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Trade Facilitation and Economic Development

Measuring the Impact

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Abstract

Wilson, Mann, and Otsuki analyze the relationship between trade facilitation, trade flows, and GDP per capita in the Asia-Pacific region for the goods sector. They define and measure trade facilitation using four broad indicators. These are constructed using country-specific data for port efficiency, customs environment, regulatory environment, and electronic-business usage. They estimate the relationship between these indicators and trade flows using a gravity model. The model includes tariffs and other standard variables.

The authors find that enhanced port efficiency has a large and positive effect on trade. Regulatory barriers deter trade. The results also suggest that improvements in customs and greater electronic-business use significantly expands trade, but to a lesser degree than the effect of ports or regulations. The authors then estimate the benefits of specific trade facilitation efforts by quantifying differential improvement by members of the Asia Pacific Economic Cooperation (APEC) in these four areas. Based on a scenario in which APEC members below average improve capacity halfway to the average for all members, the authors find that intra-APEC trade could increase by $254 billion. This represents approximately a 21 percent increase in intra-APEC trade flows, about half coming from improved port efficiencies in the region. Using Dollar and Kraay's estimate of the effect of trade on per capita GDP, these improvements in trade facilitation suggest an increase in APEC average per capita GDP of 4.3 percent.

This paper—a product of Trade, Development Research Group—is part of a larger effort in the group to explore the link between trade and development. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Paulina Flewitt, room MC3-333, telephone 202-473-2724, fax 202-522-1159, email address pflewitt@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at jswilson@worldbank.org, clmann@iie.com, or totsuki@worldbank.org. March 2003. (43 pages)

Trade Facilitation and Economic Development:

Measuring the Impact

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Corresponding email: totsuki@worldbank.org. This paper is part of a series of research efforts to explore the link between trade facilitation and development at the World Bank. The study on *Trade Facilitation: A Development Perspective in the Asia-Pacific region (Wilson, et al 2002)* is part of this on-going initiative. The views expressed here are those of the authors and should not be attributed to the World Bank or the Institute for International Economics. The authors would like to thank Baishali Majumdar of the World Bank for assistance in producing the manuscript. Comments by Caroline Freund, Carsten Fink, and Bernard Hoekman on the work are also appreciated.

1. Introduction

The relationship between trade facilitation, trade flows, income growth, and human development is simple in theory, but complex and challenging in empirical design and estimation. Economic theory generates a relatively simple chain of causality: Human development is enhanced through income growth; Income growth is greater with more cross-border trade; Trade is increased through trade facilitation efforts. Empirical work has focused on quantifying each of these links in the chain: The human development index is positively related to Gross Domestic Product (GDP) per capita; Countries with a growing income have a higher GDP per capita; The positive relationship between trade and growth has come under scrutiny recently, but there is no evidence that increased cross-border trade *reduces* income growth. The focus of this paper is the last, or perhaps the first, link in the chain—the empirical relationship between trade facilitation and trade flows.

Trade facilitation, as used in general parlance, usually implies improved efficiency in the administration, procedures, and logistics at ports and customs. A broader definition includes streamlined regulatory environments, deeper harmonization of standards, and conformance to international regulations (Woo and Wilson 2000). Trade facilitation has become part of the policy debate inside countries, with donor agencies, and in negotiating forums.

What is the relative magnitude and complementarity of trade facilitation initiatives (narrowly or broadly defined) vis-à-vis reducing traditional trade barriers (such as tariffs and quotas)? In the context of their own development strategies, some countries on their own, or with donor assistance or public-private funding and partnership, are considering whether to engage in unilateral trade facilitation efforts and in what areas. At the Singapore Ministerial of the WTO (1996), trade facilitation was added to the new basket of trade issues. Preliminary discussions are focusing on what kind of capacity building projects and development assistance might best promote trade facilitation in the content of the Doha Development Agenda. Decisions on the modalities for negotiations on trade facilitation, including customs procedures, must be made at the Ministerial Conference of the WTO in Mexico in September 2003. Debate also continues about whether to extend the Information Technology Agreement to non-tariff measures and standards, as well as whether international standards should be mandated in national regulations. Informed discussion and policy-making on these questions have been impaired due to the lack of empirical measures of trade facilitation and of their impact on international commerce.

Three challenges face empirical research on the issue of trade facilitation: Defining and measuring trade facilitation; Choosing a modeling methodology to estimate the importance of trade facilitation for trade flows; Designing a scenario to estimate the effect of improved trade facilitation on trade flows. The research approach taken by this study contributes in each of the three areas. We explore the topic within the context of trade among members of the Asia Pacific Economic Cooperation (APEC), which account for about 57 percent of world GDP and about 47 percent of global trade.

First, we define and measure trade facilitation using several different indicators (port efficiency, customs environment, regulatory environment, and e-business usage) rather than proxy trade facilitation with a single parameter, such as import prices, international transportation costs, or productivity of the transport sector. Second, to model cross-border trade and to estimate the effect of trade facilitation on trade, we use a gravity model of bilateral trade flows rather than use a computable general equilibrium (CGE) approach. Third, the scenarios we explore to determine the benefits of improved trade facilitation do not assume that all countries improve procedures and capacity to support trade flows by the same amount. Rather our simulation exercise acknowledges that some countries have further to go to reach best practice in regulatory reform or port efficiency, for example, than do others.

This paper is organized as follows. Section 2 reviews definitions of trade facilitation and previous efforts to measure the impact of its improvement on trade. Section 3 discusses the data. Section 4 develops the methodology used in this study and presents the results from the empirical model used to estimate the relationship between bilateral trade flows and country-specific trade facilitation measures. Section 5 offers simulation exercises that explore the consequences of improving trade facilitation measures for APEC as a whole, for individual countries as exporters to all of APEC, and for individual countries as importers from APEC. Section 6 concludes.

2. Overview of Previous Work

2.1 Definition of Trade Facilitation

There is no standard definition of trade facilitation in public policy discourse. In a narrow sense, trade facilitation efforts simply address the logistics of moving goods through ports or more efficiently moving documentation associated with cross-border trade. In recent years, the definition has been broadened to include the environment in which trade transactions take place, to include transparency and professionalism of customs and regulatory environments, as well as harmonization of standards and conformance to international or regional regulations. These move the focus of trade facilitation efforts inside the border to "domestic" policies and institutional structures where capacity building can play an important role. In addition, the rapid integration of networked information technology into trade means that modern definitions of trade facilitation need to encompass a technological concept as well. Table 1 reproduces definitions of trade facilitation drawing from various international organizations to show the evolving definition of trade facilitation.

In light of this broadening definition of trade facilitation our definition of trade facilitation will incorporate relatively concrete "border" elements such as port efficiency and customs administration and "inside the border" elements such as domestic regulatory environment and the infrastructure to enable e-business usage.

2.2 Measuring the Impact of Trade Facilitation

The empirical literature on trade facilitation is limited. Maskus, Wilson, and Otsuki (2001) address some of the more important empirical methods and challenges in quantifying the gains of trade facilitation in the area of harmonized regulations. The Asia Pacific Foundation of Canada (1999) outlines the relative importance of the three kinds of trade facilitation measures (customs, standards and regulatory conformance, and business mobility) for APEC business but does not assess the impact on APEC trade of trade facilitation improvements. Australian Department of Foreign Affairs and Trade and Chinese Ministry of Foreign Trade and Economic Cooperation (2001) suggests that moving to electronic documentation for trade would yield a cost savings of some "1.5 to 15 percent of the landed cost of an imported item." If a simple average of a 3 percent reduction in landed costs were applied to intra-APEC merchandise trade, the gross savings from electronic documentation could be US$60 billion.[1] The Organization for Economic Cooperation and Development (OECD) summarizes other available studies, most of which are limited in their definition of trade facilitation or use data that are quite old.[2]

Several recent studies use CGE models to quantify the benefits of improved trade facilitation. In CGE models an improvement in trade facilitation can be modeled equivalently as a reduction in the costs of international trade or as an improvement in the productivity of the

[1] See Paperless Trading: Benefits to APEC (2001), page 18.
[2] See OECD TD/TC/WP(2001)21/FINAL

international transportation sector. Since this sector is already included in the CGE model, the effect of improved trade facilitation comes from "shocking" the sector by an appropriate amount.

UNCTAD (2001) uses CGE analysis to consider trade facilitation in the broader context of creating an environment conducive to developing e-commerce usage and applications. The objective of the CGE analysis is to consider the relationship between a given size shock to productivity growth, applied equally to all members of the group, on GDP of regional groups of countries. These results show that a 1 percent reduction in the cost of maritime and air transport services could increase Asian GDP some US$3.3 billion.[3] If trade facilitation is considered in a broader sense to include an improvement in wholesale and retail trade services, an additional US$3.6 billion could be gained by a 1 percent improvement in the productivity of that sector.

APEC (1999) also uses CGE analysis. The "shock" reduction in trade costs from trade facilitation efforts differs by members of the group: "1 percent of import prices ... for the industrial countries and the newly industrializing countries of Korea, Chinese Taipei and Singapore, and 2 percent for the other developing countries."[4] The Report estimates that APEC merchandise exports would increase by 3.3 percent from the trade facilitation effort to reduce costs. In comparison, the long-run increase in merchandise trade from completing Uruguay Round commitments is estimated in this model to increase APEC merchandise exports by 7.9 percent.

Hertel, Walmsley and Itakura (2001) use CGE analysis to quantify the impact on trade of greater standards harmonization for e-business and automating customs procedures between Japan and Singapore. They find these reforms will increase trade flows between these countries as well as their trade flows with the rest of the world.

Other research addresses specific aspects of the trade facilitation agenda and use the gravity model analysis. Freund and Weinhold (2000) apply a gravity model to estimate the role of e-commerce in promoting bilateral trade. They find that a 10 percent increase in the relative number of web hosts in one country would have increased by one percent trade flows in 1998 and 1999. Fink, Mattoo and Neagu (mimeo) apply a gravity model to estimate the effect of the communication costs on bilateral trade. They find that a 10 percent decrease in the bilateral calling price is associated with an 8 percent increase in bilateral trade. Moenius (2000) applies a gravity model to estimate the effect of bilaterally shared and country-specific standards on goods trade. He finds that the bilaterally shared standards can promote trade. Otsuki, Wilson and Sewadeh (2001a, 2001b) apply a gravity model to the case of food safety standards, finding that African export of cereals, nuts and dried fruits will decline by 4.3 (cereals) and 11 (nuts and dried fruits) percent with a 10 percent tighter EU standard on aflatoxin contamination levels of these products.

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[3] See UNCTAD, E-Commerce and Development Report 2001, table 8, page 33.

[4] Assessing APEC Trade Liberalization and Facilitation: 1999 Update, Economic Committee, September 1999, page11.

We will use the gravity model of bilateral trade in the region, and will incorporate a richer set of indicators of trade facilitation as well as include tariffs to see which of these factors might have a greater effect on trade flows in APEC.

3. Data in This Study

3.1 Data to Measure Trade Facilitation

The greatest challenge to new research on the issue of trade facilitation is to find conceptually distinct measures of trade facilitation that better meet policymakers needs for specificity on how to approach trade facilitation efforts. Should they focus on ports, on customs reforms, on international regulatory harmonization, or e-commerce? Of course there are synergies among these various reforms, but limited resources mean that not all can be tackled at once. Previous efforts that proxy trade facilitation with import prices or transportation costs cannot provide this link to policies or projects that decision-makers need. Accordingly, we derive indicators of trade facilitation that measure these four different approaches to trade facilitation.

Specifically, our analysis includes four indicators of trade facilitation that measure four different categories of trade facilitation effort:

1. Port efficiency,
2. Customs Environment,
3. Own regulatory environment, and
4. E-business usage.

'Port efficiency' is designed to measure the quality of infrastructure of maritime and air ports. 'Customs environment' is designed to measure direct customs costs as well as administrative transparency of customs and border crossings. 'Regulatory Environment' is designed to measure the economy's approach to regulations. 'E-Business Usage' is designed to measure the extent to which an economy has the necessary domestic infrastructure (such as telecommunications, financial intermediaries, and logistics firms) and is using networked information to improve efficiency and to transform activities to enhance economic activity.[5]

Each of these indicators is generated from data specific to each APEC economy. Thus, empirical estimation aside, these indicators help policymakers judge how their economy stacks-up relative to APEC's best practice in each of these four areas. Between these self assessments against best practice and estimation results on the effect of these four trade facilitation indicators on trade flows, substantially more information is available to policymakers about what might be the most fruitful direction for reform, capacity building, and negotiation.

[5] For further discussion of the relationship between domestic infrastructure and e-commerce, see Mann, Eckert, and Knight.

In order to generate the trade facilitation indicators we rely heavily on survey information. Our sources include: World Economic Forum Global Competitiveness Report (henceforth GCR). IMD Lausanne, World Competitiveness Yearbook, (henceforth WCY), Transparency International, and Micco, Ximena and Dollar (2001), Maritime Transport Costs and Port Efficiency, World Bank Group (henceforth MXD). See the Appendix for a more complete description of these sources and their methodology for collecting and preparing data about a country.

We turn to survey data because there are no other empirical data available on a consistent basis for all of the APEC members. Some APEC members have done empirical studies of, say, improvements in customs costs or release-times from customs warehouses. But, we cannot assume that gains obtained, for example, by Singapore would equally be enjoyed by Vietnam. Indeed, the objective of our research is to distinguish Singapore and Vietnam in their need for capacity building or pilot projects in the various trade facilitation areas.

Nor is there much hard data available on the conceptual basis relevant for the trade facilitation analysis. We need consistent country-specific assessments of port efficiency, customs environment, regulatory environment, and e-business usage. We deploy survey data in our analysis because it is available for the range of trade facilitation indictors that we wish to examine. While such survey data must clearly be used with caution and checked across alternative sources for similar proxies, it offers the potential for cross-country quantitative policy analysis.

3.2 Generating Trade Facilitation Indicators

Our approach to generating the four trade facilitation indicators "over-samples" the survey data so as to reduce dependence on any one source or survey response. That is, each of the four trade facilitation indicators is constructed with multiple data inputs. We can analyze the inputs to gain even greater information about the trade facilitation measures, both for an individual economy and across the APEC region.

The first step in the construction of each of the four trade facilitation indicators is to put all the original data on a comparable basis. This is necessary since some of the data are actual values, some come from surveys where responses can range from 1 to 7, and others from surveys that range from 1 to 10, and so on. To put all original or "raw" data on a comparable basis, each observation of a raw series (which is an observation representing an APEC member) is indexed to the average of all the APEC members' value for the raw series. That is, each individual APEC-member data point is indexed to the average of all APEC members' data points. Each of these indexed-series we shall call an "indexed input."

So an "indexed input" for APEC member J (J=1,2, .. , 19)[6] is constructed as:

[6] Data for Papua New Guinea and Brunei Darussalam were universally unavailable.

$\overline{II}_J = II_J / (\sum_{J=1}^{19} II_J / 19)$ where II_J denotes the "raw" data for APEC member J.

The next step in creating the trade facilitation indictors involves averaging the indexed inputs into the four specific trade facilitation indicators. A simple average of the indexed inputs is used for transparency of method, and also because there is no specific argument (theoretical or statistical) to choose a different aggregation method.[7] The various raw data series were chosen because of their relevance to the four concepts of trade facilitation. Details of the questions underpinning each of the indexed inputs is in the Data Appendix.

- "Port efficiency" for each APEC member J is the average of three indexed inputs:
  - Port Efficiency Index (MDX).
  - Port facilities and inland waterways (GCR)
  - Air transport (GCR)

- "Customs environment" for each APEC member J is the average of five indexed inputs :
  - Irregular payments (GCR)
  - Import fees are low (GCR)
  - Hidden import barriers (GCR)
  - Bribery and corruption (WCY)
  - Corruption Perceptions Index (Transparency International)

- "Regulatory environment" for each APEC member J is constructed as the average of four indexed inputs (all GCR):
  - Transparency and stability of environmental regulations (GCR)
  - Stringency of regulatory standards (GCR)
  - Compliance with international environmental agreements (GCR)
  - Enforcement of environmental regulation (GCR)

- "E-business" for each APEC member J is from GCR:
  - "Percentage of companies that use the Internet for e-commerce"

Examining the indexed inputs that are averaged to generate the trade facilitation indicators is informative for several reasons. First, summary statistics on the indexed inputs and the aggregated indicators points out the countries with best practice, worst practice, as well as the range between best and worst practice (Table 2). This range and the countries involved will be important later when building the scenarios on benefits of trade facilitation, and for considering

[7] The statistical properties of the trade facilitation indicators may require further consideration. The original or raw data come from different metrics (percent, survey ranges from 1 to 7 or 1 to 10, numbers of users, etc) So, the standard deviations around the mean of each of these indicators will differ from the standard deviation of the indexed inputs that they become. When averaged into the trade facilitation indicator, the standard deviation of the final product and its relationship to the standard deviation of the original data is unclear. The implication of this for using the trade facilitation indicators for estimation in the gravity model is also unclear.

which areas of trade facilitation might be most fruitful for a country or for APEC as a whole to consider for policy attention.

Second, correlation matrixes of the indexed inputs into the average help determine how well the "over-sampling" of indexed inputs works to reduce dependency on a single source or raw data input while still measuring the relevant trade facilitation concept. Table 3 shows that, within each of the trade facilitation concept, the correlation of the indexed inputs that are its components is high—above 0.85—suggesting robustness of the trade facilitation indicator as to source of the information and raising confidence that it is correctly assessing the APEC member on that particular indicator of trade facilitation.

Finally, Figures 1 to 4 (one for each trade facilitation indicator) shows all the indexed inputs for all of the APEC members for each specific trade facilitation indicator. These figures are useful both for self-assessment as well as for another perspective on the validity of the averaging technique to create the trade facilitation indicator. APEC members are ordered by real GDP per capita on the vertical axis. Each indexed input is represented by a horizontal bar. The vertical line at 1.0 represents the APEC average for that indexed input. If a bar extends beyond 1.0, that indexed input for that country represents a condition superior to the APEC average. If a bar extends to less than 1.0, that indexed input for that country represents a condition that does not meet the APEC average. Countries can see how they stack up against the APEC average along a range of measures.

The Figures also help assess the validity of the averaging technique. The correlations discussed above measure the *cross-economy correlations of the indexed inputs* that are used to create each trade facilitation measure. But, we might also want to know what are the *similarities of the indexed inputs within an economy*. To the extent that the lengths of the indexed input bars for an economy are more similar to each other, rather than similar to bars from another economy, then this supports the notion that the dominant variation in the indexed inputs is across countries, not within countries. It is the dominance of variation of the trade facilitation indicators across countries that is important in the estimation.

3.3 Trade Flows and Other Variables

We use bilateral trade flow data available at the Commodity and Trade Database (COMTRADE) of the United Nations Statistics Division. Our definition of manufacturing goods covers commodities in categories 5 to 8 in SITC 1 digit industry except those in category 68 (non-ferrous metals) in SITC 2 digit industry.[8] The data on Gross National Product (GNP) and per capita GNP were derived from the World Development Indicators published by the World Bank. Our tariff data were derived from the Trade Analysis and Information System (TRAINS) of the United Nations Conference on Trade and Development (UNCTAD). We use the weighted average of applied tariff rates where bilateral trade values are used as the weight. Applied tariff records are considerably sparse. In order to avoid a significant loss of observations, we linearly

[8] Standard International Trade Classification. Revision 1 is used for our definition.

interpolate or extrapolate the applied rates over the period 1989-2000 for a given pair of importing and exporting countries when records for at least two years are available.

4. The Econometric Model and Results

The gravity model of international trade flows is a common approach to modeling bilateral trade flows. Initially more of an empirical success than having a theoretical pedigree, it now is enjoying a resurgence of interest given its natural kinship with current interests in the relationship between geography and trade. The gravity model was first developed by Tinbergen (1962) and Pöyhönen (1963) to explain bilateral trade flows by trading partners' GNP and geographical distance between countries. Recent theoretical and empirical work supporting this modeling approach includes Evenett and Keller (1998), Feenstra, Markusen and Rose (1998), and Frankel (1997). Other factors beside GDP and distance are relevant for bilateral trade, including for example, population, GDP per capita (to account for intra-industry trade effects that may be associated with countries of similar incomes but varied tastes), regional trade arrangements, and language/ethnic similarities.

Some studies attempt to add additional structural elements to the gravity model to better reflect real world observations. These mainly concern the heterogeneity of traded goods in quality and price by origin, and price differentials associated with border and transportation costs. Anderson (1979) develops a gravity model in line with a general equilibrium framework. He incorporates into a gravity model consumers' preferences over goods that are differentiated by region of origin, assuming the constant elasticity of substitution (CES) structure on consumers' preferences. Anderson and von Wincoop (2001) additionally introduce the border costs as premiums on the export prices. Balistreri and Hillberry (2001) further extend the results of the Anderson and von Wincoop's gravity model to estimate the transport and border costs separately by distinguishing consumers' and producers' price indices. Using a rather standard specification of the gravity model, Otsuki, Wilson and Sewadeh (2001a, 2001b) control for differences in the prices and unobservable factors that are specific to exporting countries by allowing fixed-effects for exporting countries. While somewhat crude, such a model is less data demanding, and more applicable for developing countries whose price data are less reliable and complete.

In our model, the key economic variables of the gravity model such as Gross National Product (GNP) and the geographical distance between corresponding pair of importing and exporting countries are used. In the general specification of the gravity model, the logarithm of bilateral trade flows in real value is regressed on logarithms of GNP of the exporters and the importers, of geographical distance between each pair of importers and exporters, and other variables that can account for the rest of the variation (Maskus, Wilson and Otsuki 2001). Our model employs the specification of the exporter-specific fixed-effects developed in Otsuki, Wilson and Sewadeh (2001a, 2001b).

The trade data used here is bilateral trade flow of manufacturing goods among APEC member nations from 1989 to 2000. In the context of this research report, we augment the standard gravity model specification with the various indicators of trade facilitation.

4.1 The Gravity Model Analysis

Using a standard gravity model as reviewed above, the basic structure of our specific gravity equation is the following:

$$ln(V_{IJ}^t) = b_1 ln(100+TARIFF_{IJ}^t) + b_2 lnPE_I + b_3 lnCE_I + b_4 lnRE_I + b_5 lnEB_I + b_6 ln(GNP_I^t)$$

$$+b_7 ln(GNP_J^t) + b_8 ln(GNPPC_I^t) + b_9 ln(GNPPC_J^t) + b_{10} ln(DIST_{IJ}) + b_{11} D_{NAFTA} + b_{12} D_{ASEAN}$$

$$+ b_{13} D_{LAIA} + b_{14} D_{ENG} + b_{15} D_{CHN} + b_{16} D_{SPN} + b_{17} D_{ADJ} + \alpha_J + \varepsilon_{JI}' \quad (1)$$

where I and J stand for the exporter and importer respectively, and t denotes trading years (t=1989, ..., 2000). The value of manufactures exports from country J to I is denoted as V_{IJ}. The term $TARIFF_{IJ}^t$ denotes applied tariff rate in the percent ad valorem term that is specific to the trading partners I and J and year t. The inclusion of the tariff variable is useful for reducing omitted variable biases. It is particularly important for APEC since, unlike the EU whose tariff policies are harmonized, applied tariff rates generally vary across the member countries and possibly across their exporting partners.

The terms PE_I, CE_I, RE_I and EB_I denote importing country I's indicators of port efficiency, customs environment, regulatory environment, and e-business usage. The term GNP denotes gross national product and $GNPPC$ denotes per capita GNP, where both are expressed in 1995 US dollar terms. Geographical distance between capital cities I and J is denoted as $DIST_{IJ}$. Dummy variables are included to capture the effect of preferential trade arrangements, language similarity and adjacency. The trade arrangements dummies include NAFTA (D_{NAFTA}), ASEAN (D_{ASEAN}), and LAIA (D_{LAIA}). The language dummies include English (D_{ENG}), Chinese (D_{CHN}), and Spanish language (D_{SPN}). The adjacency dummy D_{ADJ} takes the value of one if country I is adjacent to country J and zero otherwise.

Parameter b's are coefficients. The time invariant term α_J is the exporter-specific intercept that captures the exporter-specific fixed-effects such as variation of trade flows due to the unobserved difference in quality of goods, domestic policies and border costs in exporting countries. The term ε_{JI}' is the error term that is assumed to be normally distributed with mean zero. Table 4 shows the variable names and expected signs for the four trade facilitation measures.

Table 5 shows the simple correlations among the included variables. Three of the trade facilitation variables (ports, customs, regulatory) are rather highly correlated with each other and

rather highly correlated with per capita income of the importer. This is to be expected, first because the trade facilitation indicators are different facets of overall trade facilitation and second because some of the elements of trade facilitation (administrative transparency, available resources to build quality ports, and so on) are more prevalent in higher income economies. The correlations for e-business are much lower (0.5), both against the other trade facilitation measures and against per capital income of the importer.

4.2 Regression Results

Table 6 displays regression results. The approach used here to generate a set of distinct trade facilitation indicators and deploy them in a gravity model of trade is generally successful. The coefficients for the four trade facilitation measures are generally significant and all are of the expected sign. The estimated coefficients differ for the different trade facilitation indicators. From a policy perspective, these differences in estimated elasticities of trade flows with respect to trade facilitation indicator implies that different approaches to trade facilitation will differentially affect exports of individual countries and of the APEC region as a whole. Figure 5 illustrates the relative effectiveness of a one percent of increase in each measure (a one percent of decrease in the regulatory environment measure) on the increase in intra-APEC manufactures trade in percentage.[9]

Overall, our analysis reveals that trade facilitation involves more than reducing the cost of transportation—although this factor is quite important. These results indicate that other empirical research on quantifying the benefits of trade facilitation that used transport costs as a proxy for trade facilitation likely underestimated the elasticity of trade with respect to broad trade facilitation efforts. This is an important first consideration for policymakers as they consider trade and development priorities in the future.

Tariffs have a significant and negative effect on intra-APEC manufactures as expected, as does distance. The coefficients on these two variables are both about 0.7 (slightly higher for customs and slightly lower for distance). These figures are useful benchmarks against which to compare the coefficients on the trade facilitation indicators.

'Port efficiency' has the largest elasticity among the trade facilitation indicators, about 4.2. This suggests that the greatest gains to intra-APEC manufactures trade would come from improvements in this trade facilitation area. An elasticity of trade with respect to port functions of this magnitude is supported by internal analyses reported by Hong Kong, China; and Japan as presented in a Trade Facilitation Seminar held in Bangkok, Thailand (August 2002). Fink, Mattoo and Neagu (2002) also support this finding in the context of maritime-based trade. In some sense, the fact that trade is most elastic with respect to direct border costs in comparison to indirect costs should not be a surprise.

[9] We set the some of the increased trade flows associated with a one-percent increase in each measure to be 100 percent, for the comparison purpose.

'Customs environment' is positively associated with intra-APEC manufactures trade. The coefficient is not large (0.42), about one-half the magnitude of the tariff and distance elasticity and one-tenth the size of the port efficiency indicator. Equal sized improvements in the 'Customs environment' will complement port improvement, but the additional effect of customs improvement would be relatively small overall. On the other hand, improvements in customs can make up for less improvement in tariff barriers. Moreover, the range of potential for country performance in the area of customs is large (for example, Russia and Indonesia in Table 2), suggesting that there may be opportunities for great improvements in this area compared to improvements in the ports indicator. This greater potential for improvement in customs in some countries should raise the profile of this trade facilitation indicator in policy discussion in those countries.

'Regulatory environment' has a negative and significant effect on intra-APEC manufactures trade as expected with a coefficient of (-1.56). To the extent that regulatory barriers are used as alternatives to border barriers, reducing these regulations will be positively associated with trade. The higher coefficient than for tariffs is consistent with the relatively more costly consequences for trade of non-market barriers to trade. The large absolute value of the coefficient points out that tightening regulations can offset improvements in other trade facilitation measures.

'E-business usage' has a positive and significant effect on intra-APEC manufactures trade. The coefficient is about the size of the tariff and distance coefficients (0.63) suggesting that the benefits of having facilitating domestic infrastructures and increasing engagement in e-commerce are as large as for trade liberalization. Moreover, the range of performance on this measure of trade facilitation among APEC members is the largest among the trade facilitation indicators (Table 2). So, the opportunities for increased trade from improvements in this measure of trade facilitation could be quite large. These results are consistent with the findings in Fink, Matoo, and Neagu, and in Freund and Weinhold that good telecommunications and greater access to the Internet could increase bilateral trade flows. These results would tend to support efforts within APEC to enhance e-commerce usage through the e-APEC Strategy and Paperless Trading initiatives.

4.3 Endogeneity between Trade and Trade Facilitation Measures

Cross-section regression analysis inevitably faces the problem of an ambiguous causal relationship and the use of a single-year set of trade facilitation measures limits our interpretation of the coefficients as elasticities. We cannot exclude the possibility that greater bilateral trade will lead to higher values of trade facilitation measures rather than the postulated reverse relationship as estimated. Port efficiency, customs environment and e-business usage may improve with a country's import flows and the estimated coefficients for these variables would be biased upwards if this endogeneity is present. A logical approach to the endogeneity problem is (1) to employ instrumental variables for the trade facilitation variables so the error term does not correlate with trade facilitation measures, and/or (2) to extend the trade facilitation data to multiple year series and to use time-lagged measures of trade facilitation as explanatory variables.

The first approach requires instrumental variables that are exogenous to the trade facilitation measures and trade flow. But such instruments are difficult to find in practice and the power of such instruments is always an issue. Moreover, the endogeneity problem remains if instruments that best account for the state of trade facilitation are also likely to be dependent on trade flows. Use of instruments is consequently not an effective solution to the endogeneity problem.

Unfortunately, time series are unavailable for most of our raw inputs to trade facilitation measures. But the second approach still can be implemented partially by investigating the model specification using the few raw inputs that are time variant. Data on 'port facilities and inland waterways', 'air transport' and 'bribery and corruption' are available for a limited time period, from 1996 to 2000. The first two are inputs to our 'Port efficiency' and the third is an input to our 'Customs environment'. There are no time series for inputs to the 'Regulatory environment' or 'E-business' measures.

We approach investigating the issue of endogeneity as follows: First, we reconstruct a time-series of 'Port efficiency' using the same method as detailed in Section 3.2 except we use only the raw inputs that are available in time series: 'port facilities and inland waterways' and 'air transport'. We do similarly to reconstruct a time series for the 'Customs environment' measure using just 'bribery and corruption'.

Second, we re-estimate the model specification using these two time-series indicators, both with and without the other two indicators of trade facilitation (to investigate specification bias) and with lagged values of the measures that are available in time series (to investigate endogeneity bias). (Table 7). In our new regressions, the reconstructed 'Port efficiency' and 'Customs environment' measures replace the previous ones in Equation (1). First, these variables are included with and without the 'Regulatory environment' and 'E-business' measures (Models I and II, respectively). The 'Port efficiency' and 'Customs environment' variables are then time-lagged by one year so that the causal relationship is better isolated (Models III and IV). The inclusion of 'Regulatory environment' and 'E-business' may introduce measurement errors since they are time-invariant. On the other hand leaving out these measures could contribute to omitted variable biases. Out of our entire sample, observations from 1996 to 2000 are used for Models I and II, and those from 1997 to 2000 are used for Models III and IV.

Comparing the results of Models I and II suggests that the coefficients for 'Port efficiency' and 'Customs environment', will be biased if the other two trade facilitation measures are omitted. On the other hand, comparing Models I and III, as well as Models II and IV, indicates that the coefficients for the time-lagged 'Port efficiency' and 'Customs environment' are close to those for the unlagged measures. Endogeneity bias between these measures and trade would tend to bias upward the coefficients. These results of the alternative models indicates that endogeneity bias is not present for 'Port efficiency' and 'Customs environment'.

In sum, the original specification of the model and using time-invariant measures of trade facilitation receives support. So, the policy simulations in the next section are based on the regression model in Equation (1). A further advantage of using this model over the alternative models with time-variant trade facilitation measures is that it includes the full sample period 1989-2000 which improves the preciseness of the estimated coefficients.

5. Potential Benefits From Trade Facilitation: Simulation Results

5.1 Simulation Design

The gravity model approach allows us to consider how much trade in the APEC region might be increased under various scenarios of "improved" trade facilitation and/or tariff reduction. We will examine scenarios that focus on improved port efficiency, improved customs environment, improved e-business usage, and regulatory harmonization. Our objective in the simulations is to help inform policymakers on which specific trade facilitation initiatives might have the greatest potential to increase trade and economic well-being.

Our simulations using the gravity model and the trade facilitation indicators can give us three perspectives on trade facilitation in APEC. First, the simulations allow us to analyze the implications of different trade facilitation initiatives for *intra-APEC trade as a whole*. Second, the simulations allow us to examine an *individual APEC member's exports* to other APEC members (bilaterally and total). Finally, we can use the simulations to *proxy for the costs* suffered by businesses and consumers in an individual APEC member when their own trade facilitation indicators are below APEC best practice.

One possible simulation design is one where all APEC members improve trade facilitation measures by a given percentage. This is analogous (although using the broader set of trade facilitation indicators) to the CGE analysis wherein all economies have a one percent reduction in transportation costs. But, some countries are already at best practice, where others are far from the APEC average. The simulation methodology of applying a common percentage improvement to each trade facilitation indicator implies that even an economy that is already using best practice will also have to improve. Our simulation approach acknowledges the differential potential for improvement revealed by Table 2.

To better tailor the simulation exercise to inform policy decisions on what kind of trade facilitation initiative might yield the greatest improvements in trade, we examine the metric of bringing the *below-average* members *half-way* to the APEC average. We focus on the *below-average* APEC member on the grounds that donor attention and capacity building efforts should be extended to this group. It is not that the country with the best practice should not try to do better; it is just that limited multilateral resources are not best utilized there. We choose an improvement of *half-way* to the APEC average because there are limited development resources and improvements take time. Dramatic improvements are possible, but it is not realistic to presume a scenario whereby all APEC members are assumed to achieve best practice as

measured by the APEC member with the highest score on a particular measure of trade facilitation.

Therefore, the countries for which we will simulate an improvement in trade facilitation will differ by the trade facilitation indicator. However, because trade facilitation links exporters and importers, all economies enjoy and increase in intra-APEC trade even when only some have an improvement in their trade facilitation indicator. Consider the following example for Chile and New Zealand. Chile is an economy that is 'below average' for ports efficiency and the scenario for improvement in port efficiency will increase the trade facilitation indicator for Chile half-way to the APEC average. But, Chile is above-average for customs environment, so no improvement is postulated for Chile in the scenario of improved trade facilitation indicator of customs environment. New Zealand has above-average trade facilitation indicators for all except e-business usage. Thus, only when we run a scenario of improved e-business will the trade facilitation indicator for New Zealand be "improved." However since Chile and New Zealand trade with each other in APEC, when Chile improves its ports, New Zealand gains. And when New Zealand improves its e-business usage, Chile gains.

We run a simulation given the rule (bring the below-APEC-average members half-way to the initial APEC-average) for 'port logistics,' 'customs environment,' and 'e-business usage.' We run a different simulation for the 'regulatory environment.' Research (Moenius, and Hertel, Walmsley and Itakura) suggest that standards harmonization increases trade. Therefore, our simulation brings the above-average members half-way down to the APEC average as a proxy for how relaxing regulatory barriers will increase trade. At the same time, we bring the below-average members half-way up to the APEC average as a proxy for how standards harmoization aids trade.

As background for these scenarios, Table 8 gives the range of values for these trade facilitation indicators, as well as the economy that represents "best practice" and therefore whose indicator value is greatest. It is worthwhile to note that the 'best practice' economy is not the same for all of the trade facilitation measures considered. Second, it is worthwhile to note that the range between lowest value and highest value is significantly greater for e-business usage and customs environment, and narrower for port efficiency and regulatory environment.

Table 9 summarizes the results for the simulations and presents the results for intra-APEC trade as a whole. In total, for APEC as a whole, the collection of simulations yield an increase in intra-APEC trade worth about $250 billion dollars. This is an increase of about 21 percent in total intra-APEC manufactures trade. About $117 billion of the total gain (and 10 percent of the increase in trade) comes from the improvement in port efficiency. About $139 billion of the total gain comes from the improvements "at the border" in port efficiency and customs environment. Another $116 might come from improvements "inside the border" in regulatory harmonization and e-business usage.

The large increase in intra-APEC trade derived from improved 'port efficiency' is partly because of the large coefficient on the relationship between trade and port logistics (4.2 ; see

Table 6), and partly because countries such as Mexico and particularly China are very large intra-APEC traders and have much room for improvement in the area of port logistics (this can be seen by examining the country detail for "Port Efficiency Scenario—Experience of Importers). In terms of the distribution of the export gains, large APEC exporters such as the US, Japan, and Korea would see the greatest increase in dollar terms ($38 billion, $22 billion, and $9 billion respectively). But many APEC countries (Russia, Hong Kong, China; Chile, Chinese Taipei,) would see large double-digit increase in exports to the APEC region (36%, 28%, 20%, 15%, respectively).

Based on these scenarios, the attention devoted by policymakers to improvements in port efficiency appears productive. According to these scenarios, improvements to port efficiency by below-average APEC members could have the greatest impact on intra-APEC trade. In contrast, though, based on the overview of the trade facilitation measures (Table 8) the *room for improvement* is relatively small for port logistics. That is, the range of the port logistics indicator from best practice to worst practice is smaller than other trade facilitation indicators that are the focus of this analysis. Hence, there may be countries where port efficiency is not the principal bottleneck to their trade.

Individual APEC members differ in terms of which trade facilitation measures are above and below the APEC average. Moreover, each APEC member has a unique trade pattern with other members of APEC. It is useful to consider, therefore, the simulation output for individual APEC members. The simulated change in bilateral trade flows associated with the simulation for port efficiency, customs environment, e-business, and regulatory harmonization are presented for APEC members as exporters and as importers in Tables 10 to 13. From the exporters' perspective, the gains in exports for any individual economy will depend on which countries within APEC the economy trades with and how much improvement is achieved by those trading partners under that particular trade facilitation scenario. From the importers' perspective, efficiency gains (which are measured as increased imports) depend only on unilateral trade facilitation efforts of the economy itself. They are, therefore, are presented only for those APEC members who start below the APEC average in that particular trade facilitation measure.

Examining these more detailed tables can help inform policy makers where the greatest gains from trade facilitation initiatives might lie for them--It might not lie with the APEC general result! For example, Thailand's port efficiency indicator is near to the APEC average. A small improvement (which would still cost resources) to the APEC average would increase Thailand's imports by some $4.4 billion. But, Thailand's customs environment and e-business usage are much further away from the APEC average. An improvement half-way to the APEC average in customs environment would increase Thailand's imports by $2.4 billion. If the cost of improving customs is much less than improving port efficiency, then the net gain of focussing the policy effort on customs might make more sense than focussing attention on port efficiency. On the other hand, an improvement half-way to the APEC average in e-business usage would increase Thailand's imports $7.9 billion, nearly fifty percent more than the 'border' measures taken together. Therefore, Thai policymaker might want to consider policies that would enable higher e-business usage. Proceeding on a policy plan to use e-business techniques to improve

customs (as in the Paperless Trading initiative) would improve both of these trade facilitation indicators yielding big gains compared to with following the focus on ports based on the overall APEC results. This example shows careful attention not only to the estimated coefficient of trade with respect to trade facilitation indicator, but also to where an economy ranks in the range of APEC economies may point to which trade facilitation indicator might be the best target for policy effort.

5.2 Tariff Reduction versus Trade Facilitation

The regression results also enable us to compare the potential trade gains from improvements in trade facilitation with that from tariff reductions. The estimated coefficients point to trade-offs between trade facilitation measures and tariff reduction. Reducing tariffs to zero is used as the benchmark against which to evaluate what equi-proportionate improvement in the trade facilitation indicator would generate the same amount of gain in total intra-APEC exports. A separate calculation is done for each trade facilitation indicator. The results are presented in Table 14.

The average reduction in the applied tariff rates in the ad valorem term is 6.5 percent in order to remove all tariffs on manufactures in all APEC members. The total gain in trade flows in APEC countries would be $27.8 billion from this reform. To achieve the same increase in intra-APEC trade, the Port Efficiency indicator needs to be improved by 0.55 percent from the previous levels of all members. The Customs Environment indicator would have to be improved by 5.5 percent for all APEC members equally, and the E-business indicator would have to be improved by 3.7 percent to generate, each on their own, an increase in trade equal to complete elimination of tariffs.

In overall, it seems the required improvement in trade facilitation indicators are relatively small compared to the tariff reduction. In particular, the improvement in port efficiency to generate a similar trade gain is far smaller. This implies that improvements in trade facilitation measures can be a good policy alternative to tariff reduction if the latter is not feasible. [10]

5.3 Implications for GDP per capita

How trade facilitation contributes to a country's development is also of great interest to policy makers. While our previous analysis does not provide a direct read-out on a country's development, Dollar and Kraay (2001)'s cross-country study on the link between trade and per capita GDP can be used to indirectly calculate the effect of trade facilitation on per capita GDP. The following calculation is based on the "halfway to average" set of simulations. The change in

[10] This simulation returns to the tradition of an equi-proportionate change for each of the APEC members. As noted, this equi-proportionate increase masks significant differences among the member economies in their trade facilitation indicators. Such equi-proportionate increase also does not exploit these differences to generate greater gains from one vs. another indicator.

the value of trade of each country that is estimated in our quantitative analysis is mapped into the estimated model of growth in per capita GDP and growth in value of trade.[11]

As Table 15 shows, a single APEC member country will, on average, enjoy a US$ 550 increase in per capita GDP in terms of the year 2000 figure as a outcome of the policy reforms. This corresponds to a 4.3 percent increase in the average APEC per capita GDP. The gains to some members of APEC are much larger with Russia enjoying a 14 percent increase in GDP per capita and Peru and Philippines gaining 13 and 11 percent, respectively. These countries have the greatest growth in per capita GDP because they are predicted to increase value of trade (imports plus exports), because of the low pre-reform trade facilitation indicators, and because the increased value of trade is large relative to their initial per capita GDP. Among developing countries, Malaysia will have a smallest growth in per capita GDP as its pre-reform level of trade facilitation and its trade intensity were already relatively high.

6. Conclusions

An important advantage of our research approach is that we include a variety of indicators of trade facilitation. The set of indicators includes member-specific trade facilitation indicators for port efficiency, customs environment, regulatory environment, and e-commerce use by business. Collectively these embrace the multiple approaches to trade facilitation reflected in modern international commerce. Our analysis also considers the importance of focusing on best practices and achieving benchmarks tied to what is known from experiences in best practices in trade facilitation. Considered completely separately from any model estimation of their effect on trade, this set of indicators helps policymakers judge where their economy stands relative to their peers in regard to each of these measures. In the context of quantifying the benefits of trade facilitation efforts, this multiple-indicator approach and decomposing the impact of the various indicators on trade may enable more targeted decision-making by policymakers.

The simulation approach offers several perspectives of the potential benefits of improvements in trade facilitation. It allows us to analyze the implications for intra-APEC trade as a whole. It allows us to examine an individual member's exports to other APEC members, and we can also use the results to proxy for the costs suffered by an individual APEC member when their own trade facilitation indicators are below best practice. This three-sided analysis of simulations can be a particularly valuable input to considering alternative pilot projects for individual APEC members. Of course, the resource costs of alternative policy reforms must be considered to gauge the net gain.

In sum, using this set of indicators and modeling approach offers policymakers more information about what type of trade facilitation efforts might provide the largest gains in terms of increasing trade flows for them. Whereas it remains true that a comprehensive effort yields

[11] We used the estimated model in the 6th column in Table 6 in Dollar and Kraay (2001).

the greatest increase in trade, the examination of different kinds of trade facilitation and of disaggregated trade flows could be useful for targeting of policy effort and launching of pilot projects in capacity building.

Data Appendix

Data come from the following sources:

World Economic Forum, Global Competitiveness Report, 2000. All survey data comes from the World Economic Forum's Executive Opinion Survey. A total of 4022 firms were surveyed. "In order to provide the basis for a comparative assessment on a global basis, it is essential that we interview a sufficient number of senior business leaders in individual countries and that the sample in each country is not biased in favor of any particular business group. We have taken a number of steps to ensure this. First, we have asked each of our partner institutes, the organizations that administer the surveys in each country, to start with a comprehensive register of firms. From this, they were asked to choose a sample whose distribution across economic sectors was proportional to the distribution of the country's labor force across sectors, excluding agriculture. They were then asked to choose firms randomly within these broad sectors (for example, by choosing firms at regular intervals from an alphabetic list), and to pursue face-to-face interviews, following up for clarifications where necessary. The employment distribution was taken from data in the 1998 *Yearbook of Labour Statistics* of the International Labour Office. The respondents to the survey are typically a company's CEO or a member of its senior management."

IMD Lausanne, World Competitiveness Yearbook 2000. The WCY uses a 115 question survey sent to executives in top and middle management of firms in all 49 countries of the WCY. The sample size of each country is proportional to GDP, and firms "normally have an international dimension." The firms are selected to be a cross section of manufacturing, service, and primary industries. There were 3532 responses to the Survey.

Transparency International, The Global Corruption Report. Transparency International is the only international non-governmental organization devoted to studying and fighting corruption. The organization monitors government compliance, corruption levels and transparency of regulations via 80 independent chapters around the world. Results of the monitoring are used to develop country-specific indices of improper practices. These data are publicly available through the Corruption Online Research and Information System (CORIS), a comprehensive database on corruption and governance.

The various raw data series were chosen because of their relevance to the four concepts of trade facilitation.

- "Port efficiency" for each APEC member *J* is the average of three indexed inputs:
  - Port Efficiency Index (MDX).
  - Port facilities and inland waterways are extensive and efficient (GCR)
  - "Air transport is extensive and efficient" (GCR)

- "Customs environment" for each APEC member *J* is the average of five indexed inputs :

- "Irregular, additional payments connected with import and export permits, business licenses, exchange controls, tax assessments, police protection, or loan applications are very rare (1=strongly disagree, 7=strongly agree, GCR)
- "Import fees are high (1=strongly disagree, 7=strongly agree, GCR)
- "Hidden import barriers other than published tariffs and quotas are: (1=an important problem; 7=non an important problem, GCR)
- "Bribery and corruption exist in the economy" (1=agree; 10=disagree, WCY)
- Corruption Perceptions Index (Transparency International)

- "Regulatory environment" for each APEC member *J* is constructed as the average of four indexed inputs (all GCR):
  - "Environmental regulations in your country are (1=confusing and frequently changing; 7=transparent and stable, GCR)
  - "Regulatory standards (e.g., product, energy, safety, and environmental standards) are among the world's most stringent (1=strongly disagree, 7=strongly agree, GCR)"
  - "Compliance with international environmental agreements is a high priority in your country's government" (1=strongly agree; 7=strongly disagree, GCR) [12]
  - "Environmental regulation in your country is: 1=not enforced or enforced erratically; 7=enforced consistently and fairly, GCR)

- "E-business" for each APEC member *J* is from GCR:

  - "Percentage of companies that use the Internet for e-commerce"

[12] When indexing, this index value is reversed to make it consistent with the other indexes.

Appendix Tables

Table 1: The Evolving Definition of Trade Facilitation

WTO and UNCTAD: "simplification and harmonization of international trade procedures, including activities, practices, and formalities involved in collecting, presenting, communicating, and processing data required for the movement of goods in international trade " (WTO website, and UNCTAD, E-Commerce and Development Report 2001, p 180)
OECD: "simplification and standardization of procedures and associated information flows required to move goods internationally from seller to buyer and to *pass payments* in the other direction" (OECD, TD/TC/WP(2001)21 attributed to John Raven)
UN/ECE: "*comprehensive and integrated approach* to reducing the complexity and cost of the trade transactions process, and ensuring that all these activities can take place in an efficient, *transparent, and predictable manner*, based on internationally accepted norms, standards, and best practices" (draft document 3/13/2002)
APEC: "trade facilitation generally refers to the simplification, harmonization, *use of new technologies* and other measures to address procedural and administrative impediments to trade. (APEC Principles on Trade Facilitation 2002)
APEC: "the use of technologies and techniques which will help members *to build up expertise*, reduce costs and lead to better movement of goods and services" (APEC Economic Committee 1999)

Table 2: Summary Statistics for Values of Trade Facilitation Indicators

Category	Indexed inputs	Source	Mean	Std. Dev.	Min		Max	
Port Efficiency	Port Efficiency Index (higher is better)	MXD	1 000	0.284	0.612	Philippines	1.482	Singapore
	Ports (higher is better)	GCR	1 000	0 264	0 617	Philippines, Vietnam	1.447	Singapore
	Air Transport (higher is better)	GCR	1.000	0.216	0.688	Peru, Vietnam	1 319	Singapore
Aggregate Index			1 000	0.248	0 658	Phillipines	1 416	Singapore
Customs Environment	Irregular Payments (higher is fewer)	GCR	1 000	0 324	0 464	Russia	1 372	New Zealand
	Import Fees (higher is fewer fees)	GCR	1 000	0.359	0.569	Russia	1 821	Singapore
	Hidden Import Barriers (higher is fewer barriers)	GCR	1 000	0 267	0 461	Indonesia	1 384	Hong Kong
	Improper Practices (higher is better Adm)	WCY	1 000	0 566	0 142	Russia	1 779	Singapore
	Corruption Perceptions Index (higher is less corruption)	Trans Intl	1 000	0 467	0 343	Indonesia	1 694	New Zealand
Aggregate Index			1.000	0.375	0.456	Russia	1 590	Singapore
Regulatory Environment	Effectiveness of Regulations	GCR	1 000	0 190	0 748	Vietnam	1 402	Singapore
	Regulatory Standards	GCR	1 000	0 235	0.628	Vietnam	1 342	United States
	Compliance with Agreements	GCR	1 000	0.183	0.683	Peru	1 256	Singapore
	Enforcement of Regulations	GCR	1.000	0.250	0.638	Philippines	1 448	Singapore
Aggregate Index			1 000	0 207	0 735	Philippines	1 335	Singapore
E-Business	E-commerce (% busines use)	GCR	1 000	0 305	0 461	Russia	1 683	United States
Aggregate Index			1.000	0.306	0.460	Russia	1 680	United States

Table 3: Correlation Matrixes

Three index inputs of Port Efficiency

	Port Efficiency Index	Ports	Air Transport
Port Efficiency Index	1.000		
Ports	0.979	1.000	
Air Transport	0.876	0.895	1.000

Five indexed inputs of Customs Environmemt

	Irregular Payments	Import Fees	Hidden Import Barriers	Improper Practices	Corruption Perceptions Index
Irregular Payments	1.000				
Import Fees	0.865	1.000			
Hidden Import Barriers	0.894	0.812	1.000		
Improper Practices	0.933	0.838	0.828	1.000	
Corruption Perceptions Index	0.970	0.844	0.897	0.974	1.000

Four indexed inputs of Regulatory Environmemt

	Effectiveness of Regulations	Regulatory Standards	Compliance with Agreements	Enforcement of Regulations
Effectiveness of Regulations	1.000			
Regulatory Standards	0.886	1.000		
Compliance with Agreements	0.906	0.883	1.000	
Enforcement of Regulations	0.944	0.940	0.919	1.000

Table 4: Regression Overview

Trade Facilitation Measure	Sign	Discussion of expected sign.
Port Efficiency	(+)	As port efficiency improve at destination J, X_{IJ} increases.
Customs Environment	(+)	As economy J implements APEC customs procedures, X_{IJ} increases.
Regulatory Environment	(-)	As economy J unilaterally tightens standards, X_{IJ} falls.
E-business Usage	(+)	As economy J increases business use of Internet, X_{IJ} increases.

Table 5: Correlation Matrix of Key Variables for Gravity Model

	Trade Flow	Tariffs	Port Efficiency	Customs Environment	Regulatory Environment	E-Business	GNP of Importer	GNP of Exporter	Per capita GNP of Importer	Per capita GNP of Exporter	Distance
Trade Flow	1.000										
Tariffs	-0.168	1.000									
Port Efficiency	0.276	-0.497	1.000								
Customs Environment	0.163	-0.404	0.846	1.000							
Regulatory Environment	0.276	-0.508	0.897	0.870	1.000						
E-Business	0.246	-0.334	0.505	0.626	0.616	1.000					
GNP of Importer	0.429	-0.288	0.365	0.186	0.479	0.409	1.000				
GNP of Exporter	0.598	-0.040	-0.025	-0.019	-0.029	-0.032	-0.040	1.000			
Per capita GNP of Importer	0.259	-0.569	0.865	0.834	0.890	0.509	0.478	-0.021	1.000		
Per capita GNP of Exporter	0.399	-0.093	-0.037	-0.041	-0.038	-0.023	-0.017	0.499	-0.042	1.000	
Distance	-0.304	-0.078	0.051	0.158	0.069	0.077	-0.003	0.033	0.106	0.040	1.000

Note: All variables are in the logarithmic form.

Table 6: Regression Results (Fixed-Effects, Double Logarithm)

	Coef.	Std.Err.
Constant	-81.790 **	8.465
Tariff	-0.749 **	0.375
Port Efficiency	4.200 ***	0.219
Customs Environment	0.422 **	0.169
Regulatory Envornment	-1.562 ***	0.308
E-Business	0.631 ***	0.094
GNP of Importing Country	0.846 ***	0.021
GNP of Exporting Country	3.870 ***	0.521
Per capita GNP of Importing Country	-0.376 ***	0.041
Per capita GNP of Exporting Country	-1.906 ***	0.679
Geographical Distance	-0.687 ***	0.027
NAFTA Membership Dummy	0.794 ***	0.164
ASEAN Membership Dummy	0.712 ***	0.096
LAIA Membership Dummy	1.624 ***	0.279
English Language Dummy	0.290 ***	0.075
Chinese Language Dummy	1.138 ***	0.189
Spanish Language Dummy	2.284 ***	0.168
Adjacency Dummy	0.162	0.128
Number of Observation	3,304	
Adjusted R-squared	0.865	

Note: The notations "*", "**", and "***" denote significance at the 10, 5 and 1 percent levels, respectively.

Table 7: Regression Results with Time-variant Port Efficiency and Customs Environment Measures (Fixed-Effects, Double Logarithm)

	I	II	III	IV
Constant	5.728	-0.292	-13.606	-16.677
	(23.397)	(24.618)	(35.606)	(37.521)
Tariff	-1.288*	-1.950**	-0.930	-1.955**
	(0.758)	(0.789)	(0.879)	(0.914)
Port Efficiency	1.541***	1.018***	1.606***	1.058***
	(0.234)	(0.240)	(0.251)	(0.256)
Customs Environment	0.469***	0.786***	0.488***	0.814***
	(0.090)	(0.058)	(0.100)	(0.065)
Regulatory Envornment	-3.905***		-3.964***	
	(0.380)		(0.433)	
E-Business	1.178***		1.213***	
	(0.159)		(0.179)	
GNP of Importing Country	0.762***	0.831***	0.765***	0.837***
	(0.028)	(0.023)	(0.032)	(0.026)
GNP of Exporting Country	-0.248	0.331	0.659	1.173
	(1.374)	(1.445)	(2.077)	(2.188)
Per capita GNP of Importing Country	0.090	-0.359***	0.084	-0.375***
	(0.062)	(0.052)	(0.069)	(0.058)
Per capita GNP of Exporting Country	0.552	0.077	-0.140	-0.570
	(1.666)	(1.754)	(2.402)	(2.532)
Geographical Distance	-0.675***	-0 665***	-0.694***	-0.678***
	(0.038)	(0.040)	(0.043)	(0.046)
NAFTA Membership Dummy	1.644***	1.995***	1.802***	2.174***
	(0.228)	(0.238)	(0.258)	(0.270)
ASEAN Membership Dummy	0.278**	0.671***	0.275*	0.667***
	(0.134)	(0.136)	(0.151)	(0.153)
LAIA Membership Dummy	0.696	0.567	0.763	0.640
	(0.524)	(0.552)	(0.603)	(0.635)
English Language Dummy	0.053	0.177*	0.045	0.171
	(0.105)	(0.108)	(0.118)	(0.121)
Chinese Language Dummy	1.211***	0.693**	1.229***	0.723**
	(0.313)	(0.326)	(0.350)	(0.365)
Spanish Language Dummy	2.771***	2.866***	2.753***	2.868***
	(0.256)	(0.269)	(0.290)	(0.305)
Adjacency Dummy	-0.055	-0.250	-0.094	-0.282
	(0.182)	(0.191)	(0.209)	(0.219)
Number of Observation	1,317	1,317	1,047	1,047
Adjusted R-squared	0.876	0.862	0.875	0.861

Note: The notations "*", "**", and "***" denote significance at the 10, 5 and 1 percent levels, respectively. Inside the parenthesis is standard error.

Table 8: Overview of Range of Trade Facilitation Indicators

	Best Practice	Range
Port Efficiency	Singapore	0.658-1.416
Customs Environment	Singapore	0.456-1.590
Regulatory Environment		0.735-1.335
E-Business	United States	0.460-1.680

Table 9: Overview of Simulation: Half-way to APEC Average

		Change in Trade Flow ($ billion)	Change in Trade Flow (%)
'Border' Measures			
Port Efficiency	**Bring below-average members up to the APEC average**	116.89	9.7
Customs Environment		21.63	1.8
'Inside-the Border' Measures			
E-business	**Bring below-average members up to the APEC average**	27.69	2.3
Regulatory Environment	**Regulatory Harmonization: (Bring above-average members down to the APEC average, and below-average members up to the APEC average)**	88.15	7.3
Grand Total		***254.36***	***21.0***

Table 10: Ports Efficiency Scenario

—Experience of Exporters

		Exports to APEC			
Exporter	est. coeff.	New	Initial	Change	Percent
Philippines	4.20	14.626	14.271	0.355	2.5
Peru	4.20	0.509	0.484	0.024	5.0
Vietnam	4.20	1.418	1.321	0.097	7.4
China	4.20	147.820	145.270	2.551	1.8
Russia	4.20	10.488	7.726	2.762	35.8
Indonesia	4.20	14.927	13.747	1.180	8.6
Mexico	4.20	56.738	56.295	0.442	0.8
Chile	4.20	1.109	0.924	0.185	20.0
Korea	4.20	76.407	67.119	9.289	13.8
Thailand	4.20	25.053	23.770	1.283	5.4
Malaysia	4.20	43.236	41.292	1.944	4.7
Chinese Taipei	4.20	91.409	79.868	11.541	14.5
Japan	4.20	311.606	280.064	31.543	11.3
Australia	4.20	11.349	10.193	1.155	11.3
New Zealand	4.20	2.873	2.763	0.109	4.0
Canada	4.20	105.588	103.881	1.708	1.6
United States	4.20	325.278	287.040	38.238	13.3
Hong Kong	4.20	40.517	31.621	8.896	28.1
Singapore	4.20	44.583	40.995	3.587	8.8
Total		1,325.534	1,208.644	116.889	9.7

—Experience of Importers

		Imports from APEC			
Importer	est. coeff.	New	Initial	Change	Percent
Thailand	4.20	34.003	29.584	4.419	14.9
Korea	4.20	60.405	52.437	7.968	15.2
Chile	4.20	6.330	5.222	1.108	21.2
Mexico	4.20	83.233	60.995	22.238	36.5
Indonesia	4.20	22.784	15.141	7.643	50.5
Russia	4.20	7.721	4.458	3.262	73.2
China	4.20	125.918	72.312	53.606	74.1
Peru	4.20	4.652	2.345	2.307	98.4
Philippines	4.20	28.680	14.340	14.340	100
Total	4.20	1,325.535	1,208.643	116.891	9.7

Table 11: Customs Environment Scenario

—Experience of Exporters

		Exports to APEC			
Exporter	est. coeff.	New	Initial	Change	Percent
Russia	0.42	8.109	7.726	0.383	5.0
Indonesia	0.42	13.927	13.747	0.180	1.3
Philippines	0.42	14.353	14.271	0.083	0.6
Vietnam	0.42	1.342	1.321	0.021	1.6
China	0.42	145.951	145.270	0.681	0.5
Mexico	0.42	56.345	56.295	0.049	0.1
Thailand	0.42	23.979	23.770	0.209	0.9
Peru	0.42	0.487	0.484	0.003	0.6
Korea	0.42	68.674	67.119	1.555	2.3
Malaysia	0.42	41.691	41.292	0.399	1.0
Chinese Taipei	0.42	81.616	79.868	1.748	2.2
Japan	0.42	286.06	280.064	5.996	2.1
Chile	0.42	0.944	0.924	0.020	2.2
United States	0.42	294.800	287.040	7.760	2.7
Hong Kong	0.42	32.756	31.621	1.135	3.6
Canada	0.42	104.201	103.881	0.320	0.3
Australia	0.42	10.461	10.193	0.268	2.6
New Zealand	0.42	2.784	2.763	0.021	0.7
Singapore	0.42	41.794	40.995	0.799	1.9
Total		1,230.274	1,208.644	21.630	1.8

—Experience of Importers

		Imports from APEC			
Importer	est. coeff.	New	Initial	Change	Percent
Malaysia	0.42	37.997	37.949	0.048	0.1
Korea	0.42	54.105	52.437	1.668	3.2
Peru	0.42	2.461	2.345	0.116	5.0
Thailand	0.42	31.956	29.584	2.372	8.0
Mexico	0.42	66.043	60.995	5.048	8.3
China	0.42	78.484	72.312	6.172	8.5
Vietnam	0.42	0	0	0	
Philippines	0.42	16.211	14.340	1.872	13.1
Indonesia	0.42	18.356	15.141	3.215	21.2
Russia	0.42	5.578	4.458	1.119	25.1
Total		1,230.273	1,208.643	21.630	1.8

Table 12: E-Business Scenario

—Experience of Exporters

		Exports to APEC			
Exporter	est. coeff.	New	Initial	Change	Percent
Russia	0.63	7.909	7.726	0.183	2.4
Thailand	0.63	24.024	23.770	0.254	1.1
Mexico	0.63	56.380	56.295	0.085	0.2
Chile	0.63	0.952	0.924	0.028	3.1
Malaysia	0.63	41.863	41.292	0.571	1.4
Indonesia	0.63	14.016	13.747	0.269	2.0
Philippines	0.63	14.494	14.271	0.223	1.6
Japan	0.63	286.022	280.064	5.959	2.1
New Zealand	0.63	2.792	2.763	0.029	1.0
Peru	0.63	0.494	0.484	0.010	2.0
Korea	0.63	68.538	67.119	1.420	2.1
Hong Kong	0.63	32.025	31.621	0.404	1.3
Vietnam	0.63	1.364	1.321	0.044	3.3
China	0.63	146.734	145.270	1.464	1.0
Chinese Taipei	0.63	81.200	79.868	1.333	1.7
Singapore	0.63	42.290	40.995	1.295	3.2
Australia	0.63	10.446	10.193	0.253	2.5
Canada	0.63	104.284	103.881	0.404	0.4
United States	0.63	300.501	287.040	13.462	4.7
Total		1,236.328	1,208.644	27.690	2.3

—Experience of Importers

		Imports from APEC			
Importer	est. coeff.	New	Initial	Change	Percent
New Zealand	0.63	7.072	6.957	0.116	1.7
Japan	0.63	108.036	105.528	2.508	2.4
Philippines	0.63	14.899	14.340	0.560	3.9
Indonesia	0.63	15.984	15.141	0.843	5.6
Malaysia	0.63	40.759	37.949	2.810	7.4
Chile	0.63	5.635	5.222	0.412	7.9
Mexico	0.63	71.826	60.995	10.831	17.8
Thailand	0.63	37.54	29.584	7.956	26.9
Russia	0.63	6.110	4.458	1.652	37.1
Total		1,236.330	1,208.643	27.688	2.3

Table 13: Regulatory Harmonization Scenario

—Experience of Exporters

		Exports to APEC			
Exporter	est. coeff.	New	Initial	Change	Percent
Philippines	-1.562	15.861	14.271	1.591	11.1
Indonesia	-1.562	14.906	13.747	1.159	8.4
Peru	-1.562	0.534	0.484	0.049	10.2
Vietnam	-1.562	1.433	1.321	0.112	8.5
Thailand	-1.562	26.394	23.77	2.624	11
Mexico	-1.562	63.988	56.295	7.693	13.7
Russia	-1.562	7.629	7.726	-0.097	-1.3
China	-1.562	156.84	145.27	11.57	8
Chile	-1.562	0.967	0.924	0.043	4.7
Malaysia	-1.562	46.191	41.292	4.9	11.9
Korea	-1.562	71.555	67.119	4.436	6.6
Hong Kong	-1.562	32.878	31.621	1.257	4
Taiwan	-1.562	84.59	79.868	4.723	5.9
United States	-1.562	302.536	287.04	15.496	5.4
New Zealand	-1.562	3.098	2.763	0.335	12.1
Canada	-1.562	117.542	103.881	13.661	13.2
Japan	-1.562	296.236	280.064	16.172	5.8
Australia	-1.562	10.848	10.193	0.655	6.4
Singapore	-1.562	42.765	40.995	1.77	4.3
Total		1296.791	1208.644	88.149	7.3

—Experience of Importers

		Imports from APEC			
Importer	est. coeff.	New	Initial	Change	Percent
Countries above average					
Singapore	-1.562	76.128	63.654	12.474	19.6
Australia	-1.562	34.642	29.862	4.78	16
Japan	-1.562	122.366	105.528	16.837	16
Canada	-1.562	133.861	116.391	17.47	15
New Zealand	-1.562	7.969	6.957	1.012	14.5
United States	-1.562	481.558	421.951	59.607	14.1
Taiwan	-1.562	57.162	52.439	4.723	9
Hong Kong	-1.562	118.418	117.078	1.341	1.1
subtotal		*1,032.104*	*913.86*	*118.244*	*12.9*
Countries below average					
Korea	-1.562	51.978	52.437	-0.459	-0.9
Malaysia	-1.562	37.017	37.949	-0.932	-2.5
Chile	-1.562	4.859	5.222	-0.364	-7
China	-1.562	66.545	72.312	-5.767	-8
Russia	-1.562	4.088	4.458	-0.37	-8.3
Mexico	-1.562	53.746	60.995	-7.249	-11.9
Thailand	-1.562	23.538	29.584	-6.046	-20.4
Peru	-1.562	1.718	2.345	-0.627	-26.7
Indonesia	-1.562	10.895	15.141	-4.246	-28
Philippines	-1.562	10.303	14.34	-4.036	-28.1
subtotal		*264.687*	*294.783*	*-30.096*	*-10.2*
Total		1,296.791	1,208.643	88.148	7.3

Table 14: Tariff Reduction versus Trade Facilitation

	Equivalent to Zero Tariff
Average tariff reduction	-6.5 %
Port Efficiency	+0.548 %
Customs Environment	+5.46 %
Regulatory Environment	-1.49 %
E-business Usage	+3.65 %

Table 15: Growth in Per capita GDP Associated with the 'Half-way to the APEC Average' Scenario

	Dollar&Kraay elasticity	Initial Import+Export	Change in Import+Export	Initial per capita GDP	Change in per capita GDP	% Change in per capita GDP
Australia	0.54	40.055	7.111	24,219	946	3.91
Canada	0.54	220.272	33.563	22,638	766	3.38
Chile	0.54	6.146	1.432	5,355	270	5.03
China	0.54	217.582	70.277	825	56	6.78
Hong Kong	0.54	148.699	13.033	24,272	483	1.99
Indonesia	0.54	28.888	10.243	995	73	7.38
Japan	0.54	385.592	79.015	42,992	1921	4.47
Korea	0.54	119.556	25.877	13,066	614	4.7
Malaysia	0.54	79.241	9.74	3,816	105	2.76
Mexico	0.54	117.29	39.137	4,807	336	6.99
New Zealand	0.54	9.720	1.622	17,724	653	3.69
Peru	0.54	2.829	1.882	2,385	303	12.7
Philippines	0.54	28.611	14.988	1,165	121	10.38
Russia	0.54	12.184	8.894	2,452	336	13.72
Singapore	0.54	104.649	19.925	28,123	1173	4.17
Chinese Taipei	0.54	132.307	24.068	2,801	112	4
Thailand	0.54	53 354	13.071	15,856	836	5.27
United States	0.54	708.991	134.563	31,986	1331	4.16
Vietnam	0.54	1.321	0.274	361	16	4.52
APEC average		12,939	127.226	26.774	550	4.25

We used the estimated model in the 6th column in Table 6 in Dollar and Kraay (2001).

Figure 1: Three Indexed Inputs to Port Efficiency

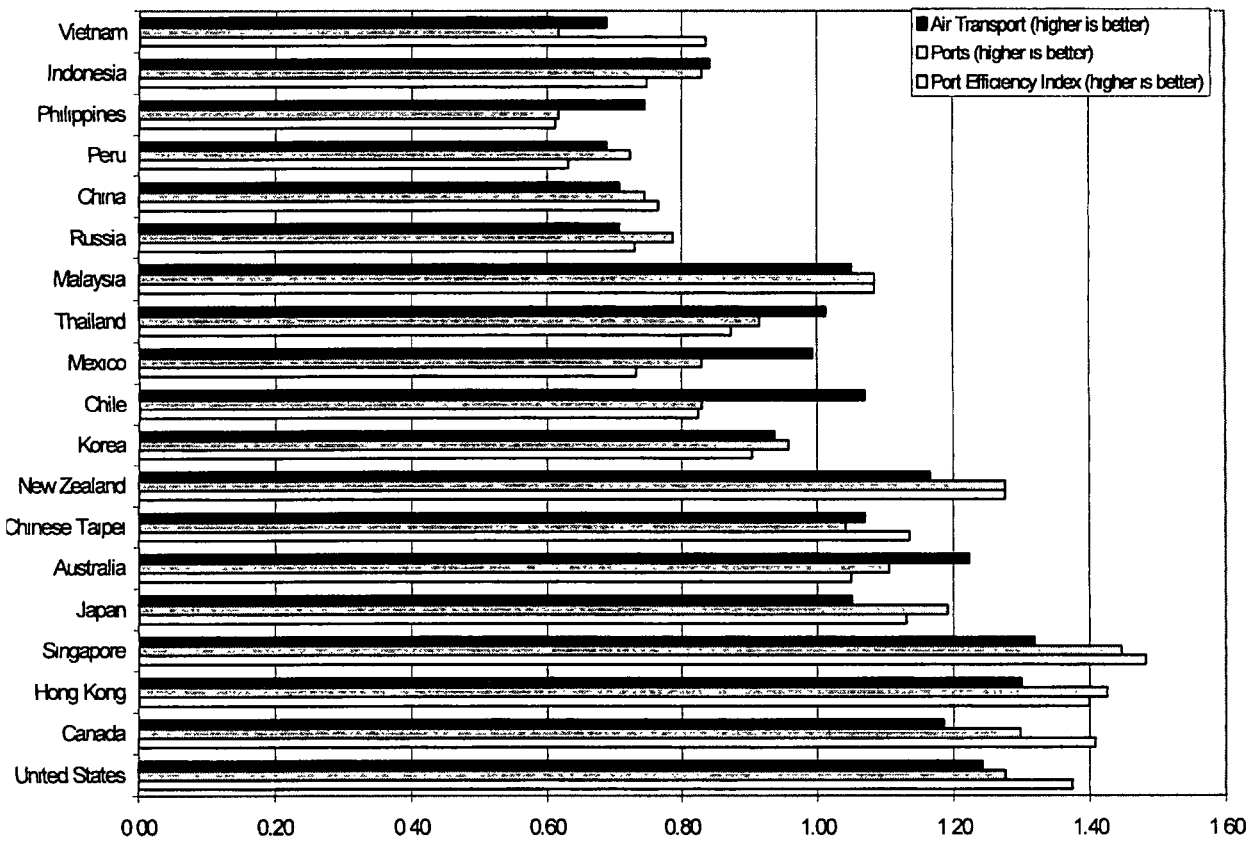


Figure 2: Five Indexed Inputs of Customs Environment

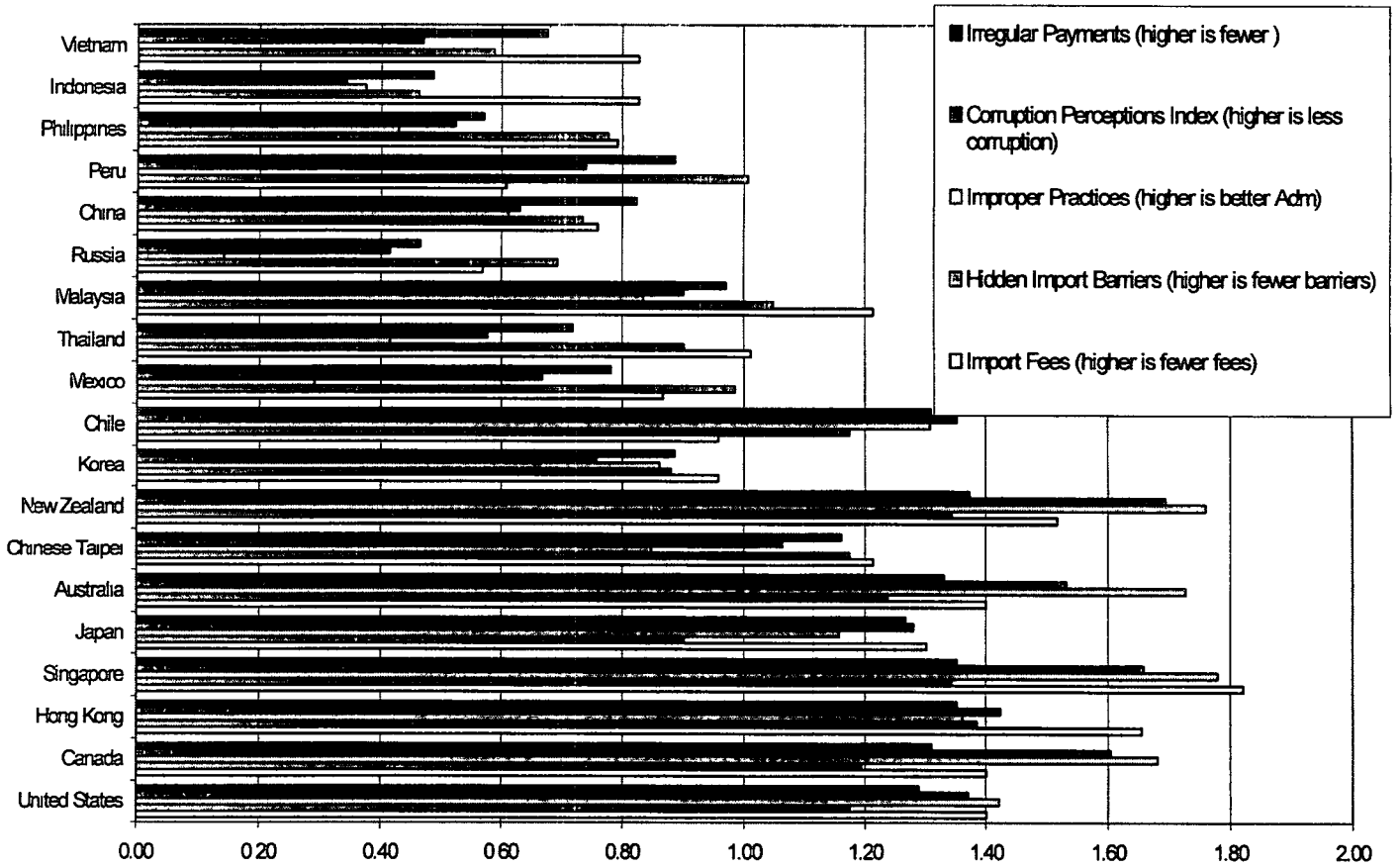


Figure 3: Four Indexed Inputs of Regulatory Environment

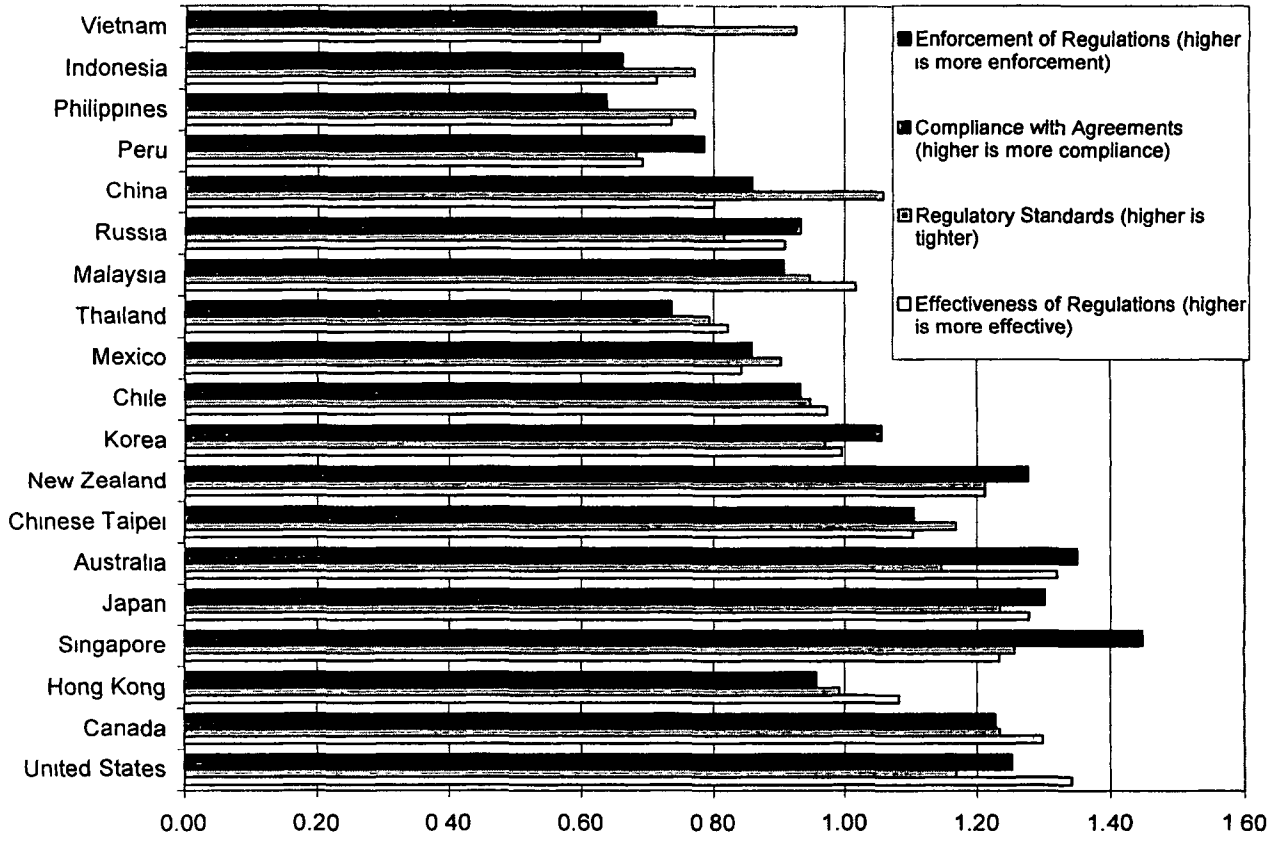


Figure 4: Indexed Input of E-business Usage

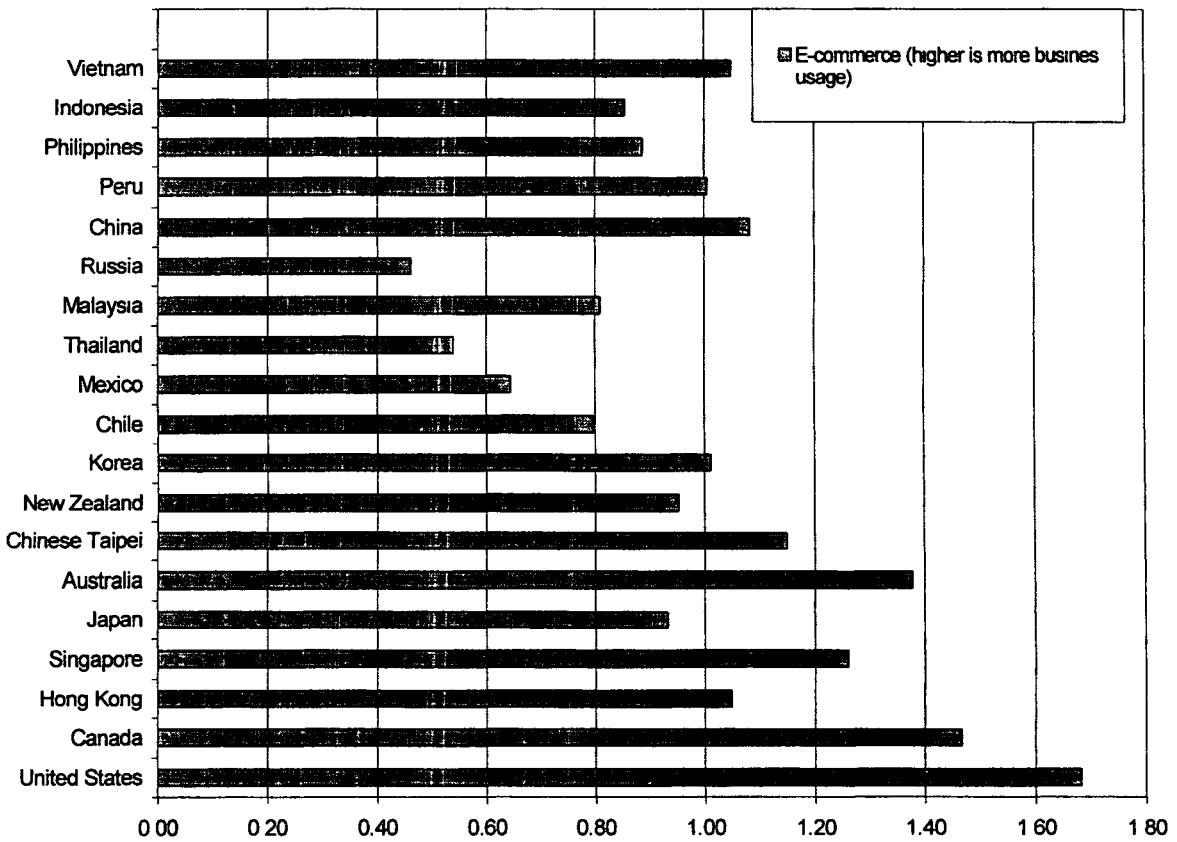
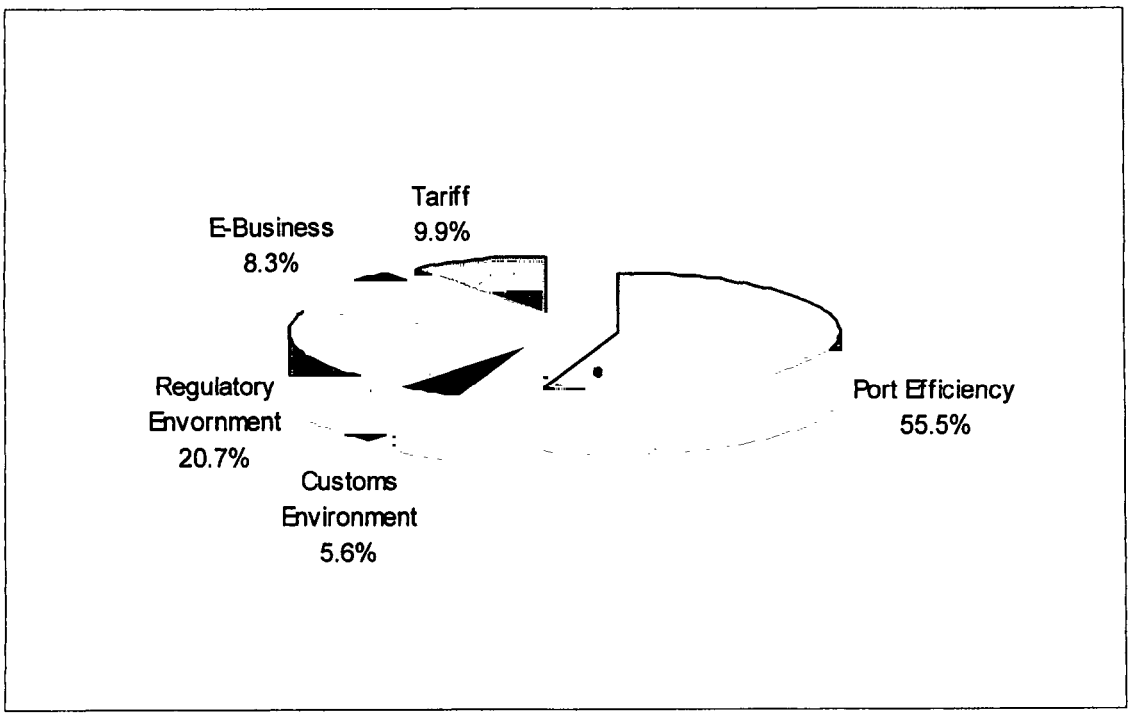


Figure 5: The Effect of 1 Percent Change of Trade Facilitation and Tariff Barrier Measures on Trade Flow



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