trade liberalization in the 1980s. Trade liberalization can also come in conjunction with reducing entry barriers or offering incentives for foreign firms to jump start the domestic export industry. This may be particularly important for those countries that have been isolated from the world market for a while. Sometimes, the Asian model is called an “outward-oriented strategy.” This is not very accurate since many Asian

[1] Myanmar (Burma) also consistently has reported double-digit real GDP growth rates every year since 2001, but international financial institutions and other observers appear to be somewhat skeptical about the reliability of the statistics. Chinese official growth rates are sometimes challenged for their veracity, although most scholars, economists of major international investment banks, and international financial institutions take the view that the officially released figures are reliable. (Or, if there is a bias, the bias could be either positive or negative.)

economies do not simultaneously embrace capital account openness, at least not by the same degree in the areas of cross-border portfolio equity and portfolio debt flows.

The second aspect of the growth model is the use of government policies to promote high-tech and high domestic value-added industries, presumably beyond what the economies would naturally develop if left to their own devices. This aspect may be labeled as a leapfrogging strategy. China, Singapore, and Malaysia all have various aggressive policies to promote certain high value added sectors. Other countries in the region do not wish to fall behind. For example, Philippines' National Information Technology Council announced in 1997: "Within the first decade of the 21st Century, the Philippines will be a knowledge center in the Asia Pacific region: the leader in IT education, in IT-assisted training, and in the application of information and knowledge to business, professional services, and the arts."

Are these two aspects responsible for the growth success? The first aspect – the role of trade openness in economic growth – has been subject to extensive (and intensive) scholarly scrutiny. While there is notable skepticism (Rodriguez and Rodrik, 2000), most economists read the evidence as suggesting that trade openness does help to promote economic growth. Following and extending the work by Frankel and Romer (1999), Feyrer (2009), in a recent paper that pays attention to sorting out causality from correlation, again shows that greater trade openness causally leads to a rise in income. Using changes in infant mortality and life expectancy as an alternative measure of well-being, Wei and Wu (2004) present evidence that trade openness helps to improve social welfare by reducing infant mortality and raising life expectancy to a degree beyond raising per capita income. Based on an overwhelming amount of evidence, we lean strongly toward believing that trade openness has played a key role in the success stories in Asia, and indeed in most high and sustained growth episodes in the world.

How about the second aspect of the growth model? Has a leapfrogging strategy played a key role as well? In comparison to the trade openness issue, there is far less scholarly work on the effectiveness of a leapfrogging strategy. In theory, if the production of sophisticated goods generates positive externalities via learning-by-doing, then there generally would be an under-investment among private economic agents relative to the socially optimal level. A leapfrogging strategy – a government-led industrial policy that tilts resource allocation to technologically sophisticated industries – could correct this market failure. The natural inference from this argument suggests that a country may benefit more from exporting sophisticated products than from exporting unsophisticated and low domestic value-added products, even if its comparative advantage in the current time is to produce the latter type of goods. Recent academic studies have reported evidence supporting such comparative advantage-defying development strategy. In Hausman, Hwang, and Rodrik (2007) (henceforth, abbreviated as HHR), the authors suggest that some export goods have higher spillover effects than others. They develop a measure of export sophistication and find that a positive relationship exists between their measure and the country's subsequent economic growth rate. However, there is no shortage of skepticism toward the leapfrogging growth strategy. On one hand, one might question the size of any such market failure in the real world if there is one. On the other hand, one might wonder whether the existence of a "government failure," if it were to pursue a leapfrogging strategy, could overwhelm whatever benefits a country may derive from correcting the market failure. In a series of papers, including Lin (2009), the World Bank chief economist Justin Lin advocates strongly for development strategies that follow a country's comparative advantage, and against what he calls "comparative advantage defying strategies" which include a leapfrogging industrial policy. (At the same time, Lin is open to the idea of a government role in helping private firms to find "latent comparative advantage" (Lin, 2010).)

In this paper, we aim to test the validity of the leapfrogging hypothesis with fresh evidence from a cross-country data set. One bottleneck in testing this hypothesis is to identify which countries (regions) engage in such a growth strategy.[2] We employ four different measures including a new indicator that is based on the proportion of identifiable high-tech products in a country's exports.

Overall, it is difficult to find strong and robust evidence that a leapfrogging strategy contributes to a higher growth rate. In other words, the empirical investigation does not support the contention that a government intervention that is aimed at raising a country's technological sophistication beyond what is expected of its level of development could produce a better growth result on a sustained basis.

There are important caveats for our approach that should be borne in mind when interpreting the results. Our measures of a country's leapfrogging strategy are based on its export data. To the extent that a country's export structure may not accurately capture its production structure, we may have missed some true leapfrogging strategies. In addition, the efficacy of a

[2] Literature review of previous tests of the hypothesis will be added in the next revision.

leapfrogging strategy could be more subtle than what is being tested in this paper. For example, it is conceptually possible that only when several policy instruments are implemented as a package can the positive effect of a leapfrogging strategy be detected. Because of these qualifications, we view the current paper as a stepping stone toward a more comprehensive examination of the leapfrogging strategy.

The paper is organized as follows. Section 2 discusses our measures of leapfrogging. Section 3 examines the empirical connections between technological leapfrogging and economic growth rate. Section 4 concludes.

2. Statistical Specification and Leapfrogging Measurement

A key to this exercise is to assess whether a country pursues a leapfrogging strategy, and, if it does, what the degree of leapfrogging is. Ideally, we would want to compare a country's actual production structure with what would have been predicted based on its factor endowment. There are two challenges. First, data on production structure by an internationally comparable classification are not available for most countries, especially developing countries for which evaluating the efficacy of a leapfrogging strategy is most pertinent. Second, even when internationally comparable production data are available, one gets only a relatively coarse classification, with less than 100 sectors. Many differences in the economic structure do not reveal themselves at such an aggregate level. For example, many countries have electronics industries, but different types of electronic products may have very different levels of skill content. We address these challenges by looking at trade data instead. Generally speaking, a country's export structure closely resembles its production structure. Trade data are available for a much larger set of economies (over 250 in the WITS database). At the most detailed and still internationally comparable level (Harmonized System 6-digit, there are over 5000 products a country can export (or import). To control for the "normal" amount of sophistication based on a country's factor endowment, we include a country's income and education levels as controls in a growth regression framework.

In the rest of the section, we first review two existing measures of export sophistication in the literature, and propose two additional measures that may address some shortcomings of the existing measures. We then describe the data that we use to implement the measures. Finally, we conduct some simple "smell checks" to see how well these measures capture those countries that are commonly reported as having a leapfrogging industrial policy.

2.1 Regression specification

We consider a growth regression specification of the following type:

$$LnGDPc_{it+k} - LnGDPc_{it} = \alpha_0 + \alpha_1 LnGDPc_{it} + \alpha_2 ExpSophis_{it} + X_{it}\Gamma + \omega_{it} \qquad (1)$$

The left-hand-side variable measures the growth rate for country *i* from year t to year *t+k*. In most cases, we examine the growth performance from 1992 to 2003. $LnGDPc_{it}$ denotes the natural log of per capita GDP for country i in year t, $ExpSophis_{it}$ denotes the level of economic sophistication measured using trade data, and X_{it} is a vector of other control variables. Coefficient α_2 measures the impact of leapfrogging policies.

2.2 Measures of a country's industrial sophistication based on export data

While it is difficult to directly measure a country's industrial sophistication, in part because the standard industrial classification is too coarse for this purpose, the existing literature has considered proxies based on the data on a country's export bundles. The idea is that, leaving aside non-tradable goods, the structure of the export bundle should mimic that of production. One measure is the level of income implied in the export bundle, introduced in Hausmann, Hwang, and Rodrik (2007). This measure builds on the concept that the degree of sophistication in a country's exports can be inferred by the income level of each good's exporter. The second measure is the Export Dissimilarity Index (EDI), introduced by Schott (2007) and adopted by Wang and Wei (2010), which gauges the distance between a country's export structure and that of high-income economies such as Japan, the U.S. and the European Union (EU15). Both measures assume that higher income countries, on average, produce more sophisticated products. One can avoid making this arbitrary assumption, and focus on the degree of technological sophistication of the product itself, based on a classification of high-tech "advanced technology products" (ATP) that comes from the OECD and the United States.

Income implied in a country's export bundle (EXPY)

This indicator of export sophistication is a measure of the typical income associated with a given country's export basket. For every good, one can compute the "typical income" (PRODY) of the countries that export the good, or the weighted average of the income levels across the exporters of this good, with weights proportional to the value of the exports by countries. For any given exporter, one can look at its export basket and compute the weighted average of the typical income levels across all products in the basket, with the weights proportional to the value of each good in the basket. The key underlying assumption here is that advanced countries produce more sophisticated goods and poorer countries produce less sophisticated goods.

$$PRODY_i = \sum_k^n \frac{s_{ik}}{\sum_j s_{ij}} \bullet Y_k \quad (1)$$

$$EXPY_k = \sum_i s_{ik} \bullet PRODY_i \quad (2)$$

Where s_{ik} is the share of country *k*'s exports in product i, Y_k is country *k*'s per capita GDP. Table 1 displays the summary statistics for the EXPY over the time period 1992-2006.

There are two major merits of this index. First, it does not require one to tediously sift through and classify goods as "sophisticated goods" or "high tech products." Second, it can be computed easily with data in trade flows and GDP per capita. But it also has several weaknesses. First, the key assumption underlying PRODY, that more advanced countries produce sophisticated goods, may not be true. Advanced countries often produce a larger set of goods than poor countries. Furthermore, larger countries also produce a larger set of goods than smaller countries. These features suggest that the PRODY index may over-weight advanced and large countries. Second, the index may conceal diversity in the quality and type of goods in finer details within a product category. Third, the index fails to capture processing trade, where a country imports sophisticated product parts to produce the final sophisticated product. This is the case in China, where a significant share of sophisticated exports is based on processing trade. Given the weaknesses of the EXPY index, we construct the following index in hopes of avoiding some of its pitfalls.

Unit value adjusted implied income in the export bundle - Modified EXPY

In this modified version of the EXPY index, we discount the PRODY of each good by the ratio of the unit value of the exporter to the mean unit value of the same goods in G3 (The United States, Great Britain, and Germany) countries.

$$PRODY_i = \sum_k^n \frac{s_{ik}}{\sum_j s_{ij}} \bullet Y_k \bullet \frac{v_{ik}}{v_{iG3}} \quad (3)$$

The modified EXPY is computed similarly as in the original EXPY index in equation (2).

The motivation of this modification is our belief that the unit value data adds an additional layer of differentiation among goods of different quality or varieties. This can take account of the diversity within the 6-digit HS category. The assumption behind this modification is that unit value is a proxy for quality, and the G3 countries export higher quality goods.

Since we only have unit value of products at the 6-digit HS level across the world for 2005, we apply the same unit value discount factor to the PRODY during our whole sample period. Table 2 shows the summary statistics of this modified EXPY.

Distance to the export bundle by high-income countries

We define an index for a lack of sophistication by the dissimilarity between the structure of a country (city)'s exports and that of the G3 economies or the export dissimilarity index (EDI), as:

$$EDI_{rft} = 100(\sum_i abs(s_{irt} - s_{i,t}^{ref})) \quad (4)$$

where $$s_{irt} = \frac{E_{irt}}{\sum_i E_{irt}} \quad (5)$$

where s_{irft} is the share of HS product *i* at the 6-digit level in a country (city) *r*'s exports at year *t*, and $s_{i,t}^{ref}$ is the share of HS product *i* in the 6-digit level exports of G3 developed countries. The greater the value of the index, the more dissimilar the compared export structures are. If the two export structures were identical, then the value of the index would be zero; if the two export structures were to have no overlap, then the index would take the value of 200. We regard an export structure as more sophisticated if the index takes a smaller value. Alternatively, one could use the similarity index proposed by Finger and Kreinin (1979) and used by Schott (2006) (except for the scale):

$$ESI_{rft} = 100\sum_i min(s_{irft},\ s_{i,t}^{ref}) \tag{6}$$

This index is bounded by zero and 100. If a country (city) *r*'s export structure had no overlap with that of the G3 developed countries, then ESI would be zero; if the two export structures had a perfect overlap, then the index would take the value of 100. It can be verified that there is a one-to-one, linear mapping between ESI and EDI:

$$ESI_{rft} = \frac{200 - EDI_{rft}}{2} \tag{7}$$

Share of Advanced Technology Products in total exports – ATP share

Besides the measures already in the literature, we also propose a new measure on the share of high-tech products in a country's exports bundle that does not require assuming that richer countries automatically export more sophisticated products.

$$ATPSH_{it} = 100\frac{EXP_{it}^{ATP}}{EXP_{it}^{TOT}} \tag{8}$$

where EXP_{it}^{ATP} is exports of ATP of country i at time t, EXP_{it}^{TOT} is total exports of country *i* at time t. This measure of export sophistication requires us to specifically define what is meant by "high-tech exports"; thus it sacrifices EXPY's simplicity.

To compute this measure, one needs an expert definition of which product is high-tech. Two lists of expert definitions are well respected. One is developed by the U.S. Census Bureau, which identified about 700 product categories as "Advanced Technology Products" (ATP) from about 20,000 10-digit HS codes used by the United States. The other is developed by the Organization for Economic Co-operation and Development (OECD), which identified 195 product categories from 5-digit SITC codes as "high tech" products. Because the Harmonized System classification (HS) is more detailed and is cross-country comparable at the 6-digit level, we concord both lists into 6-digit HS product categories. We convert the OECD "high tech" product list to 328 6-digit HS codes based on concordance between SITC (rev3) and HS (2002) published by the United Nations Statistical Division.

To condense the U.S. Census ATP list from 10-digit HS to 6-digit HS, we first calculate the ATP value share in both U.S. imports from the world at the HS-6 level based on U.S. trade statistics in 2006, bearing in mind that within each HS-6 heading, some of the U.S. HTS-10 lines are considered to be ATP and others are not. We choose two separate cutoff points. For a narrow ATP definition, we select the 6-digit HS categories which the ATP share is 100 percent in total U.S. imports from the world according to the Census ATP list, which resulted in 92 HS-6 lines. For a wider ATP definition, we select the 6-digit HS categories which the ATP share is at least 25 percent in total U.S. imports from the world, which resulted in 157 HS-6 lines. We use the 6-digit HS code in which all products are in the Census ATP list and also in the OECD "high tech" product list as our narrow definition of ATP. For a wider ATP definition, we deem an HS-6 line as ATP when either it is in the OECD high-tech product list or at least 25 percent of its value is ATP products in U.S. imports from the world according to the Census ATP list.

The recent literature also documents significant variations within the same product. Although both developed and developing countries may export products under the same 6-digit HS code, their unit value usually varies significantly, largely reflecting the difference in quality between their exports. To allow for the possibility that a very large difference in the unit values may signal different products (that are misclassified as in the same 6-digit category), we take unit value for all products from Japan, EU15 and the United States (G3) in our narrow ATP definition as reference, and any products with unit value below the G3 unit value minus 5 times standard deviation will not be counted as ATP. This gives our third definition of ATP.

2.3 Data and Basic Facts

The EXPY measure requires data on trade flow and GDP per capita. We computed EXPY for both a short and a long sample. For the short sample, dating from 1992 to 2006, the data on country exports come from the United Nations' COMTRADE database, downloaded from the World Integrated Trade Solution (WITS). The data from 1992 to 2006 is at the 6 digit HS (1988/1992 version) covering 5016 product categories and 167 countries. For the long sample, dating from 1962-2000, the trade flow data are taken from the NBER-UN data compiled by Feenstra et al., which could be downloaded from the NBER website. The data is at 4 digit SITC, revision 2, covering 700 to more than 1000 product categories and 72 countries. The GDP per capita data on PPP basis is taken from the Penn World Table.

The modified EXPY measure in addition requires data on unit value. The data are obtained from Ferrantino, Feinberg, and Deason (2008), which in turn are obtained from the United Nations' COMTRADE database. The data is only for the year 2005, and is cleaned of products that do not have well defined quantity units, have inconsistent reporting, have small value, or have unit value belonging to a 2.5 percent tail of the distribution of the product's unit values. In total, the resulting unit value dataset covers 3628 6-digit HS subheadings.

The other two export sophistication indices – EDI and ATP share (narrow, broad) – are computed excluding HS Chapters 1-27 (agricultural and mineral products) as well as raw materials and their simple transformations (mostly at HS 4-digit level) in other HS chapters. A list of excluded products is reported in Appendix Table 1. Each country's ATP exports share is computed by the country's ATP exports divided by its total manufacturing exports. Our sample of countries is listed in Appendix Table 2.

The other explanatory variables included in the growth regressions are human capital, GDP per capita, and institutional quality. The human capital variable in the cross country regressions uses the average school year in the Barro-Lee education database. GDP per capita is on PPP basis and taken from the Penn World Table. The institutional quality variable is proxies by the government effectiveness index downloaded from the World Bank and Transparency International websites.[3]

3. Do Leapfroggers Grow Faster? An Examination of Cross-country Evidence

3.1 The Elusive Growth Effect of a Leapfrogging Strategy

Since Hausman et al. (2007) is the most recent and the best known paper that is supposed to have provided an empirical foundation for the proposition that a leapfrogging strategy as measured by a country's export sophistication delivers a faster economic growth rate, we start our statistical analysis by taking a careful look at their specification, with a view to check the robustness of their conclusion. In particular, we follow their econometric strategy, regressing economic growth rate across countries on a leapfrogging measure and other control variables that are typically included in empirical growth papers. After replicating their regressions with EXPY

[3] http://www.worldbank.org/wbi/governance/govdata/ and http://ww1.transparency.org/surveys/index.html#cpi .

as the leapfrogging proxy, we use the alternative measures discussed above – modified EXP, the EDI indicator, and the ATP shares.

Table 1 shows our replication of the HHR's cross-section regressions for the short sample of 1992-2003 (corresponding to their Table 8). The controls include human capital and a measure of institutional quality. Since the source of their "rule of law" index is not clearly stated, we use four other well-known institution variables: corruption, government effectiveness, regulation quality, and the CPI score. In the OLS regressions, the coefficients on the first three institution measures are significant; in particular, the coefficient on regulation quality (0.013) is close to HHR's coefficient on their rule of law index (0.011). Columns 1, 2, 7, and 8 in Table 1 can be compared to the corresponding regression in HHR's Table 8; the coefficients on the initial GDP per capita and human capital variables are basically the same as HHR's. While the coefficients on log initial EXPY have different magnitudes than HHR's results for the same sample period of 1992-2003, they are all statistically significant (though not as strong, depending on the institution variable) and are positive as HHR's. A possible explanation for this difference in the size of the coefficients is that trade data for the countries in the 1992-2003 sample has been revised since their usage. The bottom line from this replication exercise is that their results can be replicated.

In the next step, we replace the EXPY variable with alternative measures of export sophistications—modified EXPY, EDI, and the ATP shares—and re-estimated the regressions. The results for each of these respective variables are displayed in Tables 2-5. In Table 2, the coefficient on the modified EXPY is statistically insignificant in all but the first specification with only human capital as control, even as the direction of the coefficients and significance on initial GDP per capita, human capital, and institution variables remains the same as in Table 1. This observation extends to the case where either EDI or the broad definition of ATP is used as the export sophistication measure, as shown in Tables 3 and 4. However, the coefficient on the ATP share using a more stringent definition is positively significant across all specification. We will show in the next section that even this result is not robust.

To summarize, the positive association between a country's export sophistication and economic growth rate is not a strong and robust pattern of the data. In particular, alternative measures of export sophistication often produce statistically insignificant coefficients. For example, a reasonable adjustment to the HHR measure of sophistication by taking into account possible differences in unit values when computing the implied income in an export bundle would render the positive association to disappear. We therefore infer that it may be too early to conclude that pursuing a leapfrogging strategy would raise a country's growth rate.

3.2 Does growth in sophistication lead to growth in income?

It is possible that the level of a country's export sophistication may not capture well policy incentives or other government actions. In particular, if a country pursues an education policy that generates an unusually large pool of scientists and engineers, its level of export sophistication may surpass what can be predicted based solely on its income or endowment. A useful alternative empirical strategy is to look at the *growth* of a country's export sophistication. Holding constant the initial levels of export sophistication, would those that have an unusually fast increase in sophistication also have an unusually high rate of economic growth?

In Table 6**,** we rank the 49 countries in our sample by descending order in the pace of the growth of their export sophistication. As a smell test, we pay particular attention to where Ireland and China fit by this metric as both countries are often said to be examples of extensive government programs to promote industrial transformation toward high-tech industries. While all five measures are able to capture China as having experienced a high level of change in its export sophistication, only the modified EXPY variable is able to capture both China and Ireland as having undergone a significant change in export sophistication. This again strengthens our confidence in the relative adequacy of the modified EXPY against the original EXPY in capturing leapfrogging in industrial structure.

Table 7 displays the regression results with this specification for all five export sophistication measures and their changes over the period 1992-2003. The initial GDP level, human capital, and institution variable all have the correct signs. None of the export sophistication growth variables enters significantly into the regression. But the most conspicuous observation is the initial export sophistication measures: all but the EXPY variable are insignificant with this specification. In contrast to the previous specification, the ATP share is no longer significant either. This once again shows that when export sophistication is constructed in alternative ways, it no longer indicates significant impact on growth. To summarize, these results cast doubt on the view that leapfrogging leads to higher growth.

3.3 Panel regressions with instrumental variables

The cross section regressions assume that productivity growth is the same for all countries except for differences in the leapfrog policies. As an extension that relaxes this assumption, we turn to a panel analysis with separate country fixed effects. New challenges emerge with the panel analysis: one has to deal with shorter time intervals and has to have instrumental variables that have meaningful time series variations.

We do not have clever instrumental variables. For lack of better ones, we experiment with the idea that professional background and educational preparedness of a political leader may affect his/her choice of economic strategy, and are therefore candidates for instrumental variables. The idea is imported from Dreher, Lamla, Lein, and Somogyi (2009). After constructing a database of profession and education for more than 500 political leaders from 73 countries for the period 1970-2002, these authors find that pro-market reforms are more likely to be proposed and implemented by leaders who are former entrepreneurs and former scientists. Educational background sometimes has an influence but the effect is not robust. We follow their approach and in fact borrow their data set. One set of dummies codify the educational background for chief executives: law, economics, politics, natural science, and other. Another set of dummies codify the professions of chief executives before they take office: entrepreneur, white collar, blue collar, union executive, and science, economics, law, military, politician, and others. We use this set of variables as instruments for export sophistication.

These instruments are not ideal. In the first stage regressions (not reported), we cannot confirm the findings by Dreher et al (2009) that former entrepreneurs or former scientists-turned politicians do things differently in the context of a leapfrogging strategy. However, there is some evidence that leaders who are former blue collar workers or former labor union executives are more likely to pursue a leapfrogging strategy (when leapfrogging is measured by the criterion of EDI). There is also some evidence that life-time politicians are more likely to pursue a leapfrogging strategy.

The Durbin-Wu-Hausman chi-square test fails to reject the null that the OLS and the IV estimates are different (with a p-value of 0.50). This might imply that there is no significant endogeneity issue in the current context, and that an IV approach is not necessary. On the other hand, the F statistics (for the null that all regressors are jointly zero) is only 3.08. So we cannot rule out the possibility that these leader background variables are weak instruments.

For what it is worth, Table 8 shows the second-stage growth regression results for the long sample of 1970-2000, for using EXPY and EDI as measures of export sophistication. Unfortunately, we cannot use the ATP shares as they are not available for early years. Panel A shows the results for using EXPY as export sophistication. To compare with the analysis in Hausman et al., our sample starts a few years later (as opposed to their 1962-2000). Our OLS estimation closely replicates their estimates: the coefficient on initial GDP per capita is negative and significant at –0.001, the coefficient on initial EXPY is positive and significant at 0.02, and the coefficient on human capital is positive and significant at 0.01. In the fixed effects and IV specifications, neither of the coefficients on initial EXPY is significant, despite the improved Hansen-J statistics given our set of instruments. The R-squared of our regression for the OLS case is more than twice as large as theirs, despite the similarities in the estimates. Panel B shows the results for the same regression except replacing EXPY with EDI. None of the export sophistication variables are significant, while the initial GDP per capita and human capital variables are both significant. We conclude that in the panel regressions, there is no strong and robust support for the notion that a leapfrogging strategy promotes growth (subject to the caveat that we may not have found powerful instruments).

5. Conclusion

To be able to transform an economy's economic structure ahead of its income level toward higher domestic value added and more sophisticated sectors is desirable in abstract. Many governments have pursued policies to bring out such transformations. To be sure, there are examples of individual success cases – promotion of a certain industry by government policies that result in an expansion of that industry. However, any such policy promotion takes away resources from other industries, especially those that are consistent with the country's factor endowment and level of development. On balance, the effect is conceptually less clear. Given the popularity of such leapfrogging strategies, it is important to evaluate empirically if they work. Unfortunately, such an evaluation is difficult because it is not straightforward to quantify the degree of leapfrogging an economy may exhibit. Typical data on production structures are not refined enough. Most relevant policies are not easily quantifiable or comparable across countries.

One way to gauge the degree of leapfrogging is by inferring from a country's detailed export data. This paper pursues this strategy. It develops a number of different ways to measure leapfrogging from revealed sophistication in a country's exports, recognizing that any particular measure may have both advantages and shortcomings.

After a whole battery of analyses, a succinct summary of the findings is a lack of strong and robust support for the notion that a leapfrogging industrial policy can reliably raise economic growth. Again, there may be individual success stories. But there are failures. If leapfrogging is a policy gamble, there is no systematic evidence that suggests that the odds are favorable.

We conclude by noting again two distinct aspects of a growth model that embraces the world market. The first aspect is export orientation – an investment environment with few policy impediments to firms participating in international trade. While this paper does not reproduce the vast quantity of analysis on this, we do not doubt its validity. The second aspect is leapfrogging – the use of policy instruments to engineer a faster industrial transformation than what may emerge naturally based on an economy's stage of development and factor endowment. We cast some doubt on how effective such a strategy is empirically.

There is important follow-up research to be done. First, part of the leapfrogging strategy works on the "import side," which our current empirical strategy doesn't capture fully – for example, the use of tariff and other policies to reduce imports of high-tech or high-value added products in order to give domestically produced substitutes some space. One can imagine ways in which such a strategy could backfire. But a systematic examination of the data would be useful. Second, while a leapfrogging strategy may not work in general, there are moderate or subtle version of the strategy that aims not to defy comparative advantage generally, but to explore "latent comparative advantage" – the economical structure that a country would have evolved into naturally in the next stage. Is a pattern of "latent comparative advantage" identifiable and explorable on a systematic basis? We leave these topics for future research.

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Table 1: Cross National Growth Regressions Using EXPY as Proposed by Hausman et al, 1992-2003

Dependent variable: growth rate of GDP per capita over 1992-2003

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
log initial GDP/cap	-0.011	-0.02	-0.025	-0.026	-0.03	-0.023	-0.009	-0.017	-0.025	-0.025	-0.024	-0.02
	[0.005]*	[0.007]**	[0.007]**	[0.006]**	[0.007]**	[0.007]**	[0.006]	[0.011]	[0.012]*	[0.010]*	[0.011]*	[0.012]
log initial EXPY	0.036	0.029	0.025	0.019	0.03	0.027	0.031	0.023	0.023	0.016	0.025	0.023
	[0.011]**	[0.011]*	[0.010]*	[0.010]	[0.010]**	[0.011]*	[0.014]*	[0.015]	[0.012]	[0.011]	[0.013]	[0.014]
log human capital		0.033	0.028	0.026	0.021	0.029		0.03	0.029	0.024	0.016	0.029
		[0.012]*	[0.012]*	[0.010]*	[0.010]*	[0.013]*		[0.017]	[0.015]*	[0.012]*	[0.012]	[0.016]
corruption			0.008						0.008			
			[0.003]*						[0.004]			
government effectiveness				0.013						0.013		
				[0.003]**						[0.004]**		
regulation quality					0.021						0.018	
					[0.005]**						[0.006]**	
cpi score						0.002						0.001
						[0.001]						[0.002]
Constant	-0.193	-0.114	-0.023	0.041	-0.029	-0.066	-0.168	-0.079	-0.014	0.054	-0.019	-0.057
	[0.066]**	[0.072]	[0.065]	[0.074]	[0.061]	[0.070]	[0.078]*	[0.080]	[0.064]	[0.069]	[0.062]	[0.072]
Observations	52	42	42	42	42	42	52	42	42	42	42	42
R-squared	0.24	0.35	0.41	0.5	0.53	0.38						
Hansen J							0.93	1.69	1.61	0.82	0.35	1.95
Chi-sq p-value							0.33	0.19	0.2	0.36	0.56	0.16

Table 2: Alternative Measure of Export Sophistication – Unit Value Adjusted Implied Income in the Export Bundle: Modified EXPY, 1992-2003

Dependent variable: growth rate of GDP per capita over 1992-2003

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
log initial GDP/cap	-0.004	-0.016	-0.02	-0.023	-0.022	-0.018	-0.005	-0.017	-0.032	-0.034	-0.031	-0.022
	[0.004]	[0.006]*	[0.006]**	[0.006]**	[0.007]**	[0.006]**	[0.005]	[0.011]	[0.017]	[0.012]**	[0.013]*	[0.016]
log initial modified EXPY	0.011	0.009	0.004	-0.001	0.004	0.006	0.012	0.01	0.006	-0.001	0.005	0.008
	[0.004]**	[0.006]	[0.006]	[0.006]	[0.007]	[0.006]	[0.004]**	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
log human capital		0.033	0.03	0.027	0.025	0.031		0.035	0.041	0.038	0.033	0.035
		[0.014]*	[0.013]*	[0.011]*	[0.012]	[0.014]*		[0.023]	[0.024]	[0.016]*	[0.018]	[0.024]
corruption			0.009						0.013			
			[0.003]*						[0.009]			
government effectiveness				0.016						0.021		
				[0.004]**						[0.007]**		
regulation quality					0.019						0.024	
					[0.007]*						[0.010]*	
cpi score						0.002						0.002
						[0.002]						[0.003]
Constant	-0.024	0.037	0.123	0.195	0.144	0.077	-0.023	0.038	0.188	0.264	0.193	0.085
	[0.029]	[0.043]	[0.052]*	[0.061]**	[0.052]**	[0.050]	[0.029]	[0.048]	[0.125]	[0.103]*	[0.086]*	[0.089]
Observations	52	42	42	42	42	42	52	42	42	42	42	42
R-squared	0.17	0.28	0.34	0.45	0.4	0.3						
Hansen J							0.11	1.05	1.22	0.66	0.13	1.49
Chi-sq p-value							0.74	0.31	0.27	0.42	0.72	0.22

Robust standard errors in brackets; Instruments for IV regressions are log(population) and log(land) ; * significant at 5%; ** significant at 1%

Table 3: Cross National Growth Regressions with ATP Share (Narrow Definition), 1992-2003

Dependent variable: growth rate of GDP per capita over 1992-2003												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
log initial GDP/cap	-0.002	-0.015	-0.021	-0.023	-0.022	-0.019	-0.008	-0.017	-0.033	-0.026	-0.03	-0.026
	[0.003]	[0.006]*	[0.007]**	[0.007]**	[0.007]**	[0.007]*	[0.006]	[0.015]	[0.019]	[0.014]	[0.020]	[0.020]
initial ATP share (narrow)	0.087	0.076	0.069	0.049	0.056	0.07	0.112	0.083	0.077	0.05	0.055	0.081
	[0.026]**	[0.027]**	[0.024]**	[0.027]	[0.023]*	[0.025]**	[0.034]**	[0.030]**	[0.022]**	[0.025]*	[0.022]*	[0.024]**
log human capital		0.036	0.03	0.027	0.026	0.031		0.041	0.042	0.03	0.035	0.039
		[0.014]*	[0.013]*	[0.011]*	[0.013]	[0.014]*		[0.032]	[0.023]	[0.018]	[0.023]	[0.026]
corruption			0.009						0.015			
			[0.003]**						[0.009]			
government effectiveness				0.014						0.015		
				[0.004]**						[0.008]*		
regulation quality					0.018						0.024	
					[0.006]**						[0.015]	
cpi score						0.003						0.004
						[0.002]						[0.004]
Constant	0.054	0.098	0.164	0.181	0.172	0.129	0.105	0.112	0.241	0.198	0.225	0.173
	[0.030]	[0.036]**	[0.045]**	[0.043]**	[0.042]**	[0.044]**	[0.056]	[0.071]	[0.119]*	[0.088]*	[0.124]	[0.111]
Observations	52	42	42	42	42	42	52	42	42	42	42	42
R-squared	0.13	0.32	0.41	0.49	0.44	0.36						
Hansen J							0	0.59	0.16	0.02	0.07	0.72
Chi-sq p-value							0.97	0.44	0.69	0.88	0.78	0.4

Robust standard errors in brackets; Instruments for IV regressions are log(population) and log(land) ; * significant at 5%; ** significant at 1%

Table 4: Cross National Growth Regressions with ATP Share (Broad) as a Measure of Sophistication, 1992-2003

Dependent variable: growth rate of GDP per capita over 1992-2003												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
log initial GDP/cap	-0.002	-0.014	-0.021	-0.023	-0.023	-0.019	-0.007	-0.018	-0.033	-0.028	-0.03	-0.027
	[0.004]	[0.006]*	[0.007]**	[0.006]**	[0.007]**	[0.007]*	[0.006]	[0.014]	[0.017]	[0.013]*	[0.017]	[0.018]
initial ATP share (broad)	0.056	0.041	0.035	0.019	0.031	0.036	0.074	0.049	0.046	0.022	0.034	0.048
	[0.022]*	[0.026]	[0.023]	[0.023]	[0.020]	[0.024]	[0.028]**	[0.028]	[0.020]*	[0.020]	[0.020]	[0.022]*
log human capital		0.036	0.029	0.027	0.025	0.031		0.044	0.041	0.031	0.032	0.039
		[0.014]*	[0.013]*	[0.011]*	[0.013]	[0.014]*		[0.030]	[0.023]	[0.018]	[0.021]	[0.026]
corruption			0.01						0.015			
			[0.003]**						[0.008]			
government effectiveness				0.015						0.017		
				[0.004]**						[0.007]*		
regulation quality					0.019						0.024	
					[0.006]**						[0.012]	
cpi score						0.003						0.004
						[0.002]						[0.003]
Constant	0.055	0.097	0.164	0.183	0.178	0.129	0.094	0.118	0.244	0.212	0.222	0.18
	[0.032]	[0.036]*	[0.045]**	[0.041]**	[0.043]**	[0.044]**	[0.049]	[0.067]	[0.108]*	[0.082]**	[0.104]*	[0.101]
Observations	52	42	42	42	42	42	52	42	42	42	42	42
R-squared	0.09	0.26	0.36	0.46	0.41	0.31						
Robust standard errors in brackets												
* significant at 5%; ** significant at 1%												
Hansen J							0.03	1.2	0.48	0.23	0.01	1.34
Chi-sq p-value							0.85	0.27	0.49	0.63	0.91	0.25

Robust standard errors in brackets; Instruments for IV regressions are log(population) and log(land) ; * significant at 5%; ** significant at 1%

Table 5: Cross National Growth Regressions with EDI as a Measure of Leapfrogging, 1992-2003

Dependent variable: growth rate of GDP per capita over 1992-2003												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
log initial GDP/cap	-0.005	-0.017	-0.024	-0.026	-0.025	-0.021	-0.007	-0.02	-0.035	-0.034	-0.03	-0.031
	[0.004]	[0.007]*	[0.007]**	[0.006]**	[0.007]**	[0.007]**	[0.004]	[0.008]*	[0.010]**	[0.008]**	[0.011]**	[0.009]**
log initial EDI	-0.025	-0.011	-0.001	0.008	-0.007	-0.002	-0.029	-0.012	-0.011	0.002	-0.01	-0.011
	[0.012]*	[0.014]	[0.012]	[0.010]	[0.014]	[0.013]	[0.015]*	[0.017]	[0.014]	[0.011]	[0.015]	[0.015]
log human capital		0.038	0.029	0.027	0.026	0.03		0.044	0.043	0.036	0.031	0.044
		[0.014]**	[0.013]*	[0.011]*	[0.013]*	[0.014]*		[0.019]*	[0.017]*	[0.014]*	[0.016]	[0.018]*
corruption			0.012						0.016			
			[0.004]**						[0.005]**			
government effectiveness				0.018						0.021		
				[0.004]**						[0.005]**		
regulation quality					0.019						0.023	
					[0.007]**						[0.010]*	
cpi score						0.004						0.005
						[0.002]*						[0.002]*
Constant	0.213	0.174	0.195	0.165	0.233	0.162	0.248	0.197	0.318	0.246	0.286	0.264
	[0.081]*	[0.104]	[0.095]*	[0.083]	[0.108]*	[0.097]	[0.103]*	[0.122]	[0.114]**	[0.085]**	[0.130]*	[0.111]*
Observations	52	41	41	41	41	41	52	41	41	41	41	41
R-squared	0.09	0.23	0.37	0.48	0.36	0.31						
Hansen J							0.97	1.36	1.26	0.39	0.15	2.08
Chi-sq p-value							0.33	0.24	0.26	0.53	0.7	0.15

Robust standard errors in brackets; Instruments for IV regressions are log(population) and log(land) ; * significant at 5%; ** significant at 1%

Table 6: Ranking Growth in Export Sophistication, 1992-2003

Ranking	**Country**	**EXPY**	**Country**	**Modified EXPY**	**Country**	**ATP (narrow)**	**Country**	**ATP (broad)**	**Country**	**EDI**
1	Hungary	3.14	Ireland	5.54	Malaysia	1.50	Malaysia	2.01	Australia	-2.32
2	Bangladesh	3.12	Hungary	4.44	Iceland	1.41	Hungary	1.93	Korea, Rep.	-1.70
3	Kenya	3.05	Madagascar	4.38	China	1.20	China	1.88	Oman	-1.56
4	Madagascar	2.78	Kenya	3.55	Singapore	1.09	Finland	1.31	Hungary	-1.50
5	Korea, Rep.	2.10	Ecuador	3.41	Netherlands	0.88	Singapore	1.10	Mexico	-1.46
6	Thailand	2.07	Indonesia	3.22	Hungary	0.56	Korea, Rep.	1.09	Kenya	-1.45
7	China	2.03	South Africa	3.12	Indonesia	0.50	Iceland	1.08	Greece	-1.42
8	Trinidad and Tobago	1.96	Bangladesh	3.04	Thailand	0.49	Netherlands	1.04	Thailand	-1.40
9	Paraguay	1.89	Singapore	3.01	Korea, Rep.	0.40	Indonesia	0.95	Indonesia	-1.38
10	Singapore	1.83	China	2.98	Mexico	0.33	Mexico	0.93	Turkey	-1.35
11	Turkey	1.82	Brunei	2.98	Portugal	0.33	Thailand	0.70	Portugal	-1.28
12	Colombia	1.50	Turkey	2.91	St. Lucia	0.20	Greece	0.64	Ecuador	-1.09
13	Iceland	1.40	Malaysia	2.87	Tunisia	0.16	Croatia	0.61	China	-1.02
14	Malaysia	1.37	Thailand	2.61	Switzerland	0.15	Switzerland	0.59	India	-1.00
15	Cyprus	1.30	Korea, Rep.	2.29	Australia	0.15	Brazil	0.54	Spain	-0.98
16	Bolivia	1.24	Greece	2.05	Finland	0.15	Denmark	0.49	Saudi Arabia	-0.96
17	Portugal	1.24	Portugal	1.96	Bolivia	0.13	Portugal	0.45	Malaysia	-0.79
18	Croatia	1.16	Cyprus	1.94	Sweden	0.13	St. Lucia	0.42	Colombia	-0.73
19	Greece	1.15	Colombia	1.78	Greece	0.11	Australia	0.39	Sweden	-0.63
20	Finland	1.12	Tunisia	1.75	Kenya	0.09	New Zealand	0.39	Denmark	-0.59
21	India	1.08	Croatia	1.70	Croatia	0.09	Paraguay	0.30	Paraguay	-0.55
22	Ecuador	1.01	Mexico	1.67	India	0.08	Tunisia	0.26	New Zealand	-0.54
23	Mexico	0.99	Iceland	1.41	New Zealand	0.08	Sweden	0.24	Romania	-0.51
24	Indonesia	0.90	Sri Lanka	1.35	Denmark	0.07	Romania	0.21	Iceland	-0.50
25	Sri Lanka	0.86	New Zealand	1.24	Cyprus	0.05	Kenya	0.20	St. Lucia	-0.48
26	South Africa	0.86	St. Lucia	1.15	Romania	0.05	India	0.15	Brazil	-0.46
27	Switzerland	0.65	Australia	1.06	Algeria	0.04	Bolivia	0.14	Cyprus	-0.46
28	Australia	0.63	India	1.06	Saudi Arabia	0.03	Algeria	0.14	Japan	-0.43
29	New Zealand	0.54	Netherlands	1.04	Paraguay	0.03	Saudi Arabia	0.10	Tunisia	-0.42
30	Oman	0.52	Switzerland	0.98	Ecuador	0.03	Turkey	0.08	South Africa	-0.40
31	Ireland	0.31	Finland	0.93	Peru	0.01	Chile	0.05	Croatia	-0.39
32	Brazil	0.27	Denmark	0.91	Chile	0.01	Spain	0.03	Sri Lanka	-0.37
33	Tunisia	0.27	Bolivia	0.88	Turkey	0.01	Peru	0.02	Canada	-0.36
34	Denmark	0.27	Paraguay	0.80	Bangladesh	0.00	Japan	0.02	Peru	-0.31

35	Japan	0.25	Spain	0.67	South Africa	0.00	Bangladesh	0.01	Singapore	-0.25
36	Sweden	0.25	Peru	0.66	Belize	0.00	Belize	0.01	Bolivia	-0.22
37	Netherlands	0.20	Brazil	0.24	Trinidad and Tobago	0.00	Trinidad and Tobago	0.00	Algeria	-0.07
38	St. Lucia	0.20	Japan	0.24	Brunei	0.00	Canada	0.00	Brunei	-0.01
39	Spain	0.20	Sweden	0.17	Jamaica	0.00	Brunei	0.00	Bangladesh	-0.01
40	Canada	0.17	Algeria	0.11	Spain	-0.01	Jamaica	-0.01	Netherlands	0.00
41	Chile	0.07	Chile	0.09	Japan	-0.01	Ecuador	-0.02	Chile	0.00
42	Algeria	0.01	Macao	-0.22	Colombia	-0.02	Madagascar	-0.02	Switzerland	0.01
43	Brunei	-0.03	Canada	-0.37	Madagascar	-0.02	Sri Lanka	-0.03	Belize	0.02
44	Saudi Arabia	-0.07	Belize	-0.42	Brazil	-0.03	Cyprus	-0.05	Trinidad and Tobago	0.04
45	Jamaica	-0.25	Saudi Arabia	-0.50	Sri Lanka	-0.04	Colombia	-0.05	Finland	0.11
46	Macao	-0.40	Oman	-0.51	Macao	-0.06	Ireland	-0.08	Madagascar	0.14
47	Romania	-0.68	Romania	-0.91	Ireland	-0.15	South Africa	-0.10	Jamaica	0.16
48	Peru	-0.84	Trinidad and Tobago	-2.74	Canada	-0.24	Macao	-0.13	Ireland	0.34
49	Belize	-1.09	Jamaica	-3.17	Oman	-0.25	Oman	-0.23	Macao	0.48

Table 7: Cross National Growth Regressions, with Growth in Export Sophistication as Key Regressor

Dependent variable: growth in real GDP per capita, 1992-2003

	(1)	(2)	(3)	(4)	(5)
Log initial GDP per capita	-0.028	-0.02	-0.02	-0.02	-0.02
	[0.005]**	[0.005]**	[0.005]**	[0.005]**	[0.005]**
Human Capital	0.016	0.021	0.022	0.019	0.023
	[0.010]	[0.011]	[0.010]*	[0.010]	[0.011]
Regulation quality	0.018	0.015	0.015	0.016	0.018
	[0.006]**	[0.007]*	[0.006]*	[0.006]*	[0.007]*
Log initial EXPY	0.032				
	[0.009]**				
Growth in log EXPY	0.252				
	[0.240]				
Log initial modified EXPY		0.005			
		[0.005]			
Growth in log modified EXPY		0.081			
		[0.153]			
Initial ATP share (narrow)			0.04		
			[0.031]		
Growth in ATP share (narrow)			0.891		
			[0.567]		
Initial ATP share (broad)				0.026	
				[0.023]	
Growth in ATP share (broad)				0.731	
				[0.388]	
Initial log EDI					-0.001
					[0.015]
Growth in log EDI					-0.003
					[0.407]
Constant	-0.06	0.12	0.16	0.162	0.17
	[0.070]	[0.052]*	[0.033]**	[0.033]**	[0.095]
Observations	41	41	41	41	39
R-squared	0.51	0.36	0.44	0.43	0.33

Robust standard errors in brackets; * significant at 5%; ** significant at 1%

Table 8: Long Sample, Panel Regressions with Fixed Effects

A. EXPY

5-year panels

	(1)	**(2)**	**(3)**
	OLS	FE	IV
log initial GDP/cap	-0.0103	-0.0479	-0.0113
	[0.0027]**	[0.0060]**	[0.0104]
log initial EXPY	0.0208	0.0027	0.0223
	[0.0055]**	[0.0091]	[0.0423]
log human capital	0.0116	-0.0102	0.0088
	[0.0027]**	[0.0065]	[0.0078]
Constant	-0.059	0.3688	-0.0573
	[0.0379]	[0.0788]**	[0.3033]
Observations	640	640	369
R-squared	0.39	0.47	
First stage F stat			1.35
Hansen J-statistics (p-value)			0.186

B. EDI

5-year panels			
	(1)	(2)	(3)
	OLS	FE	IV
log initial GDP/cap	-0.0065	-0.0517	-0.0097
	[0.0026]*	[0.0062]**	[0.0054]
Initial log EDI	-0.0117	0.004	-0.0271
	[0.0071]	[0.0191]	[0.0180]
log human capital	0.0128	-0.0256	0.0081
	[0.0030]**	[0.0079]**	[0.0041]*
Constant	0.1555	0.4266	0.2709
	[0.0473]**	[0.1136]**	[0.1222]*
Observations	475	475	314
R-squared	0.43	0.59	
First stage F stat			3.08
Hansen J-statistics (p-value)			0.089

* significant at 5%; ** significant at 1%; Robust standard errors in brackets; The instruments are professions and educational background of political leaders from Dreher, Lamla, Lein, and Somogyi (2008).

Appendix Table 1: HS products excluded from export data

HS Code	Description	HS Code	Description
01-24	Agricultural products	25-27	Mineral products
4103	Other raw hides and skins (fresh, o	8002	Tin waste and scrap.
4104	Tanned or crust hides and skins of	8101	Tungsten (wolfram) and articles the
4105	Tanned or crust skins of sheep or l	8102	Molybdenum and articles thereof, in
4106	Tanned or crust hides and skins of	8103	Tantalum and articles thereof, incl
4402	Wood charcoal (including shell or n	8104	Magnesium and articles thereof, inc
4403	Wood in the rough, whether or not s	8105	Cobalt mattes and other intermediate
7201	Pig iron and spiegeleisen in pigs,	8106	Bismuth and articles thereof, inclu
7202	Ferro-alloys.	8107	Cadmium and articles thereof, inclu
7204	Ferrous waste and scrap; remelting	8108	Titanium and articles thereof, incl
7404	Copper waste and scrap.	8109	Zirconium and articles thereof, inc
7501	Nickel mattes, nickel oxide sinters	8110	Antimony and articles thereof, incl
7502	Unwrought nickel.	8111	Manganese and articles thereof, inc
7503	Nickel waste and scrap.	8112	Beryllium, chromium, germanium, van
7601	Unwrought aluminium.	8113	Cermets and articles thereof, inclu
7602	Aluminium waste and scrap.	9701	Paintings, drawings and pastels, ex
7801	Unwrought lead.	9702	Original engravings, prints and lit
7802	Lead waste and scrap.	9703	Original sculptures and statuary, i
7901	Unwrought zinc.	9704	Postage or revenue stamps, stamp-po
7902	Zinc waste and scrap.	9705	Collections and collectors' pieces
8001	Unwrought tin.	9706	Antiques of an age exceeding one hundred years
530521	Coconut, abaca (Manila hemp or Musa	811252	Beryllium, chromium, germanium, van

Appendix Table 2: Countries (165) included in the sample used in cross country regression

Code	Reporting Country	# Year reported	Code	Reporting Country	No. Year reported	Code	Reporting Country	No. Year reported
ABW	Aruba	5	GBR	United Kingdom	14	NCL	New Caledonia	8
AIA	Anguila	6	GEO	Georgia	11	NER	Niger	11
ALB	Albania	11	GHA	Ghana	10	NGA	Nigeria	8
AND	Andorra	12	GIN	Guinea	8	NIC	Nicaragua	14
ARG	Argentina	14	GMB	Gambia, The	12	NLD	Netherlands	15
ARM	Armenia	9	GRC	Greece	15	NOR	Norway	14
AUS	Australia	15	GRD	Grenada	14	NPL	Nepal	5
AUT	Austria	13	GRL	Greenland	13	NZL	New Zealand	15
AZE	Azerbaijan	11	GTM	Guatemala	14	OMN	Oman	15
BDI	Burundi	14	GUY	Guyana	10	PAK	Pakistan	4
BEL	Belgium	8	HKG	Hong Kong, China	14	PAN	Panama	12
BEN	Benin	8	HND	Honduras	13	PER	Peru	14
BFA	Burkina Faso	10	HRV	Croatia	15	PHL	Philippines	11
BGD	Bangladesh	12	HTI	Haiti	6	PNG	Papua New Guinea	6
BGR	Bulgaria	11	HUN	Hungary	15	POL	Poland	13
BHR	Bahrain	7	IDN	Indonesia	15	PRT	Portugal	15
BHS	Bahamas, The	6	IND	India	15	PRY	Paraguay	15
BIH	Bosnia and Herzegovina	4	IRL	Ireland	15	PYF	French Polynesia	11
BLR	Belarus	9	IRN	Iran, Islamic Rep.	10	QAT	Qatar	7
BLZ	Belize	15	ISL	Iceland	15	ROM	Romania	15
BOL	Bolivia	15	ISR	Israel	12	RUS	Russian Federation	11
BRA	Brazil	15	ITA	Italy	13	RWA	Rwanda	10
BRB	Barbados	10	JAM	Jamaica	13	SAU	Saudi Arabia	14
BRN	Brunei	9	JOR	Jordan	12	SDN	Sudan	12
BTN	Bhutan	4	JPN	Japan	15	SEN	Senegal	11
BWA	Botswana	7	KAZ	Kazakhstan	7	SER	Yugoslavia	11
CAF	Central African Republic	13	KEN	Kenya	11	SGP	Singapore	15
CAN	Canada	15	KGZ	Kyrgyz Republic	9	SLV	El Salvador	13
CHE	Switzerland	15	KHM	Cambodia	5	STP	Sao Tome and Principe	8
CHL	Chile	15	KIR	Kiribati	6	SUR	Suriname	6
CHN	China	15	KNA	St. Kitts and Nevis	13	SVK	Slovak Republic	13
CIV	Cote d'Ivoire	12	KOR	Korea, Rep.	15	SVN	Slovenia	13
CMR	Cameroon	10	LBN	Lebanon	8	SWE	Sweden	15
COK	Cook Islands	4	LCA	St. Lucia	15	SWZ	Swaziland	6
COL	Colombia	15	LKA	Sri Lanka	9	SYC	Seychelles	11
COM	Comoros	10	LSO	Lesotho	5	SYR	Syrian Arab Republic	6
CPV	Cape Verde	10	LTU	Lithuania	13	TCA	Turks and Caicos Isl.	6
CRI	Costa Rica	13	LUX	Luxembourg	8	TGO	Togo	12
CUB	Cuba	8	LVA	Latvia	13	THA	Thailand	15
CYP	Cyprus	15	MAC	Macao	14	TTO	Trinidad and Tobago	15
CZE	Czech Republic	14	MAR	Morocco	14	TUN	Tunisia	15
DEU	Germany	15	MDA	Moldova	11	TUR	Turkey	15
DMA	Dominica	13	MDG	Madagascar	15	TWN	Taiwan, China	10
DNK	Denmark	15	MDV	Maldives	12	TZA	Tanzania	10
DZA	Algeria	15	MEX	Mexico	15	UGA	Uganda	13
ECU	Ecuador	15	MKD	Macedonia, FYR	13	UKR	Ukraine	11
EGY	Egypt, Arab Rep.	13	MLI	Mali	11	URY	Uruguay	13

ESP	Spain	15	MLT	Malta	13	USA	United States	15
EST	Estonia	12	MNG	Mongolia	11	VCT	St. Vincent and the Grena	14
ETH	Ethiopia(excludes Eritrea	11	MOZ	Mozambique	7	VEN	Venezuela	13
FIN	Finland	15	MSR	Montserrat	8	VNM	Vietnam	6
FJI	Fiji	6	MUS	Mauritius	14	WSM	Samoa	5
FRA	France	13	MWI	Malawi	13	ZAF	South Africa	15
FRO	Faeroe Islands	11	MYS	Malaysia	15	ZMB	Zambia	12
GAB	Gabon	13	NAM	Namibia	7	ZWE	Zimbabwe	6