A Review of Trade Liberalization and its Aftermath

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AND ITS AFTERMATH

ABSTRACT

Large barriers to international trade were gradually but systematically and substantially reduced across the world in recent decades. Virtually all countries moved away from trade policies designed to promote import substitution to development strategies that embraced international trade as the main avenue for prosperity. Trade policy restrictions are still significant in most developing countries, but their trade regimes are substantially more open than they were decades ago.

Even though a return to the Imports Substitution Industrialization (ISI) Strategy is not part of mainstream economics today, such seismic reorientation in trade policies across the world has not been without criticism. This thesis addresses three important areas of questioning about these trade liberalizations and their aftermath. Have there been enduring negative effects on some economic segments of the population because of lifting import restrictions? Is state interventionism a needed requirement to thrive under the new export-oriented environment that followed ISI? Are we accurately measuring the magnitude of trade liberalizations? While all these questions have already been addressed through different angles, this thesis proposes new answers based on new perspectives.

The first chapter, co-authored with Yothin Jinjarak (Senior Economist at the Asian Development Bank), contributes to the literature that seeks to identify, at the district level, the impact of increased import competition linked to import tariff reductions in developing

countries by accounting for spillovers from neighboring districts. As opposed to other district level assessments that are based on liberalization events in the 1990s, we focus on a later trade liberalization event (in Peru in 2008-10) for which there are very comprehensive datasets and during which there were no simultaneous structural reforms that could blur the relation between trade liberalization and its outcomes. With these improvements on board, commonly used OLS regressions find an unexpected positive impact of tariff reductions on import-competing districts, which contradicts the findings in related studies for other countries. We find some evidence that significant migration in response to tariff reductions could be affecting OLS estimation and note that spatial panel techniques may partly control for the migration reaction to enhanced trade exposure and for trade-related spillovers. And, in fact, we do identify the expected negative effect of increased import-competition under a spatial panel estimation framework. We thus conclude that accounting for spillovers is an important methodological improvement over existing estimation techniques, as there can be significant spillovers among localities not only through trade but also through migration. This may be very important in studying numerous developing countries with high labor informality and no legal restrictions to migration.

This first chapter was started in 2013 under guidance of Professor Beata Javorcik. Initially, the intended main contribution was simply to provide an analysis of trade liberalization in a developing country with no legal restrictions to migration, as opposed to India, the country studied in the seminal analysis of Topalova (2005, 2010). However, Kovak (2013) and Dix-Carneiro and Kovak (2017) analyses on the 1990s trade liberalization in Brazil, a developing country without legal restrictions to migration, took away the novelty initially expected for this chapter. Yet, I noted that these studies on Brazil mainly relied on formal sector surveys and that

labor market legislation in Brazil is relatively rigid. In addition, the trade liberalization event in Brazil was simultaneous to other major structural reforms including on the labor market and I also noted the possibility of significant spillovers among localities (especially within Brazil's large cities) that were not accounted for in any related study. Considering time constraints, I reached out to a former co-author, Yothin Jinjarak, to work on this chapter, splitting between us the data gathering and econometric work (we both worked on both aspects). In contrast to the study on Brazil, our study on Peru relies on household surveys that include both formal and informal sectors. Another important difference is that the share of informal labor in Peru's labor force is about twice as high as in Brazil, thus suggesting higher de facto labor mobility. The main contribution of our study is the use of spatial panel regression techniques that allow for a better understanding of potential spillovers through inter-localities trade or migration.

Lack of a clear link between general economic fundamentals and export diversification indicators has backed the believe that diversification necessarily requires heterodox/industrial policies, which were also key components of ISI strategies. The second chapter of this thesis, however, does find a strong connection between horizontal policies and export diversification by making two substantial changes to traditional estimation methodologies. Noting that indices commonly used as dependent variables are exogenously determined by natural resource abundance, it focuses instead on export categories that lead to diversification (for example, manufacturing exports). And besides including productivity-related independent variables, it adds gravity equation and labor costs related variables, in line with international trade theory. Income per capita is introduced to control for endogeneity. Regression fits are higher than in other studies and coefficients more robust. Proximity to other economies explains close to a third of cross-country heterogeneity of dependent variables, and four fifths when adding

horizontal policies (mainly governance, education, infrastructure, and trade policy openness). New role models of diversification policies arise including Australia, Chile, and New Zealand.

This chapter was started recently, in 2018, responding to intense discussion in the international trade policy literature on the need to diversify export baskets in a vast number of countries that are over dependent on hydrocarbon or mineral commodities. The chapter has just been published as an IMF Working Paper (cited in chapter two) and, per request of the head of the IMF Western Hemisphere Department, will be summarized and published as an IMF blog and used to develop a toolkit for IMF country teams to assess policies that promote export diversification. Although I include this research as a second chapter of my thesis, I believe its contribution to the economic literature is by no means less important than the first one.

Given significant criticism to studies on the economic impact of trade liberalization because of measurement error of the strength of the liberalization, chapter three proposes a methodological improvement by focusing on the import reaction to liberalization. Measuring the degree of trade liberalization has traditionally involved measuring the restrictiveness of trade policies before and after reforms, but existing measures of restrictiveness are either imprecise or not available for years in which the most significant liberalization episodes occurred. This chapter takes a different approach in measuring the degree of import liberalizations and their economic impact. It estimates an index that reflects the strength of liberalizations based on the evolution of imports right after liberalization, after controlling for other determinants of imports through a demand equation. To illustrate its potential use, the resulting index is incorporated into a traditional growth regression setting that aims to estimate the impact of liberalization on economic growth.

This third chapter is a combination of analysis presented in two chapters for my D.Phil. confirmation in 2006, and which I worked under the guidance of Professor Gavin Cameron. I used part of this analysis for a World Bank Working Paper (cited in chapter three) coauthored with World Bank Senior Consultant, Mr. Ataman Aksoy, but chapter three is fully based on work developed by myself before working with Mr. Aksoy. The working paper with Mr. Aksoy was recently cited and commented in a review of the trade and growth literature by Dartmouth College Professor Irwin Douglas (cited in chapter three). I decided to combine these two thesis chapters into one because they are complementary to each other and because I have two other pieces of research (chapter one and two) that I would like to include in my thesis to strengthen it.

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CHAPTER 1

ACCOUNTING FOR THE SPILLOVER EFFECTS OF TRADE LIBERALIZATION[1]

1. INTRODUCTION

The impact of increased imports competition on local-level socioeconomic outcomes in developing countries (for example, on consumption, unemployment, and informality) has been the focus of recent research and discussion (notably, Topalova, 2010; Autor and others, 2013; Dix-Carneiro and Kovak, 2017). Although the conclusions from these studies are broadly in line with the theoretical a priori that increased exposure to imports competition is associated with less favorable socioeconomic outcomes at the district level, some of these studies suggest unexpectedly long periods of adjustment to these shock events. Such thought-provoking findings though require addressing some methodological weaknesses to strengthen their validity. Summing up, these empirical exercises could be questioned because of: (i) potentially omitted variables from not accounting for simultaneous structural reforms; (ii) omitted variables from not accounting for simultaneous changes in non-tariff barriers whose effects on local-level trade exposure are harder to measure than those of tariff changes; [2] (iii) measurement error from reliance on datasets that integrate samples taken through different methodologies, use industry codes with limited disaggregation, exclude the very significant informal sector, and/or have relatively few observations (a major drawback when analyzing subsamples); and (iv) unaccounted spillovers from changes in trade exposure and economic outcomes in neighboring localities, as shown in this paper.

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[1] Co-authored with Yothin Jinjarak, Senior Economist at the Asian Development Bank.

[2] Non-tariff coverage ratios are only rough measures of trade restrictiveness.

Most of these drawbacks can be addressed by focusing on the recent and substantial trade liberalization episode in Peru during the 2000s, more significantly between 2008 and 2010. No other major economic reforms took place in Peru during this period as its structural adjustment process was largely completed during the 1990s. As opposed to trade liberalization in the 1990s, the liberalization during the 2000s was centered on tariff reductions not on lowering non-tariff barriers and, therefore, change in trade exposure is more accurately measured than in other studies. Another advantage of focusing on this liberalization episode is the availability of annual household surveys since the early 2000s, which provides a methodologically homogeneous database with more disaggregated industry codes, and a more comprehensive set of indicators and coverage including both formal and informal workers. Moreover, tariff data since the 2000s is available by tariff line and import country source on an annual basis, further allowing to sharpen the measure of trade exposure.

A first interesting finding is that, as we address these drawbacks, OLS panel regression methodologies do not identify a significant impact of trade liberalization on socioeconomic indicators of import-competing districts. We hypothesize that the high mobility of the largely informal Peruvian labor force could be affecting OLS estimation, as we identify in the data a significant migration response to increased import-competition pressure.[3] This could suggest that other developing countries with similarly high informality and no other significant restrictions to mobility could adjust faster to the shock of trade liberalization.

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[3] Mobility in informal labor markets is not only expected to be higher than in formal markets because of the absence of hiring and firing restrictions, but also because there is evidence of higher entry/exit in informal firms than in formal ones (see for example, Gong and others, 2000).

A second important finding is that once we use spatial panel estimation to account for potential spillovers from neighboring districts, we find that: (i) district-specific weighted tariff reductions lower consumption per capita, and increase unemployment and informality; and (ii) socioeconomic developments in neighboring districts have a significant effect on districts' socioeconomic outcomes. This confirms that changes in socioeconomic indicators and/or trade exposure in one locality likely have significant implications on consumers and firms in nearby localities that needs to be accounted to improve estimation. It may also suggest that a locality that experiences increased trade exposure from trade liberalization could partly alleviate this pressure through outbound migration. This can be particularly important in urban areas, which agglomerate several localities and closely link their markets.

Section 2 reviews related studies on within-country variation in trade exposure and discusses main findings, identifying some methodological weaknesses and dependency on idiosyncratic factors, mainly on labor mobility, which underscore the need for precision in estimations. Section 3 presents the proposed methodology of this paper while Section 4 presents estimates of trade exposure and socioeconomic indicators in Peruvian districts. Section 5 estimates the impact of tariff reduction under OLS and under the spatial panel regressions proposed in the methodological section. Section 6 provides concluding remarks.

2. LITERATURE REVIEW

Lower restrictions to international trade are expected to increase domestic output as a country specializes along its comparative advantages, gains access to larger economies of scale, and benefits from technological absorption. Yet, as the standard economic analysis of international trade suggests, these overall benefits partly involve the reallocation of production factors

through an adjustment process that can significantly reduce the income of some economic agents. Reductions in import restrictions allow foreign production to improve its price in the domestic market and put pressure on the income of factors involved in local production. Restrictions or frictions to factors' mobility and their reallocation to internationally competitive sectors can considerably strengthen and extend this negative effect.

Thus, while increasing integration of the global economy has pulled a large share of the world out of poverty, there is increasing concern about its negative impact on some segments of the population, especially among the poor. Following a period in which empirical analysis largely focused on estimating the impact of trade integration on output growth, studies on its impact on poverty and specific economic sectors gradually gained prominence. Several studies focused on the impact of liberalization on overall poverty. Initially main cross-country studies did not find a significant relation between liberalization and poverty (for example, Krueger, 1983; Dollar and Kraay 2001; Beck and others, 2007), but some later studies found evidence of a poverty-reducing impact of liberalization conditional on other factors such as institutional settings (see Sindzingre, 2005; Haltiwanger, 2011; McMillan and Verduzco, 2011; Newfarmer and Sztajerowska 2012; and Le Goff and Singh, 2013). At the country level, Porto (2004) focused on the labor income channel, finding a poverty-reducing impact of liberalization in Argentina (Porto, 2004), while Goldberg and Pavcnik (2004) found no significant impact on poverty in the urban areas of Colombia (Goldberg and Pavcnik, 2004). Another branch of the literature focused on the impact of liberalization on employment based on cross-country (Felbermayr and others, 2011) and country-specific analysis (Hasan and others, 2012, for the case of India), these studies found that trade liberalization is associated with lower unemployment.

With growing social and political concern on the "losers" from trade liberalization, the empirical literature has increasingly focused on identifying and quantifying the specific impact of increased trade openness on import-competing producers. The most cited studies in this literature suggest unexpectedly long periods of adjustment to these shock events, but it is arguable whether this apparent conclusion from examining a handful of countries could be extrapolated to all countries as there seem to be many determinants at play.

Seminal analysis in Topalova (2005, 2010) using a Difference-in-differences approach with district level data, focused on trade liberalization in India in the 1990s and found that lower tariffs exacerbated poverty and reduced spending per capita in import-competing districts. However, when splitting the sample this study found the effect to be significant only among the least geographically mobile segments at the bottom of the income distribution, and in states where rigid labor laws restrict factor reallocation across sectors. In fact, in the most mobile segments of the population the relations between tariff reductions and changes in poverty and expenditure become insignificant and/or sensitive to changes in regression specification. Labor mobility may therefore be a major determinant of the eventual impact of increased import-competition. But even if this weak results for the most mobile population segments are consistent with standard economic theory, they may also be the result of noise from simultaneous structural adjustment reforms, of not accounting for the impact of simultaneous changes in non-tariff barriers, and/or of data sources that are not comprehensive and methodologically homogenous. For sure, data and methodology need to be sharpen before arriving to strong conclusions.

With better data sources and in the absence of similarly strong structural reforms as in many developing countries decades ago, Autor and others (2013) identifies a significant link between

increased import-competition from China (the so-called "China shock") and reduced wages in the long run in the United States, a country without legal or cultural barriers to labor mobility. Despite a common perception that the U.S. population is highly mobile, this study further finds no significant population adjustment for local labor markets with substantial exposure to imports. As the authors suggest, the persistence of local decline perhaps explains the breadth of public transfer programs whose uptake increases in regions subject to rising trade exposure. Arguably, these public transfer programs may themselves delay reallocation in the face of increased trade exposure. Institutional development and size caution against extrapolating conclusions from a study of the United States to developing countries. Maybe the highly informal labor markets in poorer countries allow them to better adjust to increased import-competition through migration?

Kovak (2013) and Dix-Carneiro and Kovak (2017) study on the impact of trade liberalization on localities in Brazil could be more applicable to developing countries. Both studies find an association between lower trade barriers faced by import-competing producers and lower wages in Brazil. Their finding could suggest that the migration response to increased import-competition is not enough to alleviate the impact of liberalization even in a developing country without restrictions to mobility but note that these studies are based on formal labor market surveys and that Brazil has a relatively rigid labor market legislation. Labor market rigidity could limit the degree of adjustment that is needed to alleviate the impact of increased import-competition. Moreover, as is the case of the Indian trade liberalization episode studied in Topalova (2005, 2010), the Brazil trade liberalization episode took place amidst other major structural adjustment reforms, including in the labor market, thus likely adding noise, orthogonal or not, to the expected relation between trade reforms and economic outcomes.

A general lesson that can be extracted from these studies is that the the import-competition impact of trade liberalization can be highly dependent on cultural, institutional/policy, sectoral, geographical, and other idiosyncratic factors, and therefore statistical results for a country or even for population segments within a country cannot simply be inferred to be true for other countries or population segments. This implies that this branch of the trade liberalization literature will likely persist in coming years as there is a need to more deeply and comprehensively understand the import competition effect of trade liberalization in different contexts. And as we find in our study, controlling for spillovers can be crucial to strengthen estimation.

3.   THE PERUVIAN TRADE LIBERALIZATION EPISODE

After its significant trade liberalization in the 1990s Peru further reduced import tariffs during the 2000s. While the former episode was part of a structural reform program aimed at bringing back economic growth after decades of stagnation, the latter was undertaken amidst one of the fastest economic growth periods that the country has ever recorded.

Both liberalizations in 1990s and 2000s included unilateral policy liberalizations, as well as bilateral and regional liberalization agreements. Among the bilateral liberalizations in the 2000s, the most relevant were the Free Trade Agreements (FTAs) implemented with the United States (since 2009) and with China (since 2010) considering their share of Peru's total imports. While Peru also signed an FTA with Chile (another major source of imports), tariffs to imports from that country were already very low before the FTA. The most significant regional liberalizations in terms of shares of Peru's total imports were the gradual liberalizations agreed with the countries of the South American Common Market (MERCOSUR) and with the

Community of Andean Nations (CAN). The latter process deepened an earlier liberalization launched in the 1990s.

The earlier reduction in trade barriers in the 1990s was a momentous reform to the highly protective regime that was set up decades earlier as part of an Import Substitution Industrialization (ISI) strategy. Like many trade liberalizations in the those years, Peru's reforms included tariff rationalization, a major reduction in MFN tariffs (down from an average of almost 70 percent in 1990 to less than 20 percent by 1993), dismantling of non-tariff barriers reducing their coverage to negligible levels, and elimination of foreign exchange market controls. Since 1993 MFN tariffs were gradually, further reduced, reaching a simple average of 10.4 percent by 2004.

Although milder than the 1990s reform, the liberalization of the late 2000s was still very significant. The 2000s liberalization implemented large reductions in tariffs to important sectors that remained highly protected after the 1990s liberalization partly because of their political sensitivity and economic significance (for example, agriculture and textiles). As seen in Table 1, the simple average MFN tariffs and preferential tariffs to the main imports source countries came down considerably between 2004-07 and 2012-18. Preferential tariffs to Peru's major sources of imports almost vanished between 2004-07 and 2012-18, while the average MFN tariff also came down considerably. The average tariff weighted by each country's share of Peru's total imports (the bottom tariff in Table 1) came down from 9.1 percent in 2004-07 to 2.2 percent in 2012-18. In this period the most significant tariff reductions took place between 2008 and 2010, as a significant reduction in MFN tariffs in 2008 was followed by the entrance into force of the FTAs with the US in 2009 and China in 2010.

Table 1. Peru's Simple Average Tariffs
(2004-2018, in percent)

	2004-07	2008-11	2012-18
Argentina	7.9	3.2	0.5
Brazil	7.8	2.4	0.5
Chile	2.2	0.3	0.0
China	10.0	4.6	2.5
Colombia	7.9	0.4	0.0
Ecuador	9.1	4.1	0.5
United States	10.0	2.4	0.7
Most-Favored-Nation	10.0	4.8	3.1
Weighted By Source Countries 1/	9.1	3.9	2.2

Source: UNCTAD's Trade Analysis Information System (TRAINS) and authors' estimates.
1/ Tariffs are weighted by countries' shares of Peru's total imports. Includes country-specific tariffs for the top seven import source countries (Argentina, Brazil, Colombia, Chile, China, Ecuador, Mexico), and MFN tariffs for remaining countries.

As seen in Table 2, which shows average tariffs (weighted by source countries) by sector, the late 2000s liberalization was strongest for animal, vegetable, food, wood, and textiles, the sectors that were most protected by 2004. This resulted in a more homogeneous tariff structure after liberalization, with most sectors having an average tariff below 5 percent by 2018 (except for wood and textile/clothing). Imports of minerals, metals, and machinery and electricity were left with negligible protection levels.

Table 2. Tariffs by Sector
(In percent)

	2004	2018	Change 2004 to 2018
Animal	13.1	1.5	-11.6
Vegetable	12.7	1.9	-10.8
Food Products	13.7	2.0	-11.7
Minerals	8.5	0.8	-7.7
Fuels	6.4	1.2	-5.2
Chemicals	7.2	1.6	-5.6
Plastic or Rubber	11.1	2.8	-8.2
Hides and Skins	9.3	2.4	-6.9
Wood	16.0	6.3	-9.7
Textiles and Clothing	15.6	5.6	-9.9
Footwear	8.3	1.5	-6.8
Stone and Glass	7.8	0.8	-7.0
Metals	7.4	0.6	-6.8
Machinery and Electricity	8.1	1.0	-7.0
Transportation	9.8	1.7	-8.2

Source: UNCTAD's Trade Analysis Information System (TRAINS) and authors' estimates.
1/ Tariffs are weighted by countries' share of Peru's total imports

As mentioned earlier, liberalization occurred amid high economic growth, which is reflected in the improvements in average expenditure and poverty indicators between 2004 and 2018 (see Table 3). During that period poverty indicators were more than halved and expenditure per capita doubled, an evolution that was broadly similar in both urban and rural areas. Interestingly though, total district-level unemployment, as defined in household surveys, increased during this period although remaining at very low levels.

Table 3. Simple Average of Main Variables Across Districts (in %)

	2004-07	2008-11	2012-18
Scaled tariffs 1/	1.8	0.7	0.3
Unscaled tariffs 1/	10.4	3.8	1.8
Poverty headcount ratio	56.7	41.0	29.9
Poverty Gap	23.3	14.9	9.5
Expenditure per person (in 2004 Nuevos Soles)	263.0	367.1	472.5

Source: UNCTAD's Trade Analysis Information System (TRAINS) and authors' estimates.
1/ Tariffs are estimated based on panel balanced at the district level. Tariffs are weighted by countries' share of Peru's total imports.

4. METHODOLOGICAL DISCUSSION

The literature discussed above largely concluded that trade exposure encountered by workers has an important economic effect. As in those studies, our analysis approximates the location-specific (district-specific) change in trade exposure through industry-specific tariff reductions weighted by the number of workers in the respective industry-location. We also control for fundamentals across locations (districts) using education (human capital accumulation), mining royalty revenues, and population size.

Along this line, to measure the exposure of district workers to the change in tariffs, we construct a weighted tariff at the district level:

$$(1) \ X_{d,t} = \frac{\sum_i L_{d,i;2007} \tau_{i,t}}{TL_{d;2007}}$$

where $L_{d,i;2007}$ is the number of workers in district d involved in economic activity i in the year 2007, $TL_{d;2007}$ is the total number of workers in district d in 2007, and $\tau_{i;t}$ is the tariff linked to the economic activity i in year t.[4] To increase sample size in this calculation we add districts with no household survey observations in 2007, but with observations in 2006, or otherwise in 2005, or otherwise in 2004.

As in Topalova (2010), we fix the composition of workers in each district in the initial year $(\frac{L_{d,i;2007}}{TL_{d;2007}})$, thus abstracting from the effect of tariff reduction on the adjustment of worker share across economic activities. To understand why this is important, consider an import-competing

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[4] We use a weighted average tariff which: (i) for the top seven exporters to Peru multiplies their share in Peru's total imports by their preferential tariffs, and (ii) multiplies the remaining share of Peru's imports by its MFN tariff.

industry. A significant tariff reduction could reduce the worker share in this industry over the years, thereby inducing the endogeneity of the weighted tariffs across localities.

For non-traded industries we assign a zero tariff as in Topalova (2010) and denominate the average tariff thus calculated as *scaled tariff*. For robustness check and noting that the *scaled tariff* could be sensitive to the share of people involved in nontraded production sectors and this may not be orthogonal to the structural evolution of socioeconomic indicators, Topalova (2010) also builds a variable that replaces *scaled tariff* as an instrument denominated *unscaled tariff*, which is calculated through equation (1) but excluding non-traded industries. We also include this instrument in our analysis below.[5]

Using this measure of exposure to import liberalization we first do a baseline estimation of the relation between changes in trade exposure and changes in socioeconomic indicators based on OLS regressions. We then extend the baseline model to account not only for the impact of tariff reduction on a given district's socioeconomic performance, but also by any indirect effect from neighboring districts' socioeconomic performance.

To better appreciate the potential spillover effects that could have been at play during this trade liberalization episode consider the cattle producing districts in the Puno department. As Table 2 indicates, animal products were among the most significantly liberalized. On the other hand, many districts in Puno, especially the main cities, benefited in recent years from the dynamism of other sectors like tourism. In fact, as we will see ahead, Puno was one of the departments in Peru that most significantly reduced headcount poverty. It is therefore very likely that cattle

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[5] Unscaled tariffs serve as an instrument because they are expected to have a positive correlation with scaled tariffs, but not with the structural evolution of socioeconomic indicators that is feared in Topalova (2010).

producing districts that could have been affected by increased meat imports competition could have benefited through inter-districts trade from the improvement of socioeconomic indicators in nearby tourism-intense districts. The negative effects of increased meat imports competition could have also been washed out by migration of affected cattle producers to the tourism intense cities. For sure, spillover effects could also negatively affect neighboring districts and thus the direction of the bias they introduce is unknown a priori.

Since these relationships hold for all districts, they imply via a reduced form that each district's socioeconomic level is related to the tariff reduction of all districts. With these spatial interactions measured, we can test the null hypothesis of no spillovers in socioeconomic development and trade exposure across districts.

We address the implied endogenous spatially lagged dependent variable using the generalized spatial two-stage least squares, a spatial form of the GMM (Generalized Method of Moments) estimator with instruments drawn from geographic information on location, infrastructure, and market access. Kelejian and Prucha (2010) develop a methodology of inference for a spatial estimation with spatial lags in the dependent variable, exogenous regressors, and the error terms, while allowing for unknown heteroskedasticity in the innovations. They generalize the GMM estimator for the spatial autoregressive parameter in the disturbance process, then define IV estimators for the regression parameters. We apply their approach in the current setting. In our specification, the spatial lag is a weighted average of socioeconomic levels in neighboring districts. Thus, socioeconomic development in each district is influenced by that of its neighbors. The spatial lag is endogenous.

It is possible that exogenous shocks affecting one area have effects that spillover to other districts. This association is captured in a spatially correlated error term. Following Kelejian, Murrell, and Shepotylo (2013) we estimate the relationship by generalized spatial two-stage least squares (GS2SLS), an instrumental variable model that accounts for the endogeneity of the spatially lagged socioeconomic development and for the spatially correlated shocks. The instruments are the predetermined variables in our specification (geographic location, infrastructure, and market access) and their spatial lags.

MODELS

Our model estimates two spatial processes: (a) spatial spillovers between socioeconomic levels and (b) spillovers between idiosyncratic aspects of trade exposure that affect socioeconomic levels.

(2) $y_t = X_t \beta_1 + H \beta_2 + \lambda W y_t + u_t$

$u_t = \rho W u_t + \epsilon_t; t = 1, \ldots, T$

where y_t is an $n \times 1$ vector of observations on socioeconomic levels for n districts. X_t is a $n \times (k_1)$ matrix of observations on k_1 time-variant fundamentals (including $X_{d,t}$); H is an $n \times (k_2)$ matrix of observations on k_2 time-invariant fundamentals; W is an $n \times n$ weighting matrix related to contiguity or distance between districts; u_t is the $n \times 1$ disturbance vector; and ϵ_t is the exogenous shock vector. β_1 and β_2 are, respectively, $k_1 \times 1$ and $k_2 \times 1$ parameter vectors. λ and ρ are scalar parameters. $W y_t$ is the spatial lag of the dependent variable y_t. In this framework, y_t depends on u_t, as $W y_t$ does, and thus they are both endogenous.

We define the weighting matrix W so that the value of the variable (dependent and control variable of interest) for each district depends directly on an average of that variable for bordering districts (and alternatively, depending on inverse distance to other districts). The spatial weighting matrix represents the spatial structure or the relative connectivity of entities across space (Getis, 2009). The weighting structure captures the first law of geography by Tobler (1969): "everything is related to everything else, but near things are more related than distant things". Suppose the ith district has ϕ_i districts that border it. Then, the ith row of W has zeroes everywhere except in ϕ_i positions corresponding to ϕ_i neighbors. In these positions, the values in the ith row are $\frac{1}{\phi_i}$. The weighting matrix is row normalized, so the elements of each row sum to unity.

The diagonal elements of W are zero (no district is considered as its own neighbor).

If $|\lambda| < 1$ and $|\rho| < 1$ and let $G = (I - \lambda W)^{-1}$, the solution for y_t is:

(3) $y_t = GX_t\beta_1 + GH\beta_2 + Gu_t$

$u_t = (I - \rho W)^{-1}\epsilon_t; t = 1, \ldots, T$

Implying that the value of y_t for each district depends on all the fundamentals (including exposure to tariff reduction) of each district, as well as the shocks in all the districts. If $\lambda = 0$, there are no spillovers in the fundamentals between districts.

Considering again the case of cattle-producing districts in Puno, equation (3) and the definition of matrix W imply that their own socioeconomic indicators (y) are significantly dependent on the determinants of the socioeconomic indicators of nearby tourism-producing districts as well as the shocks in those districts. The buoyant tourism activity in the nearby districts could be

one of those shocks. And explicit determinants may include the changes in trade exposure in the nearby districts.

If ϵ_t elements are *i.i.d.* over districts with $mean = 0, variance = \sigma^2$, the variance-covariance matrix of u_t is:

(4) $VC_u = \sigma^2(I - \rho W)^{-1}(I - \rho W')^{-1}$

such that the elements are spatially correlated.

ESTIMATION PROCEDURE

An IV procedure is used to address the spatial lag term Wy_t, which is endogenous. The estimation involves three steps: (1) $\beta_1, \beta_2, \lambda, \rho$ are estimated by an IV procedure, accounting for the spatial correlation of u; (2) the estimated parameters are used to estimate u and ρ; (3) the estimated ρ is used to transform model, which is then estimated by an IV procedure.

INSTRUMENTS

Using the above,

$$(I - \rho W)^{-1} = I + (\lambda W) + (\lambda^2 W^2) + \ldots$$

It follows that

$$E[y_t] = ((I - \rho W)^{-1})[X_t \beta_1 + H\beta_2]$$

and thus

(5) $E[Wy_t] = W(I + (\lambda W) + (\lambda^2 W^2) + \ldots)[X_t \beta_1 + H\beta_2]$

Following Kelejian et al. (2013), X_t, H, WX_t, WH are used as the instruments.

As (X_t, H) change in a given district i, we can calculate direct effects, which in turn are transmitted to other districts through the spatial lag and feedback to the district i, resulting in indirect effects. If $\lambda \neq 0$, the level of socioeconomics in every district depends on the fundamentals of all areas in Peru.

Suppose there is a tariff reduction in the Machu Picchu (MP) district, corresponding to the 1st column (regressor) of X_t. Denote the tariff reduction at time t for MP as $x_{t,MP}$. Then the change in the Jth element of y_t with respect to $x_{t,MP}$ is:

(6) $\qquad \frac{\partial y_t^J}{\partial x_{t,MP}} = b_{1,1} G_{J1}; J = 2, \ldots, N$

where $b_{1,1}$ is the 1st element of β_1 and G_{J1} is the $(J,1)^{th}$ element of G. These spillovers (emanating effects) are calculated with respect to the mean y_t conditional on the exogeneous variables and is not involved with ρ (that is, unrelated to the error terms).

5. DATA ANALYSIS

Data sources

We source the information to construct our sample as follows.

- Geographic information of Peruvian districts is from **UNOCHA**.

- Weighted average tariffs are calculated using the import shares and MFN tariffs recorded in the 10-digit product classification (HS 2007) from **WITS**.

- Following Topalova (2010) and Dix-Carneiro and Kovak (2017), we match tariff data to district-level economic activities using 4-digit ISIC Rev 4 recorded in the household surveys. The matching is largely based on the concordance table of the UN Statistics Division but considering our objective to measure exposure to imports competition, we frequently modify UN correspondences to account for links between imports and suppliers of locally produced import-competing goods. This manual modification is not made in previous related studies and we also consider it an innovation of this chapter. For example, we link the HS code of imported frozen meat not only to the ISIC code of frozen meat but also with the ISIC code of cattle breeders.

- Socioeconomic indicators are from the National Household Surveys (Encuestas Nacionales de Hogares; **ENAHOs**), which include expansion factors that approximate the representativeness of each district and which we incorporate to our regressions. Our baseline indicators include consumption per capita, unemployment rate, and informality rate.

- The geographic data is in the system of UBIGEO (Código Ubicacíon Geográfica), which is a geographic location coding system in Peru used by National Statistics and Computing Institute (Instituto Nacional de Estadística e Informática INEI). There are three administrative levels: departments (25), provinces (196), and districts. We use the information of districts based on UNOCHA: 1,873 districts (Sistema Nacional de Estadística: 1,869 districts). With the shapefile, we organize the district-level data using UBIGEO. For instance, one of the largest coppers and zinc mine, the Antamina mine, is in the San Marcos district (UBIGEO: 021014), Huari province (UBIGEO: 0210), Ancash department (UBIGEO: 02).

- We use 8 geographic related data to further account for the geography of economic development: mining sites (mineros), gas and oil pipelines (gasoducto, oleoducto), roads (via), airports (aeropuertos), ports (puertos), navigable rivers (rio navegables), and high elevation lines (de lineas de elevacion (curvas de nivel)). The exposure of workers to trade and tariff changes is subject to their economic activities, which, in turn, is influenced by geographic location and access to other regions. For instance, given that mining is the most prominent Peruvian export sector, we expect that the association between tariff reduction and income is conditional on a district's connection to the mining activities.

CHANGE IN DISTRICT-LEVEL TARIFFS

The evolution of district-level tariffs (estimated through equation 1) illustrates several features of the Peruvian liberalization process and its relation to changes in districts' socioeconomic indicators. As seen in Table 3 above, the simple average of all district-level tariffs came down significantly from 2004-07 to 2012-18. As expected, *scaled tariffs* are much lower than *unscaled tariffs*.

Table A.1 shows that district tariff reductions were similar in rural and urban districts. In fact, in both areas both initial and final average tariffs are almost equal. Table A.2 presents estimated average tariffs across the main geographic areas of the country: the coast excluding Lima, the Andean Highlands, the Amazon (Rainforest), and Lima. The more isolated highland districts show lower *scaled tariff* reductions since those districts have a larger share of non-traded goods. Average district *unscaled tariff* reductions are similar across the three geographic areas, though it appears smaller for Lima districts.

The geographic dimension of liberalization can be analyzed more deeply by looking at department level tariffs, *scaled* and *unscaled*, as seen in Panel Figure A.1. We corroborate our earlier finding that *scaled tariffs* experience the largest reduction in the more integrated coastal departments (Tumbes, Ica, Lambayeque, Lima, and La Libertad) than in the less integrated highland departments (Huancavelica, Huanuco, Cajamarca). However, reductions in *unscaled tariffs* are more homogenous across departments, with slightly larger reductions in some highland departments that are more reliant on farm products (Junin, Ayacucho, Huancavelica) than in those less reliant on these products (Lima, Tacna, Arequipa).

CHANGE IN DISTRICT-LEVEL SOCIOECONOMIC INDICATORS

Regarding the evolution of socioeconomic indicators, we observe in Table 4 and Table A.3 that all regions exhibited the same pattern of significant declines in poverty, increases in expenditure per capita, and slight (and puzzling) increases in unemployment. Socioeconomic improvements are important in all geographic regions although with some heterogeneity. Headcount poverty fell more in the wealthier and more modern coastal region, but it also fell substantially in the poorer and more isolated rainforest and highland regions. On the other hand, expenditure per person increased more homogeneously across all major regions of the country.

Table 4. Change in Socioeconomic Indicators by Region
(Percentage Points)

	Headcount Poverty Ratio	Poverty Gap	Expenditure per person	Unemployment
All Districts				
2004	61.2	25.8	238.7	1.2
2014	27.6	8.6	497.9	3.5
Change	-33.6	-17.2	259.1	2.3
Coastal Districts (excluding Lima)				
2004	46.1	15.9	288.0	1.1
2014	13.7	4.4	595.5	4.5
Change	-32.4	-11.5	307.5	3.3
Highland Districts				
2004	69.5	31.5	184.2	1.4
2014	36.1	11.2	389.1	3.0
Change	-33.4	-20.3	204.9	1.6
Rainforest Districts				
2004	67.0	26.9	191.2	0.8
2014	28.4	8.1	445.8	2.9
Change	-38.5	-18.8	254.6	2.1
Lima City Districts				
2004	31.4	8.9	601.2	0.6
2014	6.2	1.5	1101.3	5.4
Change	-25.2	-7.3	500.1	4.8

Source: UNCTAD's Trade Analysis Information System (TRAINS), National Household Surveys, and authors' estimates.

Notes: Tariffs are weighted by countries' share of Peru's total imports.

Socioeconomic indicators during this period improved considerably mainly because of the high economic growth in the last decades and of several transfer programs targeting the poor. These included conditional cash transfers to districts with headcount poverty above 40 percent (Juntos), cash transfers and technical assistance to agricultural producers (Haku Wiñay), and pensions for low-income elders (Pension 65). However, there were no specific social programs targeting those affected by trade liberalization.

Scatter plots of the estimated changes in tariffs and socioeconomic indicators at the department level give us a first glance at the relation between them during the trade liberalization period. Panel Figure 1 shows a positive correlation between *scaled tariffs* and expenditure per person is stronger but not high. Panel Figure A.2 shows an even weaker

relation between *unscaled tariffs* and expenditure per person. Both *scaled* and *unscaled* tariff

reductions are positively associated with increases in unemployment at the department level.

Figure 1. Scaled Tariffs and Socioeconomic Indicators, 2004-07 to 2012-18

6. ESTIMATION OF THE IMPACT OF TARIFF REDUCTION: DIRECT EFFECTS AND NEIGHBOR-DISTRICT SPILLOVERS

LINEAR ESTIMATION

Table 5 reports the OLS estimation using the socioeconomic indicators separately as dependent

variables (see description of variables in Table A.4). In the OLS estimation, we exclude the

spatial lag of the dependent variable (Wy_t). The signs of the coefficients of education are

positive, as expected, but, puzzling, mining royalties do not have a statistically significant

impact on socioeconomic outcomes. As opposed to the findings in the Dix-Carneiro and

Kovak (2017), there is no statistically significant effect of increased trade exposure on

informality.

Table 5. Estimates of Linear Estimation, 2007-2018

Dependent Variable	Unemployment	Informality	Expenditure per capita	Monetary expenditure per capita
Education	-0.03***	-0.05***	0.10***	0.15***
Population	0.00	-0.00***	0.00***	0.00***
Mining Royalty Dist	0.00	0.00	0.00	0.00
Scaled Tariffs	-0.01***	0.00	-0.13***	-0.13***
Constant	0.45***	0.92***	9.12***	8.50***
Groups	661	661	661	661
Observations	5057	5059	5059	5059
R2	0.1	0.24	0.17	0.19

Note: * p<0.1, ** p<0.05, *** p<0.01.

Also, unexpectedly, the coefficients of *scaled tariffs* are statistically significant but positive, implying that more intense import-competition is associated with higher consumption per capita. This not only contrasts the findings in similar studies reviewed in Section 2, but also the negative relation between tariff reductions and expenditure per capita at the department level evidenced in the lower left chart of Figure Panel 1. Table A.5 show similar results when replacing *scaled tariff* by *unscaled tariff* as independent variable.

We can hypothesize several explanations for this positive relation between trade exposure and expenditure per capita. Could it be that increased import competition in some districts was a big push for them to move into more productive goods and services (maybe export-oriented)? Or where they pushed to adopt more productive technologies that increased their productivity? Could it be that increased exposure to imports prompted the migration of the least productive (lower income) and by accounting this fostered the district's per capita income? All these reasons could be explored in more depth, but this chapter focuses only on assessing whether spillovers from inter-district migration or trade may have been at play during this Peruvian liberalization event and in controlling for them.

IMPACT ON MIGRATION

We therefore aim to estimate the degree of migration that import-competition may have

prompted, which could have alleviated its economic impact. Taking advantage of the

availability of population censuses in 2007 and in 2017 (conveniently before and after the

most intense liberalization period of 2008 to 2010) we analyze the impact of trade exposure

on migration. Ideally, we would analyze this effect by using data on outbound migration so

as to assess whether districts that faced higher reduction in their average tariffs also saw

more people leaving the district to alleviate the negative impact of liberalization.

Unfortunately, there is no such data available in Peru's censuses.

However, Peru's censuses do indicate the number of immigrants that arrived within the five

years prior to the census and therefore we look at whether the change in the share of

immigrants is statistically related to tariff changes. The regression in Table 6 shows that, as

expected, lower tariffs are related to lower immigration to the district. The point estimate

implies that a 10-percentage point reduction in tariffs is associated with a 7 percentage points

lower share of immigrants.

Table 6. Immigration Determinants, 2007-14

	Change in immigration rate from 2007 to 2017	
Change in log of expenditure per capita	0.04*	
	(0.07)	
Change in district tariffs		0.49*
		(0.08)
Observations	495	495

Notes: Coefficients and p-values reported for each independent variable (* p<0.05, ** p<0.01, ***p<0.001). District and year fixed effects are used. Immigration rate is defined as the share of a district's population that did not live in the district 5 years before the year of observation. Tariffs are weighted by countries' share of Peru's total imports.

This apparently high labor market mobility likely affects earlier OLS estimates. Note that Peru is a highly urban country with a highly informal labor force and, therefore, migration across districts in reaction to increased import-competition could be intense. As workers could have migrated to nearby districts, accounting for spillovers from nearby districts can be key to understand the link between increased trade exposure and socioeconomic outcomes.

SPATIAL ESTIMATES

We can statistically test whether if spillovers are at playin in the Peruvian trade liberalization through the Moran test for determining whether the residuals of a model fitted by OLS are correlated with neighboring residuals. We create the spatial weighting matrices as described above, specifically, a contiguity matrix (nearby = shares a border) W, as well as distance matrix M.

Based on the contiguity weights, we calculate the test statistics to determine whether to accept or reject that the residuals from the model above are i.i.d. (H_o; the null hypothesis). If the test rejects the null, the residuals are correlated with neighboring residuals as defined by the weights, so we fit the spatial models in which the observations are not independent as defined by the weighting matrix, thereby allowing for spillovers from neighboring districts. There are several estimation choices of spatial models. The generalized spatial two-stage least squares (gs2sls) model is robust to violations of normality and the maximum likelihood (ml) model is more efficient when the errors are normally distributed. We consider two variants: (i) a spatial lag of independent variables; and (ii) a spatially autoregressive error.

Based on these estimations, we assess the average effects, for instance, denoting *a*, *b*, *c* from the recursive process. On average, for a 1-percentage-point change in the weighted tariff of the own-district direct effect is to change the dependent variable by *a* percentage point and the indirect spillover effect reduces the dependent variable by *b* percentage points. The cumulative effect is *c* percentage points.

As the diagnostic tests suggest spatial dependence in the data, we now undertake a more robust estimation to account for the regional spillovers. Also, it is useful to consider a spatial lag model that, besides the spatial lag of the dependent variable, also incorporates other non-spatial endogenous regressors. Although the falsification tests above do not suggest endogeneity, we use geographic information captured by district-specific distance to the mining sites, ports, and airports as the instruments.

Table 7 reports the spatial estimation. In the spatial 2SLS estimation, we include the spatial lag of the dependent variable (Wy_t). The coefficients of tariffs indicate that tariff reductions increase unemployment and informality, and lower consumption per capita. Further, we find that the coefficients of the spatially lagged dependent variables (Wy_t) are statistically significant for consumption per capita and informality.

Table 7. Estimates of Spatial Estimation, 2018

Dependent Variable:	Unemployment	Informality	Expenditure per capita	Monetary expenditure per capita
Education	-0.06***	-0.08***	0.12***	0.25***
Population	0.00	-0.00***	0.00***	0.00***
Mining Royalty Dist	0.00	0.00	0.00*	0.00**
Scaled Tariffs	-0.06**	-0.08**	0.15*	0.28***
constant	0.60***	0.99***	9.22***	8.41***
Spatial lag coefficients				
Unemployment rate	0.06			
	-0.05			
Informality Rate		0.10***		
		-0.04		
LNEH			-0.02**	
			-0.01	
LNEM				-0.03***
				-0.01
Countries	348	348	348	348
R^2	0.1	0.23	0.23	0.32

Note: * p<0.1, ** p<0.05, *** p<0.01.

Similar spatial regressions based on *unscaled tariffs* (in Table A.6) do not show a significant impact of changes in this variable on socioeconomic indicators. While this should not be fully glossed over, partly because Topalova (2010) does find a significant relation between *unscaled tariffs* and socioeconomic indicators, note that that study uses this variable as an instrument and our results could suggest that this is a weak instrument in the specific context of our study. By construction *unscaled tariffs* may not be as strongly related to socioeconomic indicators as *scaled tariffs* because the share of *tradable* (in other words, internationally traded) goods produced in a district is a key factor on the effective exposure of a district to import competition. In other words, tariff changes are not expected to affect districts that mainly produce nontraded goods as much as districts that mainly produce traded goods.

To illustrate the potential weakness of *unscaled tariffs* as an instrument, consider two districts A and B, with A employing 5 percent of its labor force in furniture production and 95 percent in non-tradables and district B inversely having 95 percent of its labor force

producing furniture and 5 percent non-tradables. Although the unscaled tariff of both districts would be equal, it is clear that a strong reduction in the tariff of furniture imports is more likely to affect the socioeconomic indicators of district A than of district B. While in Topalova (2010) this caveat did not weaken the *unscaled tariff* instrument that does not necessarily mean than this instrument should be strong in all studies.

TESTING ENDOGENEITY OF REFORMS

The fact that spatial panel estimates of the coefficients of *unscaled tariffs* on expenditure measures are not significant requires though to make sure whether the motivation behind Tolapova (2010) use of this instrument is valid in our event study or not. As mentioned earlier, *unscaled tariffs* were a suggested instrument in case *scaled tariffs* have a structural relation with socioeconomic performance not related to tariff levels but to the fact non-tradable goods are assigned a zero tariff. It may be the case that poorer districts have a higher share of their labor force employed in non-tradable production and socioeconomic indicators in poorer districts structurally perform differently than wealthier ones.

If there would be such a spurious relation we would see a relation between past trends in socioeconomic indicators and following reductions in *scaled tariffs*. For instance, it may be the case that districts in which socioeconomic indicators were improving faster before liberalization (for structural reasons that could prolong this trend during the post-liberalization period) were also those in which tariffs were reduced less significantly afterwards. This would generate a negative relation between tariff reduction and improvements in socioeconomic indicators that would not correspond to causality from the former to the latter.

To test this hypothesis, we conduct a falsification test in which pre-liberalization changes in socioeconomic indicators are regressed on tariff changes since 2007 (Table 8). We split the observation period in this year noting that most of the reduction in tariffs during 2004-18 took place in 2008-2010. Regression results show that pre-liberalization improvements in socioeconomic indicators have no statistically significant relation with tariff reductions after 2007, thus not finding evidence that past trends in socioeconomic indicators could generate a spurious statistical relation between tariff reductions and improvements in socioeconomic indicators. This further implies that the use of *unscaled tariffs* as an instrument instead of *scaled tariffs* is not needed.

Table 8. Falsification Test

	Dependent Variable: 2007-14 Changes in District Tariffs			
2004-07 Δ in income per capita	0.002			
2004-07 Δ in informality		-0.006		
2004-07 Δ in unemployment			-0.004	
2004-07 Δ in expenditure per capita				0.000
Observations	160	87	87	87
R2	0.013	0.026	0.002	0.000

Notes: Coefficients and p-values reported for each independent variable (* p<0.05, ** p<0.01, ***p<0.001). District and year fixed effects are used. Tariffs are weighted by countries' share of Peru's total imports.

7. CONCLUDING REMARKS

This study contributes to the literature estimating the local level impact of import liberalization by examining a more recent and better documented liberalization episode (Peru in the 2000s) and controlling for spillover effects from neighboring localities. In the absence of simultaneous structural reforms and using more detailed and comprehensive data than other studies for developing countries we find the more commonly expected negative link between increased trade exposure and socioeconomic outcomes only after controlling for spillover effects. This calls for caution in interpreting results when not accounting for spillovers. OLS estimates suggest that increased import-competition increased localities' expenditure per capita. While one can ponder some theoretical reasons to explain this identified relation it is better to sharpen the methodology before jumping to conclusions.

Although there is no data to measure the impact of liberalization on outward migration, there is evidence that increased import-competition linked to tariff reductions faced by district producers affect labor migration. This may help explain the need to account for spillover effects as migration to nearby, better performing localities may alleviate the negative impact of increased trade exposure.

Controlling for local level spillovers may also improve estimation even in countries with lower ease of migration, as socioeconomic indicators in a locality can be affected by developments in neighboring localities through inter-locality trade. Therefore, it is highly likely that even in studies that identified a statistically significant impact of increased trade exposure, point estimates could be biased under panel regression specifications that do not control for the spatial dimension.

In the case of Topalova (2010), her finding through OLS of significant negative effects of trade exposure in rural but not on urban areas may suggests that their identification of the impact in urban areas requires a spatial setting to account for the strong spillover effects in cities. In the case of Dix-Carneiro and Kovak (2017), their finding of a significant negative effect of trade exposure on socioeconomic outcomes despite not using spatial econometrics could imply that their use of regional fixed effects allows it to account for spillovers even if less precisely than under this study. But it could also be related to the rigid labor market legislation of the more formal Brazilian industry or non-orthogonality between changes in trade exposure and simultaneous reforms.

The economic and welfare implications of estimated coefficients could be quite different if OLS or Spatial Panel techniques are used. As happened in our case study, if OLS fails to find a negative link between increased import-competition and socioeconomic indicators this does not necessarily mean that there has been no negative effect from liberalization as inter-locality trade and migration may have washed out the local level impact. If Spatial Panel techniques do find a negative link between liberalization and socioeconomic outcomes this strengthens the likelihood that migration/trade spillovers alleviated the socioeconomic outcome. If migration alleviated the impact of liberalization this may have kept socioeconomic indicators unchanged, but one can argue that there is a welfare cost to migration, not only logistic cost but also personal costs in terms of weakening of family and community relations. If inter-locality trade alleviated the impact of liberalization this could be a random event with little implication to what could happen under liberalizations in the future or in other countries. Our economic and welfare understanding of the impact of liberalization can thus be clearly deepened by using spatial panel techniques. Further analysis

to determine the relative importance of trade or migration explain could be undertaken to better evaluate the economic/welfare implications of the liberalization event.

Even though our study suggests that migration may have alleviated the negative impact of increased trade exposure public policies could also help alleviate the impact and ease adjustment. Ideally, before any significant reduction in restrictions to imports, policy makers could estimate local level tariffs (as in equation 1) to identify those likely to be affected by liberalization through the imports competition channel. After such identification, they could protect and facilitate adjustment in localities likely to be affected by: (i) strengthening their social safety nets; (ii) financing the retraining of their workers; (iii) implementing job search programs; and (iv) lowering costs of migration mainly by providing infrastructure (transport and telecommunications), as well as nationwide information that could ease migration (for example, on jobs and housing). There is also a case for governments to set gradual/longer liberalization schedules for goods produced in highly vulnerable or poor localities.

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TABLE A.1: CHANGE IN TARIFFS BY REGION, 2004-18

	Average Tariff (Percent)	
	Scaled	Unscaled
All Districts		
2004	2.1	12.3
2014	0.3	1.7
Change	-1.8	-10.5
Urban Districts		
2004	2.3	12.0
2014	0.4	1.8
Change	-1.9	-10.2
Rural Districts		
2004	2.0	12.4
2014	0.2	1.6
Change	-1.8	-10.8

Source: UNCTAD's Trade Analysis Information System (TRAINS) and authors' estimates.

Notes: Tariffs are weighted by countries' share of Peru's total imports.

TABLE A.2: CHANGE IN TARIFFS BY REGION, 2004-18

	Average Tariff (Percent)	
	Scaled	Unscaled
All Districts		
2004	2.1	12.3
2011	0.3	1.7
Change	-1.8	-10.5
Coastal Districts (excluding Lima)		
2004	3.2	12.7
2011	0.4	1.7
Change	-2.8	-11.0
Highland Districts		
2004	1.5	12.2
2011	0.2	1.6
Change	-1.3	-10.6
Rainforest Districts		
2004	2.6	12.2
2011	0.3	1.5
Change	-2.2	-10.7
Lima City Districts		
2004	2.4	11.4
2011	0.5	2.5
Change	-1.9	-8.9

Source: UNCTAD's Trade Analysis Information System (TRAINS) and authors' estimates.

Notes: Tariffs are weighted by countries' share of Peru's total imports.

PANEL FIGURE A.1: CHANGE IN AVERAGE TARIFFS, 2004-18

Change in Average Tariffs (Including Non-tradeables) by Department (Percentage Points)

Change in Average Tariffs (Excluding Non-tradeables) by Department (Percentage Points)

Source: Authors' calculations based on World Bank WITS database and Peruvian National Household Surveys

TABLE A.3: CHANGE IN TARIFFS BY AREA, 2004-18

	Headcount Poverty Ratio	Poverty Gap	Expenditure per person	Unemploy ment
All Districts				
2004	61.2	25.8	238.7	1.2
2014	27.6	8.6	497.9	3.5
Change	-33.6	-17.2	259.1	2.3
Urban Districts				
2004	45.8	17.0	353.1	1.1
2014	20.3	6.0	641.5	4.4
Change	-25.5	-11.0	288.4	3.3
Rural Districts				
2004	70.1	30.6	173.0	1.2
2014	33.6	10.7	381.6	2.7
Change	-36.5	-19.9	208.6	1.5

Source: UNCTAD's Trade Analysis Information System (TRAINS), National Houshold Surveys,

Notes: Tariffs are weighted by countries' share of Peru's total imports.

TABLE A.4: REGRESSION VARIABLES SUMMARY STATISTICS

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
Unemployment (UN)	13176	0.35	0.13	0.00	0.92
Informality (INF)	13182	0.71	0.20	0.00	1.00
Expenditure per Capita (EH)	13182	17938	10452	2109	127248
Monetary Expenditure per Capita (EM)	13182	12821	8715	463	84895
Education Mean (ED)	13182	2.7	0.8	0.0	5.0
Population (Pop)	14475	95	163	1	2026
Mining district (MD)	14475	29400000	50300000	0	330000000

Sources: Peru's National Household Surveys Series (ENAHO).

PANEL FIGURE A.2: CHANGE IN UNSCALED TARIFFS, 2004-18

Change in Expenditure per person (Nuevos Soles)

$y = 12.893x + 248.79$
$R^2 = 0.1549$

Change in Tariffs and in Unemployment Rate (Percentage Points)

$y = 0.7966x + 10.74$
$R^2 = 0.254$

TABLE A.5: OLS REGRESSIONS OF UNSCALED TARIFFS ON SOCIOECONOMIC INDICATORS

Dependent Variable	sUN	sIN	sLNEH	sLNEM
Education	-0.03***	-0.05***	0.11***	0.16***
Population	0.00*	-0.00***	0.00***	0.00***
Mining Royalty Dist	0.00	0.00	-0.00***	-0.00**
Unscaled Tariffs	0.00	0.00	-0.04***	-0.05***
Constant	0.44***	0.91***	9.28***	8.70***
Groups	571	571	571	571
Observations	4164	4165	4165	4165
R2	0.08	0.25	0.25	0.27

Note: * p<0.1, ** p<0.05, *** p<0.01.

TABLE A.6: SPATIAL PANEL REGRESSIONS OF UNSCALED TARIFFS ON SOCIOECONOMIC INDICATORS

Dependent Variable:	sUN	sIN	sLNEH	sLNEM
Main education	-0.04***	-0.09***	0.15***	0.28***
Population	0.00	-0.00***	0.00***	0.00***
Mining Royalty Dist	0.00	0.00	0.00**	0.00***
Unscaled Tariffs	0.00	0.01	0.01	0.02
constant	0.56***	0.96***	9.14***	8.32***
w_s001				
Unemployment rate	0.12**			
	-0.06			
Informality Rate		0.10**		
		-0.04		
LNEH			-0.01	
			-0.01	
LNEM				-0.01
				-0.01
Countries	276	276	276	276
R^2	0.09	0.22	0.25	0.34

Note: * p<0.1, ** p<0.05, *** p<0.01.

CHAPTER 2

PROXIMITY AND HORIZONTAL POLICIES: THE BACKBONE OF EXPORT DIVERSIFICATION AND COMPLEXITY

1. INTRODUCTION

Export diversification is a commonly sought objective in emerging and developing economies for several reasons. Numerous studies indicate that a more diversified export basket is statistically associated with lower output volatility (Haddad and others, 2013), and that the latter is associated with higher long-term output growth (Ramey and Ramey, 1995; Hnatkovska and Loayza, 2004). This is of outmost importance to most developing countries, as their export baskets tend to be concentrated on a handful of raw commodities with highly volatile international prices. Moreover, production of raw commodities is not labor intensive, and therefore it is argued that nurturing other more labor-intensive export sectors could improve labor market outcomes and socioeconomic conditions.

Some economists further suggest that there are some *superior* products that countries should export because they are expected to have higher economic payoff in different ways. For instance, Hallak (2006) classifies export products according to their *quality* and shows that advanced economies tend to import more of those higher quality products. Products are classified according to their *sophistication* in Hausmann and others (2006), and *complexity* in Hidalgo and Hausmann (2009), and these studies suggest that having more sophisticated/complex exports is associated with higher future economic growth.

While there are several studies aiming to identify policies that lead to export diversification and the development of *superior* exports, there are important caveats in their methodological approaches. First, the dependent variables commonly used are indices (such as concentration, sophistication, or complexity indices) that are greatly affected by exogenous changes in international commodity markets, which add noise to the expected link between export diversification/*superiority* and policy variables. Second, the explanatory variables included are commonly limited to those associated with higher productivity (for example, education, institutions), neglecting the importance of labor costs and gravity equation-related variables for exports development (especially of manufacturing products) according to standard trade models.

This paper therefore makes two fundamental shifts in the analysis of export diversification and its policy determinants. Instead of using diversification/concentration, sophistication, or complexity indices as dependent variables, it uses levels of the export categories (non-hydrocarbon/mineral (NHM), manufacturing, services, complex) that need to be nurtured so as to diversify commodity dependent export baskets.[6] In addition, it adds gravity equation and labor costs variables to productivity-related independent variables that are commonly included in studies that aim to identify the determinants export diversification/*superiority*. Income per capita is introduced as a control for endogeneity and removed for goodness of fit estimation.

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[6] In this paper, the term *NHM exports* includes only goods not services. Service exports are identified separately for analytical purposes as their dependence on distance and economic policies is considerably different from that of NHM goods exports.

The proposed methodological changes allow for a substantial estimation improvement as coefficients are more robustly significant and goodness of fit is higher than in other studies. The analysis finds a strong relation between gravity related variables and NHM, manufacturing, complex, and service exports. It also finds that governance, educational attainment, infrastructure quality, and trade policy openness are robustly related to these exports. Adding these horizontal policies to countries' proximity to international markets explains above 80 percent of cross-country variation in the targeted exports.

The paper first discusses in more detail, in Section II, the justification for the two analytical shifts proposed above, while Section III delineates this methodological approach. Section IV describes the regional and country level variation in NHM exports, as well as in independent variables. Econometric analysis in Section V statistically identifies the factors that are associated with the development of targeted exports and their explanatory power. Section VI discusses the main policy implications of these statistical findings.

2. THEORETICAL AND EMPIRICAL CONSIDERATIONS

This section advocates for a change in perspective when identifying the policy determinants of export diversification and *superiority* in commodity-dependent countries. It first proposes switching focus from studying commonly used indices of export diversification and *superiority* to targeting the NHM export sectors that promote export diversification and *superiority*, because the former are substantially affected by exogenous fluctuations in HM international markets. This switch not only allows to filter-out these fluctuations and focus on variables that are more directly dependent on policy determinants but, in the case of the

Economic Complexity, it fixes a notable measurement error. And as will be discussed below, the per capita level of NHM exports provides a more certain indication of high export diversification and income per capita than an export product concentration index alone, which can be low for low-income countries.

Furthermore, by switching the target from indices to export levels, this first change in perspective allows us to ground the identification of export diversification/*superiority* determinants in the extensive literature of export development, which is the second proposed change in perspective. From a regression analysis viewpoint, the first change in perspective is a change in the dependent variable while the second one implies changes in the independent variables. The next paragraphs deepen this discussion.

THE DEPENDENT VARIABLE

Most empirical attempts to identify the factors that foster export diversification use as dependent variable an export concentration index, such as the Herfindahl-Hirschman Index (HHI), while those aiming to identify the determinants of *superior* exports use several indices of exports *superiority*, such as the Exports Sophistication Index (ESI) (Hausmann and others, 2005; Weldemicael, 2012) or the Economic Complexity Index (ECI) (Hidalgo and Hausmann, 2009).

Nevertheless, these indices are substantially affected by exogenous factors, thus weakening their statistical link to policy determinants. Take for instance the HHI of export concentration for country j including exports (x) of several sectors (s):

$$(1)\ HHI_j = \Sigma_s \left(\frac{x_{sj}}{\Sigma_s x_{sj}}\right)^2$$

This index is higher when the nominal export value of one or few commodities is high relative to the total export basket, indicating more (less) exports concentration (diversification). In most developing countries, partly due to their weak production capacity, a handful of hydrocarbon/mineral (HM) exports account for most of their total exports. Hence when aiming to diversify exports these countries seek policies to nurture NHM products. If successful, the value of these products will narrow the gap with respect to the dominant HM exports and this would reduce their HHI.

But the HHI can also significantly fluctuate in response to variations in the nominal value of their HM exports, which are commonly the result of largely exogenous events such as changes in international commodity prices or findings of additional HM reserves. Such fluctuations can considerably weaken the statistical relationship between policy frameworks and the targeted development of NHM exports needed to diversify export baskets.

This is quite evident when looking at the evolution of the concentration index in a commodity exporting country. For instance, Chile's HHI in the early 2000s markedly reverted its previously downward trend in the absence of any substantial reform to its policy framework (see figures below). This surge in concentration is most evidently related to the international copper boom, which multiplied the value of Chile's copper exports from US$ 8 billion in 2003 to a peak of US$ 54 billion in 2011, when it accounted for half of its goods exports. The continued growth in per capita NHM exports during that period confirms that

the surge in export concentration was not related to a weakening in Chile's NHM export

potential. Because most countries that seek export diversification are strongly dependent on

HM exports, this disconnect between the HHI and policy determinants of NHM exports due

to commodity fluctuations is highly consequential.

In a regression analysis with the concentration index as dependent variable and a set of

policy variables as covariates, heterogeneity in HM abundance and prices could bias

coefficients of policy variables that are correlated to HM heterogeneity and/or inflate error

terms thus lowering estimation efficiency. In general, countries with high HM abundance

could be unfairly judged as failures of pro-diversification merely because of their exogenous

HM abundance.

A similar complication occurs when trying to identify a statistical relation between policy

variables and *superior* exports by using sophistication or complexity indices as dependent

variables. These indices are broadly a product of the sophistication/complexity of each

exported product times the product's share in the country's export basket. This concept is

more evident in the definition of the ESI. For instance, the ESI of country *j* is calculated as

the sum of the sophistication (*PRODY*) of each exported product weighted by its share in its

total exports:

(2) $ESI_j = \sum_s \left(\frac{x_{js}}{\sum x_{js}} \right) PRODY_s$

In turn, product sophistication is calculated as the weighted average of GDP per capita

(GDPpc) of the countries exporting product *s*, where the weight is the value-share of product

s in country *j's* overall export basket divided by the value-shares across all countries

exporting that good:

(3) $PRODY_s = \sum_j \frac{\left(\frac{x_{js}}{X_j} \right)}{\left(\sum_j \left(\frac{x_{js}}{X_j} \right) \right)} GDPpc_j$

Where $X_j = \sum_s x_{js}$ is the total exports of country *j*. Hence, a product is estimated as more

sophisticated when it is mainly produced in higher income countries. Because HM exports

dominate the export baskets of lower GDP per capita countries, in general, HM exports are

estimated as less sophisticated than NHM exports:

(4) $PRODY_{HM} < PRODY_{NHM}$

Since exports (*x*) are measured in nominal values, exogenous increases in international HM

prices or HM discoveries lower the ESI without any change in sophisticated exports.

Regression specifications that aim to establish a link between policies and sophisticated

exports are thus weakened by exogenous commodity related fluctuations. This caveat

similarly applies to the analysis of export complexity because, although the definition of the

ECI is more intricate than the ESI's, in essence it is similarly a product of the complexity of

each exported product weighted by the product's share in the country's export basket. [7]

Chile during the early 2000s is also an illustrative case of how these indices can mislead the identification of policies that foster *superior* exports. Chile's ECI plummeted from close to zero in 2000 to -0.6 in 2015, a considerable fall as the ECI broadly ranges

Source: Hausmann and others (2013)

between -2.5 and 2.5. This decline seems at odds with the sustained productivity growth that

Chile experienced those years which, a priori, should have increased its capacity to produce

complex goods for exporting. As was the case with the HHI, Chile's ECI decline is most

evidently related to the boom of copper (a low complexity product), thus showing how

commodity fluctuations erode the relation between target variable (complex exports) and

policy variables. [8]

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[7] The ECI of a country is calculated based on the diversity of exports a country produces and their ubiquity, or the number of countries able to produce them (and those countries' complexity). This index aims to measure the knowledge in a society in terms of the products it exports (Hausmann and others, 2013), but this is questionably the case as it is substantially affected by commodity fluctuations that are not related to the knowledge or productivity of economic agents.

[8] As an example of a similar disconnect in oil exporting countries, Nigeria's ECI has considerably deteriorated during oil price booms (in the early 1970s and early 2000s) and improved significantly in 2008, as a result of the oil price collapse of that year. At a regional level, as noted in Ding and Hadzi-Vaskov (2017), a growing trend in the share of *complex exports* in Latin American and Caribbean in the 1990s was reversed in the 2000s because of the commodity price boom, as the region is a major exporter of these products.

The disconnect between the ECI and a
country's policy framework is similarly
evident in cross-country comparisons. A
priori, the advanced Australian economy, with
strong institutional and educational quality,
should be more capable of producing complex

Exports Complexity Index in 2015
Source: Hausmann and others (2013)

products than Latin American countries. Yet, for example, the ECI of Australia is

considerably below the ECIs of El Salvador and Honduras. According to its authors the ECI

is a proxy for *productive capabilities* and measures the *knowledge of a society* (Hausmann

and others, 2013), but it is questionable that Australia's *productive capabilities* are inferior in

this illustrative cross-country comparison. Australia's low ECI is likely related to its

exogenously high mineral endowment and consequent high exports of minerals, which are

low complexity products.

Another illustrative case of the limitations of the ECI as a measure of complexity due to

natural resource abundance is the U.S. state of Texas. Despite being a global technology

leader its ECI is only 0.29, similar to the Philippines. This evident inconsistency likely

results from Texas superlative petroleum endowments and the extremely low (-2.57) Product

Complexity Index (PCI) of Petroleum Oils in Hausmann and others (2013).

This dependency of the ECI on exogenous commodity developments is systemic across

countries. Fixed effect regressions including most countries (Table A.1) indicate that the ECI

is strongly associated with resource wealth as defined in Sachs and Warner (1995). It is thus

likely that the ECI's statistical relation with future GDP growth described in Hidalgo and

Hausmann (2009) is related to the *resource curse* identified earlier in several studies

including in Sachs and Warner (1995).

The evident disconnect between the above discussed indices and policy determinants that

foster diversification and export *superiority* can be effectively addressed by focusing directly

on the evolution of the export products that lead to diversification or export *superiority*.

Since export diversification is commonly sought in countries that are dependent on a handful

of HM exports, the relevant dependent variable is the value of NHM exports. In other words,

as HHIs (defined in equation 1) are high in commodity-dependent countries because few HM

products dominate the value of NHM exports, policymakers can lower the HHI by boosting

NHM exports. The HHI could also be lowered by fostering other HM exports, but the level

of these HM exports depends exogenously on their existing reserves and prices. Therefore, it

makes sense to think of export diversification as the promotion of NHM export categories,

including in manufacturing and services. Regression analyses that seek identify the policy

determinants of export diversification can have these NHM export categories as dependent

variables.

More evidently, when aiming to foster *superior* exports the dependent variable can be

directly defined as the value of those *superior* exports itself. Doing this filters out any effect

of low-complexity HM export values, which policy makers have little influence over. For

cross-country comparability the value of superior exports can be normalized by population or

labor force to control for size. Thus, the following sections analyze complexity through the

value of *complex exports* per capita, herby defining as *complex exports* those products with Product Complex Index (PCI) above zero (the top half of most complex products in Hausmann and others (2013) categorization).

An alternative solution to deal with the weakened link between the HHI and diversification policy determinants would be to remove HM exports from the calculation of the HHI. In practice, however, there is hardly any country that has an export basket concentrated on few NHM products and therefore strongly needs to diversify its NHM export basket. A statistical analysis of HHI excluding NHM exports as dependent variable would thus have little practical relevance.

One of those exceptional countries is Bangladesh, with a high HHI (about 0.4) in recent years due to its strong dependence on garment exports. Note, however, that Bangladesh is also a country with very low per capita NHM and manufacturing exports. In general, countries that excel in the development of NHM/manufacturing/*complex* exports also have low HHI excluding HM products, as seen statistically in the table below. And, in fact, as seen in the chart below, there are no countries with high NHM exports per capita (log of NHM above seven) that do not have a low HHI excluding HM products (below 0.2). This confirms that developing high NHM exports per capita is empirically equivalent to developing export diversification. Panel Figure A.1 similarly shows that countries with high manufacturing and complex exports per capita also have low HHI excluding HM products.

Panel regressions of NHM Export Concentration on targetted exports

	HH Index excluding non-hydrocarbon/mineral exports		
Log NHM Exports Per Capita	-0.009***		
Log Complex Exports Per Capita		-0.012***	
Log Manufacturing Exports Per Capita			-0.023***
Constant	0.244***	0.244***	0.242***
N	6475	6181	6468
r2_a	0.04	0.04	0.11

Source: UN Comtrade and author's calculations.

Note: Country codes from ISO 3 nomenclature.

And while removing HM exports from the estimation of the dependent variable could be an alternative option to filter out the exogenous effect of HM abundance and price fluctuations when identifying policies that lead to export diversification, a similar option would not be applicable when identifying policies that lead to export complexity. Excluding HM exports from the ECI as a measure of a country's complexity, would not accurately measure the overall *productive capabilities* of a country as intended by its authors in cases in which a

small, non-representative elite is capable of exporting complex products but most of society does not export and is involved in low productivity activities. [9]

On the other hand, using a country's *complex exports* per capita evidently should reflect its *productive capabilities*. Fixed effects regressions in Table A.1 and the correlation table below show that *complex exports* per capita is positively associated with the ECI. Central to the analysis in this paper, this matrix also shows that the ratio of *complex exports* per capita is not significantly correlated to the ratio of HM exports to GDP. The ratio of *complex exports* per capita, as intended, is not affected by natural resource abundance and commodity price fluctuations, which should improve the identification of the factors that foster the development of *complex exports*.

Correlation ECI, natural resource abundance, and complex exports per capita			
	Economic Complexity Index	HM exports to GDP	Complex Exports Per Capita (Log)
ECI	1.00		
HM exports to GDP	-0.23	1.00	
Log Complex Exports Per Capita	0.76	0.07	1.00

Source: Hausmann and others (2013) and author's calculations.
Notes: Economic Complexity Index as defined in Hidalgo and Hausmann (2009).

The analysis substantially changes when focusing directly on the evolution of the targeted export groups per capita. As seen above, although Chile's HHI pointed to declining diversification in the early 2000s, NHM exports per capita continued to increase during that

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[9] One can think of many developing countries in which a very small elite group produces *complex exports*, but the export basket is dominated by HM products and most of the labor force is involved in a low-productivity informal economy. Such country would have a high ECI excluding HM exports, but this would be a poor measure of the overall *knowledge of society*. On the other hand, the country's level of *complex exports* per capita would surely capture the weak *productive capabilities* of its overall economy.

period. The picture similarly changes when looking directly at the value of per capita *complex exports* per capita. Unlike the ECI, the real value of Chile's *complex exports* per capita continued to grow during the copper boom and, as expected, *complex exports* per capita is higher in Australia than in Honduras and El Salvador.

Another alternative to filter out the impact of HM fluctuations on indices of export diversification and *superiority* could be to include HM prices as a covariate. But while this would control for the within variations in a panel setting it would not correct between effects of HM abundance.

More importantly, in essence, this chapter's proposal to focus on NHM/complex exports to filter out the exogenous impact of HM abundance and price fluctuations on diversification and *superior* exports goes beyond being a statistical artifact to improve regression estimations. As discussed earlier, this chapter proposes a framework that conceptually links exports *diversification/superiority* to the generally well developed literature on export development, simply by noting that the development of NHM exports, including of manufactures or services are the road to diversification of the majority of countries that seek to diversify away from commodity exports, and that the development of *complex exports* are

the road to export complexity. This framework is valuable for several reasons besides controlling for exogenous HM fluctuations in a regression setting. For instance:

- As the NHM export categories that lead to export diversification and superiority are not affected by exogenous HM fluctuations, simply observing their evolution across time provides a more accurate sense of a country's policy framework performance in promoting export diversification/*superiority*, as the discussion above on Chile's progress in recent decades shows.

- Similarly, comparing the per capita value of these NHM export categories across countries allow for more accurate comparisons of countries' performance in promoting export diversification/*superiority*, as the discussion above on Chile also suggest.

- The per capita value of *complex exports* better reflects the p*roductive capabilities* of a country, the authors of the ECI aimed to reflect.

- The per capita value of the NHM exports that promote export diversification are more unambiguously related to the goal economic development, noting that export concentration (diversification) indices can be low (high) in low income countries as that do not have HM wealth and export low values of several products (for example, Pakistan or Sri Lanka). In contrast, countries with high NHM exports per capita not only have diversified export baskets but are certainly economically prosperous.

- As will be more deeply discussed below, linking export diversification and *superiority* to the development of NHM exports grounds better the discussion in the international trade literature.

INDEPENDENT VARIABLES

A second fundamental shift needed to sharpen the identification of factors that foster export

diversification and *superior* exports is basing regression specifications on standard trade

theory. This second shift is partly related to the first one, as the dependent variables proposed

are levels of exports (not indices) and these have been extensively modelled in the

international trade literature.

Regression specifications with export levels as dependent variables can have gravity equation

specifications. This is particularly convenient as Arkolakis and others (2012) have shown

that a large class of international trade models generate isomorphic gravity equations, and

therefore the results of gravity equation-based estimates should be broadly robust to model

selection.

For selection of covariates in addition to standard gravity equation variables, without loss of

generality, we glance at the main components of an EK02 (Eaton and Kortum, 2002)

Ricardian general equilibrium model. We can relate the target export categories (NHM,

manufacturing, complex, and services) to the manufacture sector in EK02's two-sector

setting of manufactures and non-manufactures (equation 17 in EK02):

(5) $\quad \dfrac{X_{ni}}{X_n} = T_i \left(\dfrac{\gamma d_{ni} w_i^{\beta} p_i^{1-\beta}}{p_n} \right)^{-\theta}$

where the fraction of total expenditure of country *n* on manufacturing goods from country *i*

(X_{ni}) divided by its total expenditure (X_n), is a function of country *i*'s state of technology (T_i),

wages in country i (w_i), and prices in both countries i and n.[10] Note that while distance-related variables are mostly exogenous, those related to technology and wages are largely determined by public policies of the exporting economy.

Other empirical studies on the determinants of export diversification and *superior* exports include independent variables that are related to productivity/technology (T-variables) of the exporting country (i), but do not include wage and gravity equation variables. This omission implicitly assumes that labor costs and gravity-equation variables do not have a different effect in the targeted export groups (NHM or *superior* exports) from the non-targeted exports (homogeneous elasticities across exports types). A significant exception is Weldemicael (2012), which finds that distance to markets is strongly related to the ESI, thus implying a significant difference in the impact of distance on more sophisticated exports from less sophisticated exports.[11] In line with this finding, the statistical analysis below identifies heterogenous elasticity-to-distance across several export groups.

Empirical findings from the GVC literature also hint at the importance of distance to large markets and other gravity equation variables in the development of *superior* exports. Raei and others (2019) and Kowalski and others (2015) identify gravity variables as key determinants of Global Value Chain (GVC) participation. Since participation in GVCs is

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[10] Parameter γ is a measure of the sensitivity of local prices to foreign cost structures and geographic barriers. θ represents product homogeneity across countries, which governs comparative advantage. A low θ implies high product variability and in that case comparative advantage exerts a bigger force for trade. β is labor's share in production, while (1- β) is intermediate inputs' share in production.

[11] While Weldemicael (2012) innovates in the export *superiority* literature by including distance to other markets, by still using ESI as dependent variable, its statistical analysis is affected by exogenous heterogeneity related to HM abundance and prices. Neither does it include other gravity-equation and labor cost variables.

seen as a major force behind the growth of more complex, manufacturing products, it is very likely that gravity-related variables are significant determinants of *export superiority*.

3. METHODOLOGICAL DISCUSSION AND DATA

Part of the analysis in this paper focuses on the value of each export category normalized by population to allow cross-country comparisons among exporters. Admittedly, NHM exports per capita are not totally immune to commodity booms and natural resource abundance. Commodity booms could trigger Dutch Disease dynamics attracting factors of production towards HM export sectors and away from NHM exports. As seen in the case of Chile in the early 2000s and as in the stylized facts charts presented below, this effect does not appear to be substantial across time within a country (NHM exports continued to grow in Chile during the 2000s commodity boom). However, exports of HM products, for sure, use up significant labor, directly and indirectly, thereby reducing NHM exports per capita relative to non-commodity exporters. It is worth keeping this in mind especially in cross-country comparisons of NHM exports per capita.

Normalizing by population also makes the dependent variable less sensitive to commodity fluctuations than alternative normalizations. Normalizing NHM exports by dividing them by GDP is ruled out as GDP in HM abundant countries by definition includes HM exports. Dividing NHM exports by GDP excluding HM sectors is similarly rejected because commodity boosts and busts indirectly affect other sectors, such as commerce and services.

A potential drawback of normalizing targeted exports through dividing by population is that such ratio can be exogenously affected by the share of the population in working age, which can affect cross-country and cross-time comparisons. This could hence weaken the link between policies and targeted exports and suggest normalization by the labor force could be preferable. Nonetheless, participation in the labor force can be endogenous to economic activity and therefore to policy determinants under consideration in this study. For example, if policy determinants are effective in fostering the targeted exports partly by increasing labor force participation, the exports-to-labor force ratio would be relatively unchanged and not reflect the success of those policies. In any case, the identification of policy determinants of diversification does not require normalization of the dependent variable and while the analysis on goodness of fit does require normalization, it is largely robust to normalization by labor force instead of population.

Following the previous discussion, the analysis below is based on gravity-equation regression specifications including labor costs and T-variables: [12]

$$(6) \quad X_{ni,t} = \alpha_1 \log(\gamma) + \alpha_2 \log(X_{n,t}) + \alpha_3 \log(d_{ni}) + \alpha_4 \log T_{i,t} + \alpha_5 \log(w_{i,t}) +$$
$$\alpha_7 \log(X_{i,t}) + \vartheta_{ni} + \mu_t + \varepsilon_{ni,t}$$

where year (μ_t) and country-pair fixed effects (ϑ_{ni}) are introduced. In addition to distance between countries itself, other commonly used gravity equation variables (dummies for

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[12] Price variables are excluded for statistical estimation simplicity but will be indirectly considered when discussing below the introduction multilateral resistance terms.

common currency, Free Trade Agreement, common border, common language, common

colonizer, and past colonial dummy) are included as they are also somehow related to the

distance (d_{ni}) concept in EK02.

Regression specifications in most related studies include T-variables such as institutional

development, educational attainment, trade policy openness, and infrastructure

development.[13] These four variables appear significantly (though not robustly) associated

with diversification, sophistication, and complexity in several studies (for example

Hausmann and others, 2006; Weldemicael, 2012; Ding and Hadzi-Vaskov, 2017), including

through Bayesian identification (Giri and others, 2019).

The analysis in this paper also identifies these four variables as the most economically and

statistically significant in fostering diversification and complexity relative to other T-

variables. As highlighted in the gravity equation literature, exports are not only determined

by policy variables of the exporting country, but also by policies of the importing country

and therefore they are also included in regressions below. A labor market flexibility variable

is introduced to partly capture the wage variable in EK02, assuming rigid labor markets

inflate wage costs.

GDP per capita is added as an independent variable acknowledging that it can also

approximate wage costs, but mainly to control for potential endogeneity between NHM

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[13] Trade policy openness and transport infrastructure can be alternatively considered proxies for effective distance between countries.

exports per capita and T-variables. Higher NHM exports can foster GDP and higher GDP can help strengthening T-variables (for example, higher output can facilitate/finance higher educational attainment). Note though that GDP per capita is not included in the calculation of goodness of fit when estimating the predictive power of policy variables.

Some other components are added to equation (6) including: (i) a remoteness index variable of the importer as a reduced-form control for inward multilateral resistance (Rn,t); (ii) a remoteness index variable of the exporter as a reduced-form control for outward multilateral resistance (Ri,t); and (iii) T-variables of the importing country ($T_{n,t}$): [14]

(7) $X_{ni,t} = \alpha_1 \log(\gamma) + \alpha_2 \log(X_{n,t}) + \alpha_3 \log(d_{ni}) + \alpha_4 \log T_{i,t} + \alpha_5 \log(w_{i,t}) +$

$+ \alpha_6 \log((\frac{X}{N})_{i,t}) + \alpha_7 \log(X_{i,t}) + \alpha_8 \log(RI_{n,t}) + \alpha_9 \log(RI_{i,t}) + \alpha_{10} \log(T_{n,t}) + \vartheta_{ni} +$

$\mu_t + \varepsilon_{ni,t}$

As in Wei (1996) and Anderson and van Wincoop (2003), the remote index of a country i is calculated as a weighted average of the distance of country i to its trading partners (n), where the weights are the incomes of trading partners (Xn): [15]

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[14] Although including log GDP per capita and log GDP of the source country can add multicollinearity to the specification (the correlation among them in the sample is 0.5) this does not directly impact the main conclusions of this paper because: (i) the estimated coefficient of log GDP, which is used to calculate the equation (9), appears stable and statistically significant across regressions; (ii) conclusions based on equation (9) do not change if the coefficient is replaced by 1 (as commonly assumed in the gravity equation literature); main conclusions of the paper are not directly based on the coefficient of log GDP per capita.

[15] The use of remoteness indices to control for multilateral resistance could be considered a second-best option, as Yotov and others (2012) suggests that a first-best option would be the use of exporter-time and importer-time fixed effects. However, this potentially first-best option would wash out the identification of the hypothesized determinants of the dependent variables in this study due to multicollinearity with the proposed fixed effects.

(8) $\quad RI_i = \sum X_{n,t} \mathrm{d}_{ni,t}$

Since country-pair fixed effects terms are fully correlated with time invariant variables, equation (7) is estimated using the Hausman and Taylor (1981) instrumental variable technique. [16]

After estimating the elasticities of gravity and policy variables within the bilateral trade framework of equation (7), it proofs quite insightful to analyze cross-country predictive power of these estimates. This can be done by aggregating for each exporting country all its bilateral export flows and comparing its total exports to the level predicted by its gravity equation and policy covariates. This provides a sense of the model's goodness of fit at the country level. A complication in doing this is aggregating gravity-equation related variables from the bilateral to the export country level in an intuitive manner. A simple route is to aggregate X_n and d_{ni} of equation 7 by building a Proximity to Markets (PM) index for each country, using these two variables and their coefficients:

(9) $\widehat{PM}_i = \sum \dfrac{X_n^{\hat{\alpha}_2}}{d_{ni}^{\hat{\alpha}_3}}$

Because the dependent variable in equation (3) is specified in logarithmic terms, zero trade flows cannot be included and therefore the information they could provide is neglected. While regressions on goods exports have strong statistical fit despite this omission, regressions on the smaller and less comprehensive set of service exports observations may be more affected by this omission. Yotov and others (2012) indeed suggests that the omission of zero trade flows is more significant for sectoral service trade due to their highly localized consumption and highly specialized production.

As defined here the *PM* index of country *i* aggregates the economic size of all trading

partners weighted by the inverse of their distance to country *i*. Intuitively, *PM* is a measure of

the trade-generating *gravity pull* that each country experiences from all other countries. It is

clearly an inverse concept of *RI* defined in equation (8).

Predicted exports per capita of each country (*Xi/Ni*) are first calculated based only on the

PM's "gravity pull":

$$(10) \ \log\left(\frac{x_{i,t}}{N_{i,t}}\right) = \beta_0 + \log\left(\widehat{PM}_{i,t}\right)$$

and then based on *PM, T* and *w* variables, using their coefficients estimated in equation (7),

which controlled for potential endogeneity through the inclusion of GDP per capita:

$$(11) \ \log\left(\frac{x_{i,t}}{N_{i,t}}\right) = \beta_1 + \log\left(\widehat{PM}_{i,t}\right) + \left(\hat{\alpha}_4 \log T_{i,t} + \hat{\alpha}_5 \log\left(w_{i,t}\right)\right)$$

The gravity equation approach to model exports is not novel, of course, and as mentioned

earlier, it has also been used to identify the determinants of GVC participation. In a certain

way, this GVCs exercises are studies of export *diversification* and *complexity*. The

innovation of this chapter is in conceptually making the link explicit, in addition to revealing

the weaknesses of identifying policies that lead to export diversification/superiority without

controlling for HM fluctuations and improving the measure of export complexity as a proxy

for *productive capabilities*.

As indicated earlier the dependent variables of interest in this paper are those types of exports

that are conducive to diversification and/or are identified as *superior* in some studies. These

are, specifically, exports of NHM, manufacturing, complex, and service products. Based on SITC Revision 2 classification, the NHM group excludes codes 3000-4999, 6772-6999, and 9000-9999, while manufactures includes codes 6900-8999. Services excludes government services (code 11 under classification EBOPS 2002). Complex products include goods that in Hausmann and others (2013) have a PCI above zero (approximately the top half of the PCI ranking). [17] A group including only HM exports is also analyzed for comparison purposes. The data source for exports of goods and services is UN's Comtrade (United Nations, 2020), which includes the Extended Balance of Payments Services (EBOPS) database. Data for goods goes back to 1962 for most countries and for services it starts in 2000 for practically all countries.

Gravity equation variables are extracted from the CEPII gravity database constructed by Head and others (2010) and Rose (2004). [18] Variables measuring political stability and governance are extracted from Polity IV (2014) and World Bank (2020a), respectively. Educational attainment data was retrieved from the United Nations Education index (UNDP, 2020) and Barro-Lee (Barro and Lee, 2013). Tariff data comes from the World Integrated Trade Solution (World Bank, 2020b). Infrastructure quality and other measures of T-variables come from the Global Competitiveness Report (World Economic Forum and Harvard University, 2020), the World Bank's World Development Indicators, and the Doing Business database (World Bank, 2020c). Labor market flexibility is approximated through related subindices in the Global Competitiveness Report (GCR) and in International

[17] The Product Complexity Index is available at < https://atlas.cid.harvard.edu/rankings/product >.

[18] Available at http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp.

Monetary Fund (2019). These different data sources have different starting years, with Polity IV, Barro-Lee, and the World Development Indicators going back to the 1960s, while the Global Competitiveness Report and Doing Business databases starting in the 2000s. The regressions below include as many years as data availability permits.

4. DESCRIPTION OF KEY VARIABLES

Interesting patterns stand out when looking at per capita levels of the export categories associated with diversification and *superior* exports. In a regional comparison, the level of NHM exports per capita appears higher in the wealthier regions East Asia High Income (EAHI), European Union (EU), and Scandinavian (SCN) countries and lower in the lower income regions of South Asia (SAR), Sub-Saharan Africa (SSA), and India (IND). In general, there appears to be a correlation between NHM exports per capita and GDP per capita(see figure below).

Non-Hydrocarbon/Mineral Goods Exports per Capita in 2016-18

Source:UN Comtrade.
EAHI=East Asia High Income; EU=European Union; OCE=Oceania; NAM=North America; EE=Eastern Europe; ARB=Arabic countries; EAEM=East Asia Emerging Market; SCC=Southern Cone Countries; CAM=Central America and Mexico; ME=Middle East; CAR=Caribbean; CA=Central Asia; PAC=Pacific Islands; EAOTH=East Asia Others; AND=Andean; NA=North Africa; SAR=South Asia Region; SSA=Sub-Saharan Africa; IND=India.

Note that even though some Eastern European (EE) and East Asian Emerging Market (EAEM) countries are commonly considered champions of diversification because of their low concentration indices, the higher income, natural resource abundant countries in Scandinavia (SCN) and Oceania (OCE, Australia and New Zealand) have considerably higher levels of NHM exports per capita[19]. And notwithstanding their higher export concentration indices, Southern Cone (SCC) countries (Argentina, Brazil, Chile, Paraguay, and Uruguay) have in average a similar level of NHM exports per capita as EAEM and Central American countries (CAM). This confirms the discussion above suggesting that concentration indices are not an accurate reflection of the development of NHM exports.

But while there is a close relation between income and NHM exports the association is far from perfect. For instance, although natural resource abundant SCN and OCE countries have a higher income per capita than EU countries, their NHM exports per capita are significantly lower. Also prominent is the superlative level of NHM exports per capita of East Asian High-Income economies (EAHI, Hong Kong, Japan, Singapore, South Korea, and Taiwan), even though their income per capita is not considerably different from that of European Union (EU) and SCN countries.

At least two characteristics seem to explain these misalignments between income per capita and NHM exports per capita. One is that, as discussed earlier, even if the production of HM exports is not particularly labor-intensive, the share of labor it demands directly is not negligible, and the share of labor employed in industries and services that support HM

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[19] Regional acronyms are described in Table A.2.

production is significant. With less labor force available to other sectors, NHM exports per capita is expected to be lower in countries with significant HM exports. This then could partly explain why HM intensive OCE and SCN countries have lower NHM exports per capita than other countries with similar income per capita.

A second characteristic that can explain the misalignments is that EAHI and other countries that are close to large international markets and therefore participate more intensively in GVCs, have gross NHM exports that overstate their domestic value added. According to the OECD Trade in Value Added (TIVA) database (OECD, 2019), the domestic value added of NHM exports in remote Australia and Chile is 81 and 88 percent of their gross exports, respectively, while the value added in EAHI and EAEM economies is around 60 percent.[20] The dynamics of NHM exports per capita is also revealing (see panel figure below). In contrast to indices of export diversification and of *superior* exports, NHM exports do not appear affected by commodity prices as they grew resiliently in HM-exporting Andean (AND), SCC, and Sub-Saharan African (SSA) regions throughout the 2000s commodity boom.

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[20] Data on exports value added is not available for most countries, therefore the rest of the analysis centers on gross exports. Note that all indices of diversification and export "superiority" are similarly built based on gross export values and therefore are similarly subject to this caveat.

Non-Hydrocarbon/Mineral Exports per Capita by Region

Source: UN Comtrade

Another important pattern observed in these charts is that NHM exports growth has been faster in regions such as CAM, EE, EAEM, and EAHI, that are closer to the largest world economic centers. East Asian countries exhibited high growth since the 1960s, but their growth decelerated in recent decades. This slowdown does not seem related to a convergence dynamic because EAEM countries decelerated before reaching the level of EAHI countries. NHM exports growth in CAM and EE countries, conversely, accelerated in recent decades, broadly following their economic/trade liberalization episodes. Some remote regions, such as OCE and SCC have also experienced faster NHM exports growth following liberalization episodes.

A country-level view of NHM exports growth broadly confirms these regional patterns and provides further insights (see panel figure below). Countries close to large international

markets such as Costa Rica, El Salvador, Poland, Malaysia, and Indonesia show the fastest

NHM growth, and countries that undertook strong trade liberalization like Costa Rica, Chile,

El Salvador, Poland, experienced an acceleration in the aftermath of these reforms. Also

remarkable is the stagnation in NHM exports in countries previously considered models of

diversification, such as Dominican Republic and Mauritius. These countries though have

dynamic services sectors (mainly tourism) that are not included in these charts showing

NHM goods exports.

Non-Hydrocarbon/Mineral Exports per Capita by Country

Source: UN Comtrade

Cross-regional comparisons of the *PM* index confirms that distance to global economic

centers appears closely linked to NHM export development The charts below confirm that

regions with fast growth in NHM exports (CAM, EE, EAHI, and EAEM) have substantially

higher *PM* than most other emerging and developing regions. [21] Remarkably, CAM and EE

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[21] Exponents $\hat{\alpha}_2$ and $\hat{\alpha}_3$ in equation (9) are equal to one in these charts.

had very high *PM* already in the 1960s, but as noted earlier, they did not experience a sustained acceleration in NHM exports until they liberalized their trade regimes.

Proximity to markets

Source: CEPII gravity database constructed by Head and others (2010) and Rose (2004).
Note: Proximity to Markets defined in equation (9).
EAHI=East Asia High Income; EU=European Union; OCE=Oceania; NAM=North America; EE=Eastern Europe; ARB=Arabic countries; EAEM=East Asia Emerging Market; SCC=Southern Cone Countries; CAM=Central America and Mexico; ME=Middle East; CAR=Caribbean; CA=Central Asia; PAC=Pacific Islands; EAOTH=East Asia Others; AND=Andean; NA=North Africa; SAR=South Asia Region; SSA=Sub-Saharan Africa; IND=India.

Already in the 1960s, East Asian countries benefitted from a significantly higher *PM* than many emerging economies. In fact, the Proximity to Markets (*PM*) index of South Korea in 1965 was about 70 percent higher than SCC, a factor that could significantly help explain the often-noted higher export performance of South Korea. The high *PMs* of South Korea and other East Asian countries in the 1960s reflected their proximity to the large and already industrialized Japanese economy, which was not only beneficial as a source of nearby demand but also of capital and technology transfer.

The largeness of the East Asian economic agglomeration and its efficient sea-based interconnection are clearly an advantage relative to the relative isolation of countries in

Oceania, Sub-Saharan Africa, and South America.[22] Furthermore, the higher *PM* of East Asian countries has substantially increased in recent decades, as their high *PM*s have fostered their economies and the growth of their economies have further increased their *PM*s (a virtuous circle).

Panel Figure A.2 shows the evolution of T- variables since the 1960s. Many decades ago, EAHI countries already had superior education and infrastructure as well as lower trade barriers than other developing countries, and they improved their relative standing in decades after. This could also help explain their sustained high export performance. Eastern European countries had superlative education in the 1960s, but they improved their relatively weak infrastructure and open their relatively closed trade policies only since the 1980s.

5. MAIN RESULTS: WHAT EXPLAINS DIVERSIFICATION AND *SUPERIOR* EXPORTS

IDENTIFICATION OF DETERMINANTS

Regressions based on equation (7) confirm the importance of proximity/distance to large global markets for export diversification and the development of *superior* exports. The coefficient of distance to partner country in a first regression including only gravity-equation variables (see table below, column 1), indicates that reducing distance by half is associated

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[22] The higher *PM* in East Asia than South America and Sub-Saharan countries is likely higher if estimated based on travel time among countries, not distance among them. East Asian countries are easily and closely connected through the sea, whereas South American and Sub-Saharan African countries are mainly separated by difficult land geographies.

with a 150 percent increase in NHM exports. Note that the *PM* of the remote SCC and OCE regions is about half of that of CAM, EE, and East Asian regions and therefore the exogenous distance factor on its own can explain a substantially lower level of NHM exports per capita in these remote regions. The point estimate of the coefficient of distance does not change much when including other policy determinants in columns 2-4. The coefficients of most other gravity equation variables are statistically significant and have the expected signs.

Determinants of non-hydrocarbon/mineral (NHM) exports

Dependent Variable: Log NHM exports	(1)	(2)	(3)	(4)
Log GDP reporter	1.527***	0.660***	0.16	0.825***
Log GDP partner	0.386***	0.22	0.03	0.159*
Log distance	-1.471***	-1.247***	-1.240***	-1.329***
Common currency dummy	0.386***	0.22	0.03	0.159*
Free trade agreement dummy	0.232***	0.177***	0.131*	0.188***
Common border dummy	0.328**	1.971***	1.837***	1.383***
Common language dummy	0.753***	0.619***	0.316**	0.573***
Common colonizer dummy	0.836***	0.253*	0.716***	0.473***
Past colonial link dummy	1.534***	1.338***	1.501***	1.481***
Log GDP per capita	-0.341***	-0.08	0.644***	0.272***
Governance (WB Index)		0.457***	0.176**	
Education (UN Index)		4.854***	3.550***	
Infrastructure (GCR Index)		0.169***	0.283***	
Average Tariff		-0.0299***	-0.0429***	
Labor market flexibility (GCR Index)		0.021		
Labor market flexibility (IMF Index)			2.861***	
Political stability (Polity IV)				-0.0177***
Education (Barro Lee)				0.0438***
Infrastructure (WDI)				0.0238***
Trade liberalization (Wacziarg and Welch, 2003)				0.517***
Constant	-21.94***	0.48	15.44***	-4.178*
Observations	169,968	44,989	31,253	90,352
Rho	0.76	0.94	0.96	0.86

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN Comtrade database. Observations are non-overlapping 5-year averages within the 1962-2018 period, depending on data availability. Regression specification based on equation (7). Multilateral resistance terms and partner country's policy variables included (coefficients not reported). Dependent variable is the logarithm of the value of exports excluding hydrocarbon and mineral products (SITC2 codes 0-2999, 4000-6772, 6900-8999). Trade liberalization dummy based on identification of trade liberalization episodes in Wacziarg and Welch (2008), with a value of 1 if the country has liberalized.

The statistical and economic significance of T- variables in the second column regression is also remarkable, particularly of education. A one standard deviation increase in educational attainment is associated with a 170 percent increase in NHM exports, while same increases in governance and infrastructure quality increase them by also significant 65 and 20 percent,

respectively. Consistent with the noticeable acceleration in NHM exports after trade liberalization episodes shown above, reducing the average import tariff from 15 to 5 percent is associated with a significant 45 percent increase in NHM exports. Labor market flexibility is not significant when measured by the Global Competitiveness Report subindex, but a one standard deviation increase in the IMF labor subindex appears associated with a 45 percent increase in NHM exports in the third column regression. [23]

The fourth regression substantially extends the sample back to the 1980s by using the Polity IV political stability index as a proxy for governance; an index of railroad, phone lines, and electricity coverage as a proxy for infrastructure; and, as a proxy for trade policy, a binary variable with value of one if the trade policy regime has been liberalized according to Wacziarg and Welch (2008). In addition, the Barro-Lee education attainment indicator replaces the UN indicator and is interpolated in missing years. The estimated coefficients confirm the importance of these variables except for political stability. The coefficient of the liberalization dummy implies that liberalization episodes in Wacziarg and Welch (2008) are associated with an 80 percent increase in NHM exports per capita.

The evident association between gravity and policy determinants and NHM exports per capita for sure do not demonstrate causality from the former to the latter, but regressions with lagged covariates provide some evidence of causality. The second column of the regression table below lags the Worldwide Governance Index, UN educational attainment, GCR

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[23] Table A.3 shows that coefficients of policy variables the regression in column 2 remain economically and statistically significant to several regression specifications.

infrastructure pillar, average tariff, and the GCR labor market flexibility index by one period and finds that the coefficients of these variables are not considerably different from those in the contemporaneous specification in the first column. Regression presented in the third and fourth column lag one and two periods, respectively, the policy variates with longer span (Polity IV political stability, Barro-Lee education attainment, infrastructure coverage index, and trade liberalization dummy). The coefficients of the education, infrastructure, and trade liberalization variables remain significant when lagged one period, while the infrastructure and trade liberalization dummy remain robust even after being lagged two periods (ten years).

Determinants of exports by regression specification at different periods

Dependent Variable: Log of NHM exports					
Policy variables at time:	t	t-1	t	t-1	t-2
Log distance	-1.279***	-0.964***			
Log GDP per capita	-0.15				
Governance (WB Index)	0.484***	0.524***			
Education (UN Index)	5.099***	3.160***			
Infrastructure (GCR Index)	0.175***	0.105***			
Average Tariff	-0.0310***	-0.0428***			
Labor market flexiblity (GCR Index)	0.02	0.114**			
Political stability (Polity IV)			-0.0178***	-0.0186***	0.0131***
Education (Barro Lee)			0.0428***	0.0261**	0.01
Infrastructure (WDI)			0.0235***	0.0281***	0.0304***
Trade liberalization (Wacziarg and Welch, 2003)			0.502***	0.656***	0.684***
Observations	44,989	28,754	90,661	70,932	54,810
Rho	0.93	0.93	0.86	0.86	0.90

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN Comtrade database. Observations are non-overlapping 5-year averages within the 1962-2018 period, depending on data availability. Regression specification based on equation (7). Multilateral resistance terms and partner country's policy variables included (coefficients not reported). Dependent variable is the logarithm of the value of exports excluding hydrocarbon and mineral products (SITC2 codes 0-2999, 4000-6772, 6900-8999).

The significance of these policy determinants remains robust to the inclusion of other T-variables in the Doing Business and Global Competitiveness reports (see table below). Doing Business variables are statistically significant, but estimated coefficients imply only single-digit percent impact of a standard deviation change on NHM exports. As expected, a one

standard deviation increase in the overall Doing Business score appears more effective, as it is associated with a 15 percent increase of NHM exports. Among variables in the Global Competitiveness Index, technological readiness has a high magnitude and statistical significance, implying that a standard deviation increase in this variable is associated with a 10 percent increase in NHM exports.

Other determinants of non-hydrocarbon/mineral (NHM) exports				
Dependent Variable: Log non-hydrocarbon/mineral exports	(1)	(2)	(3)	(4)
Log distance	-1.247***	-1.265***	-1.237***	-1.223***
Governance (WB Index)	0.457***	0.391***	0.339***	0.353***
Education (UN Index)	4.854***	4.526***	4.402***	4.528***
Infrastructure (GCR Index)	0.169***	0.157***	0.0809***	0.136***
Average tariff	-0.0299***	-0.0255***	-0.0241***	-0.0246***
Labor market flexibility (GCR Index)	0.02	0.0363	0.0084	0.0390
Construction permits (Doing Business)		0.00	0.00	
Getting credit (Doing Business)		0.00177**	0.00158*	
Investment protection (Doing Business)		0.00288**	0.00317**	
Paying taxes (Doing Business)		0.00	0.00	
Contract enforcement (Doing Business)		0.00	0.00	
Resolving insolvency (Doing Business)		0.00178*	0.00194**	
Macroeconomic environment (GCR Index)			-0.0332*	
Technological readiness (GCR Index)			0.0976***	
Business sophistication (GCR Index)			0.11	
Innovation (GCR Index)			0.08	
Doing Business Score				0.0155***
Constant	0.48	-2.86	-2.20	-9.129**
Observations	44989	44704	44704	44110
Rho	0.94	0.95	0.95	0.95

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN COMTRADE database. Observations are non-overlapping 5-year averages within the 1965-2017 period, depending on data availability. Regression specification based on equation (3). Gravity equation variables, multilateral resistance terms and partner country's policy variables included but coefficients not reported.

Within the broad policy areas of governance, education, and infrastructure there are some specific areas more strongly associated with NHM exports development (see table below). Very prominently, one standard deviation increases in government effectiveness and control of corruption are respectively associated with 60 and 40 percent higher NHM exports. Among education levels, secondary and tertiary education are statistically more significant than primary, while ports and electricity are the most statistically significant infrastructure subcomponents.

Sub-determinants of non-hydrocarbon/mineral (NHM) exports

Dependent Variable: Log non-hydrocarbon/mineral exports	(1)	(2)	(3)
Log distance	-1.272***	-1.412***	-1.228***
Governance (WB Index)		0.514***	0.277***
Education (UN Index)	4.663***		4.127***
Infrastructure (GCR Index)	0.104***	0.182***	
Average tariff	-0.0267***	-0.0360***	-0.0345***
Labor market flexibility (GCR Index)	0.01	0.05	-0.03
Government effectiveness (WB Index)	0.376***		
Control of corruption (WB Index)	0.520***		
Primary education (GCR Index)		0.002	
Secondary education (GCR Index)		0.00495***	
Tertiary education (GCR Index)		0.00615***	
Port infrastructure (GCR Index)			0.0558**
Electricity infrastructure (GCR Index)			0.0717***
Constant	-1.40	0.93	-10.20**
	(-0.44)	(-0.30)	(-3.10)
Observations	44989	44989	44764
Rho	0.94	0.94	0.95

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN Comtrade database. Observations are non-overlapping 5-year averages within the 1962-2018 period, depending on data availability. Regression specification based on equation (7). Multilateral resistance terms and partner country's policy variables included (coefficients not reported). Dependent variable is the logarithm of the value of exports excluding hydrocarbon and mineral products (SITC2 codes 0-2999, 4000-6772, 6900-8999).

Independent variables in equation (7) are also strongly associated with other export groups linked to diversification and complexity (see table below). Distance to partner country has a similar large effect on NHM, complex, and manufacturing exports. Expectedly and very importantly, distance appears less relevant for service exports, thus implying that remote countries could more easily promote diversification by fostering service rather than goods exports. Governance and education are important in fostering all four groups of exports conducive to diversification, but as also expected, overall infrastructure and tariffs are not important for services exports development. [24] Labor market flexibility is, not surprisingly,

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[24] Most sub-components of the infrastructure pillar of the Global Competitiveness Report are related to transportation of goods and therefore not as critical to export of services.

more significant in determining complex and manufacturing exports than NHM exports. [25]

Except for infrastructure development, T-variables are not significantly associated with

higher HM exports, likely because these exports are more dependent on resource endowment

than on the policy environment.

Other determinants of non-hydrocarbon/mineral (NHM) exports				
Dependent Variable: Log non-hydrocarbon/mineral exports	(1)	(2)	(3)	(4)
Log distance	-1.247***	-1.265***	-1.237***	-1.223***
Governance (WB Index)	0.457***	0.391***	0.339***	0.353***
Education (UN Index)	4.854***	4.526***	4.402***	4.528***
Infrastructure (GCR Index)	0.169***	0.157***	0.0809**	0.136***
Average tariff	-0.0299***	-0.0255***	-0.0241***	-0.0246***
Labor market flexibility (GCR Index)	0.02	0.0363	0.0084	0.0390
Construction permits (Doing Business)		0.00	0.00	
Getting credit (Doing Business)		0.00177**	0.00158*	
Investment protection (Doing Business)		0.00288**	0.00317**	
Paying taxes (Doing Business)		0.00	0.00	
Contract enforcement (Doing Business)		0.00	0.00	
Resolving insolvency (Doing Business)		0.00178*	0.00194**	
Macroeconomic environment (GCR Index)			-0.0332*	
Technological readiness (GCR Index)			0.0976***	
Business sophistication (GCR Index)			0.11	
Innovation (GCR Index)			0.08	
Doing Business Score				0.0155***
Constant	0.48	-2.86	-2.20	-9.129**
Observations	44989	44704	44704	44110
Rho	0.94	0.95	0.95	0.95

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN Comtrade database. Observations are non-overlapping 5-year averages within the 1962-2017 period, depending on data availability. Regression specification based on equation (7). Dependent variable is the logarithm of the value of exports excluding hydrocarbon and mineral products (SITC2 codes 0-2999, 4000-6772, 6900-8999). Gravity equation variables, multilateral resistance terms and partner country's policy variables included (coefficients not reported).

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[25] NHM exports include some natural resource-based products (for example, agriculture, forestry, and fisheries) and therefore unit labor costs are likely less centrally determinant for them than for manufacturing.

As hinted by stylized facts, regression analysis also shows that the *gravity pull* from being close to larger international markets and an open trade regime appear positively related to NHM exports growth not just to their level. In a simple dynamic regression with growth of NHM exports

Annual growth of exports on potential determinants.		
Dependent Variable:	NHM exports per capita	HM exports per capita
Lagged growth of dependent variable	0.649	0.012
	0.00	0.233
log(Proximity to Markets)	0.143	0.353
	0.000	0.328
Log(GDP per capita)	-0.013	-0.166
	0.001	0.210
Trade Liberalization dummy	0.059	0.386
	0.000	0.090
Observations	5575	5372

Notes: Results from System GMM regressions. P-values below coefficients. Trade liberalization dummy basd on Wacziarg and Welch (2008). Data from UN Comtrade.

per capita as dependent variable and *PM*, GDP per capita, and the Wacziarg and Welch (2008) trade liberalization dummy as independent variables, the coefficients of *PM* and trade liberalization are positive and statistically significant. The point estimate of the *PM* coefficient implies that doubling *PM* is associated with a 15 percentage points higher annual growth in NHM exports, while the point estimate of the trade liberalization coefficient implies that these episodes are followed by a 6-percentage points acceleration in NHM exports growth. [26] A similar regression on HM exports per capita growth finds this variable strongly related to trade liberalization, but not as much with *PM*.

ANALYSIS OF FIT: PREDICTIVE POWER OF PROXIMITY AND HORIZONTAL POLICIES

Being located close to large economic centers is a critical advantage for the development of exports conducive to export diversification. This is most evident in a scatter plot (see figure below) comparing actual levels of NHM exports per capita versus those predicted only by *PM*. The correlation between both variables is 0.54 and the R-squared of a fitted line

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[26] The *PM* coefficient implies that the difference in *PM* between Malaysia and Chile (Malaysia's *PM* is 60 percent higher than Chile's) more than explains Malaysia's 2.8 percentage points higher average growth in its NHM exports per capita since the 1960s.

indicates that a quarter of the variation in NHM exports is predicted by countries' exogenous proximity to other economies. [27]

Source: UN Comtrade and author's estimations.
Note: R-squared=0.27, correlation=0.55. Country codes from ISO 3 nomenclature.

As previous regressions results suggest, the predictive power of *PM* is similarly important for other subcategories of goods' exports, except for HM exports, as seen in Panel Figure A.3. Countries that significantly deviate upward from the fitted line in the NHM exports scatter plot similarly deviate in scatter plots of complex and manufacturing exports. [28] Both correlation and R-squared statistics are lower for HM and service exports. Large deviations in the scatter plot of HM exports are related to natural resource abundance, as expected. [29]

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[27] The fitted line has a slope equal to one (a 45-degree line).

[28] The fitted lines of these carts also have slopes equal to one (45-degree lines).

[29] The last two charts in Panel Figure A.2 show that the model's goodness of fit does not change significantly when normalizing NHM exports by workforce instead of population.

Countries that are above their fitted lines very likely have strong diversification-conducive policies that allow them to surpass geographically determined expectations and can therefore hint at "role models" of diversification policies. These include many remote countries, such as Australia (AUS), Chile (CHL), and New Zealand (NZL). The upward deviation of AUS and NZL is remarkably high, higher than that of many well-known role models of diversification, such as Korea (KOR), Japan (JAP), or Malaysia (MYS). Panel Figure A.4 shows deviations from *PM*-predicted NHM and *complex exports* per capita on a world map.

The predictive power of combining *PM* and policy explanatory variables is impressive, with R-squared and correlation coefficient increasing up to 0.82 and 0.90, respectively.[30] In fact, no country with the *PM* and policy variables of most Sub-Saharan African or Latin American countries has the level of NHM exports per capita of Japan, Korea, or Malaysia. It seems therefore that countries cannot simply bypass the need to strengthen their horizontal institutional, educational, infrastructure, trade, and labor policy framework. This is similarly the case for the development of complex, manufacturing, and service exports as inferred from scatter plots in Panel Figure A.3.[31]

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[30] All scatter plots use policy explanatory variables and coefficients from the second regression in page 19.

[31] The slopes of the fitted lines of the charts on NHM, manufacturing, and *complex exports* are equal to one (45-degree lines).

NHM Exports per Capita in 2016-18 (log of US$)

Source: UN Comtrade and author's estimations.
Note: R-squared=0.80, correlation=0.89. Country codes from ISO 3 nomenclature.

The remarkable improvements in fit for some countries (for example, Chile, OCE, EAHI) when adding predictive policy variables suggest that their success is largely associated with their strong horizontal policies. Their policy strength is clearly appreciated in cross regional comparisons in Panel Figures A.5 and A.6.

Remaining outliers after incorporating horizontal policies to the prediction may be the result of vertical diversification policies but some can also reflect less-interesting idiosyncrasies. Positive outliers include countries that participate in GVCs (CAM, East Asia, EE) with high imported components, as noted earlier. Some small outliers are major trading points—including Hong Kong, Panama, and Singapore—with exports that include reexports with low domestic value added. And many outliers are oil exporting countries with highly subsidized industries, which may be economically inefficient and therefore not clearly desirable models of diversification.

Aggregating actual and predicted NHM exports per capita at the regional level further clarifies the big picture. A scatter plot by regions broadly maintains the same R-squared and correlation coefficients as the plot by country. High performing EE countries have NHM exports per capita in line with prediction by *PM* and policy variables identified in this paper. East Asian countries generally export above prediction, but also Central America (CAM) and Southern Cone (SCC) subregions. Sub-Saharan African countries' weak performance is broadly well predicted by its *PM* and policies.

NHM Exports per Capita in 2016-18 (log of US$)

Source: UN Comtrade and author's calculations.
Note: R-squared=0.83; correlation=0.91

6. CONCLUDING REMARKS

This paper shows that to identify the determinants of export diversification it is better to analyze directly export groups associated with diversification instead of focusing on commonly used diversification indices because the latter are extremely sensitive to exogenous HM exports. For the same reason it is more accurate to identify determinants of *superior* exports by focusing on their level instead of commonly used indices. While the Economic Complexity Index (ECI) aims to be a proxy of the *productive capabilities* of an economic system, its sensitivity to commodity-related factors, completely unrelated to an economy's productivity, severely distorts its accuracy.

The data generating process of export categories linked to diversification can be modeled with high goodness of fit as a gravity equation with horizontal policy variables. *PM* on its own explains about a quarter of the variation in NHM exports per capita and cutting distance to markets by half increases NHM exports by about 150 percent. The lower sensitivity of service exports suggests that they could provide a more feasible route to diversification for remote countries than goods exports. Interestingly, *PM* is also associated with considerably higher growth rates of NHM and *complex exports* per capita. Table A.5 describes how identifying determinants of export diversification with the methodology proposed in this paper leads to more statistically robust estimates than other related studies.

The high goodness of fit strongly rejects the null hypothesis of a disconnect between the quality of a horizontal policy framework and export diversification and *superiority,* which has led many to believe that the latter can only be attained through industrial policies.

Rejecting this null of such disconnect does not require causality. Regressions lagging policy covariates 5 to 10 years further suggest causality from policies to export diversification and *superiority*, especially from infrastructure quality and trade policy openness.

The centrality of *PM* underscores the need to effectively shorten distance to other economies by enhancing connectedness at all levels, reducing trade policy barriers, enhancing trade facilitation, strengthening transport infrastructure, investing in top-notch communication technology (particularly on internet connectivity to support the digital economy), and fostering technological diffusion (including through educational exchange programs). Enhancing connectedness is crucial for the most remote economies, thus better allowing their production agents to tap from backward and forward linkages more significantly to large global economic centers.

Adding policy variables related to the standard EK02 model, most of which have been identified less robustly in other studies, provides remarkably accurate predictions of cross-country variation in NHM, complex, and manufacturing exports per capita. Such strong fits indicate that no country has the level of NHM exports per capita of East Asian high-performing economies if they have the *PM* and quality of horizontal policy variables normally seen in Latin America or Sub-Saharan Africa. The importance of the identified policy variables is most clearly appreciated in countries that have high NHM exports per capita despite their remoteness (notably Australia, Chile, and New Zealand), as they seem to have been able to significantly offset the natural drawback of distance via strong policy frameworks.

Strengthening horizontal policy areas such as institutions, education, technological readiness, may seem a daunting and extremely long-term task, but significant payoff can be obtained from short-to-medium term reforms that reduce trade policy barriers, strengthen infrastructure, and remove excessively restrictive regulations, including of the labor market. Note also that within the wide objective of governance strengthening, more focused reforms to improve government effectiveness and control corruption seem particularly productive. And concentrating on strengthening port and electricity infrastructure seems most important among all infrastructure areas.

The identified statistical importance of horizontal policies does not necessarily deny some potential contribution from sector-specific policies. One potential reason is that the effective application of vertical policies could be partly correlated with horizontal policy covariates. It is quite possible that vertical policies are more successfully implemented in countries with higher government effectiveness, better control of corruption, and overall education.

In fact, the identified horizontal policy determinants of diversification could shed light to some second-best sector-specific interventions to offset economy wide policy/institutional weaknesses, such as is sometimes done through Special Economic Zones (SEZs). One such case happened in Mauritius in the 1970s. With high imports restrictions (average tariffs at around 100 percent) and rigid labor market legislation, this country fostered export diversification and complexity by setting up SEZs without import restrictions and with a flexible labor legislation, including one of the lowest minimum wage-to-GDP ratios in the world. These schemes most likely played an important role in Mauritius' notable export

development, together with its relatively high overall institutional strength and educational quality.

Countries could similarly strengthen diversification determinants identified in this paper at a sector level without resorting to SEZs. For example, governments could provide technical education to strengthen a specific sector's productivity, develop sector-specific infrastructure, or impose lower restrictions on imported inputs to favored sectors, although this last option is more prone to rent seeking.

Given a long and vast history of sector-specific and industrial policy failures, any assessment of these policies should consider not only their potential effectiveness in promoting targeted exports but also the risk that they could lead to fiscal erosion, facilitate rent seeking, contribute to a "race to the bottom" in international taxation, or weaken multilateralism. In this sense, tax incentives, subsidized credit, exchange rate manipulation, sector-specific trade protection, are among the "riskier" options and there seems to be no strong evidence identifying the effectiveness of this kind of "hard industrial policies" (Harrison and Rodriguez-Claire, 2012). [32] On the other hand, diversification strategies centered on strengthening horizontal policies

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[32] Harrison and Rodriguez-Claire (2012) reviews empirical work on industrial policy effectiveness and finds no support for "hard" interventions that distort prices. Several surveys have sought to provide evidence on the importance of industrial policies in promoting export diversification, particularly in East Asian countries (see for example, Rodrik, 2004; Rodrik, 2008; or Cherif and Hasanov, 2019). Yet, as Harrison and Rodriguez-Claire (2012) reflects, while it is clear that East Asian countries pursued industrial policies it is not clear that those policies should be credited for their successful industrialization, especially considering that these countries also excelled on horizontal policies, as shown in this WP. In addition, other studies have negatively assessed the role of industrial policies, notably since Caves and Uekesa (1976), which suggested that Japan's MITI created recession cartels and entry barriers that resulted in allocative inefficiency.

are not only less controversial but, as the statistical analysis shown in this study suggests, constitute the backbone of export diversification.

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TABLE A.1: DETERMINANTS OF ECONOMIC COMPLEXITY INDEX (ECI) AND ECI PLUS

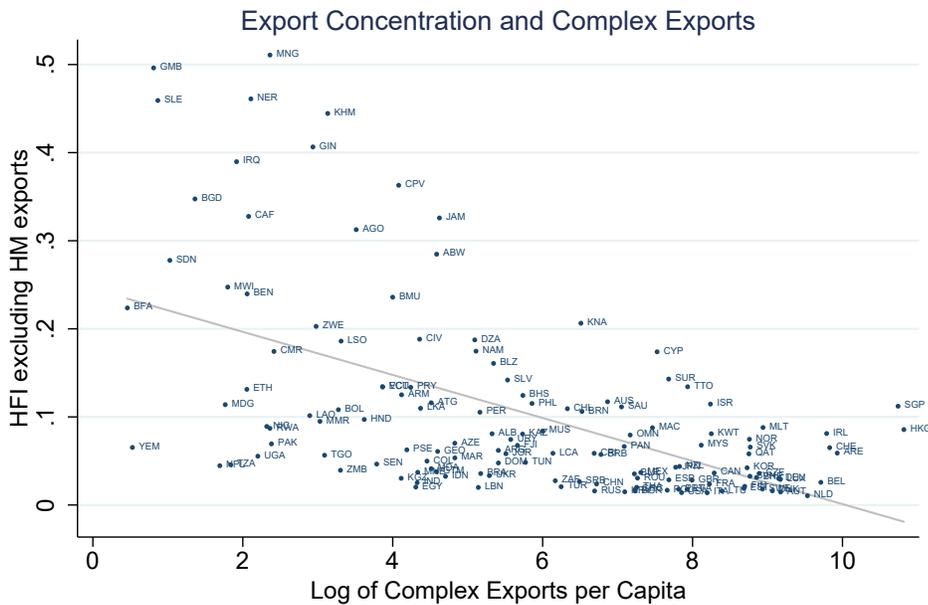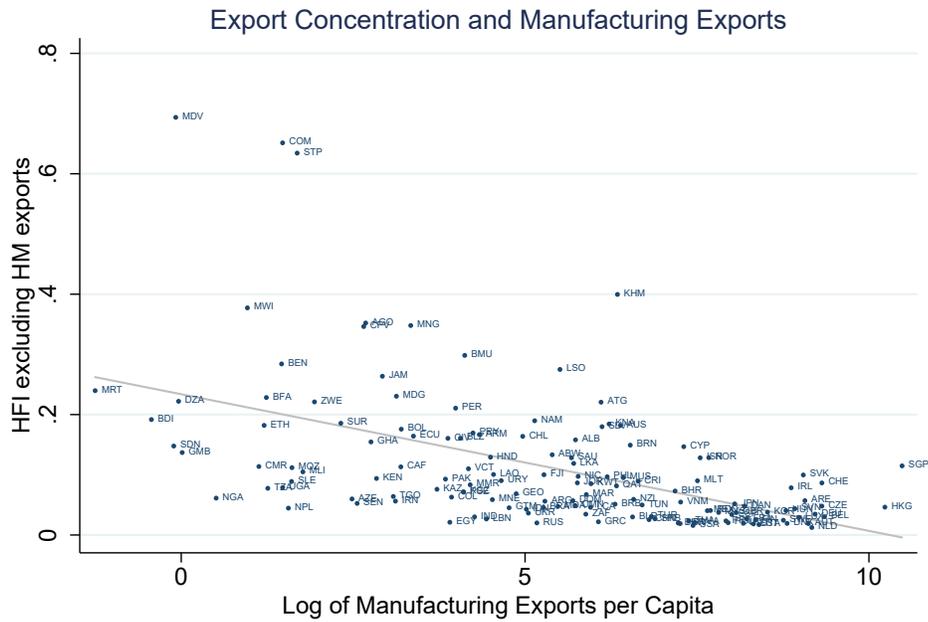| Dependent Variable:	ECI		ECI Plus	
Log Complex Exports per Capita	0.077***	0.079***	0.081***	0.083***
Hydrocarbon and Mineral Exports-to-GDP (Sachs and Warner, 1995)		-0.162***		-0.292***
Constant	-0.174***	-0.184***	-0.175***	-0.175***
Observations	4,370	4,207	4,274	4,207
R-squared	0.47	0.44	0.35	0.45

Sources: Hausmann and others (2013), World Economic Outlook (IMF), UN Comtrade, and author's calculations.

Notes: * p<0.1, ** p<0.05, *** p<0.01. Fixed effects regression.

TABLE A.2: LIST OF COUNTRIES BY REGIONAL GROUP

Region	Region Code	Country	Region	Region Code	Country	Region	Region Code	Country
Andean	AND	Bolivia	Eastern Europe	EE	Albania	Pacific Isl.	PAC	Tonga
		Colombia			Bosnia Herz.			Tuvalu
		Ecuador			Bulgaria			Vanuatu
		Peru			Croatia	South Asia	SAR	Afghanistan
		Venezuela			Cyprus			Bangladesh
Arab	ARB	Bahrain			Czechia			Bhutan
		Brunei			Estonia			Nepal
		Kuwait			Georgia			Pakistan
		Oman			Hungary			Sri Lanka
		Qatar			Latvia			Timor-Leste
		Saudi Arabia			Lithuania	Southern Cone	SCC	Argentina
		UAE			Montenegro			Brazil
		Yemen			N. Macedonia			Chile
Central Asia	CA	Armenia			Poland			Paraguay
		Azerbaijan			Moldova			Uruguay
		Belarus			Romania	Scandinavia	SCN	Denmark
		Kazakhstan			Russia			Finland
		Kyrgyzstan			Serbia			Iceland
		Tajikistan			Serb. and Mont.			Norway
		Turkmenistan			Slovakia			Sweden
		Uzbekistan			Slovenia	Sub-Saharan Africa	SSA	Angola
Central Am. & Mexico	CAM	Costa Rica			Turkey			Benin
		El Salvador			Ukraine			Botswana
		Guatemala	European Union	EU	Andorra			Burkina Faso
		Honduras			Austria			Burundi
		Mexico			Belgium			Cabo Verde
		Nicaragua			France			Cameroon
		Panama			Germany			Central African Rep.
Caribbean	CAR	Anguilla			Greece			Chad
		Antig. & Barb.			Greenland			Comoros
		Aruba			Ireland			Congo
		Bahamas			Italy			Cote d'Ivoire
		Barbados			Luxembourg			D.R. Congo
		Belize			Malta			Djibouti
		Bermuda			Netherlands			Eritrea
		Cayman Isds			Portugal			Ethiopia
		Cuba			Spain			Gabon
		Dominica			Switzerland			Gambia
		Dominican Rep.			U.K			Ghana
		French Guiana	India	IND	India			Guinea
		Grenada	Middle East	ME	Iran			Guinea-Bissau
		Guadeloupe			Iraq			Kenya
		Guyana			Israel			Lesotho
		Haiti			Jordan			Liberia
		Jamaica			Lebanon			Madagascar
		Martinique			Syria			Malawi
		Montserrat	North Africa	NA	Algeria			Mali
		St. Kitts & Nevis			Egypt			Mauritania
		Saint Lucia			Libya			Mauritius
		St. Vct. & Gren.			Morocco			Mayotte
		Suriname			Tunisia			Mozambique
		Trinidad & Tob.	North America	NAM	Canada			Namibia
East Asia Emerging	EAEM	China			USA			Niger
		China, Macao SAR	Oceania	OCE	Australia			Nigeria
		Indonesia			New Zealand			Rwanda
		Malaysia	Pacific Isl.	PAC	Cook Isds			Sao Tome & Princ.
		Philippines			FS Micronesia			Senegal
		Thailand			Faeroe Isds			Seychelles
		Viet Nam			Fiji			Sierra Leone
East Asia High Income	EAHI	China, Hong Kong			French Polynesia			Somalia
		Japan			Kiribati			South Africa
		Singapore			Maldives			Sudan
		South Korea			New Caledonia			Togo
East Asia Others	EAOTH	Cambodia			Palau			Uganda
		Lao PDR			Pap. New Gn.			Tanzania
		Mongolia			Samoa			Zambia
		Myanmar			Solomon Isds			Zimbabwe

PANEL FIGURE A.1: EXPORT CONCENTRATION, MANUFACTURING, AND COMPLEX EXPORTS

Export Concentration and Manufacturing Exports

Note: Exports SITC Rev2 from 6900 to 8999. Country codes from ISO 3 nomenclature.

Export Concentration and Complex Exports

Note: Complex exports are those with Product Complexity Index (Hausmann and others, 2013) above zero. Country codes from ISO 3 nomenclature.

PANEL FIGURE A.2: INDEX OF DETERMINANTS NHM EXPORTS

Political Stability

Source: Center for Systemic Peace, Polity IV dataset.

Educational Attainment

Source: Barro and Lee (2013)

Source: Education subindex of the Human Development Report (United Nations)

Infrastructure

1986-90

Note: Index based on electricity and phone line coverage from World Development I

2015-17

Note: Infrastructure subindex of the Global Competitiveness Report (World Economic Forum).

Average Imports Tariffs

1981-85

Source: World Development Indicators

2015-17

Source: World Development Indicators

Liberalized Trade

1970-75

Source: Wacziarg and Welch (2003)

2001-05

Source: Wacziarg and Welch (2003)

TABLE A.3: DETERMINANTS OF EXPORTS BY REGRESSION SPECIFICATION

Dependent Variable: Log of non-hydrocarbon/mineral exports

Regression specification	Hausman-Taylor	Hausman-Taylor	Hausman-Taylor	Pooled OLS	Between Effects	Random Effects	Fixed Effects
Log GDP reporter	0.756***	0.484***	0.756***	1.354***	1.345***	1.369***	-0.548***
Log GDP partner	0.858***	0.960***	0.858***	0.920***	0.904***	0.925***	0.347***
Log distance	-1.279***	-0.616***	-1.279***	-1.420***	-1.444***	-1.465***	
Common currency dummy	0.22	0.368**	0.22	-0.193*	-0.27	-0.01	
Common border dummy	1.888***	2.999***	1.888***	1.308***	1.327***	1.260***	
Common language dummy	0.617***	0.899***	0.617***	0.676***	0.773***	0.638***	
Common colonizer dummy	0.339**	0.327**	0.339**	0.602***	0.561***	0.444***	
Past colonial link dummy	1.228***	1.309***	1.228***	0.526***	0.482***	0.790***	
Log GDP per capita	-0.15	-0.04	-0.15	-0.918***	-0.973***	-0.680***	0.866***
Governance (WB Index)	0.484***	0.422***	0.484***	0.634***	0.505***	0.789***	0.099*
Education (UN Index)	5.099***	3.924***	5.099***	1.166***	1.498***	0.799***	1.031**
Infrastructure (GCR Index)	0.175***	0.166***	0.175***	0.694***	0.864***	0.307***	0.113***
Average Tariff	-0.0310***	-0.0304***	-0.0310***	-0.0722***	-0.0784***	-0.0421***	-0.0197***
Labor market flexiblity (GCR Index)	0.02	0.04	0.02	-0.334***	-0.374***	-0.04	0.03
Constant	-0.86	-19.34***	-0.86	-11.67***	-12.17***	-11.28***	-7.223**
	(-0.27)	(-14.50)	(-0.27)	(-13.71)	(-8.86)	(-9.76)	(-3.00)
Partner country policy variables	No	Yes	Yes	Yes	Yes	Yes	Yes
Multilateral resistance proxies	No	No	Yes	Yes	Yes	Yes	Yes
Observations	44,989	44,989	44,989	44,989	44,989	44,989	44,989
Rho	0.93	0.94	0.93			0.81	0.94

Notes: * p<0.1, ** p<0.05, *** p<0.01. Panel regressions based on Hausman and Taylor (1981) technique with groups consisting of all combinations of reporter and partner countries in UN Comtrade database. Observations are non-overlapping 5-year averages within the 1962-2018 period, depending on data availability. Regression specification based on equation (7). Multilateral resistance terms and partner country's policy variables included (coefficients not reported). Dependent variable is the logarithm of the value of exports excluding hydrocarbon and mineral products (SITC2 codes 0-2999, 4000-6772, 6900-8999).

Complex Exports per Capita in 2016-18 (log of US$)

R-squared=0.32; correlation=0.56

R-squared=0.81; correlation=0.89

Source: UN COMTRADE and author's calculations.
Note: Complex exports are those with Product Complexity Index (Hausmann and others, 2013) above zero.
Country codes from ISO 3 nomenclature.

Manufacturing exports per capita in 2016-18 (log of US$)

R-squared=0.37; correlation=0.59

R-squared=0.80; correlation=0.87

Source: UN COMTRADE and author's calculations.
Note: Exports SITC Rev2 from 6900 to 8999. Country codes from ISO 3 nomenclature.

Service Exports per Capita in 2016-18 (log of US$)

R-squared=0.17; correlation=0.53

R-squared=0.65; correlation=0.83

Source: UN COMTRADE and author's calculations.
Note: Country codes from ISO 3 nomenclature.

Hydrocarbon and Mineral Exports per Capita in 2016-18 (log of US$)

R-squared=0.17; correlation=0.37

R-squared=0.52; correlation=0.42

Source: UN comtrade and author's calculations.
Note: Country codes from ISO 3 nomenclature.

NHM Exports per Worker in 2016-18 (log of US$)

Note: R-squared=0.27, correlation=0.55

Note: R-squared=0.80, correlation=0.89

Source: UN Comtrade

PANEL FIGURE A.4: DEVIATION OF ACTUAL EXPORTS FROM PREDICTED-BY-DISTANCE EXPORTS

Deviation from Predicted Log of NHM Exports per Capita

Deviation from Predicted Log of Complex Exports per Capita

PANEL FIGURE A.5: DISTANCE AND FUNDAMENTALS BY SUBREGION IN 2015-17

Proximity to Markets

Note: Proximity to Markets estimated as per equation (9).

Governance

Note: Worldwide Governance Indicator (World Bank)

Education

Note: Education subindex of the Human Development Report (United Nations).

Infrastructure

Note: Infrastructure subindex of the Global Competitiveness Report (World Economic Forum).

Import Tariffs

Note: Simple average import tariff.
Source: World Integrated Trade Solution (World Bank).

Labor Efficiency and Flexibility

Note: Labor market subindex of the Global Competitiveness Report (World Economic Forum).

Government Effectivenes

Note: Worldwide Governance Indicator (World Bank)

Control of Corruption

Note: Worldwide Governance Indicator (World Bank)

Ports

Note: Infrastructure subindex of the Global Competitiveness Report (World Economic Forum).

Electricity

Note: Infrastructure subindex of the Global Competitiveness Report (World Economic Forum).

Technological Readiness

Note: Labor market subindex of the Global Competitiveness Report (World Economic Forum).

TABLE A.4: SUMMARY RESULTS BY STUDY

	This Study Salinas (2021)	Hausmann and others (2009)	Weldemicael (2012)	Ding and Hadzi-Vaskov (2017)	Giri and others (2019)
Dependent Variable:	NHM and Complex Exports per capita	Exports Sophistication Index	Exports Sophistication Index	Exports Concentration, Sophistication, and Complexity Indices	Exports Diversification
Independent Variables:					
Proximity to Markets		Not included	Significant in all specifications	Not included	Not included
Governance	Significant in all specifications (robust to inclusion of GDP per capita)	Not robust to inclusion of GDP per capita	Only significant in sub-sample regressions (all include GDP per capita)	Not included	Significant in some regressions
Education		Not robust to inclusion of GDP per capita		Significant in most specifications	Primary education significant in most regressions
Infrastructure		Not included	Not included	Significant in most specifications	Significant in some regressions
Trade Openness		Not included	Not included	Significant in most specifications	Trade-to-GDP significant in some regressions
Adjusted R-Squared with larger specification	0.80 to 0.86	0.70 to 0.75	0.70 to 0.73	0.457 to 0.751	0.457 to 0.751

MEASURING IMPORT LIBERALIZATIONS AND ASSESSING THEIR IMPACT

1. INTRODUCTION

Despite the existence of a vast literature evaluating trade reforms in developing countries, there exists yet no accurate measure of the degree of trade policy liberalization. Gauging the degree of liberalization has traditionally required an accurate measure of the restrictiveness of trade policies, but restrictiveness measures are either imprecise or limited to recent years in which not many momentous liberalization episodes have occurred. Lack of such an indicator is a fundamental limitation faced by most empirical exercises that assess the impact of trade reforms on economic performance.

One kind of trade restrictiveness indicators is based on conventional measures of trade protection such as average tariff levels or the frequency of non-tariff barriers. But although most economists would agree that they provide some sense of trade restrictiveness, many times they can be largely unrelated to the effective degree of import protection of existing trade regimes. The difficulty in establishing the restrictiveness of non-tariff barriers even for single products is well known, and these lack of transparency in their restrictiveness is the reason why many liberalization processes have first sought to switch them to tariffs and later aim at tariff rate reduction. But measuring the overall restrictiveness of tariff regimes is a complex task itself. Very typically during trade liberalization programs, governments can reduce their average tariff by lowering rates for most tariff lines while maintaining protection in key sensitive products. The impact of trade liberalization is hence severely restricted, because products defined as "sensitive" are usually

those employing exceptionally large shares of production factors or constitute a considerable part of the consumption basket. Evidently, if protection is negligible in other, less important products then aggregated measures of trade protection would incorrectly portray the openness of such trade regime. Therefore, existing empirical attempts to identify a relation between trade liberalization and economic performance include several liberalization episodes in which reforms were rather cosmetic and thus failed to trigger the economic changes that in theory would lead to both higher welfare and income distribution changes. Furthermore, available panel data on average tariffs are based on MFN regimes, thus neglecting regional or bilateral trade liberalization processes that can dramatically enhance the openness of a country.

This chapter takes an alternative approach in assessing the strength of trade liberalization episodes. Instead of approximating their magnitude by measuring the restrictiveness of trade regimes before and after the event, this study measures it based on their expected outcome: the acceleration of imports in the few years after the reforms. Although there are some studies that similarly try to measure the strength of trade liberalization by looking at the trade outcome of liberalization, they focus on longer periods after liberalization and include exports which, as will be discussed later, lowers the signal-to-noise ratio. Specifically, based on a demand equation setting it statistically approximates an index of "Effective Import Liberalization" (EIL) through the growth rate of imports in the years immediately after the event relative to their growth rate in the rest of the period of observation. Focusing on imports not exports to measure liberalization gives a better approximation of the overall strength of trade reforms because the former reacts more immediately to changes in trade policies and also because, in the studied years, import liberalizations were more often and more significant components of trade reforms than export liberalizations. Moreover, researching import liberalizations has arguably higher relevance as

they have remained more controversial than export liberalization given their negative impact on imports-competing economic agents. As will be discussed below, the magnitude of the estimated EIL seems to be broadly line with perceptions of strength of liberalization both across and within countries.

As an example of the potential use of the EIL, a dummy variable is built based on it and used to compare GDP growth (and other macroeconomic variables) before and after the strongest liberalization event in each country . This exercise largely confirms the positive link between trade liberalization and output growth as found in other related studies (for example, Sachs and Warner, 1995). Since the macroeconomic data that is used to construct the EIL is more widely available than data on trade policy restrictions it provides more observations for panel regressions. However, because the EIL is based on statistically derived point estimates and these are inherently uncertain, it may not be considered an exact measure of liberalization but can supplement other measures when assessing the strength of an import liberalization and its economic impact.

Section 2 of this chapter reviews the existing measures of trade restrictiveness and trade liberalization, citing their applications in the empirical literature and noting their major drawbacks. Section 3 goes through the construction of the EIL index, presenting its methodology, describing the data used to implement this methodology, further explaining how this list constitutes a considerable improvement over similar lists available to date, and eventually estimating the EIL index. This section further evaluates the EIL across several angles, comparing the strength of liberalization episodes across different country subgroups, and according to decade of reform and type of liberalization program, showing tests of EIL robustness by

estimating it using different samples and model specifications, and comparing the EIL to other measures of import liberalization. Section 4 takes the strongest reform episodes from each sample country and using standard growth regression analysis measures the impact of these episodes on several economic indicators. Section 5 presents the conclusions of this chapter.

2. MEASURING TRADE RESTRICTIVENESS

The cross-country literature on trade liberalization has thus far relied on several proxies of trade restrictiveness, all of them with notable caveats. Indicators of trade restrictiveness can be roughly classified in two categories: incidence-based (or policy-based) and outcome-based (Baldwin, 1989). Incidence-based indicators attempt to measure the strength of trade liberalization by calculating the change in the restrictiveness of trade regimes from before to after the reform year. Trade restrictiveness each year is measured by aggregating trade policies under varying criteria. Outcome-based indicators, in turn, are constructed based on the evolution of trade indicators (such as exports or imports) that are affected by trade policy restrictions.

The link between both type of indicators is illustrated in a classical diagram of the incidence of tariffs on domestic and world markets (Figure 1). [33] When tariff protection for a particular product is t^0 the country imports are m^0 (as shown in diagram b). If the tariff is reduced to t^1, this leads to an increase in imports to m^1. Incidence-based indicators of trade restrictiveness aim to directly measure the change from t^0 to t^1, while outcome-based indicators approximate this change through the change in domestic prices or in imports.

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[33] This diagram assumes that the country is small enough not to affect world prices, thus the horizontal supply line. In the diagram, D stands for demand, S for supply, M for quantity of imports, X for exports from foreigners, c for consumption, y for output, p for produce price, and t for tariff.

Figure 1: Incidence of Tariffs in Domestic and Import Market

INCIDENCE-BASED INDICATORS

One way to measure overall restrictiveness of a trade regime is to aggregate protection policies, such as tariff rates, non-tariffs, and exchange rate controls. [34] The most widely used indicator under this category is the unweighted average tariff, a simple arithmetic mean of ad-valorem tariffs across all tariff lines. Although there are some studies (for example, Rodriguez and Rodrik, 2000) that argue that this indicator is a reasonable proxy for trade restrictions, this measure not only fails to capture the restrictiveness imposed by other types of protection, but it does not even represent accurately the restrictiveness of tariff policies. Being a simple average, it assigns equal weight to each tariff line although some tariffs may even be redundant (in other words, non-zero tariffs that do not affect import volume). The import-weighted average tariff and the ratio of

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[34] Appendix 1 lists and describes several indicators of trade restrictiveness, pointing out their main shortcomings.

import duties to import values are an attempt to account for relevance, but they underestimate the impact of tariffs that are so high that they severely curtail import volume. Effective rates of protection fail to capture the distortion caused by cross product variation in rates of protection or the distortion of trade protection on consumption, and its usefulness for panel exercises is also limited since it is usually available for only a few years.[35] Production-weighted and consumption-weighted average tariffs are also rarely available and are distorted by the existence of redundant tariffs.

Based on Anderson and Neary (1992, 1994) and Feenstra (1995), Olarreaga et al (2006) build a tariff restrictiveness indicator that takes into consideration the varying importance of products under different tariff lines by calculating import demand elasticities. They find that overwhelmingly, the simple average tariff underestimates tariff restrictiveness. This is likely a reflection of the widespread practice in trade liberalization experiences of strongly reducing redundant tariffs while maintaining high protection of sensitive products. Tariff restrictiveness indicators as in Olarreaga et al (2006) have their own caveats as their accuracy is highly dependent on model specification (O´Rourke, 1999) and are not useful to measure the large majority of trade liberalizations since they are only available for a few years after the mid-1990s. Furthermore, average tariffs and the tariff restrictiveness measure developed in Olarreaga et al (2006) are calculated using MFN tariffs, thus completely missing trade liberalization through free trade agreements. This is particularly misguiding in assessing tariff restrictiveness of the

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[35] Effective rates of protection are a measure of the total effect of the entire tariff structure on the value added per unit of output in each industry, when both intermediate and final goods are imported. They are calculated as the tariff imposed on a final good minus the tariff imposed on the importable inputs, all divided by the international value added of the good.

large number of countries that engage in trade liberalization with their major natural trading partners.

In advocating the use of average tariffs to measure trade restrictiveness, Rodrik (2000) argues that it is hard to find countries that would be grossly misclassified when one uses only their average tariff levels. However, there are several instances in which there are clear divergences between trade restrictiveness and any tariff-based indicator irrespective of the aggregation method used. A country's trade restrictiveness is significantly determined by non-tariff barriers, and average tariffs are a poor instrument for them. Simple average tariffs and coverage of non-tariff barriers in the period 1984-1993, show a correlation of only 0.24, and in the subperiod (1988-90) just 0.14. Hence, using changes in average tariffs as a proxy for reform misrepresents liberalization episodes in many countries that reformed mainly through tariffication (for example, Eastern European countries) or that reduced tariffs but imposed NTBs to protect sensitive products (for example, Latin American countries that imposed price band mechanisms or import surcharges in agriculture after tariff reform). Moreover, because they do not account for preferential trade agreements, average tariffs considerably misrepresent trade restrictiveness in countries like Tunisia and Morocco which impose low tariffs on imports from European countries, or like Mexico and Central American countries which impose low tariffs on goods from the United States. Under these considerations one can argue that the average tariff is as rough an indicator of trade policy as the Sachs and Warner index.[36] Measuring trade restrictiveness of NTBs, in turn, is a challenge on its own. The most common measure of the

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[36] Similarly, Warner (2003) notes that trade restrictiveness would be grossly misrepresented by just considering the very low average tariffs of Algeria and Mozambique, without considering their significantly high black market premium and stringent marketing board, respectively.

restrictiveness of NTBs, the ratio of tariff lines that are covered by non-tariff barriers, does not provide any information about the restrictiveness of each NTB.

Several indicators attempt to provide a comprehensive measure of protection by combining the measures of trade policies described above either through an explicit weighting rule (for example, Lee, 1993; Heritage Foundation, 2006; Gwartney and Lawson, 2005; IMF trade restrictiveness index; Sachs and Warner, 1995; Wacziarg, 1998; Wacziarg and Welch, 2003; World Bank CPIA) or through purely subjective criteria (World Bank, 1987; Papageorgiou et al, 1991). Being a combination of imperfect aggregated measures of trade restrictiveness, the resulting indicators are no better than their components. Furthermore, the criteria for their combination, either explicit or not, are purely arbitrary with no solid theory to back the applied weighting.

The most widely known and commented of these aggregated measures is the Sachs and Warner (SW) openness index (Sachs and Warner, 1995), a binary indicator that identifies the year in which a country's trade regime has become open, without determining the strength of the trade liberalization in that year. A country is classified as closed if it satisfies any of the following five criteria: i) its average import tariff is above 40 percent; ii) the coverage of its non-tariff barriers is above 40 percent; iii) it has a socialist economic system; iv) it has state monopoly in a major exports sector; or v) its black market premium in the exchange market is above 20 percent. Rodriguez and Rodrik (2000) advise against using this indicator in growth regressions because its relation to economic growth is mainly determined by the black-market premium and by the export monopoly criterion, and both have important caveats. The black-market premium is largely determined by the macroeconomic context and not by the trade policy regime, while the export market monopoly criterion was applied using data only for Sub-Saharan African countries,

and thus may be capturing the growth effect of other factors that characterize this region. It is also evident that the socialist economy criterion captures the effect of many other economic policies besides trade policy openness.

In a response to the Rodriguez and Rodrik (2000) critique, Warner (2003) showed additional evidence concluding that the black-market premium is not historically related to macroeconomic imbalances and notes that the marketing board monopoly variable is not an African dummy since it only triggers the protection index in half of the African countries. However, it is also clear that being binary and an arbitrarily weighted composite of imperfect measures of restrictiveness (for example, average tariffs and frequency of non-tariff barriers), this index provides only a rough representation of overall trade policy restrictiveness.

Despite all these criticisms and given the lack of an accurate measure of trade liberalization, binary indices in the spirit of the Sachs and Warner index have been commonly used in empirical research (for example, Bosworth and Collins, 2003; and Greenway et al, 1998). However, one should be cautious when using this index to identify liberalization episodes in event studies, as in Sachs and Warner (1995) and Wacziarg and Welch (2003). Event studies require the correct identification of a significant reduction in trade policy restrictions, but one can think of hypothetical cases in which a minor reform in one of the criteria allows a country to meet all five criteria (for example, a reduction in average tariffs from 55 to 45 percent in a country meeting the other four criteria). In other cases, using this index leads to the incorrect conclusion that a country has never significantly liberalized because, despite strong reforms in most criteria it never met few of them (for example, India, China, or Croatia).

The well-known caveats of policy-based indicators have led several researchers to approximate trade restrictiveness through its expected impact on prices and trade flows. An evident effect of trade restrictions is to create a wedge between domestic and international prices. Thus, Dollar (1992), Bhalla and Lau (1992), Barro (1991), among others, approximate trade restrictiveness through the divergence from international prices of tradable or investment goods. Rodriguez and Rodrik (2000) criticized this approach as applied in Dollar (1992), noting that, domestic divergences from international prices are not only motivated by trade policy restrictions, but are also the result of exchange rate policies and transportation costs. Indeed, the literature on the Law of One Price (LOP) mentions several factors besides trade policies (for example, transaction costs, impact of domestic taxes on demand elasticities, fixed transactions costs of arbitrage, delay in shipment of goods, pricing to market strategies) that lead to such price divergences.

Exports and imports volumes are also affected by several structural factors besides trade restrictions such as market size, transportation costs, and resource endowments. Using models that take these factors into account, Balassa (1985), Lamer (1998), Hiscox and Kastner (2002), among others have sought to estimate trade policy restrictiveness from the deviation of trade volumes from the level predicted by the above-mentioned factors. A major caveat with this approach is that the accuracy of the resulting indicator depends on the validity of the model specification. As Rodrik (2000) notes, trade volumes can be the result of omitted economic policies and institutions that are hard to identify and control for. Export growth can be the result not of trade liberalization but of isolated, even heterodox policies of exports marketing or enhancement of competitiveness. Since these policies also promote GDP growth, regressions

evaluating the impact of trade liberalization on growth based on such measures of trade openness will clearly be endogenous. Dollar and Kraay (2000) avoid modeling trade volumes and instead look at changes in trade volume during a decade, assuming that the determinants of trade volumes do not change significantly across time. However, changes in non-trade policies and institutions could indeed happen within one decade and thus this indicator could also be endogenous to GDP growth (2000). As discussed below, this chapter proposes an outcome-based indicator of the strength of liberalization that is focused on the import demand reaction in the very few years following liberalization thus increasing the signal-to-noise ratio relative to other outcome-based indicators.

3. BUILDING AN EFFECTIVE IMPORT LIBERALIZATION (EIL) INDEX

METHODOLOGICAL DISCUSSION

This chapter develops an indicator of the degree of import liberalization that does not depend on the accurate measurement of trade restrictiveness. As mentioned earlier, instead of measuring the change on trade restrictiveness indicators this chapter develops an estimate of Effective Import Liberalization (EIL) by measuring the upsurge in imports that are expected to follow a reform to imports protection policies, while controlling for other factors that affect imports in the short-to-medium run.

To establish a regression specification that properly controls for other imports determinants, note that sample countries are not large enough to affect the price of their imports, [37] and thus we can neglect the supply side of the market and concentrate solely on imports demand. Leamer and

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[37] Indeed, none of the countries in our sample account for more than 1% of world trade.

Stern (1970) describes how demand relations of individual consumers can be aggregated and over commodities leading to an general aggregate import demand equation that relates the demanded amount of imports with income, the price of imports, and the price of domestic substitutes:

$$(1) \quad M = f\left(Y_d, P_f, P_d\right)$$

in which the volume of imports, M, depends on the price of foreign goods (P_f), the price of domestic goods P_d, and on domestic income, Y. Assuming no monetary illusion as suggested in Leamer and Stern (1970), an ordinary Marshallian demand function can be assumed so that Equation 1 can be considered homogeneous of degree zero in prices and nominal income:

$$(2) \quad M = f\left(Y_d, \frac{P_f}{P_d}\right)$$

To fit this relation statistically using least squares a particular log linear form must be chosen. A log linear form, one of the most common forms, is chosen:

$$(3) \quad log(M) = log(A) + \eta \, log\left(\frac{P_f}{P_d}\right) + \gamma \, log(Y_d)$$

Import barriers directly increase the price of foreign goods and thus have an impact on the level of imports. Foreign prices can be defined as: [38]

$$(3) \quad P_f = P_{cif}(1 + T)$$

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[38] Except for the decomposition of foreign prices to denote the impact of trade barriers, this equation is similar to those conventionally used in empirical estimations of imports demand (Khan, 1974, Warner and Kreinin, 1983, Bahmani and Oskooee, 1986, Senhadji, 1998).

where P_f is equivalent to the price of foreign goods at the importers port including cost of insurance and freight (P_{cif}) times one plus the ad-valorem equivalent of existing imports barriers (T). Redefining P_f in equation (2):

$$(4) \quad log(M) = log(A) + \eta \, log(P) + \eta \, log(1+T) + \gamma \, log(Y_d)$$

Differentiating this equation with respect to time (representing growth rates of all variables through their lowercase) and adding terms for a panel regression estimation:

$$(5) \quad m_{i,t} = a_i + \alpha m_{i,t-1} + \eta p_{i,t} + \beta_j D_{i,t} + \gamma y_{i,t} + \mu_i + \vartheta_t + \varepsilon_{i,t}$$

in which observations are included for each country i and year t, μ_i a country fixed effect term, ϑ_t a year fixed effect term, and $\varepsilon_{i,t}$ is the error term. Equation (5) includes a lagged value of the dependent variable, transforming equation (4) to a Partial Adjustment Model (PAM), indeed a very frequent modification in the estimation of import demand equations. [39] Using a PAM acknowledges the dynamic nature of imports demand. And in line with our proposal not to measure import liberalization through measures of imports restrictions, equation (5) approximates the change in trade protection dT/dt by introducing, D, a vector of dummy variables for each announced liberalization episode. β, is the coefficient of each liberalization dummy (j=1,…,N; N being the total number of liberalizations in the sample) and hence during a year of liberalization:

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[39] Examples of the use of this specification in a cross-country setting include Senhadji (1998) and Santos-Paulino and Thirlwall (2004).

$$(6) \qquad \beta = \frac{\eta}{1+T}\frac{dT}{dt} \propto \frac{dT/dt}{T} = \tau$$

the coefficient of the liberalization episode is proportional to the change in imports barriers. This coefficient of the liberalization dummy D is then defined as the Effective Import Liberalization (EIL), normalized to a range of 0 to 1, with 1 being the strongest liberalization estimated. Because the reduction of imports barriers during trade liberalization is usually implemented during more than one year, each liberalization dummy takes the value of one in the first three years since an announced trade reform. For robustness check, the EIL is also calculated based on a liberalization dummy that takes the value of one in the first two and in the first four years since the announced reform.

Moreover, the constant term in equation (5) can vary across countries reflecting that countries could have different long-term levels of imports growth. Considering the dynamic nature of the PAM specification (including a lagged term of the dependent variable) we estimate it using System GMM and other panel regression techniques as robustness check (see Arellano and Bond, 1991; Arellano, 1993; and Arellano and Bond, 1998). Note that the time dimension of the panel in average exceeds 20 observations so a fixed-effects in an equation that includes a lag of the dependent variable should not be affected by Nickell bias.

The sample of countries is the one presented in Jinjarak and others (2015), which excludes developing countries that either experienced a major civil conflict; were in transition out of communism; have population below one million; or have data of poor quality. In addition, I eliminate those countries that during the period 1975-2004, either had fuel exports accounting for more than 50 percent of merchandise exports or experienced a hyperinflation episode. This

reduction of the sample size aims to increase the signal-to-noise ratio in the error term in equation (5) by eliminating cases of excessive economic instability, data inconsistency, or extreme vulnerability to external shocks.

ADVANTAGES OF THE EFFECTIVE IMPORT LIBERALIZATION INDEX

The EIL index approximates the degree of trade liberalization without measuring restrictiveness of a trade regime at a particular time, thus, avoiding the seemingly insurmountable difficulties of doing accurately so for many countries and years. Being in the class of outcome-based indicators, the EIL circumvents the need to determine the restrictiveness of each trade policy or to aggregate among them, which have been the main obstacles faced in building a policy-based indicator.

As argued in Section 2, the main drawbacks of outcome-based indicators is that they depend on a correct model specification and that they do not control for potential endogeneity in the relation between these indicators and GDP growth as argued in Rodrik (2000). Unlike outcome-based indicators that approximate trade restrictiveness from the deviation of trade (both exports and imports) from its expected medium to long-term level, the EIL is based on the immediate change in imports flows following liberalization and hence, does not depend on the accuracy of the prediction of the structural level of trade. Dollar and Kraay (2004), for example, measure the strength of liberalization based on the deviation of trade since liberalization over a period of ten years. During such a long period, trade's structural determinants (institutions, education, and so on) are more likely to have changed thus reducing the signal-to-noise ratio from the trade liberalization. In contrast, the estimation of the EIL focuses on the immediate imports response from liberalization, which is likely to carry a higher signal-to-noise ratio as import demand rapidly react to significant changes in import restrictiveness.

Admittedly, an approach that similarly measures the import reaction to liberalization but using a bilateral gravity equation specification instead of a simpler import demand equation could also dodge the limitations of other techniques to measure the impact of trade liberalization. In fact, numerous studies use gravity equation specifications to measure trade-creation impact from Regional Trade Agreements (RTAs).[40] The technique proposed in this chapter could be considered a simpler, less data intensive methodology and as is seen below, results are in line with common perceptions of the strength of several import liberalization events.

A major feature of the EIL is that it is based on a very inclusive list of trade liberalization episodes identified in World Bank (2006), shown in Table A.3. Although most countries have undergone several episodes of trade reform, most episode lists identify only one reform by country (Sachs and Warner, 1995, Santos-Paulino and Thirlwall, 2005, Wacziarg and Welch, 2003). Furthermore, these other liberalization lists sometimes identify years of reform that are not included in the more comprehensive list in World Bank (2006) such as for Benin and Mauritius. Such measurement error can lead to biased or inconsistent estimates in regressions that assess the economic impact of trade liberalization.

DATA SOURCES

The World Bank´s World Development Indicators is the main source for the economic variables used in estimating equation (5). Growth in the volume of imports is estimated as the annual change in total imports of goods and services at constant 2000 U.S. dollars; the change in relative prices is the change in the imports price index minus the change in the GDP deflator; while

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[40] In fact, empirical exercises to measure trade creation from RTAs are included in United Nations' guide on gravity equation exercises (Yoto and others, 2016).

change in domestic income is the annual growth of GDP in constant 2000 US dollars. Data on these indicators is gathered for the period between 1975 and 2004.

This list of trade liberalization episodes includes 99 episodes for the 40 sample countries in the period between 1980 and 2001 (see Table A.3). It is based on World Bank (2006), which in turn relies on Dean et al (1994) , World Bank project documents, World Bank Economic and Sector Work (ESW), Trade Policy Reviews of the World Trade Organization, Country Profiles produced by the Economist Intelligence Unit and country surveys from the International Monetary Fund. Unlike other lists of liberalization episodes such as Santos-Paulino and Thirlwall (2004), Sachs and Warner (1995) and Wacziarg and Welch (2003) and World Bank (2006), which include only one liberalization episode by country, this list includes all announced liberalization episodes during the period under consideration, which are 2.5 episodes per country in average. The source documents identify trade liberalization documents indicate there was large heterogeneity in design and implementation of these liberalization. As deduced from the prior discussion, this heterogeneity should be reflected in the import response measured through equation 5. Liberalizations with weak (strong) objectives and/or implementation should lead to weak (strong) import response.

DATA DESCRIPTION

Table 1 compares the main economic variables in equation (5) (imports volume, the price of foreign goods relative to domestic goods, and domestic activity) between developing countries in and out of our sample for the period 1975-2004. The economic performance of both groups is not significantly different from each other. In average, out-of-sample countries had slightly higher growth rates of exports and imports, but also slower GDP growth and higher inflation.

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The comparison is similarly mixed in terms of trade restrictiveness according to conventional measures of protection with in-sample countries having slightly higher simple average tariffs and frequency of NTBs, but much lower premiums in the foreign exchange black market. Differences in these variables are also minimal. Table A.2 presents the main economic indicators averaged over the period 1975-2004, for each sample country and compared to other countries not included in the sample.

Table 1: Main indicators and Regression Variables in Developing Countries 1975-2004

	Out-of-Sample	In-Sample
Main Indicators		
Real GDP growth	3.0	3.7
GDP per capita (Atlas Method)	1701	1343
GDP per capita (PPP)	3407	2756
Inflation	87.9	16.5
Exports Growth	7.8	6.0
Imports Growth	5.6	5.1
Exports Concentration	0.40	0.32
Current Account	-5.2	-4.1
Simple Average Tariff (%)	16.8	21.8
Frequency of Non-Tariff Barriers	28.4	33.8
Black Market Premium	138	20
Regression Variables		
Imports Volume Growth	5.6	5.3
Change in Foreign/Domestic Prices	7.8	7.2
Growth of Economic Activity	2.9	3.7

Data Source: World Bank (2005) and World Bank (2006)

Exports and imports seem to be significantly affected by trade liberalization episodes as shown in Table A.4, even when including all announced liberalization episodes without regard of their strength. In the three years following announced trade liberalizations, imports growth is 3.8 percentage points higher than in the rest of the period 1975-2004. This difference is above 10 percentage points in the cases of Ghana and Uruguay. If we consider only strong liberalization episodes as identified in World Bank (2006), the difference in imports growth goes up to 5.2

percent (Appendix 10). [41] Table A.4 also shows that exports growth are 1.8 percentage points higher after announced trade liberalizations, which confirms our presumption that imports growth is more reactive to changes in trade policy barriers.

ESTIMATION AND DESCRIPTION

Equation (5) is estimated through SGMM and estimates are presented in Table 2. Table A.5 presents results of all estimations techniques mentioned earlier. All variables are statistically significant and their signs are as expected from theory. Either a reduction in the relative price of imports or an increase in output is associated with an increase in the growth of imports volume. The coefficient of the lagged dependent variable implies that there is in fact a tendency towards mean reversion. The price elasticity of imports is in line with estimates in Senhadji (1998), Perraton (2003), and Santos-Paulino and Thirlwall (2004). The trade liberalization dummy based on the list of liberalization episodes in World Bank (2006) is positive and indicates that imports growth tends to be about 8 percentage points higher after liberalization. Additional regressions including only non-hydrocarbon/mineral imports and manufacturing imports show similar results for this imports group.

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[41] World Bank (2006) identifies one strong liberalization episode per country based on a review of country reports of several international organizations.

Table 2: Determinants of imports growth including trade liberalization

Dependent Variable: Imports growth by group	All	Non-hydrocarbon/mineral	Manufactures
Log dependent variable t-1	-0.093***	-0.093***	-0.002
Real GDP growth	0.683***	0.724***	0.815***
Real GDP growth t-1	0.212***	0.179***	0.238***
Change in relative price of imports	-0.003	-0.039	-0.073
Change in relative price of imports t-1	-0.109***	-0.170***	-0.198***
Trade liberalization t, t+4 (World Bank, 2006)	0.084***	0.075***	0.065***
Year	-0.001	-0.002***	-0.003***
Constant	2.150	4.175***	5.471***
Observations	1,191	1,191	1,191

Notes: p-values below coefficients. Estimates based on System GMM regressions. Trade liberalization dummy based on identification of trade liberalization episodes in World Bank (2006), with a value of 1 the year of liberalization and three years after. Time trend variable included in all regressions. Data Source: UN COMTRADE database.

Table 3 shows replicates of the regressions in Table 2 but using a trade liberalization dummy based on Wacziarg and Welch (2003) list of liberalization. All regressions results are similar using either of these two liberalization dummies.

Table 3: Determinants of imports growth, including trade liberalization

Dependent Variable: Imports growth by group	All	Non-hydrocarbon/mineral	Manufactures
Log dependent variable t-1	-0.088***	-0.090***	-0.001
Real GDP growth	0.692***	0.735***	0.812***
Real GDP growth t-1	0.217***	0.188***	0.235***
Change in relative price of imports	-0.015	-0.048	-0.077
Change in relative price of imports t-1	-0.189***	-0.171***	-0.201***
Trade liberalization t, t+4 (Wacziarg and Welch, 2006)	0.083***	0.073***	0.066***
Year	-0.000	-0.002***	-0.003***
Constant	1.443	4.058***	5.226**
Observations	1,262	1,262	1,262

Notes: p-values below coefficients. Estimates based on System GMM regressions. Trade liberalization dummy based on identification of trade liberalization episodes in Wacziarg and Welch (2003), with a value of 1 the year of liberalization and three years after. Time trend variable included in all regressions. Data Source: UN COMTRADE database.

The estimated βs of trade liberalization dummies are normalized to a range of 0-1 and shown as the Effective Import Liberalization (EIL) index in Table 4. Within countries that had marked periods of strong liberalization according to common perception, there is a clear correspondence between this perception and the estimated EIL. Since the 1980s, East Asian countries had their strongest liberalizations in the 1980s (albeit from already relatively open trade regimes) and,

except for Vietnam, their liberalizations in the 1990s were not as momentous. In Latin America, except Bolivia, Chile, and Mexico, most countries implemented their strongest liberalizations in the early 1990s and some had weaker follow up liberalizations in the late 1990s and the EiL seems to confirm this.

Table 4: Effective Import Liberalization Index

Country	Year	EIL	Country	Year	EIL	Country	Year	EIL
Vietnam	1988	1.000	China	1988	0.285	Brazil	1987	0.17924
Vietnam	1992	0.760	Trinidad and Tobago	1993	0.279	Malawi	1999	0.16977
Zimbabwe	1992	0.677	Kenya	1984	0.277	Egypt, Arab Rep.	1991	0.1686
Argentina	1991	0.655	South Africa	1995	0.276	Mauritania	1987	0.16808
Zambia	1989	0.628	Nepal	1991	0.273	Indonesia	1997	0.16737
Zambia	1992	0.548	Costa Rica	1986	0.270	Tunisia	1997	0.16688
Mali	1994	0.501	Turkey	1989	0.267	Egypt, Arab Rep.	1995	0.16421
Malawi	1988	0.494	Bangladesh	1986	0.264	Venezuela, RB	1996	0.16347
Cote d'Ivoire	1994	0.490	Chile	1985	0.262	Jamaica	1994	0.16203
Malawi	1991	0.480	Madagascar	1989	0.261	Morocco	1996	0.16191
Mauritius	1984	0.477	Niger	1994	0.257	Thailand	1995	0.15824
Benin	1994	0.441	Jordan	1989	0.256	Malawi	1997	0.1582
Thailand	1986	0.440	Jordan	1999	0.252	Morocco	1984	0.15512
Malaysia	1988	0.432	Cote d'Ivoire	1996	0.250	Cote d'Ivoire	1985	0.15396
Cameroon	1994	0.428	Kenya	1993	0.248	Zambia	1985	0.15379
Paraguay	1991	0.419	South Africa	1991	0.248	Paraguay	1995	0.15379
Pakistan	2001	0.413	Venezuela, RB	1991	0.246	Peru	1997	0.14858
Benin	1990	0.410	India	1991	0.245	Mali	1988	0.14414
Honduras	1990	0.408	India	1994	0.243	Pakistan	1991	0.14151
Senegal	1994	0.404	Ecuador	1994	0.240	Turkey	1996	0.13458
Philippines	1986	0.403	Mali	1996	0.240	Jordan	1994	0.13373
China	1991	0.390	Mauritania	1995	0.240	South Africa	1986	0.12368
Bangladesh	1992	0.372	Bangladesh	1995	0.234	Jamaica	1991	0.10592
Madagascar	1992	0.371	Mauritania	1998	0.222	Zambia	1996	0.10068
Mexico	1986	0.371	Kenya	1988	0.222	Papua New Guinea	1999	0.09838
Central African Republic	1994	0.369	Madagascar	1996	0.219	Burkina Faso	1998	0.09827
Uruguay	1991	0.364	Cameroon	1989	0.213	Panama	1995	0.09074
Brazil	1991	0.361	Korea, Rep.	1987	0.209	Burkina Faso	1991	0.08873
Ecuador	1991	0.358	Tanzania	1985	0.208	Ghana	1985	0.087
Lao PDR	1994	0.343	Costa Rica	1992	0.208	Pakistan	1983	0.08265
Tanzania	1992	0.342	Colombia	1986	0.204	Cote d'Ivoire	1990	0.078
Turkey	1982	0.338	Pakistan	1987	0.204	Thailand	1983	0.07703
Bolivia	1985	0.335	Senegal	1998	0.202	Panama	1985	0.07253
Trinidad and Tobago	1988	0.333	Central African Republic	1987	0.200	Pakistan	1994	0.06889
Uruguay	1985	0.332	Vietnam	1995	0.198	Saudi Arabia	1999	0.06315
Mexico	1994	0.309	Ecuador	1986	0.198	Korea, Rep.	1982	0.05438
Peru	1991	0.306	South Africa	2000	0.197	Jamaica	1997	0.02958
Panama	1991	0.304	Jamaica	1985	0.194	Argentina	1987	0.01786
Tunisia	1989	0.304	Senegal	1987	0.190	Papua New Guinea	1990	0.01461
Indonesia	1986	0.292	Cameroon	1997	0.185	Papua New Guinea	1997	0.00499
Ecuador	1998	0.290	Dominican Republic	1992	0.183	Tanzania	1998	0
Colombia	1991	0.290	South Africa	1997	0.181			

Source: World Bank (2006) and author's estimations.

Common perceptions of trade liberalization among regions also seem to be broadly confirmed by the EIL. South Asia has maintained relatively closed trade policy regimes and, except for Bangladesh, none of their liberalization episodes has a high ETL. Bilateral trade liberalizations with main trading partners (for example, Mexico and Central America in the mid-1990s); emblematic cases of strong MFN tariff reductions in Africa (Mauritius in 1984; and Zambia in 1992); and transitions out from very closed trade policy regimes (China, Tanzania, and Vietnam) also show high EIL indicators.

Using the EIL we can compare import liberalizations across time periods and country subgroups, although one should keep in mind the small sample size of some subgroups and the large range of variation within groups. According to Table 5, we note that liberalizations in the 1980s and 1990s are not significantly different, which reflects the fact that some regions had their strongest liberalization periods in different decades. There are also very small differences and wide ranges in EIL among groups of countries divided according to income or population size. Across regions, East Asian and Southern Cone countries exhibit the highest EIL average, while Arab, Caribbean, and North African show the lowest.

Table 5: EIL by Country Subgroup

	Mean	Min	Max
Decade of Reform			
1980s	0.269	0.018	1.000
1990s and 2000s	0.257	0.000	0.760
Income Level			
Low Income	0.270	0.000	1.000
Middle Income	0.242	0.018	0.655
Population Size			
Large (>50m)	0.315	0.069	1.000
Middle (>10m and <50m)	0.254	0.078	0.490
Small (<10m)	0.260	0.005	0.677
Region			
Andean	0.253	0.149	0.358
Arab	0.063	0.063	0.063
Central America and Mexico	0.254	0.073	0.408
Caribbean	0.184	0.030	0.333
East Asia Emerging Markets	0.384	0.077	1.000
East Asia Others	0.343	0.343	0.343
Eastern Europe	0.247	0.135	0.338
India	0.244	0.243	0.245
Middle East	0.214	0.134	0.256
North Africa	0.187	0.155	0.304
Pacific	0.039	0.005	0.098
South Asia	0.253	0.069	0.477
Southern Cone	0.305	0.018	0.655
Sub-Saharan Africa	0.269	0.000	0.677

Source: Author's estimates.

ACCURACY AND ROBUSTNESS

The accuracy of the EIL depends to a large extent on how reactive are imports to significant reductions in policy barriers relative to normal fluctuations in non-liberalization years (signal-to-noise ratio). The impact of the strongest liberalizations on imports volume was indeed considerable. Estimations of impulse response functions presented in Figure 2 show that the most significant reforms led to an increase in imports volumes that ranged between -10 and 50 percent with a positive average, whereas imports growth in other years mainly ranged between -20 and 15 percent with an average around 0. Since there is a significant overlap between both distributions it can be inferred that the EIL is not precise enough to distinguish the difference

between liberalization episodes within its quintiles, but most likely yes between three or more quintiles of difference.

Figure 2: Distributions of Imports Growth

Source: UN Comtrade and Aksoy and Salinas (2006)

Furthermore, the EIL is considerably robust to several alterations to the methodology described in Section 3. For instance, our indicator assumed that each liberalization was implemented over a period of three years (years 0, 1, and 2), but ETLs constructed assuming implementation periods of two or four years are still significantly correlated to the EIL of Table 4, as seen in Table 6. An alternative estimation of the EIL could have used a larger sample of developing countries not limited to the ones included in Jinjarak et al (2013). But if we estimate imports demand parameters using a sample of about 120 developing countries, the estimated EIL using those parameters for our 39 countries is also highly correlated to the EIL in Table 3. Table 6 also shows the correlation between the EIL and an alternative indicator based on imports growth without controlling for output growth or changes in the relative price of imports. Although significant, the correlation of the EIL and this indicator is lower than with any of the alternative estimators. This is expected given the importance of output and import prices in determining import volumes.

Table 6: Correlation between EIL and alternative indicators

	Correlation Coefficient
Correlation of EIL and Alternative EIL Using…	
Period 0-1	0.70
Period 0-3	0.85
Imports growth	0.60
Including all developing countries	0.98

Source: Author's estimates

Moreover, the EIL does not seem to be determined by a spurious relation with past economic behavior. Table A.6 presents the correlation between the EIL and the evolution of several economic indicators in the three years preceding trade liberalization. The largest correlation in absolute terms is of only 0.3 between the EIL and the real exchange rate. This means that real exchange rate depreciations still affect the EIL even though the inclusion of the relative price of imports partly controls for this effect. A positive correlation between the previous occurrence of a structural adjustment program and the EIL could mean that the imports growth may increase because of the structural reforms. However, this correlation is low and negative. Appendix 6 also presents the relation between the EIL and previous GDP growth. A negative correlation in this case would imply that the EIL may be capturing not only the effect of trade liberalization, but also of an economic rebound even though equation (5) controls for economic activity. The correlation between the EIL and previous output growth is however very small.

4. INCORPORATING THE EIL INTO TRADITIONAL GROWTH REGRESSIONS

METHODOLOGICAL DISCUSSION

This section follows a similar growth regression methodology to Sachs and Warner (1995), Wacziarg and Welch (2003) and Salinas and Aksoy (2006) to illustrate how the EIL can contribute to the country level analysis of the impact of trade liberalization on several economic indicators. The main modification is that the list of liberalizations presented on those studies is here replaced by the one that includes the strongest liberalization episodes in each country according to the EIL. [42]

A word of caution first on the validity of growth regressions. Several studies have questioned growth regression methodologies along multiple dimensions (notably Barro, 1991; Levine and Renelt, 1992; Islam, 1995; Caselli and others, 1996; Temple, 1998).[43] The analysis in this subsection is based on the system GMM estimator (Blundell and Bond, 1998), a dynamic panel technique that addresses some of the caveats of growth regressions, but as shown through Monte Carlo simulations (for example, in Hauk and Wacziarg, 2009) is subject to bias related to autocorrelated regressor, weak instruments, and GMM moment conditions violations. The purpose of this subsection more than providing conclusive evidence on the impact of import

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[42] The authors determined this list based on qualitative descriptions of liberalization episodes found in World Bank projects' documents.

[43] As summed up in Hauk and Wacziarg (2009), there are at least seven factors that bias estimates from panel growth regressions: (i) omitted variables resulting from the possible correlation between country-specific effects and the regressors; (ii) endogeneity problem specific to dynamic panels; (iii) a more general endogeneity problem of the steady-state determinants due to reverse causation; (iv) measurement error of the independent variable; (v) possible autocorrelation in measurement errors; (iv) weak instruments problem of dynamic panel techniques; and (vii) possible invalidity of the specific moment condition of dynamic panel techniques.

liberalization on growth is illustrating the use of the EIL in commonly implemented analysis in this field.

The study of the impact of trade liberalization on economic growth is rooted in the empirical literature on income convergence (for example, Barro and Sala-I-Martin, 1991; Mankiw et al, 1992). [44] The standard approach assumes a three-factor Cobb-Douglas production function:

(7) $\quad Y_{i,t} = K_{i,t}^{\alpha} H_{i,t}^{\phi} (A_{i,t} L_{i,t})^{1-\alpha-\phi}$

in which Y is aggregate income, K is physical capital, H is human capital, A is Total Factor Productivity, and L is the size of the labor force, in country i and at time t. Greek letters represent the respective shares of each production factor, and constant returns to factors is assumed. Mankiw, Romer, and Weil (1993) show that under certain assumptions one can test the convergence hypothesis through a cross-country regression based on:

(8) $\quad\quad\quad \gamma_i = g - \beta_0 logA + \beta_1 logy_{i,0} + \beta_2 \frac{\alpha+\phi}{1-\alpha-\phi} log(n_i + g + \delta) -$

$\beta_3 \frac{\alpha}{1-\alpha-\phi} log(ns_{K,i}) - \beta_4 \frac{\phi}{1-\alpha-\phi} log(ns_{H,i}) + \varepsilon_i$

where γ is growth of income per capita, g is the growth rate of A (in other words growth rate of income per capita at the steady-state), $y_{i,0}$ is initial income per capita, s_K is the saving rate for physical capital, s_H is the saving rate for human capital, n is the growth rate of population, δ is the depreciation rate, and ε_i is a residual composed of a random error term and a country-specific shock. Equation (8) assumes that the steady-state growth rate (g) is equal across countries, and that the labor force and population grow at the same rate. Cross-country growth

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[44] Durlauf et al (2004) provide a detailed review of the empirical study of growth economics, including the income convergence hypothesis.

regressions as in Barro (1991) introduce a vector of control variables, C_i, to equation (8) that indirectly allows for heterogeneity in growth rates across countries.

(9) $\gamma_i = g - \beta_0 log A + \beta_1 log y_{i,0} + \beta_2 \frac{\alpha+\emptyset}{1-\alpha-\emptyset} log(n_i + g + \delta) - \beta_3 \frac{\alpha}{1-\alpha-\emptyset} log(ns_{K,i}) -$

$\beta_4 \frac{\emptyset}{1-\alpha-\emptyset} log(ns_{H,i}) + \omega C_i + \varepsilon_i$

Control variables such as geography, institutional quality, or population size are hence expected to have an impact on steady-state growth. Studies of the impact of trade liberalization and growth tests whether trade openness is a significant control variable:

(10) $\gamma_i = \alpha - \beta_1 log y_{i,0} + \varphi X_i + \omega C_i + \delta TO + \varepsilon_i$

where TO is an index representing the degree of trade openness of an economy, α is a constant, and X_i is composed of log A, log $(n_i+g+\delta)$, log s_{Ki} and log s_{Hi}. Factors that are time-invariant are dealt with by implementing fixed effects or within group estimation, transforming covariates in the above equation into deviations from the mean, so that time invariant growth factors are dropped out. Geography is clearly a time invariant factor, while the overall institutional quality changes only gradually.

As mentioned in the previous section, a main challenge in the estimation of the impact of TO on growth is measuring the change in TO. SW and WW, among others, use a dummy variable equal to zero in the years prior to trade liberalization, and one afterwards.

(11) $\gamma_i = \alpha - \beta_1 log y_{i,t-1} + \varphi X_{i,t} + \omega C_{i.t} + \delta POSTLIB_{i,t} + v_i + \varepsilon_{i.t}$

in which the subindex t represents time, and POSTLIB is the dummy of trade liberalization. Thus, π measures the increase in GDP per capita growth attributed to trade reforms.

This chapter, having estimated already a measurement of the strength of trade liberalization (the EIL) proposes a different measurement of the change in trade openness linked to liberalization by replacing the SW and WW liberalization dummies with the identified episode of stronger trade liberalization in each country, which we name EILMAX. Therefore, POSTLIB takes the value of one in the years on or after EILMAX and zero on the previous years. In doing this, note that the EIL is calculated through regression analysis that includes GDP growth as a covariate in equation 5 and that GDP growth is the dependent variable in equation 11. Since the estimation of EIL is centered on the three years after the liberalization event, to avoid any spurious relation between the estimation of EIL and the estimation of equation 11 the three post-liberalization years are removed from the estimation of equation 11.

Although dropped from fixed effects estimates in SW and WW, income per capita does change over time and, in many countries, it multiplied significantly in a period of 20 years (for example, East Asian countries). If, for instance, a country has significantly narrowed its income gap with respect to developed nations and unconditional convergence holds, then the exclusion of this variable would lead to a downward bias in the estimation of *POSTLIB*. We thus include the logarithm of income per capita of each country relative to the one in the U.S. for each year throughout our period of estimation (one-year lagged).

In addition, this chapter considers growth determinants suggested by the Solow growth model (X-variables in Equation (11)). As commonly done, investment in human capital is approximated through the school enrollment rates.[45]

It can be complicated to control for the impact of changes in physical capital investment on growth. Because trade liberalization is expected to boost investment, this variable is usually considered as an outcome variable in empirical analysis. Thus, including it in the multivariate specification of Equation (11) would generate endogeneity in our estimates. If we exclude this variable, then our estimates of the coefficient of POSTLIB would be biased upwards (downwards) only if this omitted variable systematically increases (decreases) after reforms in our sample, and this increase (decrease) is prompted by a factor other than trade reform (for example, savings policy, foreign direct investment policy). The only reason we think this could systematically be the case is if simultaneous structural adjustment reforms lead to higher investment. Nevertheless, we observe in Section 5 that there is only a mild increase in investment before and after trade liberalization, and therefore it cannot significantly explain an increase in output growth after reforms. We thus exclude this variable from most regressions but include the investment share of output (two-years lagged) in one of our specifications to test for the robustness of our results.

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[45] But although conventional wisdom and micro studies suggest a positive effect of education on economic growth, cross-country growth econometrics using enrollment has not confirmed this hypothesis. Several reasons have been proposed for this apparent contradiction (Pritchett, 1996; and Krueger and Lindahl, 2002).

It is also noteworthy that several variables in C, although assumed to vary only gradually, may have changed significantly over the period under scrutiny. [46] Geography is constant but other factors listed in Table A.2, are clearly not. Institutions can change over time and indeed, one vast and systematic institutional reform occurred during the period under consideration in this chapter: transition from communism. This move launched a radical transformation from state-led to market institutions. The transition from communism is such a cataclysmic event, that we opt to remove transition economies from the sample. [47] [48] To further limit the effect of other possibly omitted variables that could gradually change over time, our estimations only consider the twelve years before and nine after the reforms. [49] [50]

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[46] The control variables considered in this study is taken from a list from Bosworth and Collins (2003), which includes those most commonly used in the empirical growth literature. See Table A.2.

[47] A similar but less dramatic event is the implementation of structural adjustment reforms. Given that basically all developing countries have undertaken trade liberalization as part of structural adjustment programs, we maintain structural adjusters in the sample (see footnote 5). These reforms (exchange rate reform, fiscal adjustment, privatization of imports and exports companies, openness to foreign capital, etc) are complementary to trade liberalization. Thus, as in Baldwin (2003), our conclusions talk about the impact of trade liberalization defined in a broader sense: the dismantling of ISI and switch to outward orientation.

[48] Wacziarg and Welch (2003) attempt to separate the effect of trade reform from the impact of other complementary policies embedded in structural adjustment reforms by estimating their results after removing from the sample those countries that implemented trade liberalization together with a comprehensive privatization program. There are three main caveats in their approach as some of the pure reformers: (i) did undertake privatization few years before or after the trade liberalization episode, thus also significantly affecting growth rates after trade liberalization (Kenya); (ii) implemented significant privatization though considerable state involvement in the economy remains (India and Morocco); or (iii) implemented other non-privatization reforms (for example, deregulation, sectoral reforms, fiscal adjustment, etc) that could equally alter potential growth by stabilizing an economy or fostering the development of market institutions (for example, Bolivia, Ghana, Kenya). Taking these caveats into consideration, their sample of pure trade reformers would be reduced to only 3 countries.

[49] Wacziarg and Welch (2003) also include a time trend and year dummies in their analysis.

[50] Limiting the period before trade liberalization to 12 years prior to reform possibly leaves out some years of high growth under the ISI model (for example, Brazil, Argentina) and one could argue that this could bias our estimates in favor of the post-liberalization period. On the other hand, note in the following paragraph that we also opt to eliminate from our sample the recessionary period prior to reform [-4,-1] and one could argue that this could bias our estimates against the post-liberalization years.

Sample modifications are also performed to reduce other sources of volatility in our dependent variable. Thus, we remove countries with characteristics that exacerbate such volatility: those with considerable oil dependence (fuel exports accounting for more than 50 percent of merchandise exports) and a small size of its population (below 1 million people).[51] Economic performance in such countries is excessively dependent on the evolution of oil prices and external shocks, respectively.[52] To avoid variation due to changes in the sample throughout time we include only countries with GDP data for all years in the [-12,9] period. We also exclude countries that have gone through serious conflicts as a large literature documents their pernicious impact on economic growth.[53] The determination of this sample is in line with the methodology applied in Jinjarak et al (2013). [54]

Finally, years of economic crisis that preceded trade reforms are removed, as we observe later that in average our sample countries experience a period of economic downturn four years before reform. Such exclusion is particularly needed for the countries that experienced hyperinflation.

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[51] Table A.2 presents a classification of developing countries according to several characteristics, including those used to define our sample of countries.

[52] A valid critique to our methodology in this regard is that several other countries that remain in our sample are highly dependent on a handful of non-oil commodities and thus could be highly volatile. Yet, we cannot exclude such countries due to sample size considerations and expect that the inclusion of terms of trade would control for volatility in commodity prices.

[53] Collier and Hoeffler (1998). We define conflict countries as those that experienced war (internal or external) according to Gleditsch et al. (2002)

[54] The obvious caveat of concentrating on this sample is its reduced size. Whereas SW and WW use more than 100 countries in their analysis we are left with only 39.

The sample selection technique in this chapter also permits a more accurate application of within country estimation of the impact of trade liberalization on other economic indicators, such as investment, exports, share of manufacturing exports, industry value added, and exports concentration. These indicators will allow us to obtain a comprehensive picture of the impact of trade liberalization on economic performance.

The estimation of equation 11 further includes a fixed effect term by country, using the entire sample of 39 countries and for subgroups of countries grouped by world region, income per capita, and size of the population. We consider non reversed trade liberalization episodes between the years 1970 to 2004 and for each country we analyze economic performance 12 years before to 9 years after trade reforms, excluding the years in the runup to liberalization [−4,1]. Given the dynamic nature of equation 11, it is estimated through System GMM (Blundell and Bond, 1998).

DATA SOURCES

The World Bank's World Development Indicators (World Bank, 2005) is the source for most variables in our analysis. The main dependent variable, GDP per capita growth (GDPPCG), is the annual real change in gross domestic product (in local currency) minus annual population growth, both indicators extracted from World Bank (2005). Other dependent variables are also obtained from this source are gross capital formation as a share of GDP (IGDP), the share of exports of goods and services in total GDP (XGDP), the share of manufacturing exports in total merchandise exports (MANX), and industrial valued added as a share of GDP (IND). UNCTAD's Handbook of Statistics (UNCTAD, 2006) is our source for our measure of exports

concentration (which is based on the Herfindahl-Hirschman Index). Among our independent variables, World Bank (2005) is the source of total population and our estimate of GNI per capita relative to the one of the United States. It is also the source of our measure of terms of trade, current account balance, fiscal balance, and inflation. Our list of natural disasters comes from the OFDA/CRED Emergency database (EM-DAT, 2006) and we use estimates of real exchange rate misalignments (RXRDEV) from Elbadawi and Soto (forthcoming). In addition to regression variables, we use other statistics to compare the general economic status and evolution of countries in and out of the sample, and before and after trade liberalization. These statistics are all listed and described in Table A.2.

DATA DESCRIPTION

Figure 3 shows the evolution of the average growth of GDP per capita 14 years before and 12 years after the identified reforms for our sample of countries. There are three markedly different periods of growth: a first one that corresponds to the years of stable growth (years [-14, -5]) under an ISI regime; a second period (years [-4,1]) of economic crisis prior to trade liberalization and a rebound right after the reforms; and the years of stable growth that follow the reforms (years [2,12]). Within the period [-12,-5] we see that the initial 3 years are much higher than in the following years. These three years of relatively high growth includes the significant output expansion that countries under the ISI model commonly experienced resulting from state expansionism financed by foreign borrowing. Thus, when comparing economic performance before and after trade liberalization, we delete periods of abnormally

high and low growth (in years [-14,-13] and [-4,0], respectively), as well year 1 of expected

growth rebound.[55]

Figure 3: GDP Per Capita Growth Before and After Reforms

Liberalization in our sample countries was followed in average by a significant growth increase

of more than 1 percent vis-à-vis the period of stable growth under ISI.[56] The increase in GDP

per capita growth is from 0.6 in years [-12, -5] to 2.1 percent in years [2,9]; or an increase of

1.5 percent. Table A.8 confirms that there is an acceleration in all country subgroups classified

according to geographic region, population size and income per capita.

Table A.7 and Figure Panel A.1 in turn give a more comprehensive picture of the economic

evolution before and after trade liberalization. Output acceleration is most impressive if we

consider that macroeconomic variables were clearly more expansionary in the years before

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[55] Since our sample includes those countries for which we have GDP growth data for at least 20 years within the [-12,9] period, Figure 1 and other tables in this section are not much distorted by a time-varying country sample.

[56] Year -12 is preceded by two years of growth below 1 percent and Year 9 is followed by an average growth around 2 percent.

trade liberalization. State dirigisme prior to reform translated into high growth in the external debt and unsustainably high levels of current account deficits. The period after reform in turn is characterized by reduction in the levels of debt to GDP and considerably lower current account deficits. Furthermore, terms of trade were higher before trade liberalization than afterwards. Table A.7 shows that trade liberalization was also followed by considerable increases in investment, exports share of GDP, share of manufacturing exports, with only a minor reduction in industry value added and even a reduction in exports concentration. This is later confirmed through fixed effects estimates.

An interesting development complementary to trade liberalization is the evolution of the real exchange rate in the years around economic reform. Theoretically it is clear that a reduction in imports barriers needs to be accompanied by a real exchange rate devaluation to maintain external equilibrium. Trade reforms increase the demand for imports and therefore the demand and price of foreign exchange. Thus, the real exchange rate should fall after trade liberalization to avoid misalignment. Figure 4 shows that in average in our sample the real exchange rate depreciated in the years preceding reform. The real exchange rate falls by about 20 percent in the 6 years prior to trade liberalization, and in the years after trade reforms there is only a mild, temporary appreciation.[57] However, an index of real exchange rate misalignment presented in Elbadawi and Soto (forthcoming) shows that the real exchange rate first falls slightly below its equilibrium value, but that afterwards it increases to 10 percent above equilibrium.

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[57] In fact, as shown in Table 1, the actual fall in the real exchange rate from period [-12,-5] to [2,9] is of about one third.

Figure 4: REER Before and After Reforms

Developing countries included in our sample did not differ considerably or systematically from those left out during the period under consideration (1970-2004). According to the average values presented in Table 8, countries in the sample had higher output growth, but lower income per capita and lower level of industrialization. The general macroeconomic outlook is slightly better for in-sample countries having lower inflation, debt to GDP share, current account deficits, and fiscal deficits. On the other hand, countries in the sample were also slightly less open to trade in terms of their share of exports and imports to GDP but had similarly restrictive trade barriers than other developing countries. In-sample countries also had lower concentration of exports and a larger share of manufacture to merchandise exports.

Table 7: Main Variables In and Out of Sample

	Out-of-Sample	In-Sample
Main Indicators		
Real GDP growth	3.0	3.7
GDP per capita (Atlas Method)	1701	1343
GDP per capita (PPP)	3407	2756
Inflation	87.9	16.5
Exports Growth	7.8	6.0
Imports Growth	5.6	5.1
Exports Concentration	0.40	0.32
Current Account	-5.2	-4.1
Simple Average Tariff (%)	16.8	21.8
Frequency of Non-Tariff Barriers	28.4	33.8
Black Market Premium	138	20
Regression Variables		
Imports Volume Growth	5.6	5.3
Change in Foreign/Domestic Prices	7.8	7.2
Growth of Economic Activity	2.9	3.7

Data Source: World Bank (2005) and World Bank (2006)

The list of trade liberalization episodes in our chapter considerable differs from the one used in WW (see Table A.3). Out of the 39 countries included in the sample, there are 13 countries (33 percent) in which our identified liberalization year coincides with the one in WW. Out of the 13 countries of disagreement, there are five countries in which the divergence is less than three years. In 8 of our identified reforms (Central African Republic, India, Jordan, Malaysia, Malawi, South Korea, Senegal, and Thailand), WW did not recognize a year of reform as these countries have either permanently met or unmet the SW criteria throughout the period 1970-2004. [58]

ESTIMATION AND DESCRIPTION

Growth regressions based on the EILMAX index also shows a positive and statistically significant association between EILMAX import liberalizations and GDP growth. The panel exercise in Table 8 regresses GDP growth on dummy variable POSTLIB in equation 11. In columns 1 and 3, the dummy EILMAX is used as POSTLIB, and in columns 2 and 4the Wacziarg and Welch (2003) openness dummy is used as POSTLIB.[59] Regressions in columns 1 and 2 only add the first two terms of equation 11, while regressions in columns 3 and 4 include also other policy covariates. The increased GDP growth rate associated with POSTLIB in all regressions is above 2 percentage points, which confirms the similar findings in other event studies on the growth impact of trade liberalization, including Sachs and Warner (1995) and Wacziarg and Welch (2003).

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[58] In the case of Chile we do not consider the liberalization started in the 1970s (as SW and WW do), since it was significantly reversed in the early 1980s.

[59] Note that EILMAX and the WW dummy are positively correlated but not strongly so (0.58 correlation).

Table 8: Growth impact of trade liberalization

Dependent Variable: GDP growth	(1)	(2)	(3)	(4)
Log dependent variable t-1	0.121***	0.120***	0.087*	0.081*
GDP per capita to U.S.	-0.001	-0.010	0.006	-0.002
Maximum ETL dummy (EILMAX)	.025*		0.029*	
Liberalization dummy (Wacziarg and Welch, 2003)		0.028**		0.039**
Investment-to-GDP t-2			-0.002***	-0.002***
Political Stability (Polity IV)			0.001*	0.001*
Education Attainment (Barro-Lee 2013)			-0.011	-0.024
Year	0.000	0.000	-0.001*	-0.001
Constant	0.000	0.000	-0.011	-0.024
	-0.274	-0.021	2.598*	2.815*
Observations	767	767	683	683

Notes: * p<0.1, ** p<0.05, *** p<0.01. Estimates based on System GMM regressions. Maximum ETL dummy has a value of 1 in the years after the strongest trade liberalization of each country listed in World Bank (2003). Wacziarg and Welch dummy has a value of 1 in the years after the trade liberalization identified in Wacziarg and Welch (2003). Strongest Wacziarg and Welch dummy includes those Wacziarg and Welch (2003) dummies followed by strongest imports response (upper quintile). Time trend variable included in all regressions. Data Source: UN COMTRADE database.

It is still frequently claimed that any potential benefits of trade liberalization on overall growth come at the cost of an increased economic vulnerability to external shocks because of deindustrialization and concentration of exports in a few products. Table 9 shows that such claims are not supported by cross-country evidence. Trade reforms have been followed by only a very small decrease in industry valued added (on average of less than 1 percent of GDP) and in fact reforms were followed in average by a considerable decrease of 0.04 points in the Herfindahl-Hirschman Index of exports concentration. The move towards trade liberalization has been followed also by an industrialization of exports: an increase of 17 percentage points in the share of manufacturing exports in total merchandise exports. [60]

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[60] We do not present any results about the impact of trade liberalization on social indicators given the lack of such data for the period prior to the reforms.

Table 9: Impact of Trade Liberalization on Other Economic Variables

Between Years [-12,-5] and [2,9]

Dependent Variable:	Exports to GDP	Investment to GDP	Industry Value Added	Exports Concentration	Share of Manuf. Exports
POSTLIB	4.819	0.981	-0.997	-0.056	14.442
	(11.53)**	(3.31)**	(3.66)**	(7.83)**	(17.73)**
Constant	24.275	19.89	27.767	0.356	27.509
	(82.03)**	(94.65)**	(143.80)**	(63.94)**	(46.91)**
Observations	773	774	756	504	656
Number of country	39	39	39	39	39
R-squared	0.15	0.01	0.02	0.12	0.34

Absolute value of t statistics in parentheses
* significant at 5%; ** significant at 1%

SOURCES OF HETEROGENEITY

As was shown in Table A.7, there is large heterogeneity by country in the evolution of GDP per capita growth before and after trade liberalization. Panel Figure A.1 investigates the sources of such variation by estimating equation (11) for different country subgroups. We find that some of this heterogeneity is explained by country characteristics that are expected to influence the effect of liberalization. For instance, the growth increase following trade reforms is more significant in small developing countries which because of their reduced internal market, are expected to suffer more from the economic isolation imposed by ISI policies. Interestingly, low income countries experience a similar increase in growth following trade liberalization as middle-income countries. Since there is a positive relation between the quality of institutions and income per capita, this implies that supply response from trade opening was not limited by weak institutions. Furthermore, countering frequent criticisms, the evidence in this Panel Figure shows that countries in Sub-Saharan Africa have indeed benefited significantly from an

outward orientation of economic policies.[61] [62] Finally, we divide the sample according to pace of the trade reforms, either fast or gradual, based on a classification established at Jinjarak et al (2013), and we observe that gradual reformers obtain more robust benefits than fast liberalizers.

Figure 5: Evolution of GDP Per Capita Growth by Country Subgroups

5. CONCLUDING REMARKS

This chapter has produced an index that measures the degree of import liberalization without attempting the challenging task of estimating the restrictiveness of a trade policy regime. The strength of import liberalization calculated through this index largely corresponds to existing perception of the degree of reforms. It is robust to several variations in the methodology and sample. This indicator can then be used in panel regressions that assess the economic impact of trade liberalization, for instance through within country regressions centered upon the strongest

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[61] These patterns are robust to the inclusion of a time trend.

[62] We cannot make strong inferences about MNA and SAR due to the small number of countries in our sample.

liberalization episodes as identified through the EIL. In addition, the EIL can be used to compare the differentiated impact of all trade liberalization episodes according to several criteria.

Our methodology cannot address concerns about endogeneity in trade liberalization growth regressions as, for example, it may be that trade liberalization triggers a larger increase in imports in countries that are somehow "readier to grow". This would imply that trade liberalization has a causal effect on growth, but by focusing on successful cases the EIL could overestimate the effect of the average trade liberalization episode.

On the other hand, using the EIL to estimate the impact of import liberalizations on growth can address concerns of those who argue that trade liberalizations do not have a significant impact on economic growth because the increased domestic producer's exposure to foreign competition may create more damage than benefit. It is therefore those episodes that lead to higher imports response the ones that are more important to evaluate and this is done by basing the analysis on the EIL.

Replicating a standard methodology measuring the impact of trade liberalization in Sachs and Warner (1995) among others, while using the list of strongest liberalization episodes (EILMAX) elaborated in this chapter confirms most of the conclusions related to the economic impact of trade liberalization presented in those papers. Import liberalizations are associated with an estimated average increase in growth of about 2 percent. And as expected by free traders, stronger import liberalizations are followed by stronger growth accelerations. Despite the claims of skeptics, growth has increased substantially after the dismantling of the ISI regime in Sub-Saharan African and Latin American countries. Also disproving usual criticisms, trade

liberalization has not significantly changed the level of industrialization of an economy and has

been followed by lower export concentration and a higher share of manufacturing exports.

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TABLE A.1: TRADE RESTRICTIVENESS INDICATORS

Indicator	Description	Main Shortcomings
Policy Based		
Simple Average Tariffs	Unweighted average of tariffs.	Identical weights on products that have different economic significance. Omits NTBs. Does not take into account tariffs under preferential agreements (e.g Paraguay, Tunisia and Morocco protectionism is overestimated)
Weighted Tariffs	Average tariff weighted by import volume, production and consumption.	Downward bias since puts low weights on tariffs that are prohibitively high. Omits NTBs. Does not take into account trade policies under preferential agreements (e.g. Paraguay, Tunisia and Morocco protectionism is overestimated). Distorted by existence of non zero tariffs that do not affect the domestic price of a product (i.e. zero import demand elasticity)
Non-Tariff Barriers	Share of products covered by a non-tariff barrier	Does not account for the restrictiveness of each NTB
Import Duties	Ratio of import duties revenues to imports value	Downward bias since puts low weights on tariffs that are prohibitively high. Omits NTBs
Lee (1993)	Weighted index of imported-weighted average tariffs and black market premium	Import-weighted average tariffs have a downward bias since puts low weights on tariffs that are prohibitively high and omits NTBs. Restrictiveness of black market premium depends on foreign exchange source for importers and exporters.
Heritage Foundation Index	Based on weighted average tariff, non-tariff barriers, and corruption in customs service.	Subjective aggregation of indicators that have several drawbacks
Fraser Institute Trade and Globalization Index	Weighted average of Taxes on international trade, regulatory trade barriers, actual size of trade sector compared to expected size, difference between official exchange rate and black-market rate, and index of international capital market controls	Subjective aggregation of indicators that have several drawbacks
IMF Trade Restrictiveness Index	Based on average tariffs and NTBs coverage	Average tariffs and NTBs coverage are not good indicators and aggregation of both is largely arbitrary.
Wacziarg (1998)	Linear combination of average tariff, the NTB coverage ratio, and Sachs and Warner Indicator.	Drawbacks in all these indicators are mentioned elsewhere in this table.
Sachs and Warner (1995)	Episode identification based on average tariffs, NTBs coverage, black market premium, exports monopoly, socialist system.	Problems with average tariffs, NTBs coverage, and black market premium mentioned above. Data of exports monopoly is limited to countries a few African countries in World Bank report. Threshold and aggregation are arbitrary. Does not capture strength of reforms. Lack of data led to an inconsistent implementation of identification criterion.
Greenaway et al (1998)	Episode identification in Dean et al (1993), Sachs and Warner (1995), and World Bank (1993)	Episode identification does not take into account strength of reforms. Drawbacks in Sachs and Warner mentioned above.
Wacziarg and Welch (2003)	Episode identification based on average tariffs, NTBs coverage, black market premium, exports monopoly, socialist system.	Episode identification does not take into account strength of reforms. Errors in identification of liberalization episodes, especially ommited episodes. Same as Sachs and Warner, except that export monopoly variable is not limited to African countries. Lack of data led to an inconsistent implementation of identification criterion.
Bhagwati (78) and Krueger (78)	Effective Exchange Rates: Nominal rates for imports and exports corrected for export subsidies, import tariffs, and NTBs, respectively.	
Heitger (1986)	Effective rate of protection in manufacturing	Aggregated values do not capture variation across products/industries though such variation is an important distortion. Only few observations per country.
World Bank Index of Outward Orientation (WDR, 1987)	Subjective classification of trade strategy considering effective rate of protection, use of direct controls, export incentives, degree of exchange rate overvaluation.	Subjective consideration with notable errors identified in Rodrik and Rodriguez (2000)
Papageorgiou, Michaely, and Choksi (1991)	Subjective classification based on country case studies	Subjective classification
World Bank CPIA	Subjective classification under guidelines that consider restrictions on imports, exports and foreign exchange (tariffs, non-tariff barriers, exports taxes, and others)	Subjective classification
Kee et al (2004) Trade Restrictiveness Index based on	Based on tariffs and import elasticities	Can be implemented for few, recent years (can only be expanded back to the late 1980s for major countries and mid 1990s for most developing countries), extremely sensitive to model specification (O´Rourke, 1997) requires strong assumptions about generating production function (parameters are time and country invariant, homogeneity assumptions, ignores general equilibrium effects), ignores trade policies under preferential agreements
Anderson and Neary (1992, 1994), Feenstra (1995) Trade Restrictiveness Index	Based on tariffs and import elasticities	Can be implemented for few, recent years (can only be expanded back to the late 1980s for major countries and mid 1990s for most developing countries), extremely sensitive to model specification (O´Rourke, 1997) requires strong assumptions about generating production function (parameters are time and country invariant, homogeneity assumptions, ignores general equilibrium effects), ignores trade policies under preferential agreements

Appendix 1: Trade Restrictiveness Indicators (cont´d)

Indicator	Description	Main Shortcomings
Outcome Based		
Dollar (1991)	Relative price of traded goods	Does not distinguish between the effect of import protection and exports taxation. Assumes LOP holds.
Bhalla and Lau (1992)	Relative price of tradables to international prices	Assumes LOP holds.
Barro (1991)	Relative domestic price of investment goods to international prices	Assumes LOP holds.
Quah and Rauch (1990)	Trade shares	Trade level can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Low trade share can be due to protectionism of others.
Holger Wolf´s Index	Deviation from predicted trade	Trade level can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Deviation of trade can be due to protectionism of others.
Leamer´s Index (1998), Balassa (1985)	Deviation from predicted trade	Trade level can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Deviation of trade can be due to protectionism of others.
Guillamont (1999, 2000)	Deviation from predicted trade	Trade level can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Deviation of trade can be due to protectionism of others.
Hiscox and Kastner (2002)	Deviation from predicted trade (bilateral)	Trade level can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Deviation of trade can be due to protectionism of others.
Syrquin and Chenery (1989)	Deviation from predicted export share	Exports growth can be higher as a result of GDP growth policies that foster it (e.g. heterodox policies in East Asian countries)
Helliwell and Chung (1991)	Change in trade shares	Exports growth can be higher as a result of GDP and growth policies that foster it (e.g. heterodox policies in East Asian countries)
Lee (1993)	Predicted import shares with zero tariffs and no black market premium	Predicted value based on regression using average import tariffs and black market premium, though these have drawbacks. Does not take into account reverse causation.
Dollar and Kraay (2001)	Decade long change of trade share and tariff reduction.	Over a decade trade growth can be higher as a result of GDP growth and policies that foster it (e.g. heterodox policies in East Asian countries). Drawbacks with using average tariff as a measure of protection.

TABLE A.2: MAIN ECONOMIC INDICATORS IN SAMPLE COUNTRIES: 1975-2004

Country	Real GDP growth	GDP per capita (Atlas Method)	GDP per capita (PPP)	Inflation	Exports Growth	Imports Growth	Exports Concentration	Current Account	Simple Average Tariff (%)	Frequency of Non-Tariff Barriers	Black Market Premium	Imports Volume Growth	Foreign/Domestic Prices	Growth of Economic Activity
Bangladesh	4.1	280	1,037	5.4	10.0	7.7	0.29	-1.5	50.1	39.6	98.0	8.3	1.9	4.4
Benin	3.6	353	686	6.7	3.1	2.8	0.68	-6.0	27.7		2.0	2.7	9.5	3.9
Cameroon	3.8	718	1,483	7.5	6.2	6.1	0.40	-3.9	20.3	1.3	2.0	6.2	5.2	3.6
Central African Republic	1.0	325	938	3.5	1.4	3.8	0.47	-4.2	20.0	0.4				1.0
Chile	4.8	2,843	5,115	36.6	8.9	7.1	0.32	-4.2	13.5	7.8	6.8	8.6	7.4	5.4
Costa Rica	4.0	2,386	5,345	17.8	6.7	6.0	0.29	-6.1	11.3		18.6	6.5	8.0	4.1
Cote d'Ivoire	1.9	784	1,265	7.4	3.6	2.7	0.37	-6.2	22.2	30.0	2.0	2.6	8.7	1.7
Ecuador	3.1	1,299	2,435	31.6	5.0	3.8	0.46	-4.1	16.0	50.6	15.6	3.2	8.5	2.9
Ghana	2.6	360	1,334	40.0	3.3	2.7	0.42	-3.2	19.5	48.4	91.2	3.3	11.7	3.1
Honduras	3.7	733	1,860	11.8	2.3	2.9	0.40	-6.5	8.3	0.1	17.6	3.3	8.5	3.7
India	5.4	349	1,440	7.4	9.9	10.2	0.14	-0.8	51.8	67.4	8.4	10.1	3.0	5.3
Jamaica	1.0	1,811	2,433	19.4	-0.1	1.6	0.57	-5.5	14.4		25.8			1.0
Jordan	6.0	1,733	3,084	6.3	6.0	5.0	0.29	-2.0	16.7	23.2	3.2	4.9	5.0	6.0
Kenya	3.2	345	777	13.4	3.0	3.6	0.31	-3.8	28.9	45.3	5.2	4.4	6.8	3.3
Korea, Rep.	7.0	6,074	8,764	8.0	13.3	8.1	0.13	0.2	15.1	4.9	5.0	11.8	8.1	7.0
Lesotho	4.7	580	1,753	12.8	11.3	5.0	0.35	-5.3	13.5	5.2		3.4	11.8	5.3
Madagascar	1.4	287	670	14.8	4.5	4.6	0.35	-6.4	6.3	25.2	17.2	3.3	6.1	1.4
Malawi	3.2	178	418	23.4	3.8	1.5	0.59	-9.5	18.7	82.9	21.8	0.5	7.1	3.1
Malaysia	6.4	2,628	4,784	3.4	9.9	10.1	0.22	0.1	11.5	3.5	0.6	11.0	4.6	6.6
Mali	3.7	237	580	2.9	8.9	5.8	0.70	-8.8	14.6	39.1	2.6	6.2	6.9	3.4
Mauritania	3.0	434	1,227	6.1	0.5	2.9	0.53	-11.9	19.4			1.1	3.4	3.3
Mauritius	5.4	2,750	6,332	9.1	6.6	6.1	0.39	-1.5	28.7	27.4	10.0	6.6	3.4	5.4
Mexico	3.4	3,357	5,995	34.0	10.3	8.4	0.18	-2.4	16.3	10.4	23.6	9.0	10.1	3.3
Morocco	3.9	975	2,464	6.0	4.9	6.3	0.20	-3.6	29.3	18.2	4.8	5.5	5.4	3.8
Nepal	4.1	191	853	8.2			0.39	-3.8	16.7	5.6	13.6			4.2
Pakistan	5.1	402	1,255	8.1	8.3	4.1	0.23	-2.6	52.7	39.8	10.6	3.8	6.7	5.2
Panama	3.3	2,610	3,987	2.4	1.7	2.6	0.35	-3.0	9.4		0.0	2.6	5.4	3.4
Paraguay	3.9	1,338	3,634	16.1	8.1	8.7	0.41	-3.2	11.1	8.9	54.0	9.4	4.0	3.8
Philippines	3.4	793	3,056	10.2	7.0	6.7	0.31	-1.9	21.0	13.4	4.4	6.2	6.7	3.3
Senegal	3.3	533	1,071	5.9	4.1	2.0	0.27	-8.0	14.9	100.0	2.0	1.7	7.5	3.2
South Africa	2.1	2,862	7,464	11.1	2.8	2.5	0.36	-0.1	10.6	10.8	7.0	2.9	10.7	2.2
Tanzania	4.2	223	474	20.5	10.0	3.3	0.33	-9.9	23.9	60.9	114.0	3.3	6.9	4.2
Thailand	6.4	1,482	3,747	5.0	11.2	9.4	0.12	-2.1	27.5	9.5	1.6	9.9	6.4	6.4
Tunisia	4.7	1,541	3,784	5.1	5.7	5.3	0.26	-4.8	28.6	54.8	8.4	5.1	6.2	4.6
Turkey	4.1	2,206	4,352	54.7	10.2	10.4	0.11	-1.7	19.7	87.0	4.8	11.6	7.3	4.0
Uruguay	2.0	3,571	5,830	47.3	5.6	5.1	0.19	-1.4	19.9	14.0	0.0	4.9	6.8	1.9
Zambia	1.2	427	676	65.2	1.5	-2.1	0.59	-9.0	18.6	1.0	71.0	-1.8	8.9	1.3
Zimbabwe	2.0	743	1,883	26.5	5.6	5.2	0.27	-2.4	16.8	43.4	31.2	5.2	15.9	2.1

Data Source: World Bank (2005) and World Bank (2006)

TABLE A.3: LIST OF LIBERALIZATION EPISODES SINCE 1982 BY SOURCE

Country	Year	Indicator*					Country	Year	Indicator*				
		ETL	SW	WW	TAE	ST			ETL	SW	WW	TAE	ST
Bangladesh	1985	X					Malaysia	1992	X				
Bangladesh	1988	X					Mali	1988	X	X	X	X	
Bangladesh	1991	X					Mali	1994	X				
Bangladesh	1992				X		Mali	1997	X				
Bangladesh	1994	X					Mauritania	1987	X				
Bangladesh	1995			X			Mauritania	1992		X			
Benin	1986	X					Mauritania	1994	X				
Benin	1990		X	X	X		Mauritania	1997	X		X	X	
Benin	1994	X					Mauritius	1983	X				
Benin	1997	X					Mauritius	1987				X	
Cameroon	1991					X	Mauritius	2000	X				
Cameroon	1993	X	X	X	X		Mexico	1986	X	X	X	X	X
Central African Republic	1987	X					Mexico	1994	X				
Central African Republic	1994	X			X		Morocco	1981	X				
Chile	1976					X	Morocco	1984		X	X	X	X
Chile	1986	X			X		Morocco	1996	X				
Costa Rica	1986	X	X	X	X		Nepal	1991	X	X	X	X	
Costa Rica	1990					X	Pakistan	1987	X				
Costa Rica	1992	X					Pakistan	1991	X			X	X
Costa Rica	1995	X					Pakistan	1994	X				
Cote d'Ivoire	1991	X					Pakistan	2001			X		
Cote d'Ivoire	1994	X		X	X		Panama	1991	X			X	
Cote d'Ivoire	1997	X					Panama	1995	X				
Ecuador	1986	X					Panama	1996			X		
Ecuador	1989	X					Paraguay	1989		X	X	X	X
Ecuador	1991		X	X	X	X	Paraguay	1990	X				
Ecuador	1994	X					Paraguay	1995	X				
Ghana	1985	X	X	X	X		Philippines	1981	X				
Ghana	1994	X					Philippines	1986					X
Honduras	1991	X	X	X	X		Philippines	1988		X	X	X	
Honduras	1994	X					Philippines	1991	X				
India	1991	X			X	X	Philippines	1994	X				
India	1994	X	X				Senegal	1987	X				
India	2001	X					Senegal	1994	X			X	
Jamaica	1985	X	X	X	X		Senegal	1997	X				
Jamaica	1991	X					South Africa	1986	X				
Jamaica	1994	X					South Africa	1991	X	X	X	X	
Jamaica	1997	X					South Africa	1995	X				
Jordan	1994	X			X		South Africa	2000	X				
Jordan	1999	X					Tanzania	1985	X				
Kenya	1984	X					Tanzania	1992	X			X	
Kenya	1988	X					Tanzania	1995			X		
Kenya	1991	X					Tanzania	2001	X				
Kenya	1993		X	X	X		Thailand	1983	X				
Kenya	2000	X					Thailand	1986				X	X
Korea, Rep.	1982	X			X		Thailand	1992	X				
Korea, Rep.	1987	X					Tunisia	1989	X	X	X	X	X
Korea, Rep.	1990					X	Tunisia	1997	X				
Lesotho	1985	X					Turkey	1982	X			X	
Lesotho	1991	X					Turkey	1989	X	X	X		
Lesotho	1995	X			X		Turkey	1995	X				
Lesotho	2000	X					Uruguay	1985	X				X
Madagascar	1989	X					Uruguay	1990	X	X	X	X	
Madagascar	1992	X			X		Uruguay	1995	X				
Madagascar	1996	X		X			Zambia	1989	X				
Madagascar	2000	X					Zambia	1990					X
Malawi	1991	X				X	Zambia	1992	X				
Malawi	1994	X			X		Zambia	1993		X	X	X	
Malawi	1997	X					Zambia	1996	X				
Malawi	2000	X					Zambia	2000	X				

*SW= Sachs and Warner (1995); WW = Wacziarg and Welch (2003); TAE: World Bank (2006); ST: Santos-Paulino and Thirlwall (2004)

TABLE A.4: EXPORTS AND IMPORTS GROWTH AFTER REFORM YEARS

Country	Imports			Exports		
	After Reform	Other Years	Difference	After Reform	Other Years	Difference
Bangladesh	9.2	7.7	1.5	10.3	9.6	0.7
Benin	0.1	3.9	-3.8	-5.2	7.0	-12.2
Cameroon	1.6	6.7	-5.2	-5.9	8.2	-14.1
Chile	13.2	8.1	5.1	9.4	8.9	0.5
Costa Rica	10.9	4.5	6.4	9.6	5.9	3.8
Cote d'Ivoire	7.8	0.3	7.5	0.9	5.1	-4.2
Ecuador	3.2	3.2	0.0	10.3	3.2	7.1
Ghana	11.4	1.2	10.2	14.8	0.5	14.2
Honduras	4.6	2.9	1.7	2.8	2.1	0.7
India	12.5	9.0	3.5	12.8	7.6	5.2
Jordan	2.8	5.5	-2.7	3.2	6.7	-3.5
Kenya	6.9	2.7	4.3	8.1	0.4	7.7
Korea, Rep.	12.1	11.7	0.4	10.1	14.5	-4.4
Lesotho	4.3	2.7	1.6	16.4	9.7	6.7
Madagascar	4.0	2.8	1.2	1.9	0.8	1.0
Malawi	1.8	-0.3	2.1	3.5	4.0	-0.4
Malaysia	15.7	10.5	5.2	15.3	9.7	5.6
Mali	5.6	6.5	-0.8	10.4	8.2	2.2
Mauritania	-2.4	3.1	-5.5	-1.8	4.4	-6.2
Mauritius	3.4	7.7	-4.3	5.7	7.6	-2.0
Mexico	10.5	8.7	1.9	14.3	10.1	4.3
Morocco	4.6	5.8	-1.2	6.3	5.5	0.8
Pakistan	5.7	2.9	2.8	8.0	7.8	0.1
Panama	8.3	0.7	7.6	5.2	0.5	4.7
Paraguay	14.3	8.1	6.3	3.7	9.7	-6.0
Philippines	7.0	5.8	1.2	6.4	6.6	-0.1
Senegal	2.6	1.2	1.4	8.3	1.8	6.4
South Africa	6.5	0.4	6.2	4.0	2.2	1.8
Tanzania	5.1	2.1	3.0	14.7	1.4	13.4
Thailand	10.7	9.7	1.0	10.3	12.0	-1.7
Tunisia	6.2	4.9	1.3	4.6	6.3	-1.6
Turkey	17.8	8.3	9.5	9.2	10.8	-1.7
Uruguay	12.0	1.8	10.2	6.3	4.6	1.6
Zambia	-2.0	-1.7	-0.3	5.3	-0.9	6.2
Total	6.9	4.6	2.4	6.9	5.8	1.1

Data Source: World Bank (2005)

TABLE A.5: DETERMINANTS OF IMPORTS GROWTH, INCLUDING TRADE LIBERALIZATION

Dependent Variable: Imports Growth	SGMM	Fixed Effects	DGMM
Log dependent variable t-1	-0.09	-0.10	-0.10
	0.00	0.00	0.00
Real GDP growth	0.69	0.69	0.68
	0.00	0.00	0.00
Real GDP growth t-1	0.22	0.21	0.20
	0.00	0.00	0.00
Change in relative price of imports	-0.01	-0.02	-0.01
	0.77	0.75	0.86
Change in relative price of imports t-1	-0.19	-0.20	-0.19
	0.00	0.00	0.00
Trade liberalization t, t+4 (World Bank, 2006)	0.08	0.07	0.09
	0.00	0.00	0.00
Constant	0.35	0.86	0.61
	1.44	-0.24	0.85
Observations	1,262	1,262	1,209

Notes: p-values below coefficients. Estimates based on System GMM, Fixed Effects, and Difference GMM regressions. Trade liberalization dummy based on identification of trade liberalization episodes in Wacziarg and Welch (2003), with a value of 1 the year of liberalization and three years after. Time trend variable included in all regressions. Data Source: UN COMTRADE database.

TABLE A. 6: CORRELATION BETWEEN EIL AND PREVIOUS ECONOMIC BEHAVIOR

	Correlation Coefficient
Imports Growth (-2,0)	0.1127
Real Exchange Rate Change (-2,0)	-0.2971
Terms of Trade Change (-2,0)	0.0133
GDP Growth (-2,0)	-0.1305
World Bank Structural Adjustment Program	-0.2646

Data Source: World Bank (2005) and World Bank (2006)

TABLE A.7: MAIN ECONOMIC AND SOCIAL INDICATORS BEFORE AND AFTER TRADE LIBERALIZATION

Variable	Obs	Mean	Std. Dev.	95% Conference Interval	
				Min	Max
Pre Liberalization (Years [-10,-1])					
General Indicators					
Gross National Income Per Capita (US$)	386	1043.73	827.97	150.86	3864.04
Inflation (% annual)	351	63.85	283.31	-6.87	3079.81
Fiscal Balance (% of GDP)	320	-4.67	4.44	-21.63	5.41
Growth in External Debt (% Annual)	359	10.25	21.33	-50.45	137.58
Current Account Balance (% of GDP)	377	-5.39	4.96	-29.75	9.44
Real Effective Exchange Rate (2000=100)	325	157.67	175.25	36.91	2211.44
Terms of Trade (2000=100)	335	110.66	31.86	57.47	313.39
Imports of Goods and Services (% of GDP)	385	29.27	16.13	2.98	97.20
Unweighted Average Tariffs (%)	159	33.73	21.52	6.00	107.00
Frequency of Non-Tariff (% of tariff lines)	72	44.32	30.09	1.70	96.10
Regression Variables					
Growth in GDP per Capita (% Annual)	390	0.18	4.83	-19.94	15.18
Investment (% of GDP)	385	19.89	6.72	3.15	45.38
Exports of Goods and Services (% of GDP)	385	23.90	13.93	3.14	98.20
Industrial Value Added (% of GDP)	375	27.79	9.64	6.25	52.48
Exports Concentration (Herfindahl-Hirschmann Index)	188	0.34	0.17	0.09	0.82
Manufacturing Exports (% of Merchandise Exports)	306	29.08	23.77	0.40	91.90
Post Liberalization (Years [1,10])					
General Indicators					
Gross National Income Per Capita (US$)	388	1691.85	1973.61	156.75	12207.86
Inflation (% annual)	383	27.68	152.92	-6.24	2075.89
Fiscal Balance (% of GDP)	279	-2.18	4.30	-30.72	5.27
Growth in External Debt (% Annual)	369	-1.30	14.66	-37.83	78.43
Current Account Balance (% of GDP)	356	-3.37	3.94	-17.62	14.80
Real Effective Exchange Rate (2000=100)	386	103.98	23.54	54.91	241.43
Terms of Trade (2000=100)	341	104.25	17.19	70.60	190.43
Imports of Goods and Services (% of GDP)	388	34.47	18.06	8.13	98.10
Unweighted Average Tariffs (%)	317	17.39	8.63	5.70	56.00
Frequency of Non-Tariff (% of tariff lines)	88	22.72	30.76	0.10	100.00
Regression Variables					
Growth in GDP per Capita (% Annual)	389	1.85	3.81	-15.43	15.11
	389	20.87	7.32	4.30	43.64
Exports of Goods and Services (% of GDP)	388	29.46	17.54	6.60	116.00
Industrial Value Added (% of GDP)	381	26.75	7.74	9.22	44.57
Exports Concentration (Herfindahl-Hirschmann Index)	316	0.31	0.17	0.08	0.85
Manufacturing Exports (% of Merchandise Exports)	350	40.58	27.76	0.21	98.80

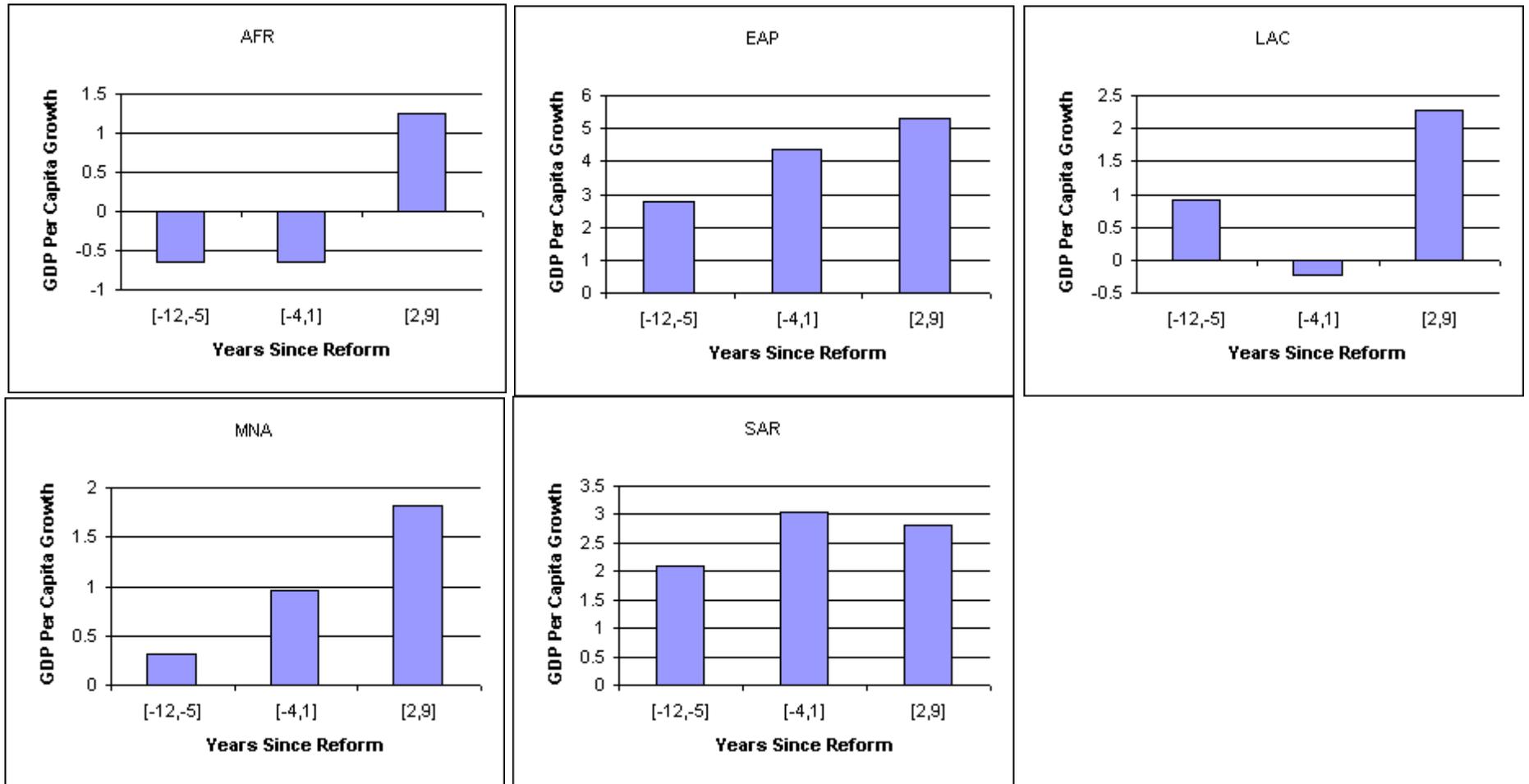Source: World Development Indicators (2006) and UNCTAD's Handbook of Statistics

FIGURE PANEL A.1: GDP PER CAPITA GROWTH BY COUNTRY SUBGROUP
(CONTINUED)