Trade Facilitation Benchmarks and Priorities for Action:

A Product-Specific and Supply-Chain Focused Tool

Template Analysis for Argentina, Brazil, Colombia, Dominican Republic, and Peru

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Executive Summary

What is Trade Facilitation?

With negotiations to reduce trade barriers at the border increasingly contentious and lengthy, some policymakers are focusing on other impediments to international trade, including those that originate within their own economies. 'Trade facilitation' is the rubric that covers the research and policy analysis on impediments to cross-border trade that are not tariffs or quotas.

The traditional definition of trade facilitation (TF) focused on non-tariff direct costs of getting products across international borders, such as the cost of loading a container on a ship or the number of days to clear a package through customs. These days, with complex international supply chains of production, this traditional definition of TF that focuses on port facilities and customs is too narrow. To participate in just-in-time and fragmented international supply chains, firms must be able to communicate and transact with supply chain partners in a timely manner, and often via the Internet. Therefore, information and communications technology[1] (ICT) networks and financial institutions are key for modern trade facilitation.

In addition, with 'arm-length' relationships, those that do not involved corporate ownership) increasingly the norm, firms that adhere to certain international standards may have a competitive edge in some international supply chains over firms that do not. So, meeting standards promulgated by the International Organization for Standardization (ISO), for example, are part of modern trade facilitation. Thus, a broader definition of TF incorporates financial institutions, information and telecommunications technology, and standards and regulatory adherence.

In sum, trade facilitation that promotes competitive engagement in global supply chains requires attention to ports and transportation networks, customs facilities and clearance, financial infrastructure, information and telecommunications technology and finally, industry-specific standards and regulations.

This broad TF rubric represents a huge policy agenda—basically the whole of an economic development strategy! Policy makers cannot address all aspects of TF all at once. How should policy makers and their advisors prioritize the reform efforts and allocate spending and other resources? The task of this paper is to create a country-specific tool to help inform and prioritize policy and other stakeholder action across the various dimensions of trade facilitation.

Overview and Objective

This paper outlines how to develop a data-rich and country-specific tool for policy-makers and their advisors. The tool allows a country to assess its business environment

[1] ICT is the common acronym for information and communications technologies and networks. It comprises the hardware, software, and networks.

in six areas germane to trade facilitation and international supply chain competitiveness: corruption, transportation infrastructure, financial institutions, regulatory adherence, customs performance, ICT usage. The tool is then applied to five economies—Argentina, Brazil, Colombia, Dominican Republic, and Peru—and assessed.

The tool uses product- and country-specific data of three types: Trade patterns, supply chain intensities, business environment metrics. First, it evaluates the country-specific pattern of trade disaggregated by broad product group. This helps a country know which supply chain to focus on—the most important product in current trading patterns, or perhaps the product that is the target for competitiveness policy. Second, it considers which inputs into the product's supply chain are the most important to make that product internationally competitive. This helps a country determine which input in the supply chain is most important for the country's overall international trade competitiveness. Third, it measures the quality of a country's business environment in six areas relevant for trade facilitation and supply chain competitiveness; these business environment indicators differ by product. This helps a country determine which aspects of the business environment are strongest and weakest.

The three parts of the tool are linked together to offer each country specific insight into which aspects of its business environment are most important for which supply chains for its key products in international trade. The result is a tool that presents a unique picture for each country of which trade-facilitation reforms could bring the greatest gains in international supply chain competitiveness and therefore enhance the most its international trade performance.

The methodology outlined in this paper matches product-specific trade data with product-specific supply chain data and product-specific business environment data. No previous research has used product-specific data along these three dimensions to inform policy and business as to the most relevant area of trade facilitation reform.

The Trade Facilitation Benchmark Tool: In Brief

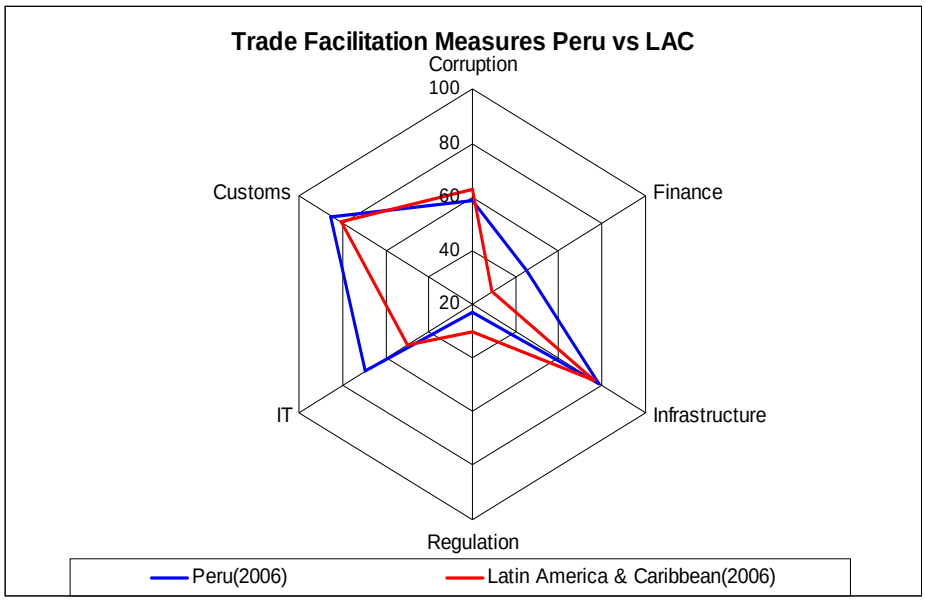
The ultimate objective of the trade facilitation analysis is to aid policy design. Benchmarking a country's business environment along the dimensions of the trade facilitation matrix is the core of this exercise. But, benchmarking indicators of the business environment alone do not have sufficient specificity to aid policy makers. Therefore, we must examine products in international trade and benchmark along the international supply chain for each product as well as the business environment overall.

The trade facilitation (TF) tool developed in this paper creates indicators for six different TF areas. The first three, *Corruption, customs, regulatory adherence* are primarily measures of 'soft' TF along both the 'border' and 'behind-the-border' dimensions. The next two, *Financial infrastructure and use* and *ICT networks and use* incorporate both 'soft' and 'hard' dimensions of TF and are often considered 'behind-the-border' areas, but in fact, are crucial to the international supply chain. The sixth, *Transport and utilities infrastructure* incorporates the traditional 'hard' 'border' TF definition. Each of these six

TF measures is derived for products for each country in the template analysis. Product-specific TF measures are a new innovation of this tool and analysis.

The Figure below shows how to gauge the relative 'quality' of business environment along these six dimensions for Peru, one of the template economies. (See Part 2.2. and Appendix 4 for more discussion and presentation of TF data for all template economies.) However, these data do not give policy-makers sufficient information to guide reform to maximize international competitiveness—more information about specific products and their international supply chains are needed.

For example, although Peru's overall TF measures appear in general to be comparable or better than the Latin average, along the dimension of *regulatory adherence*, Peru appears to have a relatively poorer business environment. What if *regulatory adherence* is a key aspect of the supply chain for the products that are important for Peru's export performance? Further analysis on product-specific supply chains and on trade patterns are needed to qualify the overall impression of Peru's TF environment and to aid policymakers.



Therefore, to gauge international competitiveness, the TF measures have to be examined in light of trade data and supply-chain data. The Table below shows the relative importance of exports by product group for the template economies. These trade shares indicate which supply chains are most important to keep internationally competitive. (More detailed data on trade patterns are presented in Part 2.2 and Appendix 1 of the main Report.)

The Table reveals that exports of the product group 'food' are quite important for all of these template economies. But, for Peru and Dominican Republic, metals products are quite important and for Peru, non-metallic and plastic products are also quite important exports. Autos and auto components are relatively more important for Argentina and

Brazil. Therefore, when considering which aspect of trade facilitation might be most important, policymakers need to consider the supply chain of these important export products.

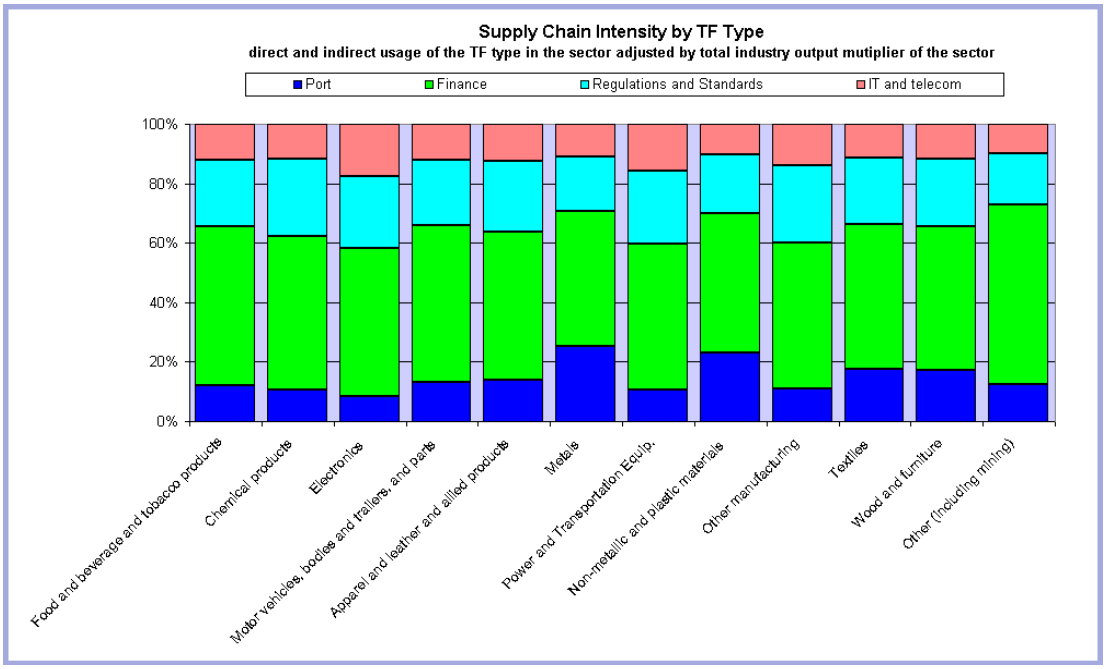
Share of Sectors' Exports of Country's Total Exports

Sector	Argentina 2006	Brazil 2003	Colombia 2006	Dominican Republic 2001	Peru 2006
Auto and auto components	8.64%	8.26%	3.20%	0.12%	0.03%
Chemicals and pharmaceutica	6.01%	5.01%	4.65%	5.37%	1.55%
Electronics	0.92%	4.34%	1.50%	0.94%	0.15%
Food	44.69%	29.01%	15.22%	41.09%	14.89%
Garments	0.28%	3.14%	4.78%	1.31%	5.22%
Leather, Fur and Feather	2.22%	1.62%	0.79%	0.59%	0.16%
Metals	5.32%	10.52%	8.86%	19.32%	19.56%
Power and transport equipme	3.17%	10.60%	1.61%	0.34%	0.33%
Non-metallic and plastic mate	4.72%	4.54%	10.27%	4.46%	20.50%
Other manufacturing	0.49%	0.80%	0.53%	0.21%	0.13%
Textiles	0.85%	1.36%	1.05%	0.11%	1.10%
Wood and furniture	1.24%	6.19%	0.75%	1.46%	0.95%
Other	21.46%	14.62%	46.78%	24.68%	35.43%

Dates for trade data chosen to match dates for which TF metrics are available
Product groups chosen to match groups for which TF metrics are available

A key innovation of this policy tool examines the supply chain for each product along four of the six TF dimensions: *financial infrastructure and use, ICT networks and use, regulatory adherence, transport infrastructure.* (*Corruption* and *customs* are not incorporated into the supply chain component of the analysis because supply-chain data do not include these two aspects of the business environment.) Research in Part 2.3 and Appendix 3 of the main Report detail how the international supply chain differs for 'food products', 'metals products', 'autos', and so on for each of the product groups. Because the supply chains differ by product, which TF areas are most important also will differ. The Figure below shows an example of how the international supply chain differs by product.[2]

[2] 'Finance' represents *financial infrastructure and use*, 'IT and telecom' represents *ICT networks and use*, 'ports' represent *transport infrastructure*, and 'regulations and standards' represents *regulatory adherence*.

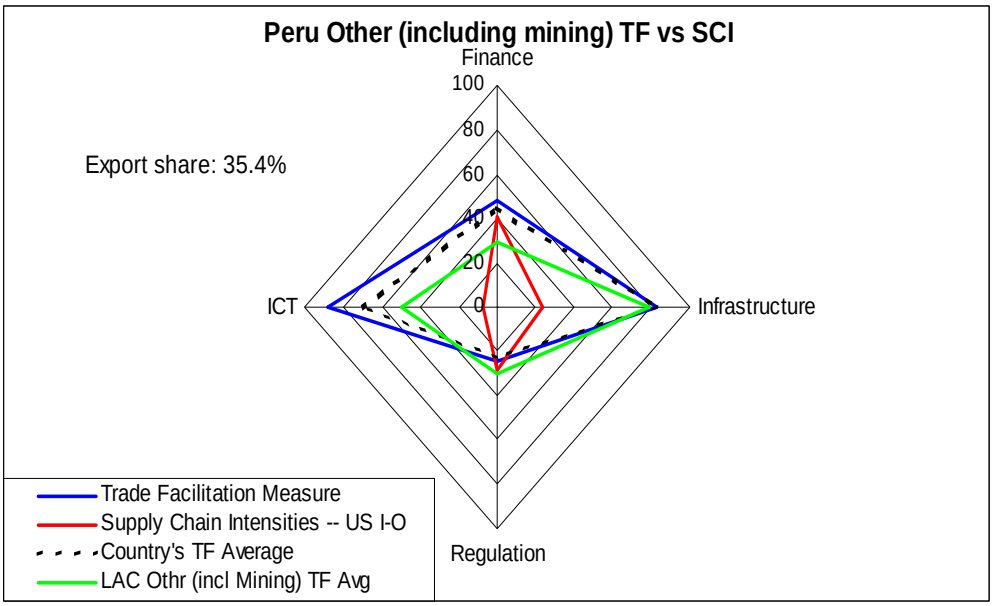


Finally, putting the data on business environment together with the supply chain data allows a country to benchmark its measures of business environment in the TF areas used most intensively in the supply chain of the product that is most important in the country's export trade.

For example, the Figure below for Peru shows that for an important export group (Other, Incl. Mining accounts for 35.4% of exports[3]), the supply chain (in red) is relatively intensive in the use of resources devoted to financial institutions and regulatory standards. Therefore, to maintain international competitiveness, Peru needs a high score on *finance* and on *regulation* to maintain international competitiveness.[4]

In fact, the overall business environment enjoyed by Peru's Other, Incl. Mining exporters (in blue) is somewhat better than the business environment for Peru's businesses as a whole (in dotted-black) along all four dimensions of the business and trade facilitation environment. Along one dimension—*ICT*-- Peru's Other, Incl. Mining exporters enjoy a much better environment than most Peruvian businesses.

[3] See the Appendix for a complete list of all products in each category.
[4] In these charts, the scalars 0-100 divide the arms into equal length so as to compare across TF metrics. The TF metrics are constructed data with 0 being worse TF and 100 being the best TF measure; the constructed data are unit-less.



However, to truly gauge whether Peru's Other, Incl. Mining producers can compete internationally, we need to consider as well the ranking of Peru's TF environment as compared to its competitors in the LAC region (in green). On most aspects of the supply chain, Peru's producers have the advantage, but on a key aspect of the supply chain—*regulation* --the competitors in the region could outflank Peruvian exporters. That is the score for regulation for the LAC region as a whole is higher than for Peru, both the country average (in dotted black) and for the exporters of Other, Incl. Mining (in blue).

Even greater detail on the specific underpinnings of each aspect of the business environment can further hone policymaker effort. Continuing the Peruvian example, a key weakness in area of *regulatory adherence* turns out to be ISO standards—very few of the firms exporting in the Other, Incl. Mining category have ISO certification.

All told, this collection of product-specific information on exports, supply-chain intensity, and comparative trade facilitation metrics can help inform policy-maker efforts. (See Part 2.6 and Appendix 5 of the main Report for presentation of the data and analysis of each of the template economies.)

Empirical Findings on Gains from Improved Trade Facilitation: In Brief

Benchmarking a country's TF environment against other countries, paying attention to supply-chain intensities, and trading patterns are all important steps in considering the direction for policy. However, policy makers often ask the concrete question, "If we make improvements in such-and-so a TF area, what will be the gains?"

Part 3 of the Report quantifies how much a country might gain from different types of TF improvement. The most important conclusion is that when a country undertakes trade

facilitation reforms overall, its balance of payments is likely to improve: The gains to a country's own exports that come from a superior trade-facilitation environment exceeds the increases in imports that also come from that improved environment. Different countries' gains come from different improvements in their trade facilitation environment, depending on which areas of trade facilitation was weakest.

For the template economies, the broad-brush overview of findings is as follows: Considering improvements in *port efficiency*, Colombia and Peru generally would see the greatest percentage increase in trade (Colombia: 14.8% increase in exports, 5.4% increase in imports and Peru: 21.4% increase in exports, 7.6% increase in imports). In terms of trade gains from improvements in *customs environment*, Argentine and Colombian exports could increase by some 4%.

An improved *customs environment* tends to raise imports relatively more than exports. For example, Brazil's imports might increase by some 6.2%, whereas exports might only increase some 1.9%. Colombia's exports and imports might increase both about 4%.

With respect to improved *regulatory environment*, Argentina's exports could rise by some 27.7%, and imports rise only 12.8%. Colombia also could see dramatic trade increases from improved *regulations*, some 9.3% increase in exports and 4.4% increase in imports.

Finally, large increases in trade might accompany increased *e-business (ICT) usage.* Peru might see increased exports of some 12% and increased imports of some 4.9%. Brazil's exports might increase 6.2% and imports increase 2.7%.

Of course, these results are indicative of potential gains. The key point is that each country improves a different amount in different TF areas depending on the area that needs to greatest improvement.

Policy Recommendations for Template Countries: In Brief

Part 4 of the main Report takes the detailed analysis for each of the template countries and points to potential policy recommendations. These come from an assessment of the product-specific trade exposure, the individual elements of the product-specific trade facilitation measures, and the data on the product-specific supply chains. Of course, policy makers, firms, and other stake-holders, such as local Chambers of Commerce and business groups, must use many more inputs before deciding on a course of action. However, the trade facilitation analysis presented in the main Report does suggest a different area for policy-maker attention for each of the template countries.

For Argentina, the data and analysis point to systemic issues in the financial infrastructure. Beyond this general problem, there are issues in ICT and regulatory adherence for certain product groups. Argentine firms, except for those in the large export group of 'Other, incl. Mining', report long delays in getting a telephone landline. But even the favored industries do not engage in web-based transactions (although all use

e-mail). Web-based transactions often go hand-in-hand with financial system quality: It is difficult to engage in cross-border Internet sales and purchases if the banking system is weak. Hence the problems in finance may be spilling over to use of ICT. There are also weaknesses in the area of regulatory adherence. In key product groups 'chemicals and pharmaceuticals' (6% of exports), 'other, incl. Mining' (21%), and 'metals and machinery' (5%) a program of action could assist firms to gain ISO certification and to work with external auditors.

For Brazil, updating the survey information is key. As of 2003, Brazilian firms faced significantly longer delays in clearing exports, and particularly imports than other Latin countries: This is a clear detriment to international competitiveness. This suggests a program of reducing days to clear customs is of broad-based value. Adherence to regulatory standards is also an area of general concern. In product groups that might be a focus of export diversification programs ('chemicals and pharmaceuticals' 'garments', and 'wood/furniture' (representing about 5 percent of exports each totalling about 15 percent of exports) the lack of audited statements and ISO certification may not only hurt supply-chain competitiveness, but may also hamper access to financial resources necessary for expansion. A program of action focussed on customs clearance for importers and ISO certification for all firms, but particularly for up-and-coming exporters of garments and wood/furniture could reduce trade costs and enhance international competitiveness of Brazilian firms.

For Colombia, there are systemic issues in the regulatory sphere, particularly ISO certification. As in the case of Brazil, sub-par regulatory adherence spills over into lower access to financial resources for expansion. Second, despite shorter delays in getting telephones, firms are not generally users of web-based transactions, which are key critical to participating in the international supply chain. Therefore a program of action to focus on ISO certification and particularly audit could help raise the competitiveness of Colombian exporters. ICT training and potentially cost of ICT may also be undermining international supply chain competitiveness.

For the Dominican Republic, the overall trade facilitation environment is not strong, with problems in virtually all areas. 'Food' exports (41% of exports) take twice the number of days as the LAC regional average to clear customs. This sector also experiences difficulties with infrastructure and regulations. For other up-and-coming areas for potential export diversification, the customs clearance situation is worse. These firms also face disadvantages in ICT usage. This suggests a program of reducing days to clear customs may yield a systemic gain and should be the focus of general policy initiatives. A second program that focuses on small firms struggling to get access to ICT also may be warranted.

For Peru, the overall area of concern is regulatory adherence, specifically financial audit and ISO certification. For the largest category in trade ('other, incl. mining at 35% of exports) less than 1 percent of firms surveyed held ISO certification. ICT usage is a second area of concern: Only about 30 percent of firms in export categories outside 'other, incl. mining' use web-based transactions. Thus a program of awareness of the

importance of web-based transactions for international supply-chain strategies, with some attention to cost and or training may be warranted.

Potential Role for US and Local Chambers of Commerce: In Brief

The analysis of each country offers both general areas for policy attention (e.g. customs clearance), as well as specific areas where business groups could take the lead (e.g. ISO certification and ICT training). This offers direction for initiatives by local Chambers, potentially with assistance from the US Chamber. Continuing to promote data collection and survey analysis of how firms perceive the trade facilitation environment will assist policymakers in prioritizing reforms.

Main Report

Introduction

With negotiations to reduce trade barriers at the border increasingly contentious and lengthy, some policymakers are focusing on other impediments to international trade, including those that originate within their own economies. 'Trade facilitation' is the rubric that covers the research, analysis, and policy on non-tariff/quota impediments to and costs of international trade.

The traditional definition of trade facilitation (TF) focused on non-tariff direct costs of getting products across international borders, such as the cost of loading a container on a ship or the number of days to clear a package through customs. But, these days, with products in international trade increasingly part of an international supply chain of production, this traditional definition of TF is too limited. To participate in fast-moving and fragmented international supply chains, firms must be able to communicate and transact with supply chain partners in a timely manner, and often via the Internet. In addition, with arms-length relationships increasingly the norm, firms that adhere to certain international standards may have a competitive edge in some international supply chains over firms that do not.

Thus, a broader definition of TF incorporates financial institutions, information and telecommunications technology (ICT), and regulatory adherence. Clearly, competitive engagement in global supply chains requires attention to both type of TF – traditional border measures and non-traditional 'behind the border' aspects of an economy. Yet, this broader TF rubric represents a huge policy agenda. It is unrealistic to suppose that policy makers can pay equal attention to each of these aspects of TF.

The objective of this paper is to create a country-specific tool to help prioritize policy attention. First, it examines the country-specific pattern of trade disaggregated by broad product group. Then it considers what are key supply-chain inputs to being internationally competitive in that broad product group. Finally, it measures the quality of a country's trade facilitation areas by those broad product groups, as well as mapping the TF areas into the supply-chain inputs. Looking inward as well as comparing a country to its neighborhood and global competitors can assist policymakers and business groups in prioritizing their efforts.

The structure of the paper is as follows. Part 1 gives the overview of the research content and the tool. Part 2 implements the tool for the five template countries: Argentina, Brazil, Colombia, Dominican Republic, and Peru. Part 3 draws on previous econometric work to determine potential trade gains from improvements in the trade facilitation metrics for the five countries. Part 4 concludes with policy recommendations. Several Appendixes follow, including Appendix 1 on details of constructing the trade data aggregates, Appendix 2 on details of construction of Trade Facilitation measures, Appendix 3 on details of constructing the supply-chain intensities, Appendix 4 shows the trade facilitation measures for the economies relative to Latin average, Appendix 5 shows

the benchmarked TF measures for each product category against the category's supply chain intensities.

Part 1—Overview of the Context and Method

1.1 Research Context

The empirical literature on trade facilitation takes several tracks: First, deep analysis of one area of trade facilitation, such as transport infrastructure; second, case studies of a specific product or of one type of trade facilitation reform in a single-country analysis; third, econometric modeling of trade facilitation and economic variables such as trade flows or GDP. There are advantages and disadvantages of each type of analysis.

The advantage of deep analysis on a specific type of TF is that researchers can bring to bear extensive granularity in the data, such as the density of firms next to major roads to ports, or number of web-hosts, or aflatoxin regulations, and investigate the impact of changes in those specific TF aspects on trade prospects.

Research on deep analysis of one type of TF includes:

- On the ports and transportation aspects of trade facilitation, including Hummels (2001), Clark, X., D. Dollar and A..Micco. (2002), Fink, Mattoo, and Neagu (2002a) on anticompetitive practices in port services.Hausman, Lee, and Subramanian (2005), and Nordis, Pinali, Grosso (2006) on logistics and shipping time; IADB (2008);

- On other specific aspect of trade facilitation, including Freund and Weinhold (2000) on the Internet; Fink, Mattoo, and Neagu (2002b) on communication costs; Moenius (2000) on standards; Otsuki, Wilson, and Sewadeh (2001a, 2001b) on food safety standards.

However, such investigations cannot determine whether the specific TF aspect being investigated is the most important for a country to consider because the analysis is not done in a comparative setting against other areas of potential TF reform. That is, if the objective is to increase trade flows the most for a given amount of reform effort, this deep analysis does not enable the comparison. Moreover, in most cases the degree of granularity in the data is not with respect to the product-sector but relates to the economy as a whole. In other words, transport might not be that important for the product that is the most important in the international trade pattern of a particular country.

The advantage of case studies on specific products is that the supply chain is dissected completely, revealing great detail about business relationships, costs of production, and so on. But often case studies use terminology that is different from TF terminology, in part because this research usually is more focused on doing business *given* a policy environment, rather than on investigating areas for policy reform. Moreover, case studies focus on a specific product, whereas policy makers may wish to consider the impact of reform across a variety of products.

Case studies of product or one type of TF in a single-country setting include:

- Specific products in the global supply chain, including Humphrey and Memedovic (2003) for autos; Kaplinsky, Memedovic, Morris, Readman (2003) for furniture; Gereffi and Memedovic (2003) for apparel.
- Specific countries and specific types of TF reforms, including for example the country studies in Wilson, Mann, Pau, Assanie, Choi (2002) Moise (2003)

Case studies of TF reforms in specific countries are extremely valuable because they can more explicitly address the costs of engaging in some of these reforms, as well as consider the benefits. But, being a specific country analysis, the conclusions may not be applicable to other countries. As more case studies are done on a consistent basis, and with attention to initial conditions in the country, the case study method will increase in value for policymakers.

Finally, the advantage of the third type of analysis—complex econometric analysis—is that many countries and many types of TF can be considered at once. There are two types of this research that depend on statistical modeling. One type of model (computable general equilibrium or CGE model) considers only one type of TF reform – that to transportation. The other type of model (so-called gravity econometric model) incorporates multiple TF indicators in the same analysis, which enables a comparison of the importance of one TF area vs. another.

Key research in this area includes:

- CGE with TF proxied by trade cost or productivity parameters including, APEC (1999), UNCTAD (2001), Walkenhorst and Yasui (2003)

- Gravity models incorporating border and behind-the-border TF measures, including Wilson, Mann, Otsuki (2003, 2005); OECD (2003, 2005); Francois and Manchin (2007).

A gravity-type econometric model with multiple TF measures enables a comparison of the importance of one TF area vs. another, which can assist policy consideration. However, to date, gravity models have focused on total merchandise trade for a country, not trade in specific products.

This research in this paper uses trade data, supply-chain data, and trade facilitation measures that are all product specific. This matching by product allows us to see which areas of TF reform might yield the biggest gains in trade because of the differential potential of certain TF reforms to improve the international supply chain competitiveness in product that are key to international trade performance.

1.2 A Product-Focused Tool

The greatest challenge to new research on trade facilitation is to find conceptually distinct measures of trade facilitation that meet policymakers needs for specificity on how to

approach trade facilitation efforts. Should they focus on ports and related infrastructures, on customs reforms, on international regulatory harmonization, or financial markets or ICT networks? Of course there are synergies among these various reforms, but limited resources mean that not all can be tackled at once. The payoff from policy effort in one TF area might be much bigger than that from reform in some other area. Previous efforts that focus deeply but narrowly on one area of trade facilitation, such as transport infrastructures, while extremely valuable, do not provide the comparison overview that decision-makers seek.

Wilson, Mann, Otsuki (WMO 2003, 2005 and related papers with additional authors) pioneered analysis using disaggregated trade facilitation measures. They considered four different areas of TF: port (air and sea) efficiency, customs environment (including corruption), regulatory environment and adherence, and ICT usage. However, this work used the same TF data for all products in trade—e.g. the TF measure for port efficiency for trade in foods was assumed to be the same as the TF measure for port efficiency for trade in electronics—because TF data were not available disaggregated by product. Moreover, this (and most other) previous research has focused on the impact of improved TF measures for increased trade in manufactured goods overall rather than investigating what might be achieved for international trade of certain products if TF reforms are pursued along one vs. another dimension.

The new methodology offered in this paper is unique in that it matches trade data for products with trade facilitation measures for those same broad product groups. Further, we derive measures of the supply chain (so-called supply chain intensity) for each of these broad product groups that correspond to the trade facilitation areas. No previous research has used sector-level TF measures, no other research has investigated supply chain intensities for a wide range of sectors using a consistent methodology, and no research has considered sector-specific TF measures in light of sectoral trade patterns.

The focus on sector-level analysis is important for several reasons. First, obviously the product mix a country trades differs from one country to another. If the characteristics of international supply chains differ across these products (some more intensive in the use of ports, others more intensive in the use of ICT) then what a country trades exposes it to different TF needs to maintain or become competitive in the international supply chain. Indeed, case studies of international supply chain in autos, apparel , and furniture cited above reveal different relative dependencies on different areas of we call the TF environment. Similarly, research on the role of ICT in the international supply chain (Mann, 2006) yielded differences by broad product group in the importance of ICT usage in the international supply chain—from very important for the electronics and processed food supply chain, to less important for extractive industries. This report proposes using an input-output matrix to define supply-chain intensity in the various TF aspects for each type of traded product.

Second, the perceived adequacy of the country's current TF environment may differ across sectors. That is, because supply chains differ across products, firms in one sector may be adequately served by the country's current TF environment, but firms in a

different sector may be held back by the country's TF environment. Therefore getting information about the state of a country's TF environment from the standpoint of firms in specific sectors is important. We use newly available data on TF by sector in the template economies that map into five areas of the TF environment.

1.3 Specifics of the Tool

The tool that is developed here builds country and product specific TF measures in six areas that map into country and product-specific supply chains and international trade data. The tool allows a country to benchmark its product-specific TF characteristics against other countries and allows a country to investigate whether its TF environment is strongest in those areas demanded by the international supply chain for the products that it trades the most.

In overview, the tool incorporates the following data. Discussion of the specifics of the data for the template countries follows in the next section of this report.

Product groups are chosen because much of the trade facilitation data are available according to these broad product groups. These product categories are also used to describe the trade patterns of a country. Finally, these product categories are also used for the variables on supply chain intensity. Details on how trade data are aggregated into these Product Groups are in Appendix 1.

<u>Product Groups, for trade, for TF measures, and for supply-chain intensity</u>

- Auto and auto components
- Chemicals and pharmaceuticals
- Electronics
- Food
- Garments
- Metals and Machinery
- Non-metallic and plastic materials and manufactures
- Other manufacturing
- Textiles
- Wood and furniture
- Other, including mining

Six areas within the trade facilitation environment are considered. Each is available for the product-specific category (above). We create a corruption variable (for each product group) and include it for consideration as part of the TF rubric. The details of the data underlying each TF measure are in Appendix 2.

<u>Trade Facilitation areas, for each product category, most of which are mapped into supply chain intensity</u>[5]

- Infrastructure

[5] More complete descriptions of these TF categories are in Appendix 2

- Customs environment
- Regulatory adherence to international standards
- ICT infrastructure and usage
- Financial market access and quality
- Corruption

Finally, we use input-output matrixes to generate a product-specific variable called the 'supply chain intensity' that allows us to map the TF areas into the supply chain for each product. If the production of a product, say processed foods, uses relatively more inputs of say, ICT, then we can say that processed foods has an ICT-intensive supply chain. Appendix 3 gives more details on how input-output matrixes are used to generate supply-chain intensities.

<u>Supply Chain Intensity, for each product category and mapped into TF measures</u>

- Port/transport
- ICT
- Finance
- Regulation-related services

How can all these indicators come together and be used? First, since the point of this TF analysis is to understand the impact of the trade environment on trade, we must start with describing what products a country trades. Starting with very detailed data, we build up to trade aggregates that match the Product Group. Since we build up to this aggregate, we also know important underlying detail. For example, we know that about 30 percent of Brazil's exports is in the Food category, comprising 20 or so categories of food products. The detailed data reveal that 6 percent of total exports is 'oil seeds, oleagi fruits, miscellaneous grains and seeds', part of the Food aggregate. See the next section and Appendix 1 for more discussion and details of exports for the template countries.

Second, the TF indicators for each Product Group can be compared with neighboring countries, countries in a similar income cohort, or with competitors in international trade. Such benchmarking of a country against others can be useful for assessing the overall TF environment, and can be an input into the policy agenda. To continue the Brazil example, Brazil's exports of this detailed category 'oil seeds, oleagi fruits, miscellaneous grains and seeds' accounts for 16 percent of the world market! Even so, Brazil is number two in the global market in this detailed product category; the number one global exporter is the United States and number three global exporter is Argentina, so these are Brazil's main competitors in the international marketplace for its key export within the food product group. Among the many comparisons to be made, for this Report we compare the TF indicators for each Product Group against the Latin American and Caribbean average.

Third, adding in the Supply Chain Intensity, allows the country to consider the relative importance of the TF measures for key exports. Continuing the example, according to the SCI measure, 'food' production uses, among the TF categories, relatively more 'finance' inputs in production. Therefore, for this example where Brazil exports a lot of

processed foods, the quality of its ‘finance’ infrastructure will be particularly important in the sense of facilitating trade in the country’s key export. And, comparing Brazil’s ‘finance’ infrastructure with its international competition gives policymakers an idea of how they stack up against global competitors in the most important area of the supply chain of its most important export product.

Part 2—Analysis for Template Countries

2.1 Benchmarking: Introduction

The ultimate objective of the TF analysis is to aid policy design. Benchmarking TF metrics is the core of this exercise. In some previous analyses benchmarking has looked at a time series of a specific country-wide TF indicators (such as days to clear customs) to benchmark changes; but most TF indicators are not available over time. Another approach to benchmarking has been to compare, at a point in time, a set of country-wide TF indicators to other countries in the neighborhood, or to other regions or income groups (WMO do this).

The key innovation of this analysis is TF metrics for a country for different products. Thus, the primary benchmarking objective in this Report is to compare a country's TF metrics against the TF areas used most intensively in the supply chain of the product that is most important in the country's export trade. Focusing on the intersection of key export products and key TF metrics in the supply-chain of these products offers a new input into the policy discussion about how to use TF reform to generate the greatest gains in trade competitiveness.

Benchmarking performance over time is also important, however. For a few of the country-wide TF indicators, data are available to examine the change in TF over time and to compare the template countries with other regions and income groups.

2.2 Trade Intensities: Overview

The first piece of the product-level benchmarking exercise is international exposure through trade by product groups. Table 1 shows, for each of the template economies, the relative importance of the export product groups that match the product-specific TF metrics. These are the trade shares that we will use throughout the analysis.

Table 1 reveals that exports of the product group 'food' is quite important for all of these economies. But, there are 22 2-digit HS codes in the 'food' group as compared to only 1 in the 'auto and auto components group'. (HS is the so-called Harmonized Systems of classification of traded products. See Appendix 1) So does the aggregation mean that 'food' is overstated in the exports of these economies? Looking at the details in the Appendix Tables, a selection of which are shown in Table 2 suggests that this is not the case and that the aggregated groups do a good job in describing important trading patterns in the economies exports.

Table 1: Export intensity for template economies

Share of Sectors' Exports of Country's Total Exports					
Sector	Argentina 2006	Brazil 2003	Colombia 2006	Dominican Republic 2001	Peru 2006
Auto and auto components	8.64%	8.26%	3.20%	0.12%	0.03%
Chemicals and pharmaceutica	6.01%	5.01%	4.65%	5.37%	1.55%
Electronics	0.92%	4.34%	1.50%	0.94%	0.15%
Food	44.69%	29.01%	15.22%	41.09%	14.89%
Garments	0.28%	3.14%	4.78%	1.31%	5.22%
Leather, Fur and Feather	2.22%	1.62%	0.79%	0.59%	0.16%
Metals	5.32%	10.52%	8.86%	19.32%	19.56%
Power and transport equipme	3.17%	10.60%	1.61%	0.34%	0.33%
Non-metallic and plastic mate	4.72%	4.54%	10.27%	4.46%	20.50%
Other manufacturing	0.49%	0.80%	0.53%	0.21%	0.13%
Textiles	0.85%	1.36%	1.05%	0.11%	1.10%
Wood and furniture	1.24%	6.19%	0.75%	1.46%	0.95%
Other	21.46%	14.62%	46.78%	24.68%	35.43%

Dates for trade data chosen to match dates for which TF metrics are available
Product groups chosen to match groups for which TF metrics are available

Table 2 gives alternative approaches to determine trade exposure. It shows the top five products in a country's exports, the share of those products in global exports. In the third panel, it shows the products of the country that are the highest share of world exports. For Argentina, for example, which has a 45% share of 'food' exports, three of its top five exports (left panel in green) are also tops in world exports of those products (middle panel in green), and also are the products in which Argentine exporters take the top world market share.

Brazil offers a different perspective. Its export exposure is also in 'food'. Looking at the detail in Table 2, only one 2-digit HS 'food' code is in the top 5 exports. But looking at the middle panel and right panel, it is clear that indeed food is the major export group for Brazil. The other top 5 2-digit HS codes in the left panel are very small in their global export markets (red). And, the world markets where Brazil excels (blue in the right panel) are mostly food products.

Table 2: Alternative Definitions of Trade Exposure: Examples
Green: High shares of exports and world market
Red: High shares of exports, but low importance in world market
Blue: Tops in world market, but not tops in own export ranking

Top 5 Exports (% of Country's Total Exports)		Top 5 Exports (% Worlds Exports)		Top 5 Shares in the World Market	
Argentina 2006		**Argentina**		**Argentina**	
Mineral fuels, oils & product of their distillati	14.63%	Mineral fuels, oils & product of their distillati	0.47%	Residues & waste from the food indust; pre	14.57%
Residues & waste from the food indust; pre	10.02%	Residues & waste from the food indust; pre	14.57%	Animal/veg fats & oils & their cleavage proc	9.03%
Vehicles o/t railw/tramw roll-stock, pts & ac	8.64%	Vehicles o/t railw/tramw roll-stock, pts & acc	0.40%	Oil seed, oleagi fruits; miscell grain, seed, f	6.19%
Animal/veg fats & oils & their cleavage proc	8.34%	Animal/veg fats & oils & their cleavage proc	9.03%	Cereals	5.98%
Cereals	6.35%	Cereals	5.98%	Raw hides and skins (other than furskins) a	3.11%
Brazil 2003		**Brazil**		**Brazil**	
Vehicles o/t railw/tramw roll-stock, pts & ac	8.26%	Vehicles o/t railw/tramw roll-stock, pts & acc	0.85%	Oil seed, oleagi fruits; miscell grain, seed, f	15.90%
Nuclear reactors, boilers, mchy & mech app	7.72%	Nuclear reactors, boilers, mchy & mech app	0.54%	Sugars and sugar confectionery.	12.90%
Iron and steel.	6.42%	Iron and steel.	2.91%	Ores, slag and ash.	12.49%
Oil seed, oleagi fruits; miscell grain, seed, f	5.93%	Oil seed, oleagi fruits; miscell grain, seed, f	15.90%	Residues & waste from the food indust; pre	10.92%
Mineral fuels, oils & product of their distillati	5.19%	Mineral fuels, oils & product of their distillati	0.56%	Coffee, tea, matï and spices.	10.84%
Source: Sector HS Definition spreadsheet		Source:World Data spreadsheet		Source:World Data spreadsheet	

Another observation revealed by these tables is that for many of the 2-digit products, and therefore the TF categories as well, key competitors and/or supply chain partners are also neighbors. (Table 3 is color coded to match 2-digit HS codes across the template countries.) Why competitor and/or supply chain partner? The 2-digit HS codes are still quite aggregated and contain much more detailed segments of the globally fragmented production process. Two countries that export the same 2-digit HS products could be producing and exporting different parts of a common supply chain, so they would be supply chain partners. But, those firms might want to expand their part of the supply chain, which would put them into competition in the export market with their neighbors. Consider Brazil and Argentina in HS 87 'vehicles other than railway…. '. Or, two countries that have similar supply chains but very different products within the HS code, could learn from each other about TF metrics and their importance in the supply chain. For example, Colombia's number 4 exporters of HS 71 'pearls, precious stones' could learn from Peru's HS 71 exporters and visa-versa.

Table 3: Key Exports by Detailed Product Code
(Color codes show competitors/supply chain partners among template set of economies.)
See Appendix 1 for other competitor countries

Top 5 Exports (% of Country's Total Exports)

Argentina		Brazil	
Mineral fuels, oils & product of their distillati	14.63%	Vehicles o/t railw/tramw roll-stock, pts & access	8.26%
Residues & waste from the food indust; prepr ani	10.02%	Nuclear reactors, boilers, mchy & mech appliance	7.72%
Vehicles o/t railw/tramw roll-stock, pts & access	8.64%	Iron and steel.	6.42%
Animal/veg fats & oils & their cleavage products;	8.34%	Oil seed, oleagi fruits; miscell grain, seed, fru	5.93%
Cereals	6.35%	Mineral fuels, oils & product of their distillati	5.19%

Colombia		Dominican Republic	
Mineral fuels, oils & product of their distillati	38.43%	Iron and steel.	17.76%
Coffee, tea, matï and spices.	6.12%	Mineral fuels, oils & product of their distillati	15.81%
Iron and steel.	5.20%	Sugars and sugar confectionery.	8.41%
Plastics and articles thereof.	4.30%	Edible fruit and nuts; peel of citrus fruit or me	7.48%
Natural/cultured pearls, prec stones & metals, co	4.01%	Cocoa and cocoa preparations.	5.24%

Peru	
Ores, slag and ash.	26.49%
Natural/cultured pearls, prec stones & metals, co	19.35%
Copper and articles thereof.	15.04%
Mineral fuels, oils & product of their distillati	8.00%
Residues & waste from the food indust; prepr ani	5.01%

Source: Sector HS Definition spreadsheet

Of course, global competition is not just with the neighbors. Trade facilitation matters for keeping the country's exporters competitive vis-à-vis other global competitors. Appendix Table A1-6 details which countries are the competitors for the top export products for each template economy.

2.3 Trade Facilitation Data: Overview

Several sources were employed to create the Trade Facilitation measures. The most important source was the World Bank's Enterprise Survey Portal.[6] This comprehensive survey covers firms' responses to multiple questions on the investment climate and business environment, as shaped by domestic economic policy; governance; regulatory, infrastructural and financial impediments, as well as assessments of public service quality. To our knowledge, this is the only source of trade facilitation indicators at the industry level. The data available for the countries of interest is available for the following years: Argentina-2006, Brazil-2003, Colombia-2006, Dominican Republic-2005 and Peru-2006.

Each trade facilitation measure in this report was created by taking the average of several survey and data indicators. This approach is discussed in depth in WMO (2003). Table A2-1 shows the specific questions taken from the Enterprise Survey and other sources to create these variables.

[6] www.enterprisesurveys.org/Portal/.

Table 4 shows gives an example of the inputs to the product-specific TF measures for Peru.[7] The values for the indicators also vary by sector, indicating the potential additional information to be gained on the nature of the TF environment by disaggregating by product group.

[7] Average is the average response from survey firms. Count is the number of firms surveyed.

Table 4: Example of Trade Facilitation Inputs: Peru

Inputs to the product-specific Regulation TF				
Sector	% of Firms with ISO certification ownership		% of Firms with annual financial statement reviewed by external auditor	
	Average	Count	Average	Count
Chemicals and pharmaceuticals	24.84	83	39.27	82
Food	22.87	120	35.82	119
Garments	23.52	119	33.33	120
Textiles	0	35	14.63	35
Other	0.49	20	47.84	19

Inputs to the Product-Specific ICT TF Measures						
Sector	% of Firms using technology licensed from foreign companies		% of Firms using the Web in interaction with clients/suppliers		% of Firms using email to interact with clients/suppliers	
	Average	Count	Average	Count	Average	Count
Chemicals and pharmaceuticals	20.38	83	62.6	83	97.12	83
Food	8.94	120	36.53	120	85.25	120
Garments	5.8	120	56.42	120	85.16	120
Textiles	10.48	35	20.09	35	96.26	35
Other			68.77	20	100	20

	Inputs to the Product-Specific Customs TF Measures									
Sector	Average time to clear direct exports through customs (days)		Average time to claim imports from customs (days)		% of Firms That Trade Identifying Customs & Trade Regulations as a Major Constraint			Products exported directly lost due to theft (%)		
	Average	Count	Average	Count	Average	Count	Standard Deviatio	Average	Count	Standard Deviatio
Chemicals and pharmaceuticals	4.03	33	10.13	56	15.27	75	36.91	0	35	0
Food	4.91	37	15.33	41	7.51	74	27.48	0.29	39	0.92
Garments	3.71	43	11.14	29	6.54	74	37.11	1.05	45	14.88
Textiles	5.69	9	13.73	10	9.18	22	29.42	0.03	9	1
Other					20.59	11	40.45			

Table 4: continued

Inputs to the Product-Specific Corruption TF Measures						
Sector	% of Firms expected to pay informal payment (to get things done)		% of Firms Identifying Corruption as Major Constraint		% of Firms believing the court system is fair, impartial and uncorrupted	
	Average	Count	Average	Count	Average	Count
Chemicals and pharmaceuticals	19.22	66	57.43	78	11.63	80
Food	11.53	97	60.24	118	6.12	115
Garments	9.14	108	63.17	119	12.07	114
Textiles	9.68	31	59.61	35	7.26	33
Other	23	13	71.75	20	1.5	18

Sector	Inputs to the Product Specific Finance TF Measures											
	% of Firms with Bank Loans/Line of Credit		% of Firms Using Banks to Finance Investments		Supplier credit financing (%)		% of Firms Using Banks to Finance Expenses		Supplier Credit financing (%)		% of Firms Identifying Access/Cost of Finance as a Major Constraint	
	Average	Count	Average	Count	Average	Count	Average	Count	Average	Count	Average	Count
Chemicals and pharmaceuticals	69.1	82	33.21	83	8.68	62	54.73	83	21.78	83	25.45	83
Food	64.59	119	31.52	118	7.63	70	60.63	119	17.12	119	17.1	118
Garments	73.12	120	34.45	120	13.42	87	51.76	120	15.67	120	16.34	119
Textiles	48.89	35	34.42	35	22.89	23	51.79	35	11.13	35	19.68	35
Other	70.2	20	55.56	20	7.32	15	70.15	20	12.8	20	27.75	20

For some of the TF measures—corruption, customs, ports—the inputs to the TF metric are similar to those in previous TF research, except our TF measures are on a product-specific basis. The infrastructure variable is broader than just ports/transport, including electricity as well. For this metric we examined augmenting the sector-specific inputs with some country-wide metrics from Logistics Performance Indicators, the Doing Business Survey and the World Bank Trade Indicators. The comparisons are the same.

Building on the analysis of economy-wide TF indicators of WMO, which showed the importance of 'behind the border' TF such as ICT and regulations, we push the TF research frontier further with product-specific TF in the areas of finance, regulatory adherence, and ICT. The finance TF averages the shares of firms that have access to various types of finance, including lines of credit, bank loans, and supplier credit. The regulatory adherence and standards TF measure averages the share of firms with ISO certification and the share of firms whose annual financial statements are reviewed by an external auditor. The ICT TF metric averages the share of firms that engage in web-enabled transactions, that use technology licensed from foreign companies' it also incorporates the delay in getting a telephone line.

Not all product groups for all countries have data for all of the survey questions, and some product groups are not represented at all. For example, no survey data are available for the product group 'autos and auto components', which accounts for nearly 10 % of exports for Argentina and Brazil. Important product-specific TF data missing for Brazil are 'power and transport' equipment (11% of exports). Important TF data missing for Colombia are product-specific TF data for metal products (9% of exports) and non-metallic and plastic products (10% of exports). Important TF data missing for Peru are product-specific TF data for metal products (20% of exports) and non-metallic and plastic products (20% of exports). To the extent that these product-specific data could be obtained on a consistent basis, perhaps with the help of local Chambers of Commerce, the World Bank data set would be that much stronger for this type of product-specific analysis.

2.4 Supply-Chain Intensities: Overview

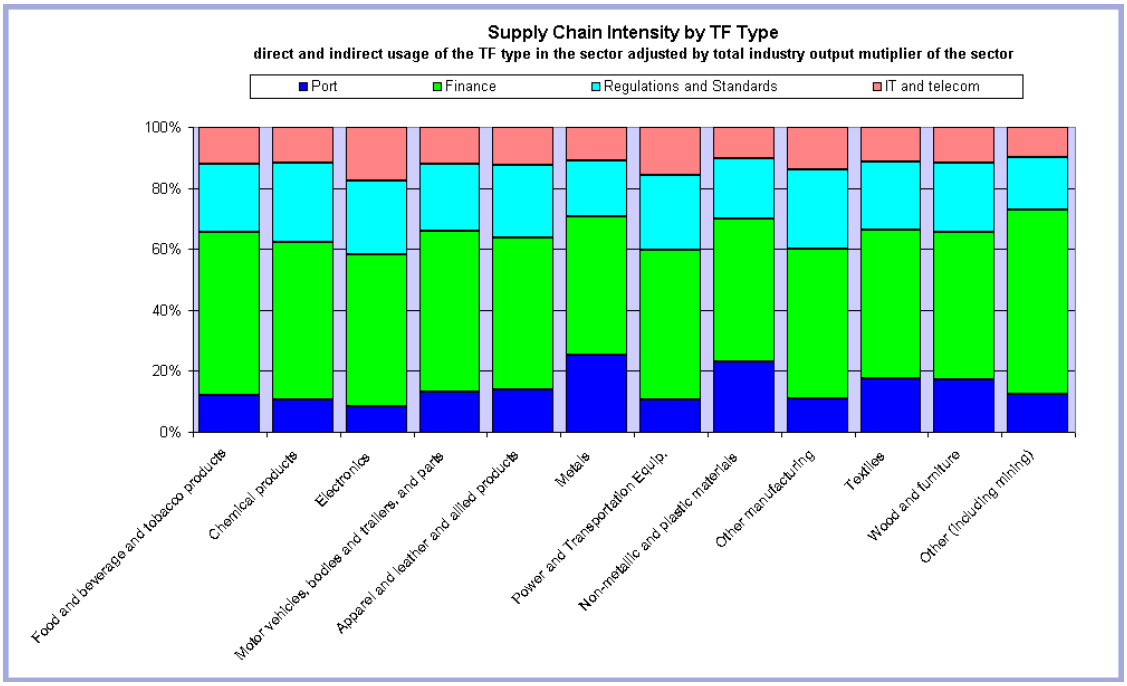
Using an input-output matrix to create a supply-chain intensity is a relatively new idea[8] and has not been applied to TF analysis before because product-specific TF were not available. We have input-output matrixes at differing degrees of detail for Argentina and Colombia, which we do use in the analysis. Here we focus on the very detailed I-O matrix of the United States to discuss how to create the supply-chain intensities. As a major buyer of the region's exports and as a world leader in foreign direct investment (which may play a role in driving supply chain requirements[9]), the US supply chain probably gives a good picture of what are the key inputs to the global supply chain.

[8] This method is used in National Research Council (2006) to investigate the foreign content of US exports and US content of imports.
[9] See the case discussion of the Thai autoparts manufacturer in Mann, Eckert, and Knight.

Creating the Supply-Chain Intensity measure starts with matching the inputs (rows) in the I-O matrix to the TF indicators. Then the outputs (columns) of the I-O matrix are matched to the product categories in both the TF data and the trade data. See Appendix 3 for more discussion of mapping the I-O inputs to the trade facilitation metrics and I-O outputs to the trade product groups.

For the rest of the analysis, we use the supply-chain intensity of each TF metric—ports/transport, finance, ICT, and regulations and standards—for each product group. These supply-chain intensities will be examined against the TF metrics for the template economies. Figure 1 shows the relative importance shares of the four inputs to the supply chain; these are the supply-chain intensities. These supply chain intensities only address the parts of the supply-chain that match the TF measures. Of course other aspects of the supply chain will be even more important, such as distribution and of course labor share. (See Appendix 3 for more details.)

Figure 1: Supply-Chain Intensity by Product



We are now ready to discuss the data from the standpoint of the template economies.

2.5 Benchmarking the Overall Trade Facilitation Environment

Appendix 4 contains the full set of charts for the template economies comparing the overall TF environment compared with the regional average. Because the data for the template economies are available for various years between 2003 and 2006, the TF

metrics for the regional as a whole can be seen in time series. Examples for Argentina (2006) and Brazil (2003) are shown in Figure 4.

The first observation is that between 2003 and 2006, LAC region improved TF measures across the board. Improvements in finance and regulation were most needed, and are still lagging compared with customs and infrastructure. Perceived corruption in the region remains about unchanged.

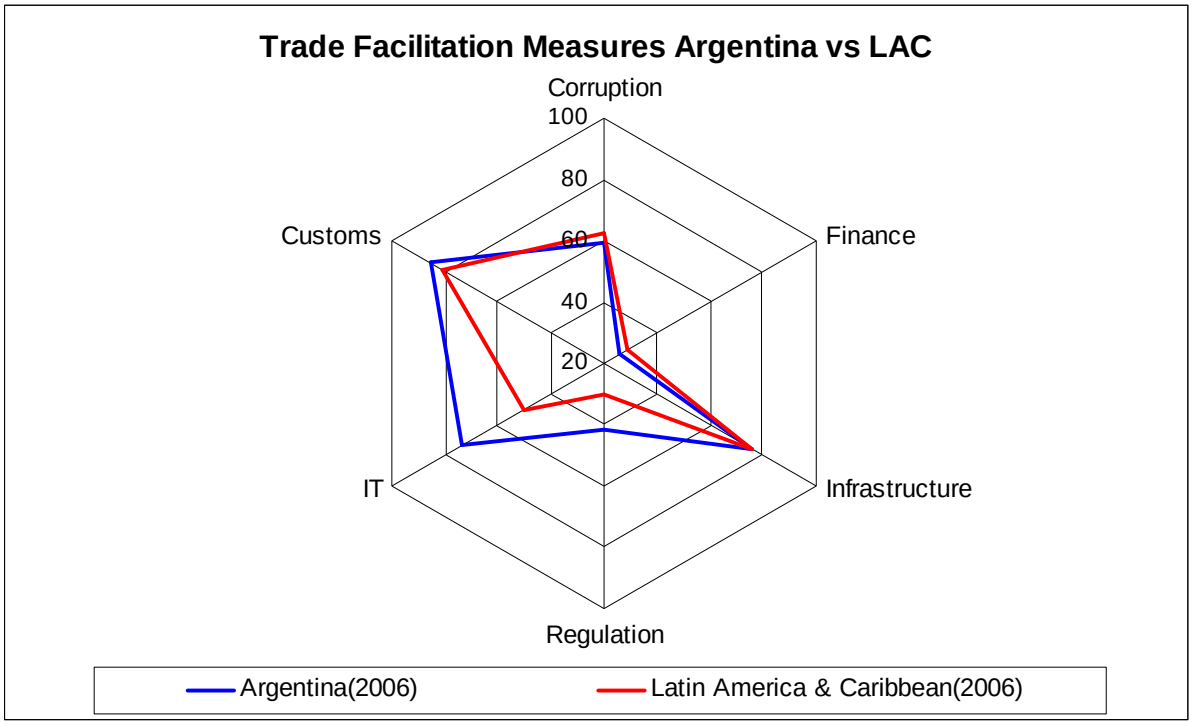
The next set of observations compares the template countries to the LAC regional average.

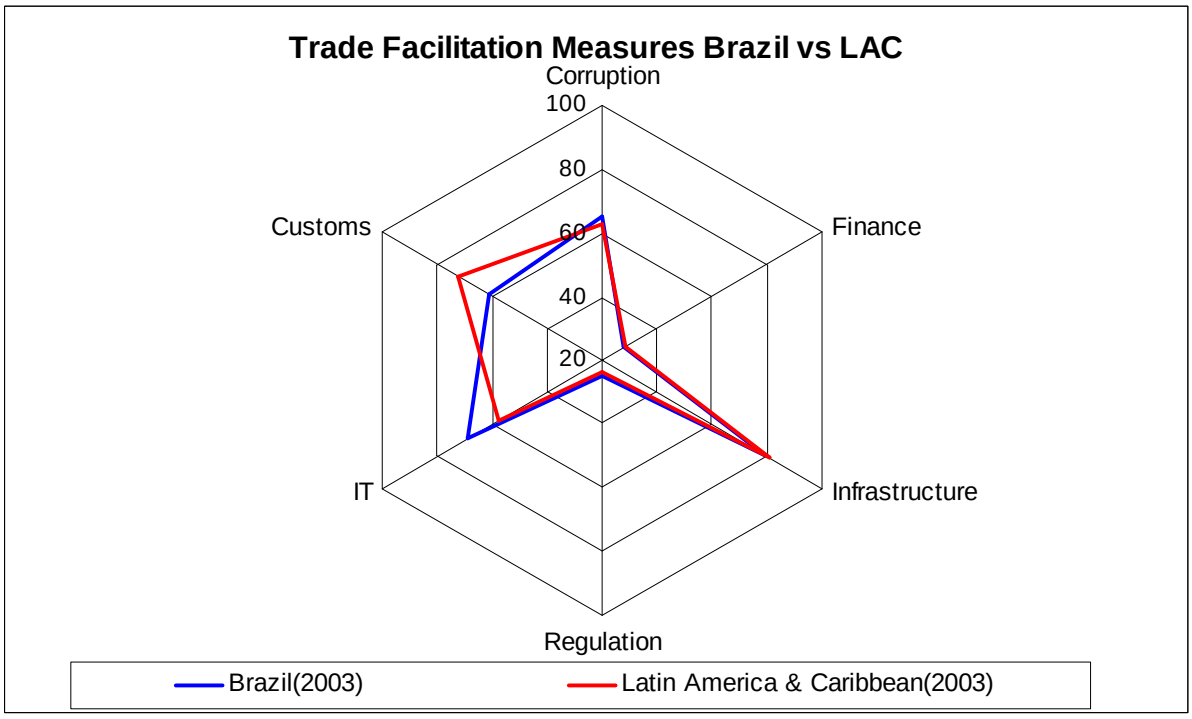
For Argentina in 2006, its overall TF environment is superior to the average for the region, except lagging a bit in corruption and in financial access (use of banks and supplier credit). Argentine ICT environment (use of licensed technology, web-based transactions, and lack of telecom delay) appears particularly better than in the region. For Brazil in 2003, the customs environment (perceived problems and days to clear) lagged the region as a whole, but the ICT environment was superior.

In reviewing the Appendix charts for the other economies, the TF environment in Colombia in 2006 was better than for the region as a whole, except in the areas of infrastructure (electricity and transport), and in regulatory adherence (ISO and external audit). The TF environment in Dominican Republic in 2005 lagged the region as a whole in all areas except regulatory adherence. The TF environment in Peru in 2006 exceeded the regional average in customs, and was quite a bit better in the finance and ICT areas. region

These are overall pictures of the regulatory environment. Now the product-specific perceptions and survey data need to be brought together with the supply-chain intensities and the trade shares.

Figure 2: Examples of Overall Trade Facilitation Environment: Country vs. Latin region





2.6 Benchmarking Product-Specific Trade Facilitation, Supply-Chain Intensity, and Trade Importance

The example figures shown below (all product categories for the template economies are in Appendix 5), shows how the combination of TF metrics, trade shares, and SCI can give insights into whether a country has an adequate, inferior, or superior TF environment given supply-chain intensities of the products that are key to its current export performance. These figures show the trade facilitation environment facing producers in the specific product, for the economy as a whole, and for the Latin America and Caribbean (LAC) region.

For some economies, we have the country's own I-O matrix and therefore construct the country's own product-specific SCI. Comparing the supply-chain intensities as derived from the country's own I-O matrix vs. the supply-chain intensity from the US I-O matrix also may yield important insights. Differences in input requirements could be due to different mix of products, as well as differences in the input industries, and certainly could be affected by the share of production destined for domestic vs. international markets. Similarities in input requirements might be due to the globalization of the supply chain and the use of common technologies, or requirements coming from direct investment partners, among other things.

Figure 3 shows the data for one of Argentina's major export groups: Food (45% of exports). First, let's look at the supply-chain intensities, since this will indicate which inputs to the supply chain for foods are the most important. Since we have an input-output matrix for Argentina, both the supply-chain intensity for Argentina (in red) and for the US (in dotted black with bold circles) are shown.

First, comparing the Argentine SCI with the US SCI suggests that regulatory inputs are a very important part of the supply chain, regardless of whether Argentina's I-O matrix or the US I-O matrix is used. The port/transport and electricity infrastructure is more important in the Argentine SCI, whereas finance is of greater importance in the US SCI. ICT inputs do not appear to be particularly important in either SCI.

Therefore, to maintain competitiveness in the international supply chain, Argentine 'food' producers need a TF environment strong in *regulatory adherence* for sure, and in infrastructure and/or finance, depending on whether the Argentine or US SCI is the focus. If the focus is on exporting to the US market, then the US SCI may be the more important one to consider.

So, how does the trade facilitation environment for 'food' exporters stack up? Comparing the product-specific TF measure (in blue) against the business environment measure for the country as a whole (dotted black) along the four dimensions of supply chain intensity reveals that in fact Argentina's 'food' specific business environment is much better than the country's overall average in terms of the key area of *regulation.* In other important areas of the supply chain, such as infrastructure, the environment of the

‘food’ exporters is about on par with the country average. The ‘food’ business environment measure ranks higher for finance. This is consistent with the demands of the US SCI. The ‘food’ TF measure for ICT is not as good as the economy-wide average, but since the supply-chain intensity of ICT appears to be less important, being a bit behind may not necessarily hamper the ‘food’ exporters.

Comparing the Argentine ‘food’ environment to that for the LAC region as a whole (in green) indicates that Argentina’s ‘food’ exporters appear to enjoy an overall superior trade facilitation environment compared to its competitors in the region.

Figure 4 shows an example of how to use the benchmarking tool for a newly-important export-oriented industry for Colombia: ‘Garments’. Although ‘garments’ represent a small share of Colombia’s exports (6%), it is an industry that potentially could contribute to the diversification of manufacturing for the country. The benchmarking tool allows an assessment of whether firms in this export sector are operating in a environment conducive to international competitiveness or not.

A look at the supply-chain intensities (both from Colombia’s I-O matrix, shown in red, and the US I-O matrix, shown in dotted black with bold circles) suggests that inputs of regulatory services are important for international competitiveness in the ‘garment’ industry. Financial access is important to participate in the US supply chain, but is less important for domestic suppliers in Colombia.

The product-specific TF measures (shown in blue), however, reveal that the most business-friendly aspects of the Colombia economy for ‘garment’ exporters are ICT and infrastructure—not the inputs of greatest intensity as measured by either of the SCIs.

The fundamental observation, however, is that the ‘garment’ business environment (in blue) for all areas of the supply chain scores lower than the overall business environment in Colombia (black dotted). This suggests that the Colombia ‘garment’ industry is operating in a less-than favorable environment for exporting. Even though all the areas of business facilitation need improvement for this industry, the supply-chain intensity suggests that the areas in greatest need for improvement are regulatory adherence and financial access.

Further insights come from comparing the environment facing Colombia’s ‘garment’ exporters with the business environment of ‘garment’ exporters from other LAC region economies. In general, the Colombian firms are not at a particular disadvantage, except in the area of finance. In finance, the ranking for the TF environment for LAC ‘garment’ products (in green) is higher than that for Colombia (in blue).

Finally, Figure 5 gives another example of how to use the benchmarking tool, using data for Brazil. Electronics exports are not a large market for Brazil (6% of exports), but this industry has been the focus of policy attention in the past. What do the data on supply chains and on trade facilitation suggest about business environment? Do they point to areas for further policy action? The US I-O matrix (in red) suggests that ICT is a key

input to this industry, as is regulatory adherence. Finance is important, but port/transport infrastructure is the least of the requirements in the supply chain for international competitiveness.

Comparing the ranking of the 'electronics' trade facilitation (in blue) with the indicators for the business environment for the economy as a whole (black dotted) suggests that the Brazilian electronic industry enjoys an above average business environment along the four dimensions of ICT, infrastructure, regulation, and finance. However, given the dominance of regulation in the supply chain (in red), the fact that the business environment does not rank particularly highly suggests additional policymaker investigation.

Moreover, when Brazil's 'electronics' business environment is compared to that of its competitors in that industry in the LAC region, some issues crop up. It appears that on average 'electronics' exporters in the LAC region enjoy higher ranked infrastructure than do the Brazilian exporters. So, infrastructure could be a weak point for Brazilian 'electronics' exporters, even though infrastructure is not the most important piece of this supply chain.

Appendix 5 contains all the product-specific figures for the template economies.

Figure 3: Example: Argentina—Food Products

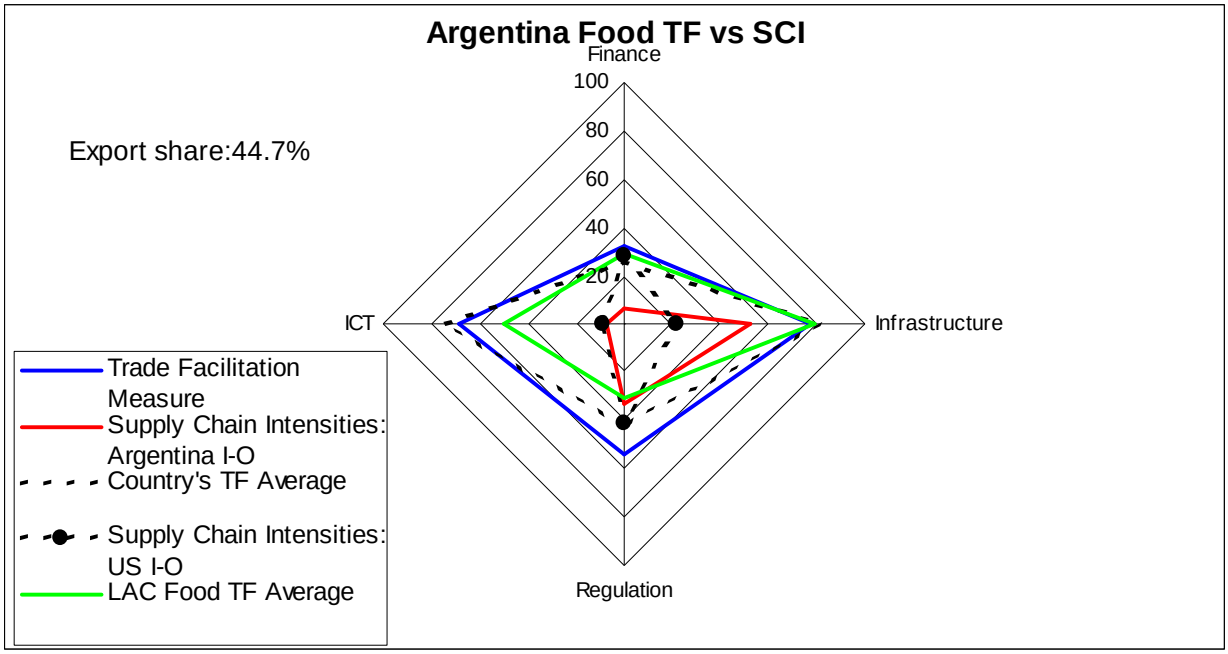


Figure 4: Example: Colombia--Garments

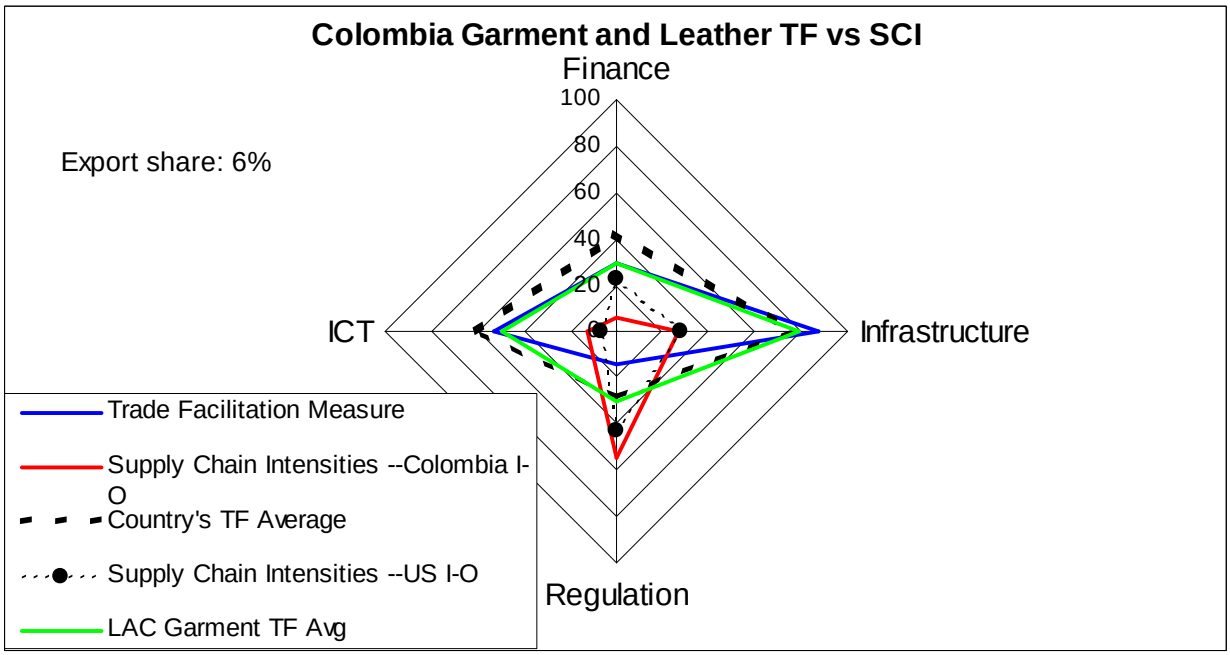
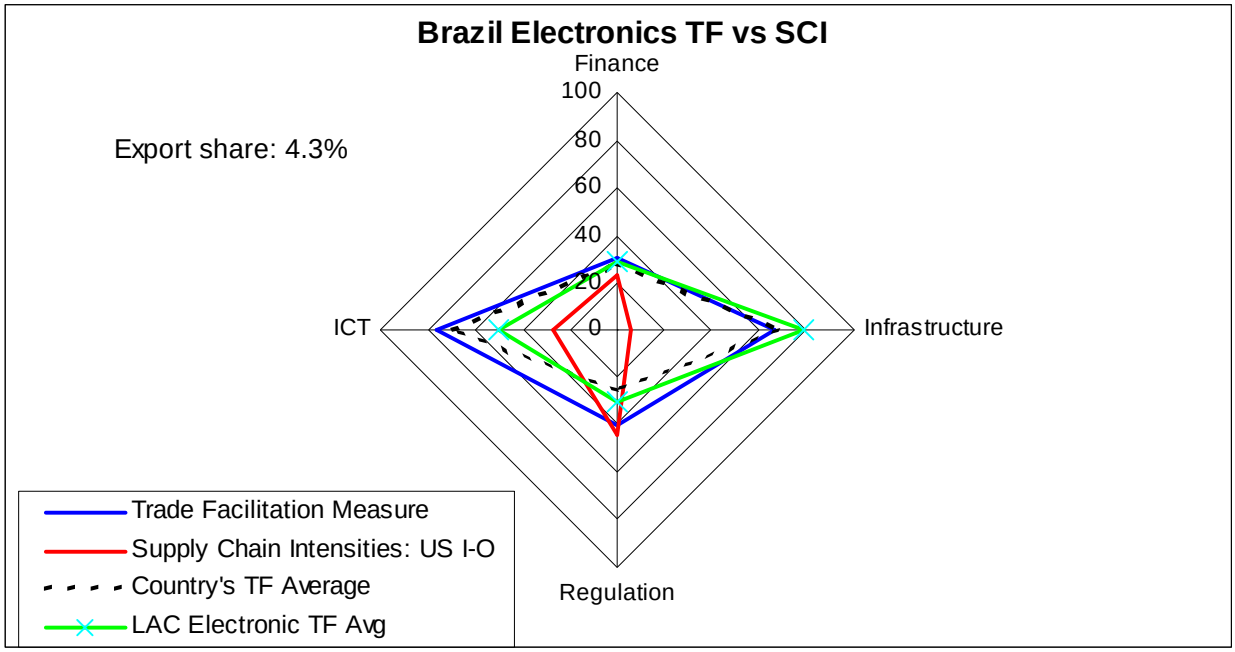


Figure 5: Example: Brazil--Electronics



Part 3—Quantifying Gains from Trade Facilitation for the Template Countries

3.1 Overview

Benchmarking a country's TF metrics against other countries, paying attention to supply-chain intensities and trading patterns, is an important step in considering the direction for policy. However, policy makers often ask, "If we make improvements in TF areas, what will be the gains?" Answering this question requires not just benchmarking, but choosing a methodology to estimate the relationship between trade facilitation metrics and trade flows.

One approach to quantifying the relative importance of trade facilitation improvements is based on an econometric model, the details of which are in Appendix 6. Table 5 displays the overall regression results from the model. The higher the coefficient estimate, the more important that type of trade facilitation is in generating increased trade flows. Overall, the analysis confirms that trade facilitation involves more than reducing the cost of transport—although that factor is quite important.

Before considering trade facilitation issues, it is worthwhile to look at the results for a well-known and quantifiable barrier to trade—tariffs. Tariffs have a significant and expected negative effect (coefficient of –1.2) on trade. This means, if the global average tariff rate fell from 8.5% to 7.5%, overall bilateral trade flows would increase by 1.2 percent. This is a useful benchmark figure against which to compare the importance of different types of trade facilitation.

In looking at the various measures of trade facilitation, it is clear that the most important type of trade facilitation for a country to improve is its 'e-business usage' ('exporting country' coefficient is the largest at 1.94). *'E-business usage'* is a proxy for both ICT infrastructure as well as financial infrastructure—both of which were seen in the country-specific supply-chain analysis to be particularly important in the global supply chain.

Among the other types of trade facilitation, *Port Efficiency'(*a proxy for ports and transport) of both the importer and the exporter is positively associated with trade, implying that better ports increases trade flows. The coefficient is higher for exporters than for importers (0.9 vs. 0.3) which means that when the exporter's port efficiency improves the country's own and global trade gets a bigger boost than if the importer's ports improve. *'Customs environment'* also has a significantly positive effect on trade, with a coefficient of about 0.47. This definition of customs environment focuses on imports. Finally, the *'Regulatory environment'* (a proxy for standards and regulations) of the importer and exporter also have a positive and significant effect on trade as expected with coefficients of 0.28 and 0.62, respectively. The higher coefficient for the exporter implies that greater regulatory adherence to international standards has a greater impact on exports than on imports.

Table 5: Overall Regression Results: Coefficients for Scenario

	Coef.	Std. Err.
Constant	-10.641***	1.558
Tariff	-1.155***	0.318
Port Efficiency of Importing Country	0.307*	0.163
Port Efficiency Exporting Country	0.924***	0.148
Customs Environment of Importing Country	0.472**	0.199
Regulatory Envornment of Importing Country	0.281*	0.144
Regulatory Envornment Exporting Country	0.620***	0.132
E-Business of Importing Country	0.729***	0.224
E-Business Exporting Country	1.943***	0.216
Adjusted R-squared	0.758	
Number of the observations	7,904	

/1/ additional variables from gravity model suppressed. See WMO(2005)

3.2 Potential Benefits From Trade Facilitation: Simulation Results

Quantifying potential benefits from trade facilitation is possible by using the coefficient estimates from Table 5 on the responsiveness of trade to improvements in trade facilitation. The simulation presented here improves TF metrics for each county half-way to the global average TF metric for 'port efficiency,' 'customs environment,' 'e-business usage,' and 'regulatory environment'. Table 6 summarizes the results for the simulations for the template countries and for selected regions. Each panel describes the gain from the country's own improvements, as an exporter and as an importer, in dollar terms and in percentage terms of initial exports or imports.

The most important conclusion is that reforms to trade facilitation overall tends to improve the balance of payments for a country. That is, improvements in trade facilitation measures increase a country's own exports more that it increases its imports. Different countries' gains come from different improvements in their trade facilitation environment, depending on which areas of trade facilitation was weakest compared to the global average.

For the template economies, the broad-brush overview of findings is as follows: Considering improvements in *port efficiency*, Colombia and Peru generally would see the greatest percentage increase in trade (Colombia: 14.81% increase in exports, 5.4% increase in imports and Peru: 21.4% increase in exports, 7.6% increase in imports). In terms of trade gains from improvements in *customs environment*, Argentine and Colombian exports could increase by some 4%.

An improved *customs environment* tends to raise imports relatively more than exports. So, in contrast to the overall results, this suggests that focusing only on improved *customs* may be balance of payments worsening, even as both exports and imports rise. For example, Brazils imports might increase by some 6.2%, whereas exports might only increase some 1.9%. Colombia's exports and imports might increase both about 4%.

With respect to improved *regulatory environment,* Argentina's exports could rise by some 27.7%, and imports rise only 12.8%. Colombia also could see dramatic trade increases from improved *regulations*, some 9.3% increase in exports and 4.4% increase in imports.

Finally, large increases in trade might accompany increased *e-business usage (ICT and finance).* Peru might see increased exports of some 12% and increased imports of some 4.9%. Brazil's exports might increase 6.2% and imports increase 2.7%.

All of these results depend on the specific scenario as outlined in the main Report. Each country engaged an improvement in the TF area 'half-way' to the global average. So, some countries gain more than others because they are improving more than others.

Table 6. Simulation Results: Selected economies and regions
Gains from improved Port efficiency

Country as Exporter	Initial Trade /*/ $ Bill	Exporter Change-- $ Bill	Percent	Country as Importer	Initial Trade $ Bill	Importer Change— $ Bill	Percent
Argentina	7.011	0.165	2.4	Argentina	16.58	0.192	1.2
Brazil	26.821	1.106	4.1	Brazil	37.605	0.663	1.8
Colombia	3.854	0.569	14.8	Colombia	8.359	0.45	5.4
Dominican Republic	3.62	0.238	6.6	/1/			
Peru	1.103	0.236	21.4	Peru	4.556	0.347	7.6
East Asia	752.689	53	7	East Asia	619.558	9.369	1.5
Latin America and Caribbean	178.899	13.132	7.3	Latin America and Caribbean	259.572	7.399	2.9
OECD	2734.81	0.884	0	OECD	2760.989	0.509	0
South Asia	36.368	4.272	11.7	South Asia	21.378	0.663	3.1
Total	3879.258	83.53	2.2	Total	3879.259	23.4	0.6
/*/ with 75 country sample				/1/ Dominican Republic not available			

Gains from Customs Environment

Country as Exporter	Initial Trade /*/ $ Bill	Exporter change $ Bill	Percent	Country as Importer	Initial Trade /*/ $ Bill	Importer Change— $ Bill	Percent
Argentina	7.076	0.27	3.8	Argentina	16.58	0.831	5
Brazil	27.048	0.527	1.9	Brazil	37.605	2.346	6.2
Colombia	3.916	0.158	4	Colombia	8.359	0.315	3.8
Dominican Republic	3.639	0.004	0.1	/1/			
Peru	1.12	0.023	2	Peru	4.556	0	0
East Asia	752.689	6.273	0.8	East Asia	619.558	13.421	2.2
Latin America and Caribbean	178.899	1.689	0.9	Latin America and Caribbean	259.572	8.926	3.4
OECD	2734.81	23.056	0.8	OECD	2760.989	3.004	0.1
South Asia	36.368	0.273	0.8	South Asia	21.378	1.235	5.8
Total	3879.258	32.865	0.8	Total	3879.259	32.865	0.8
/*/ with 75 country sample				/1/ Dominican Republic not available			

Gains from E-business Usage (ICT and finance) Improvements

Country as Exporter	Initial Trade /*/ $ Bill	Exporter change $ Bill	Percent	Country as Importer	Initial Trade /*/ $ Bill	Importer Change— $ Bill	Percent
Argentina	7.076	0.382	5.4	Argentina	16.58	0.405	2.4
Brazil	27.048	1.673	6.2	Brazil	37.605	1.032	2.7
Colombia	3.916	0.61	15.6	Colombia	8.359	0.527	6.3
Dominican_Republic	3.639	0	0	/1/			
Peru	1.12	0.134	12	Peru	4.556	0.225	4.9
East Asia	752.689	81.275	10.8	East Asia	619.558	16.533	2.7
Latin America and Caribbean	178.899	10.771	6	Latin America and Caribbean	259.572	7.478	2.9
OECD	2734.81	0.802	0	OECD	2760.989	1.527	0.1
South Asia	36.368	6.998	19.2	South Asia	21.378	1.459	6.8
Total	3879.258	117.377	3	Total	3879.259	0.225	4.9
/*/ with 75 country sample				/1/ Dominican Republic not available			

Gains from Regulatory Improvement

Country as Exporter	Initial Trade /*/ $ Bill	Exporter change $ Bill	Percent	Country as Importer	Initial Trade /*/ $ Bill	Importer Change— $ Bill	Percent
Argentina	7.076	1.96	27.7	Argentina	16.58	2.127	12.8
Brazil	27.048	0	0	Brazil	37.605	0.001	0
Colombia	3.916	0.365	9.3	Colombia	8.359	0.368	4.4
Dominican Republic	3.639	0.048	1.3	/1/			
Peru	1.12	0.003	0.3	Peru	4.556	0.012	0.3
East Asia	752.689	24.775	3.3	East Asia	619.558	6.899	1.1
Latin America and Caribbean	178.899	6.355	3.6	Latin America and Caribbean	259.572	6.193	2.4
OECD	2734.81	17.293	0.6	OECD	2760.989	5.7	0.2
South Asia	36.368	2.511	6.9	South Asia	21.378	0.704	3.3
Total	3879.258	58.858	1.5	Total	3879.259	24.393	0.6
/*/ with 75 country sample				/1/ Dominican Republic not available			

Part 4 -- Policy Recommendations

This Report offers two inputs to policy recommendations: The product-specific trade-facilitation and supply-chain benchmark tool (Part 2) and the econometric analysis of potential gains to trade by individual country and trade-facilitation metric (Part 3).

Argentina

The overall picture of the trade facilitation environment in Argentina (2006 data) relative to the neighbourhood is of better than average ICT, but somewhat worse than average in finance and corruption. In the area of finance, the issue appears to be the inability to get long-term finance from banks for investment. Although this is a problem in the region as a whole, Argentina firms, in all product groups, fair far worse. Moreover, these firms cannot access long-term funding from suppliers either, which is more prevalent for the region as a whole. This suggests systemic issues to be addressed in the financial system.

With regard to the specific product areas, where the importance of TF areas are informed by the supply-chain intensities, the key areas of regulatory adherence (recall this is ISO certification and external financial audit) appear to be problem areas for key export groups of 'chemicals and pharmaceuticals' (6% of exports), 'other, incl. Mining' (21%), and 'metals and machinery' (5%). Thus, a program of action could assist firms to gain ISO certification and to work with external auditors.

What about ICT availability and usage? Argentine firms, except for those in the strong exporter product group of 'other, incl mining' report a much longer delay in getting a landline than do their neighbors. Despite having the advantage of access, less than half of these firms report using web-based transactions (although all use e-mail). Web-based transactions often go hand-in-hand with financial system quality. Hence the problems in finance may be spilling over to use of ICT.

What are the potential gains in trade from an improvement in each trade facilitation metric? Considering improvements in *port efficiency*, Argentine exports might increase some 2.4% or $0.165 billion, and Argentine imports might increase some 1.2% or $0.192 billion. In terms of trade gains from improvements in *customs environment*, Argentine exports might increase by some 3.6% or $0.27 billion and imports might increase some 5% or $0.831 billion. In terms of trade gains from *e-business* usage (ICT and finance) Argentine exports might increase some 5.4% or $0.382 billion, and its imports by some 2.4% or $0.405 billion. Finally, an improvement in regulations and standards might increase Argentine exports by some 27.7% or $1.96 billion and increase imports by some 12.8% or $2.127.

Both the supply-chain analysis and econometric model suggest a program of action focused on the customs clearance, and the nexus of financial systems, ISO certification and external audit, and ICT training which collectively could reduce trade costs and enhance international competitiveness of Argentine firms.

Brazil

The overall picture of the trade facilitation environment in Brazil (2003 data) relative to the neighbourhood is of better than average ICT, but worse than average in the area of customs. On average LAC countries clear exports from customs in about 5 to 6 days and clear imports in about 11 days. In Brazil, export clearance is a day or so longer across all product categories. Clearing imports, on the other hand, is a particular issue, with import clearance averaging 17 days for 'garments', and 15 days for 'metals and machinery' and 'wood and furniture'. The much longer time to clear customs facing importers indicated that policy reforms focused on this task would be beneficial for all types of importers. To the extent that imports are inputs into the export supply chain, import clearance is a detriment to international competitiveness.

Looking at the product-specific trade facilitation measures relative to supply-chain intensities reveals concerns in the regulatory area for nearly all the product groups, and in finance for the 'chemical ….' (5% of exports) and 'food' groups (29% of exports). These two product groups appear to have less access to bank loans for short-term credit and also cannot replace that with short-term supplier finance. For garment and wood/furniture (representing about 10% of exports total) regulatory adherence is a severe problem Only about 5 % of 'garment' and 8% of wood/furniture firms have ISO certification (much worse that for firms in the LAC region as a whole) and only about 10% of garment firms and 15% of wood/furniture firms submit to external audit (which is somewhat closer to the LAC average). For an industry that is increasingly part of an international supply chain that demands exacting standards, all of these percentages are low.

What about ICT availability and usage? Brazil's firms in2003 enjoyed much quicker delivery of landlines compared to the regional average. Nearly all firms report using e-mail to communicate with suppliers and clients, well above the LAC average. Most also use the more sophisticated web-based transactions, except for in the product groups noted above of garment' and 'wood/furniture' only about 60 percent report using the web for transactions. Perhaps these are smaller firms, but their interaction with the international supply chain will be hampered without web-based transactions.

What are the potential gains in trade from an improvement in each trade facilitation metric? Considering improvements in *port efficiency*, Brazilian exports might increase some 4.1% or $1.106 billion, and Brazilian imports might increase some 1.8% or $0.663 billion. In terms of trade gains from improvements in *customs environment*, Brazilian exports might increase by some 1.9% or $0.527 billion, and imports might increase some 6.2% or $2.346 billion. In terms of trade gains from *e-business* usage (ICT and finance) Brazilian exports might increase some 6.2% or $1.673 billion, and its imports by some 2.7% or $1.032 billion.

Both the supply-chain analysis and the econometric analysis suggest the need for a program of action focussed on customs clearance for importers. A program of ICT training and ISO certification could also reduce trade costs and enhance international competitiveness of Brazilian firms.

Colombia
The overall picture of the trade facilitation environment in Colombia (2006 data) relative to the neighbourhood is of better than average financial system, but worse that average in the regulatory environment. On average in LAC, about 15 % of firms are ISO certified and about 50 % submit to external audit. Although somewhat mixed by product group, the problem area appears to be ISO certification.

Looking at particular product areas solidifies this general view. In a key trade area of 'food' (15% of exports) only 3 % of firms are ISO certified. In another key export of 'other incl mining' (48 % of exports), ISO certification is not the issue, but only about 30 percent of the firms submit to external audit, about half the percentage that do in the region as a whole in this product area. For other up-and-coming export categories such as garments (6% of exports) not only is regulatory adherence and issue, but so is finance. Finance is an important input in the supply chain intensity and yet the product-specific TF measure is worse than that for the country as a whole. Across the board, these firms do not have access to either bank or supplier credit. It is possible that the lower regulatory adherence (particularly audit) could have a detrimental effect on garment exporters. Therefore a program of action to focus on ISO certification and particularly audit could be helpful to raise the competitiveness of Colombia exporters.

What about ICT availability and usage? Colombia's firms face a somewhat shorter delay in getting a landline than do their neighbors. But, the overall use of ICT is only average for the region. Only about 30 % of firms use web-based transactions; this is about the LAC average, but well below Brazil and Argentina. A policy of training how to use ICT for international trade may enhance international supply chain competitiveness. In addition, policymakers should examine the local price of ICT.

What are the potential gains in trade from an improvement in each trade facilitation metric? Considering improvements in *port efficiency*, Colombian exports might increase some 14.8% or $0.569 billion, and imports might increase some 5.4% or $0.450 billion. In terms of trade gains from improvements in *customs environment*, Colombian exports might increase by some 4.0% or $0.158 billion; imports might increase some 3.8% or $0.315 billion. In terms of trade gains from *e-business* usage (ICT and finance) Colombian exports might increase some 15.6% or $0.610 billion, and its imports by some 6.3% or $0.527 billion. In terms of trade gains from *regulatory adherence* Colombian exports might increase some 9.3% or $0.365 billion, and its imports by some 4.4% or $0.368 billion

Both the supply-chain analysis and the econometric analysis point to the following areas for policy attention: training how to use ICT for international trade, port efficiencies, and regulatory adherence (particularly audit) and ISO certification.

Dominican Republic
The overall picture of the trade facilitation environment in Dominican Republic (2005 data) relative to the neighborhood is not a good one with significantly worse overall customs and corruption measures. A brighter spot is the financial system.

The data for Dominican Republic is sparser, but in the all-important 'food' export category (41% of exports), it takes an average of 13 days to clear customs, well more than twice the average for 'food' on average across the LAC countries. The 'food' sector also experiences difficulties with infrastructure and regulations.

For two potentially important areas for export diversification (garments and non-metallic and plastic products) the TF environment across the board for these firms is worse than for the country as a whole. Clearing imports of 'non-metallic and plastic manufactures' which accounts for 4.5% of exports takes almost 16 days on average, twice that for the region as a whole in this product group. To the extent that imports are inputs into the export supply chain, import clearance is a detriment to international competitiveness. This suggests a program of reducing days to clear customs is a systemic issue faced by importers.

What about ICT availability and usage? Dominican Republic's firms face a somewhat shorter delay in getting a landline than do their neighbors. The more sophisticated users of web-based transactions are only in the 'chemical and pharmaceuticals' and 'food' product groups, where about 77 and 63 percent of firms, respectively, so report using the web. Only about 30 percent of firms in the other product groups use web-based transactions; this is about the LAC average. The garment producers appear to face a disproportionately long wait for phones and so a relatively lower percentage use ICT for communicating with suppliers and clients. This puts these manufacturers at a significant disadvantage in the supply chain. A program of action to focus on what may be smaller firms struggling to get access to ICT may be warranted.

What are the potential gains in trade from an improvement in each trade facilitation metric? Considering improvements in *port efficiency*, Dominican Republic exports might increase some 6.6% or $0.238 billion; no data are available to estimate imports. In terms of trade gains from improvements in *customs environment*, Dominican Republic exports might increase by some 0.1% or $0.004 billion; no data are available to estimate imports. In terms of trade gains from *e-business* usage (ICT and finance) there are no data to estimate gains to trade. In terms of gains from *regulatory adherence*, Dominican Republic exports might increase by 1.3% or $0.048 billion; no data are available to estimate imports.

Both the supply-chain analysis and the econometric analysis point to the following areas for policy attention: regulatory adherence (particularly audit) and ISO certification. A policy of training how to use ICT for international trade may enhance international supply chain competitiveness.

Peru

The overall picture of the trade facilitation environment in Peru (2006 data) relative to the neighbourhood is overall similar to the average for the region, but with some areas of concern in corruption and significantly greater area of concern in regulations. A brighter spot, relatively speaking, is the financial system. With regard to finance, Peru has a

highly banked system with around 70 percent of firms apparently able to access the financial system for both long-term and short-term credit (about twice the percentage so reporting in LAC region).

For two product groups important for exports (food,15% and garments, 6%) the problem is regulatory adherence, apparently more on account of financial audit than ISO certification. For the largest trade category of 'other, incl mining at 35% of exports) finance and regulatory adherence is of particular concern. With regard to the latter, it may be the composition of trade in this category but less than 1 percent of firms surveyed held ISO certification.

What about ICT availability and usage? Peru's firms face a somewhat shorter delay in getting a landline than do their neighbors. A quite high percentage use e-mail to communicate with suppliers and clients (about 80% so report doing so, which is higher than the LAC average. The more sophisticated user of web-based transactions are only in the 'chemical and pharmaceuticals' and 'other incl mining, where about 60 percent of firms so report using the web. Only about 30 percent of firms in the other product groups use web-based transactions; this is about the LAC average. Thus a program of awareness of newer web-based transactions strategies, and some attention to cost and or training may be warranted.

What are the potential gains in trade from an improvement in each trade facilitation metric? Considering improvements in *port efficiency*, Peru's exports might increase some 21.4% or $0.236 billion, and imports might increase some 7.6% or $0.347 billion. In terms of trade gains from improvements in *customs environment*, Peru's exports might increase by some 2.0% or $0.023 billion; imports would not change. In terms of trade gains from *e-business usage* (ICT and finance) Peru's exports might increase some 12% or $0.134 billion and imports increase some $4.9% or $0.225 billion. In terms of gains from *regulatory adherence*, Peru's exports might increase by 0.3% or $0.003 billion and imports might increase 0.3% or $0.012 billion.

Both the supply-chain analysis and the econometric analysis suggest that port efficiency could be a key target. In addition, training on how to use ICT for international trade may enhance international supply chain competitiveness.

Summary

The detailed analysis for each of the template countries comes from an assessment of the product-specific trade exposure, the individual elements of the product-specific trade facilitation measures, and the supply-chain intensities. This detailed analysis has been augmented by econometric analysis of aggregated data. Of course, policy makers, firms, and other parties, such as local Chambers of Commerce and business groups, must use many more inputs before deciding on a course of action. However, the collection and analysis of trade facilitation metrics presented here does suggest a different direction for attention in each of the countries.

For Argentina, the overall picture of the trade facilitation environment in Argentina relative to the neighborhood is of better than average ICT, but somewhat worse than average in finance and corruption. Both the supply-chain analysis and econometric model suggest a program of action focused on the customs clearance, and the nexus of financial systems, ISO certification and external audit, and ICT training which collectively could reduce trade costs and enhance international competitiveness of Argentine firms.

For Brazil, the overall picture of the trade facilitation environment in Brazil relative to the neighborhood is of better than average ICT, but worse than average in the area of customs. Both the supply-chain analysis and the econometric analysis suggest the need for a program of action focussed on customs clearance for importers. A program of ICT training and ISO certification could also reduce trade costs and enhance international competitiveness of Brazilian firms.

For Colombia, there are systemic issues in the finance sector. Beyond this, both the supply-chain analysis and the econometric analysis point to the following areas for policy attention: port efficiencies, and regulatory adherence (particularly audit) and ISO certification to enhance the competitiveness of Colombian firms.

For the Dominican Republic, the overall trade facilitation environment is not strong, with problems in virtually all areas. Both the supply-chain analysis and the econometric analysis point to the following areas for policy attention: regulatory adherence (particularly audit) and ISO certification. A policy of training how to use ICT for international trade may enhance international supply chain competitiveness.

For Peru, the overall picture of the trade facilitation environment in Peru relative to the neighborhood is overall similar to the average for the region. Using more detailed analysis suggest that port efficiency could be a key target for policy attention. In addition, training on how to use ICT for international trade may enhance international supply chain competitiveness.

In sum, these policy recommendations come from an assessment of the product-specific trade exposure, the individual elements of the product-specific trade facilitation measures, the data on the product-specific supply chains, and econometric analysis of aggregate data. Of course, policy makers, firms, and other stake-holders, such as local Chambers of Commerce and business groups, must use many more inputs before deciding on a course of action. Nevertheless, the trade facilitation analysis presented in the main Report implies that each policy-maker faces somewhat different challenges in each of the countries.

Appendix 1: Details of Construction of Trade Data Aggregates

The trade flow data used in this study was obtained from the COMTRADE database of the United Nations Statistics Division (UNSD). The product classification used was the 1996 harmonized system (HS) at the two digit level.

The HS two digit data decomposes trade flows into ninety-nine product categories. In order to match the trade flow data with the trade facilitation measures, it was necessary to group these detailed products into sectors. Table A1-1 shows how the product categories were aggregated into thirteen sectors, and in Table A1-2 how important the sectors are for total exports of the economy. The data are pulled from the same year in which the TF metrics are surveyed. Thus the trade data come from different years as noted.

Because the sectors aggregate up different numbers of the more detailed categories (autos and auto components maps directly into the single HS 87 product code 87, whereas food is an aggregation of 22 of the 2-digit HS codes), more analysis of the detailed data is useful. Tables A1-3 through A1-6 show the top five 2 digit products for a country's exports as well as how important those products are in the global market place. For all countries except Dominican Republic, their top exports have captured substantial shares of the global market place.

Table A1-1: Product Aggregation

Table A1-1. Product Aggregation

Sector	Product Code	Detailed Product Description
Auto and auto components		
	87	Vehicles o/t railw/tramw roll-stock, pts & accessories
Chemicals and pharmaceuticals		
	28	Inorgn chem; compds of prec mtl, radioact elements etc
	29	Organic chemicals.
	30	Pharmaceutical products.
	31	Fertilizers.
	32	Tanning/dyeing extract; tannins & derivs; pigm etc
	33	Essential oils & resinoids; perf, cosmetic/toilet prep
	34	Soap, organic surface-active agents, washing prep, etc
	35	Albuminoidal subs; modified starches; glues; enzymes.
	36	Explosives; pyrotechnic prod; matches; pyrop alloy; etc
	37	Photographic or cinematographic goods.
	38	Miscellaneous chemical products.
Electronics		
	85	Electrical mchy equip parts thereof; sound recorder etc
Food		
	2	Meat and edible meat offal
	3	Fish & crustacean, mollusc & other aquatic invertebrate
	4	Dairy prod; birds' eggs; natural honey; edible prod nes
	5	Products of animal origin, nes or included.

	7	Edible vegetables and certain roots and tubers.
	8	Edible fruit and nuts; peel of citrus fruit or melons.
	9	Coffee, tea, matï and spices.
	10	Cereals
	11	Prod.mill.indust; malt; starches; inulin; wheat gluten
	12	Oil seed, oleagi fruits; miscell grain, seed, fruit etc
	13	Lac; gums, resins & other vegetable saps & extracts.
	14	Vegetable plaiting materials; vegetable products nes
	15	Animal/veg fats & oils & their cleavage products; etc
	16	Prep of meat, fish or crustaceans, mollusks etc
	17	Sugars and sugar confectionery.
	18	Cocoa and cocoa preparations.
	19	Prep.of cereal, flour, starch/milk; pastrycooks' prod
	20	Prep of vegetable, fruit, nuts or other parts of plants
	21	Miscellaneous edible preparations.
	22	Beverages, spirits and vinegar.
	23	Residues & waste from the food indust; prepr ani fodder
	24	Tobacco and manufactured tobacco substitutes
Garments		
	60	Knitted or crocheted fabrics.
	61	Art of apparel & clothing access, knitted or crocheted.
	62	Art of apparel & clothing access, not knitted/crocheted
	63	Other made up textile articles; sets; worn clothing etc
	64	Footwear, gaiters and the like; parts of such articles.
	65	Headgear and parts thereof.
Leather, Fur and Feather		
	41	Raw hides and skins (other than furskins) and leather.
	42	Articles of leather; saddlery/harness; travel goods etc
	43	Furskins and artificial fur; manufactures thereof.
	67	Prepr feathers & down; arti flower; articles human hair
Metals		
	72	Iron and steel.
	73	Articles of iron or steel.
	74	Copper and articles thereof.
	75	Nickel and articles thereof.
	76	Aluminum and articles thereof.
	78	Lead and articles thereof.
	79	Zinc and articles thereof.
	80	Tin and articles thereof.
	81	Other base metals; cermets; articles thereof.
	82	Tool, implement, cutlery, spoon & fork, of base mtl etc.
	83	Miscellaneous articles of base metal.
Power and transport equipment other than autos		
	84	Nuclear reactors, boilers, mchy & mech appliance;
	86	Railw/tramw locom, rolling-stock & parts thereof;
	88	Aircraft, spacecraft, and parts thereof.
	89	Ships, boats and floating structures.
Non-metallic and plastic materials		
	39	Plastics and articles thereof.
	40	Rubber and articles thereof.

	45	Cork and articles of cork.
	46	Manufactures of straw, esparto/other plaiting mat; etc
	69	Ceramic products.
	70	Glass and glassware.
	71	Natural/cultured pearls, prec stones & metals, coin etc
Other manufacturing		
	66	Umbrellas, walking-sticks, seat-sticks, whips, et
	90	Optical, photo, cine, meas, checking, precision, etc
	91	Clocks and watches and parts thereof.
	92	Musical instruments; parts and access of such articles
	93	Arms and ammunition; parts and accessories thereof.
	95	Toys, games & sports requisites; parts & access thereof.
	96	Miscellaneous manufactured articles.
Textiles		
	50	Silk.
	51	Wool, fine/coarse animal hair, horsehair yarn & fabric
	52	Cotton.
	53	Other vegetable textile fibers; paper yarn & woven fab
	54	Man-made filaments.
	55	Man-made staple fibers.
	56	Wadding, felt & nonwoven; yarns; twine, cordage, etc.
	57	Carpets and other textile floor coverings.
	58	Special woven fab; tufted tex fab; lace; tapestries etc
	59	Impregnated, coated, cover/laminated textile fabric etc
Wood and furniture		
	44	Wood and articles of wood; wood charcoal.
	47	Pulp of wood/of other fibrous cellulosic mat; waste etc
	94	Furniture; bedding, mattress, matt support, cushion etc
Other		
	1	Live animals
	6	Live tree & other plant; bulb, root; cut flowers
	25	Salt; sulphur; earth & stone; plastering mat; lime & cement
	26	Ores, slag and ash.
	27	Mineral fuels, oils & product of their distillation; etc
	48	Paper & paperboard; art of paper pulp, paper/paperboard
	49	Printed books, newspapers, pictures & other product etc
	68	Art of stone, plaster, cement, asbestos, mica/sim mat
	97	Works of art, collectors' pieces and antiques.
	99	99

Table A1-2, 3, 4, 5: Sector importance: Four Measures

Table A1-2. Sector's Importance (% of total exports)					
Sector	**Argentina 2006**	**Brazil 2003**	**Colombia 2006**	**Dominican Republic 2001**	**Peru 2006**
Auto and auto components	8.6%	8.3%	3.2%	0.1%	0.0%
Chemicals and pharmaceuticals	6.0%	5.0%	4.7%	5.4%	1.5%
Electronics	0.9%	4.3%	1.5%	0.9%	0.2%
Food	44.7%	29.0%	15.2%	41.1%	14.9%
Garments	0.3%	3.1%	4.8%	1.3%	5.2%
Leather, Fur and Feather	2.2%	1.6%	0.8%	0.6%	0.2%
Metals	5.3%	10.5%	8.9%	19.3%	19.6%
Power and transport equipment o/t autos	3.2%	10.6%	1.6%	0.3%	0.3%
Non-metallic and plastic materials	4.7%	4.5%	10.3%	4.5%	20.5%
Other manufacturing	0.5%	0.8%	0.5%	0.2%	0.1%
Textiles	0.8%	1.4%	1.0%	0.1%	1.1%
Wood and furniture	1.2%	6.2%	0.8%	1.5%	0.9%
Other	21.5%	14.6%	46.8%	24.7%	35.4%

Source: Own calculations using COMTRADE data

Table A1-3. Top 5 Exports (% of Country's Total Exports)

	Argentina			Brazil	
1	Mineral fuels, oils & product of their distillation; etc	14.6%	1	Vehicles o/t railw/tramw roll-stock, pts & accessories	8.3%
2	Residues & waste from the food indust; prepr ani fodder	10.0%	2	Nuclear reactors, boilers, mchy & mech appliance;	7.7%
3	Vehicles o/t railw/tramw roll-stock, pts & accessories	8.6%	3	Iron and steel.	6.4%
4	Animal/veg fats & oils & their cleavage products; etc	8.3%	4	Oil seed, oleagi fruits; miscell grain, seed, fruit etc	5.9%
5	Cereals	6.4%	5	Mineral fuels, oils & product of their distillation; etc	5.2%
	Colombia			**Dominican Republic**	
1	Mineral fuels, oils & product of their distillation; etc	38.4%	1	Iron and steel.	17.8%
2	Coffee, tea, matï and spices.	6.1%	2	Mineral fuels, oils & product of their distillation; etc	15.8%
3	Iron and steel.	5.2%	3	Sugars and sugar confectionery.	8.4%
4	Plastics and articles thereof.	4.3%	4	Edible fruit and nuts; peel of citrus fruit or melons.	7.5%
5	Natural/cultured pearls, prec stones & metals, coin etc	4.0%	5	Cocoa and cocoa preparations.	5.2%
	Peru				
1	Ores, slag and ash.	26.5%			
2	Natural/cultured pearls, prec stones & metals, coin etc	19.3%			
3	Copper and articles thereof.	15.0%			
4	Mineral fuels, oils & product of their distillation; etc	8.0%			
5	Residues & waste from the food indust; prepr ani fodder	5.0%			

Source: Own Calculations using COMTRADE data

Table A1-4. Top 5 Exports (% World's Exports)

	Argentina			Brazil	
1	Mineral fuels, oils & product of their distillation; etc	0.5%	1	Vehicles o/t railw/tramw roll-stock, pts & accessories	0.8%
2	Residues & waste from the food indust; prepr ani fodder	14.6%	2	Nuclear reactors, boilers, mchy & mech appliance;	0.5%
3	Vehicles o/t railw/tramw roll-stock, pts & accessories	0.4%	3	Iron and steel.	2.9%
4	Animal/veg fats & oils & their cleavage products; etc	9.0%	4	Oil seed, oleagi fruits; miscell grain, seed, fruit etc	15.9%
5	Cereals	6.0%	5	Mineral fuels, oils & product of their distillation; etc	0.6%
	Colombia			**Dominican Republic**	
1	Mineral fuels, oils & product of their distillation; etc	0.7%	1	Iron and steel.	0.1%
2	Coffee, tea, matï and spices.	7.1%	2	Mineral fuels, oils & product of their distillation; etc	0.0%
3	Iron and steel.	0.4%	3	Sugars and sugar confectionery.	0.4%
4	Plastics and articles thereof.	0.3%	4	Edible fruit and nuts; peel of citrus fruit or melons.	0.2%
5	Natural/cultured pearls, prec stones & metals, coin etc	0.4%	5	Cocoa and cocoa preparations.	0.4%
	Peru				
1	Ores, slag and ash.	6.9%			
2	Natural/cultured pearls, prec stones & metals, coin etc	2.0%			
3	Copper and articles thereof.	2.7%			
4	Mineral fuels, oils & product of their distillation; etc	0.1%			
5	Residues & waste from the food indust; prepr ani fodder	3.7%			

Source: Own Calculations using COMTRADE data

Table A1-5. Top 5 Shares in the World Market

	Argentina			Brazil	
1	Residues & waste from the food indust; prepr ani fodder	14.6%	1	Oil seed, oleagi fruits; miscell grain, seed, fruit etc	15.9%
2	Animal/veg fats & oils & their cleavage products; etc	9.0%	2	Sugars and sugar confectionery.	12.9%
3	Oil seed, oleagi fruits; miscell grain, seed, fruit etc	6.2%	3	Ores, slag and ash.	12.5%
4	Cereals	6.0%	4	Residues & waste from the food indust; prepr ani fodder	10.9%
5	Raw hides and skins (other than furskins) and leather.	3.1%	5	Coffee, tea, matï and spices.	10.8%
	Colombia			**Dominican Republic**	
1	Coffee, tea, matï and spices.	7.1%	1	Sugars and sugar confectionery.	0.4%
2	Live tree & other plant; bulb, root; cut flowers	6.7%	2	Cocoa and cocoa preparations.	0.4%
3	Sugars and sugar confectionery.	2.0%	3	Edible fruit and nuts; peel of citrus fruit or melons.	0.2%
4	Live animals	1.4%	4	Tobacco and manufactured tobacco substitutes	0.2%
5	Edible fruit and nuts; peel of citrus fruit or melons.	1.1%	5	Iron and steel.	0.1%
	Peru				
1	Tin and articles thereof.	7.2%			
2	Ores, slag and ash.	6.9%			
3	Lead and articles thereof.	3.8%			
4	Residues & waste from the food indust; prepr ani fodder	3.7%			
5	Coffee, tea, matï and spices.	2.8%			

Source: Own Calculations using COMTRADE data

Table A1-6: Top Competitors

Table A1-6. Top 5 Competitors for the top 5 products (% of the World Market)

Argentina			Brazil		
1	**Mineral fuels, oils & product of their distillation; etc**		**1**	**Vehicles o/t railw/tramw roll-stock, pts & accessories**	
	Argentina	0.47%		Brazil	0.85%
1	Russian Federation	13%	1	Germany	19%
2	Saudi Arabia	13%	2	Japan	15%
3	Norway	6%	3	United States	9%
4	Canada	5%	4	Canada	8%
5	European Union	5%	5	France	7%
2	**Residues & waste from the food indust; prepr ani fodder**		**2**	**Nuclear reactors, boilers, mchy & mech appliance;**	
	Argentina	14.57%		Brazil	0.54%
1	United States	13%	1	Germany	13%
2	Netherlands	10%	2	United States	12%
3	Brazil	8%	3	Japan	9%
4	European Union	8%	4	China	8%
5	Germany	7%	5	Italy	6%
3	**Vehicles o/t railw/tramw roll-stock, pts & accessories**		**3**	**Iron and steel.**	
	Argentina	0.40%		Brazil	2.91%
1	Germany	19%	1	Japan	10%
2	European Union	15%	2	Germany	9%
3	Japan	14%	3	France	6%
4	United States	9%	4	Belgium	6%
5	Canada	7%	5	Russian Federation	5%
4	**Animal/veg fats & oils & their cleavage products; etc**		**4**	**Oil seed, oleagi fruits; miscell grain, seed, fruit etc**	
	Argentina	9.03%		Brazil	15.90%
1	Malaysia	16%	1	United States	35%
2	Indonesia	14%	2	Argentina	7%
3	European Union	8%	3	Canada	6%
4	Netherlands	6%	4	Netherlands	4%
5	Spain	6%	5	China	4%
5	**Cereals**		**5**	**Mineral fuels, oils & product of their distillation; etc**	
	Argentina	6%		Brazil	0.6%
1	United States	27%	1	Saudi Arabia	12%
2	France	10%	2	Russian Federation	11%
3	Canada	8%	3	Canada	6%
4	Australia	7%	4	Norway	6%
5	European Union	6%	5	Iran, Islamic Rep.	4%

Source: Own Calculations using COMTRADE data

Table A1-6 (continued). Top 5 Competitors for the top 5 products (% of the World Market)

Colombia			Dominican Republic		
1	**Mineral fuels, oils & product of their distillation; etc**		**1**	**Iron and steel.**	
	Colombia	0.65%		Dominican Republic	0.13%
1	Russian Federation	13%	1	European Union	10%
2	Saudi Arabia	13%	2	Japan	10%
3	Norway	6%	3	Germany	10%
4	Canada	5%	4	France	7%
5	European Union	5%	5	Belgium	6%
2	**Coffee, tea, matï and spices.**		**2**	**Mineral fuels, oils & product of their distillation; etc**	
	Colombia	7.15%		Dominican Republic	0.02%
1	Brazil	15%	1	Saudi Arabia	11%
2	Vietnam	7%	2	Russian Federation	10%
3	Germany	7%	3	Canada	7%
4	European Union	6%	4	Norway	7%
5	India	6%	5	European Union	4%
3	**Iron and steel.**		**3**	**Sugars and sugar confectionery.**	
	Colombia	0.39%		Dominican Republic	0.42%
1	European Union	10%	1	Brazil	15%
2	Germany	9%	2	European Union	14%
3	Japan	8%	3	France	10%
4	China	8%	4	Germany	6%
5	Belgium	6%	5	Belgium	5%
4	**Plastics and articles thereof.**		**4**	**Edible fruit and nuts; peel of citrus fruit or melons.**	
	Colombia	0.28%		Dominican Republic	0.21%
1	Germany	13%	1	United States	14%
2	European Union	12%	2	Spain	12%
3	United States	11%	3	Italy	7%
4	Belgium	7%	4	Belgium	5%
5	China	6%	5	France	5%
5	**Natural/cultured pearls, prec stones & metals, coin etc**		**5**	**Cocoa and cocoa preparations.**	
	Colombia	0.43%		Dominican Republic	0.37%
1	European Union	16%	1	European Union	13%
2	United States	14%	2	Netherlands	12%
3	Hong Kong, China	8%	3	Cote d'Ivoire	11%
4	Belgium	8%	4	Germany	10%
5	Israel	7%	5	Belgium	9%

Source: Own Calculations using COMTRADE data

Table A1-6 (continued). Top 5 Competitors for the top 5 products (% of the World Market)			
Peru			
1	**Ores, slag and ash.**		
		Peru	6.85%
1	Australia		21%
2	Chile		16%
3	Brazil		11%
4	Indonesia		5%
5	India		5%
2	**Natural/cultured pearls, prec stones & metals, coin etc**		
		Peru	2.03%
1	European Union		16%
2	United States		14%
3	Hong Kong, China		8%
4	Belgium		8%
5	Israel		7%
3	**Copper and articles thereof.**		
		Peru	2.70%
1	Chile		16%
2	Germany		9%
3	European Union		8%
4	United States		5%
5	Japan		5%
4	**Mineral fuels, oils & product of their distillation; etc**		
		Peru	0.13%
1	Russian Federation		13%
2	Saudi Arabia		13%
3	Norway		6%
4	Canada		5%
5	European Union		5%
5	**Residues & waste from the food indust; prepr ani fodder**		
		Peru	3.73%
1	Argentina		15%
2	United States		13%
3	Netherlands		10%
4	Brazil		8%
5	European Union		8%
Source: Own Calculations using COMTRADE data			

Appendix 2: Details of Construction of Trade Facilitation Measures

Several sources were employed to create the Trade Facilitation Measures. The most important source was the World Bank's Enterprise Survey Portal.[10] This comprehensive survey covers firms' responses to multiple questions on the investment climate and business environment, as shaped by domestic economic policy; governance; regulatory, infrastructural and financial impediments, as well as assessments of public service quality. To our knowledge, this is the only source of trade facilitation indicators at the industry level. The data available for the countries of interest is available for the following years: Argentina-2006, Brazil-2003, Colombia-2006, Dominican Republic-2005 and Peru-2006.

Each trade facilitation measure in this report was created by taking the average of several Enterprise Survey indicators. Table A2-1 shows the specific questions taken from the Enterprise Survey to create these variables.

Table A2-1: Trade Facilitation Measures

Table A2-1. Creation of Trade Facilitation Measures	
Corruption	
	% of Firms expected to pay informal payment (to get things done)*
	% of Firms expected to give gifts to get an import license*
	% of Firms Identifying Corruption as Major Constraint*
	% of Firms believing the court system is fair, impartial and uncorrupted
Finance	
	% of Firms with Bank Loans/Line of Credit
	% of Firms Using Banks to Finance Investments
	Supplier credit financing to Finance Investments (%)
	% of Firms Using Banks to Finance Expenses
	Supplier Credit financing to Finance Expenses (%)
	% of Firms Identifying Access/Cost of Finance as a Major Constraint*
Infrastructure	
	% of Firms Identifying Electricity as a Major Constraint*
	% of Firms Identifying Transportation as a Major Constraint*
Regulation	
	% of Firms with ISO certification ownership
	% of Firms with annual financial statement reviewed by external auditor
ICT	
	% of Firms using technology licensed from foreign companies
	% of Firms using the Web in interaction with clients/suppliers

[10] www.enterprisesurveys.org/Portal/. This very advanced and user-friendly front end allows graphical comparisons and data downloads. Unfortunately, during the course of the project the website suddenly was taken offline due to security updates. Currently the data are not available.

	% of Firms using email to interact with clients/suppliers Delay in obtaining a mainline telephone connection (days)*
Customs	
	% of Firms That Trade Identifying Customs & Trade Regulations as a Major Constraint* Products exported directly lost due to theft (%)* Average time to clear direct exports through customs (days)* Average time to claim imports from customs (days)*

The survey database is quite rich in terms of additional information. For example, each survey question includes the number of firms surveyed in each product group. The count ranges from rather small (under ten) to quite a few (150). Most questions have responses of at least 20 firms. With these micro data the mean of the result as well as the standard deviation is presented for each survey statistic. The original survey instrument is included, and a flat file of all the individual responses is available, although rather difficult to decipher.

The objective of constructing these six measures is to grade the overall environment in these different areas of trade facilitation. Keeping this in mind, it was necessary to manipulate some of the indicators so that an increase in a single indicator would mean an improvement in the trade facilitation in a given country. For example, an increase in the '% of Firms expected to give gifts to get an import license' would mean that the trade environment in that country is getting worse. To overcome this problem we use one hundred minus the indicator. This gives us the desired effect that an increase in the measure means an improvement in the trade facilitation in that country.

On the other hand, indicators that provide information about actual days need to be normalized. For this we divide observations given in days by 30 days. This process transforms observations in days into percentages, allowing us to average them up with the other indicators. Indicators with an asterisk (*) on Table A2-1 are indicators that needed to be manipulated either to fit the "higher is better" criteria, observations that needed to be normalized, or both.

In addition to the Enterprise Survey data we used information from other sources, including data from the Logistics Performance Indicators, the Doing Business Survey and the World Bank Trade Indicators.[11] The indicators from these sources could only be used when analyzing countries, rather than sectors, because they only report data at the country level. The indicators used from these sources are summarized in Table A2-2. Again, an asterisk next to an indicator means that it was necessary to manipulate it in order to fit the "higher is better" criteria or it needed to be normalized.

[11] Data from all these sources were summarized at: http://info.worldbank.org/etools/wti2008/docs/Indicators.htm

Table A2-2: Other sources and measures

Table A2-2. Other Trade Facilitation Indicators		
Measure	**Source**	**Indicator**
Infrastructure		
	UNCTAD	Liner shipping connectivity index
	WTI	Air Freight Costs to US (% of import value)*
	WTI	Total Freight Costs to US (% of import value)*
ICT		
	WTI	Personal computers per 100 inhabitants
	WTI	Internet users per 100 inhabitants
Customs		
	LPI	Efficiency of customs and other border procedures*
	DB	Days for export*
	DB	Days for import*

Appendix 3: Details of Construction of Supply-Chain Intensities

The supply chain intensities were calculated based on the US input-output (I-O) accounts, 2002 benchmark year.[12] The I-O accounts show how U.S. industries interact; specifically, they show how industries provide input to, and use output from, each other to produce the nation's gross domestic product. In other words the I-O accounts represent the production process of each industry.

The standard I-O table details the commodities consumed by industries and final users. Commodity consumption is valued at producers' prices (there is an alternative table at purchasers prices, but this would double count transportation costs). Each row details both the intermediate consumption of specific commodities and services, by industry, and the final consumption of the commodity or service. Each industry column of the standard I-O table details the industry's production function, including the value of the industry's total output, the mix of commodities it consumes to produce this output, and the value added by the industry's labor and capital producing this output.

For the purpose of this study we aggregated the columns in the I-O accounts in such a way that they would match the thirteen sectors that are available in the World Bank's Enterprise Survey and listed in Table A1-1. We had to group the leather and garment industry because of how the data was disaggregated, resulting in only twelve industries. However, this is unlikely to have a significant impact on our results. On balance the matching between the output categories and our trade and product groups is quite good.

The rows were then aggregated to match the trade facilitation measures listed in Table A2-1. Mapping the I-O inputs to the trade facilitation metrics was more challenging. First, there was not any service that could be matched directly to the corruption and customs measures; therefore, they were left out of this part of the analysis. Appendix Table A3-1 shows the mapping.

Table A3-1: I-O Matrixes: Mapping to Trade Facilitation Metrics

Table A3-1: Mapping from U.S. I-O 'input' to TF metrics	
IOCode	**Name**
Aggregated to match TF metric 'port'	
481	Air transportation
482	Rail transportation
483	Water transportation
484	Truck transportation
Aggregated to match TF metric ICT	

[12] US's I-O tables can be found at: http://www.bea.gov/industry/index.htm

511	Publishing industries (includes software)
513	Broadcasting and telecommunications
5415	Computer systems design and related services
514	Information and data processing services
Aggregated to match TF metric 'finance'	
521CI	Federal Reserve banks, credit intermediation, and related activities
523	Securities, commodity contracts, and investments
524	Insurance carriers and related activities
525	Funds, trusts, and other financial vehicles
532RL	Rental and leasing services and lessors of intangible assets
Aggregated to match TF metric 'regulations and standards'	
5411	Legal services
5412OP	Miscellaneous professional, scientific and technical services

These mappings generally make sense. One area that might cause concern is the aggregation of legal and miscellaneous professional services to make the TF metric of 'regulations and standards'. The TF questions, however, are about the share of firms that adhere to ISO standards, and the share of firms that are audited. These are the types of activities done by the 'input' services shown in the I-O table above.

With this layout, industries listed in the columns and trade facilitation services listed in the rows, we are able to calculate how intensively each industry uses ports and related transportation, ICT, finance, and regulation related services.

There is one final hurdle. The US has two I-O matrixes that can be manipulated in this manner: a 'direct requirements' matrix and a 'total requirements' matrix. The direct requirements matrix is simply that—the direct requirements of inputs to create a unit of output. If we wanted to know the direct TF-related inputs for a firm to export, then the direct requirements matrix would be the best one to use for the exercise. However, a product produced for export implicitly uses domestic inputs, for which the TF measures such as finance, could be important. The total requirements matrix takes account of the importance of the inputs to downstream (in this case we map to export) production.

Comparing the direct requirements matrix and the total requirements matrix for our TF areas and products in trade (Figure A3-1) reveals that 'ports' (which is transportation via air, rail, sea, and truck) and 'regulations and standards' related services (which has I-O inputs of legal and other business and professional services) are relatively more important as direct requirements, whereas finance and ICT are relatively more important when the direct and indirect requirements are considered. For our analysis, we use the total requirements matrix.

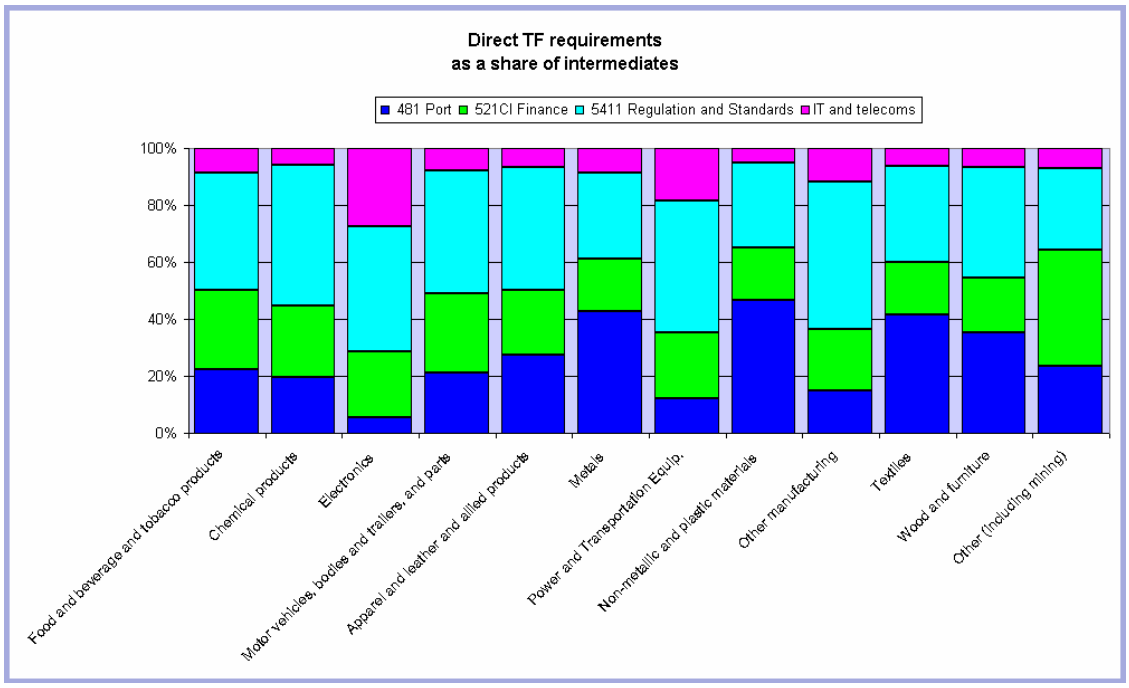
Finally, it must be remembered that the inputs included as TF-related inputs are a relatively small share of the inputs to the production process. The labor share is the

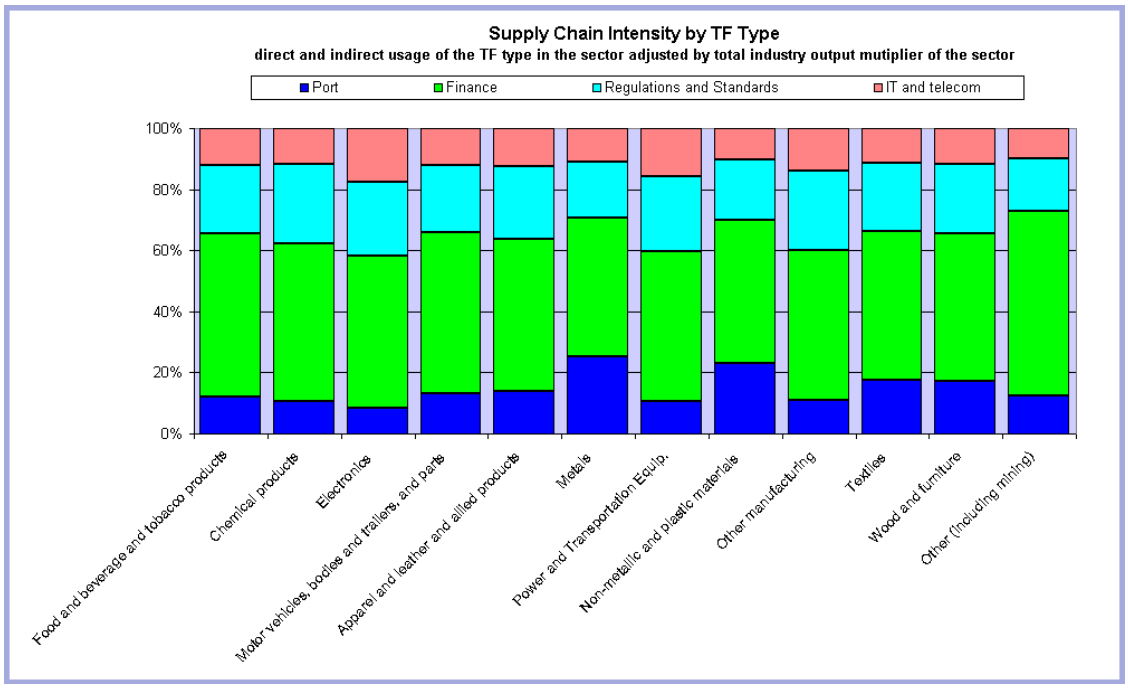
largest by far, other services, such as distribution services (wholesale and retail trade and warehousing) are also significant.

Input-output tables are readily available for every country. However, only Argentina and Colombia have I-O tables that were sufficiently disaggregated to match the other datasets.[13] This information was used when possible using a similar strategy for matching 'inputs' to the trade facilitation metrics, and matching 'outputs' to the trade product groups.

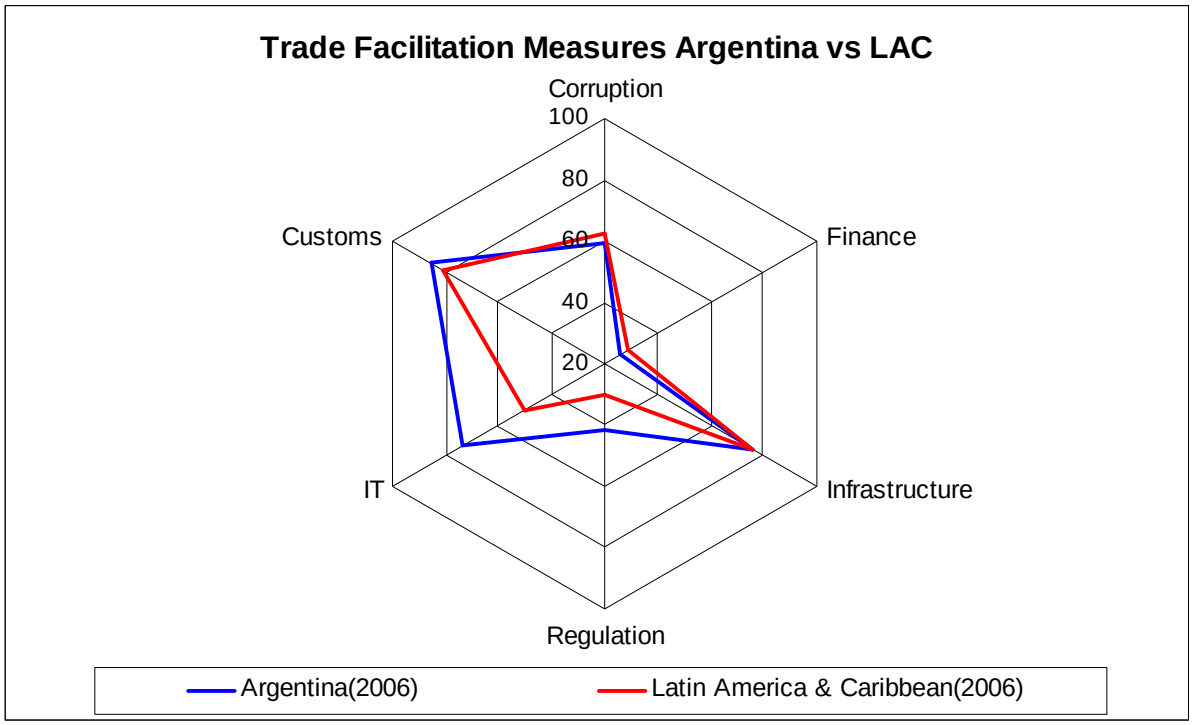
[13] Argentina's I-O tables can be found at: http://www.indec.mecon.ar/default.htm
Colombia's I-O tables can be found at:
http://www.dane.gov.co/index.php?option=com_content&task=category&sectionid=33&id=540&Itemid=1041

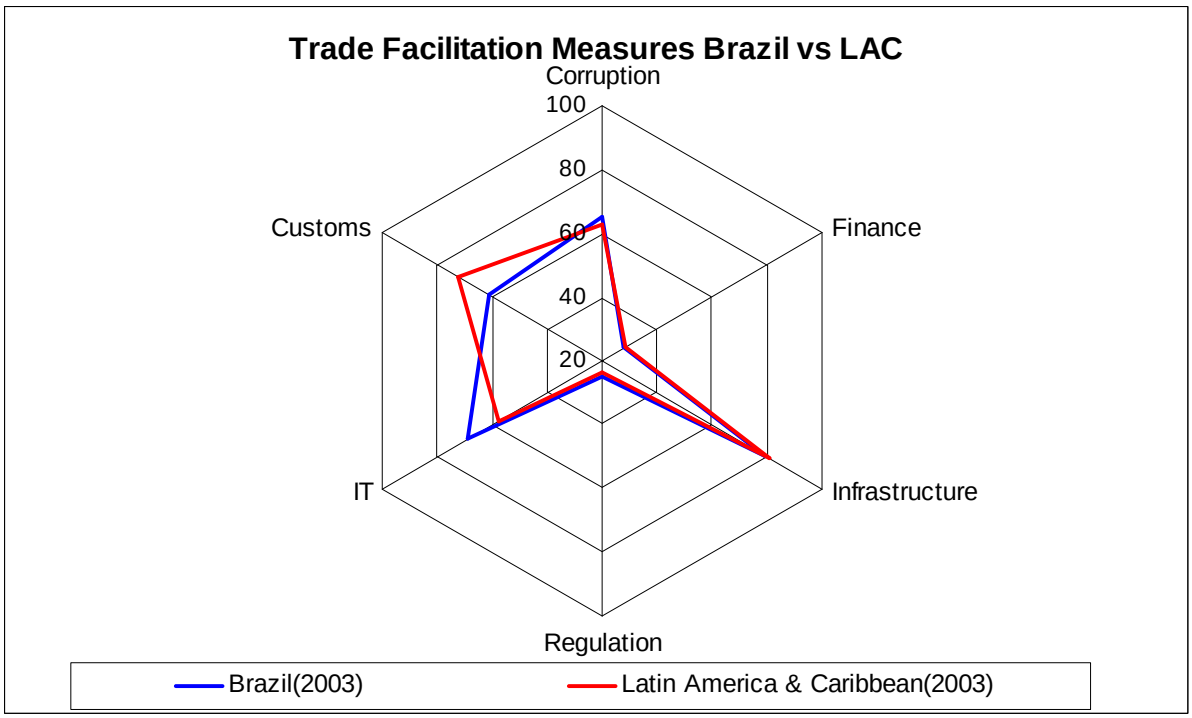
Figure A3-1: Direct vs. Indirect Input Requirements organized by TF metric

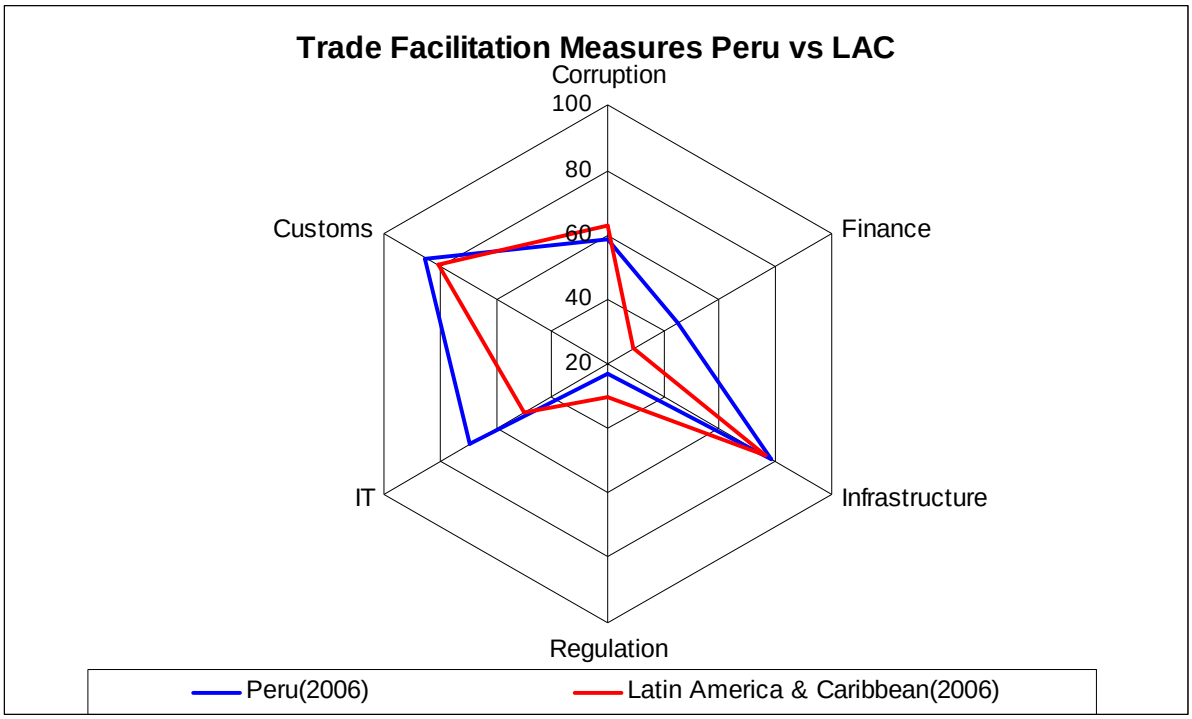


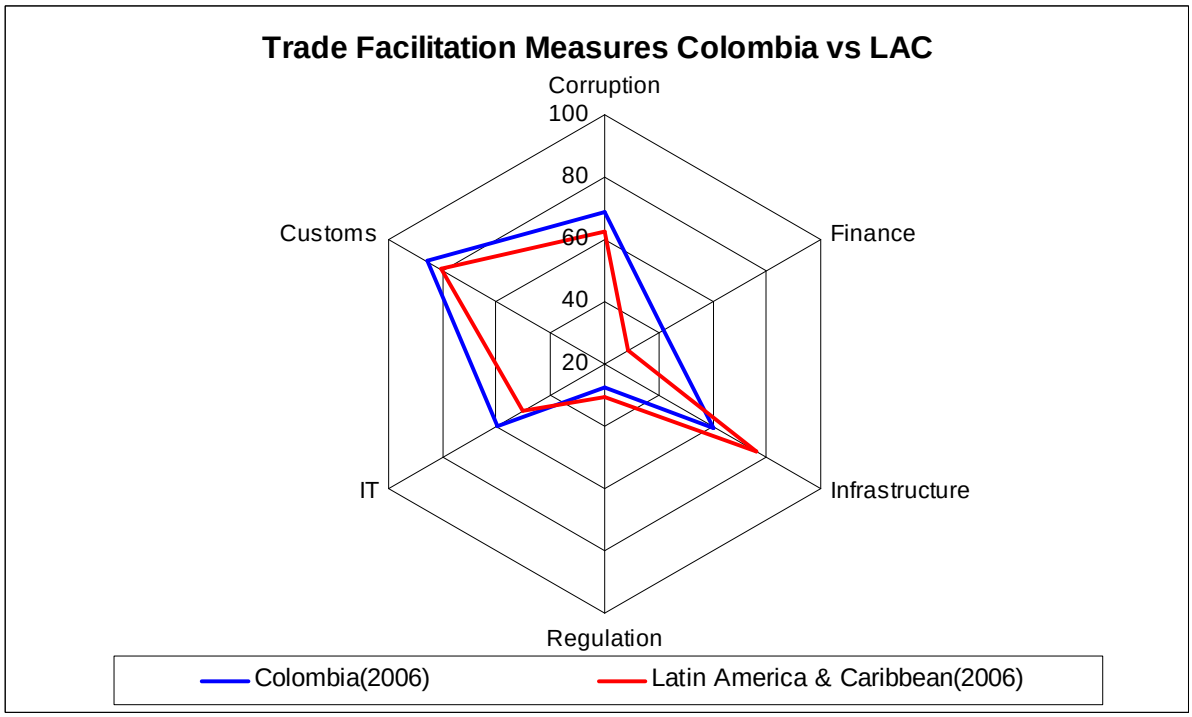


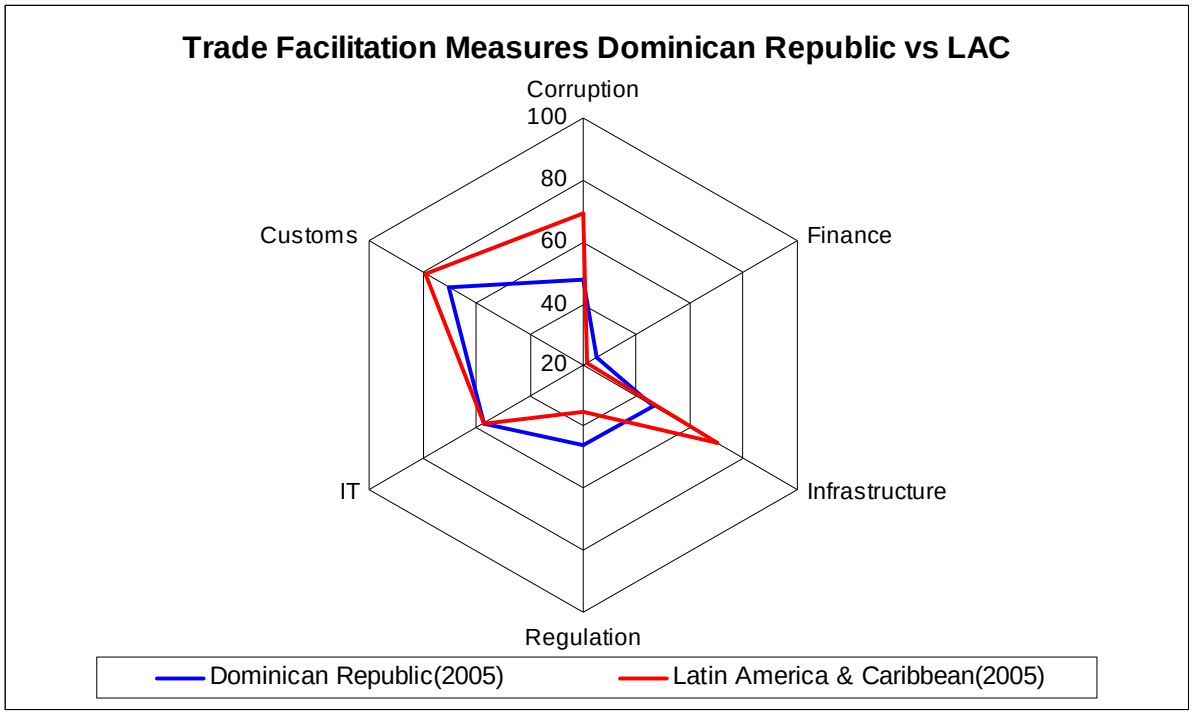
Appendix 4: Trade Facilitation Each Country Compared to LAC Average





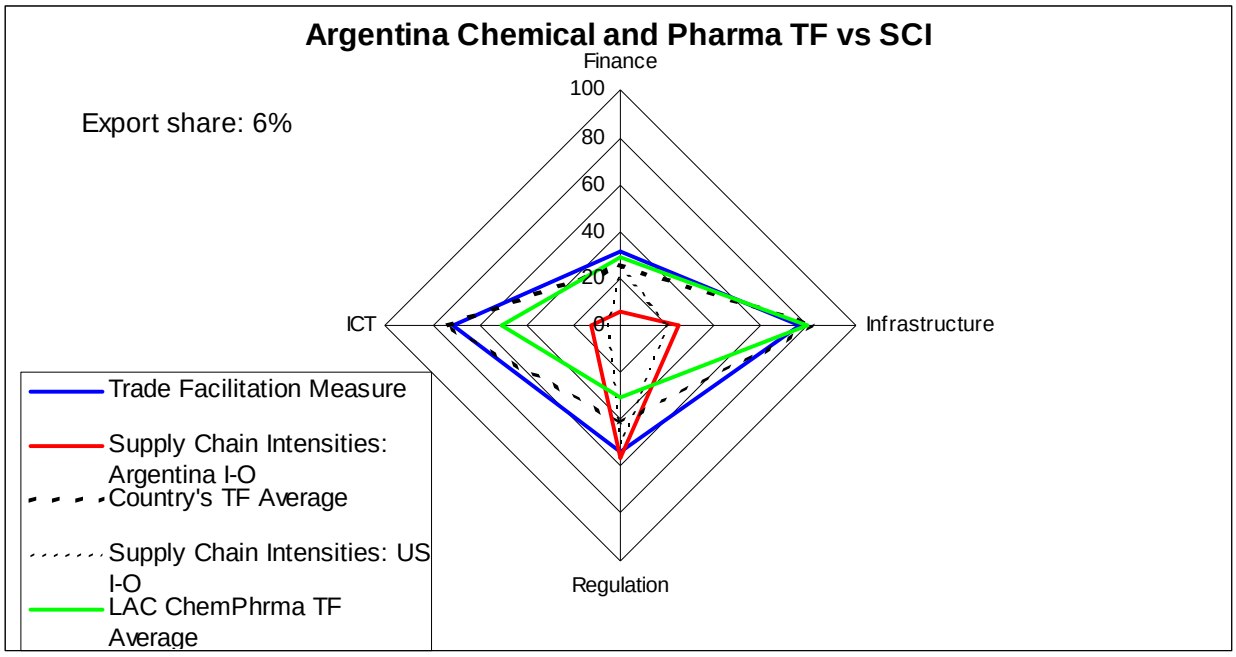

Trade Facilitation Measures Peru vs LAC
Corruption
100
80
60
40
20
Finance
Infrastructure
Regulation
IT
Customs
Peru(2006)
Latin America & Caribbean(2006)

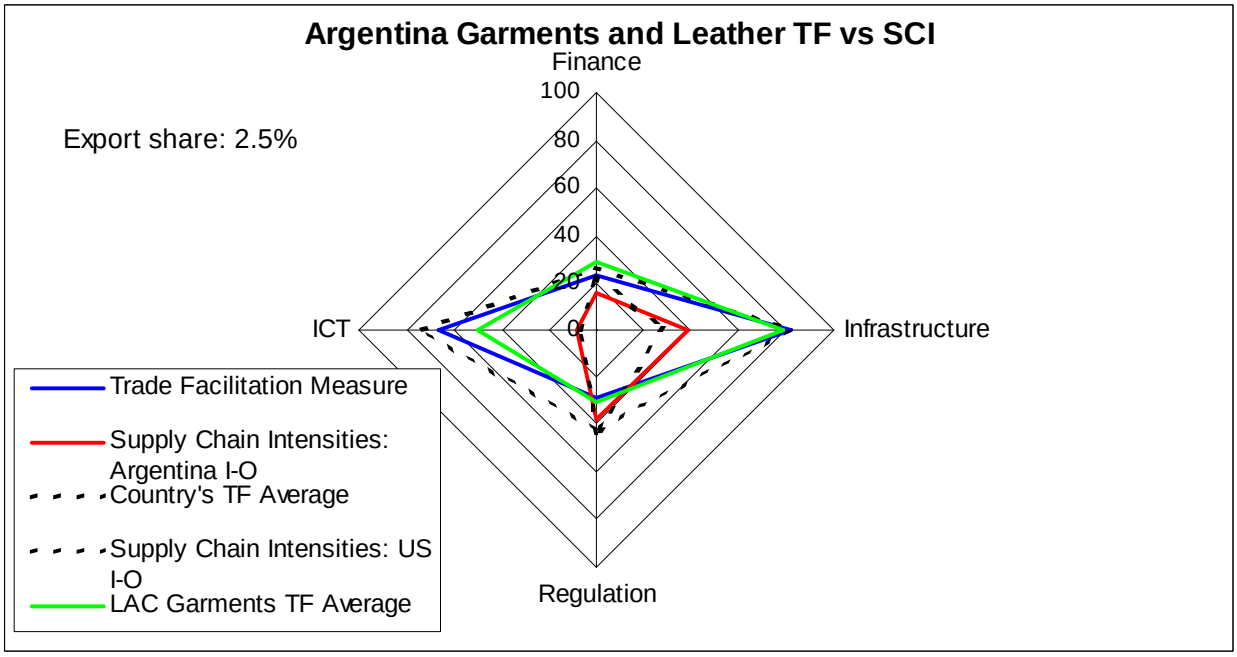

Trade Facilitation Measures Colombia vs LAC
Corruption
100
80
60
40
20
Finance
Infrastructure
Regulation
IT
Customs
Colombia(2006)
Latin America & Caribbean(2006)

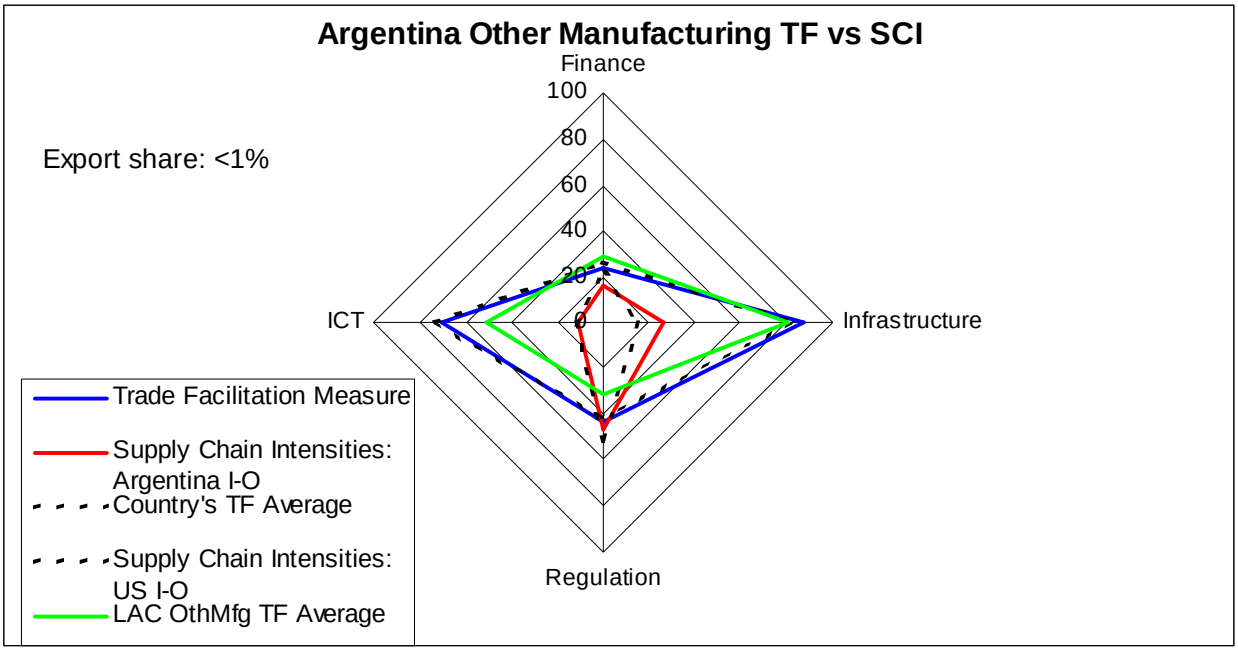

Trade Facilitation Measures Dominican Republic vs LAC
Corruption
100
80
60
40
20
Finance
Infrastructure
Regulation
IT
Customs
Dominican Republic(2005)
Latin America & Caribbean(2005)

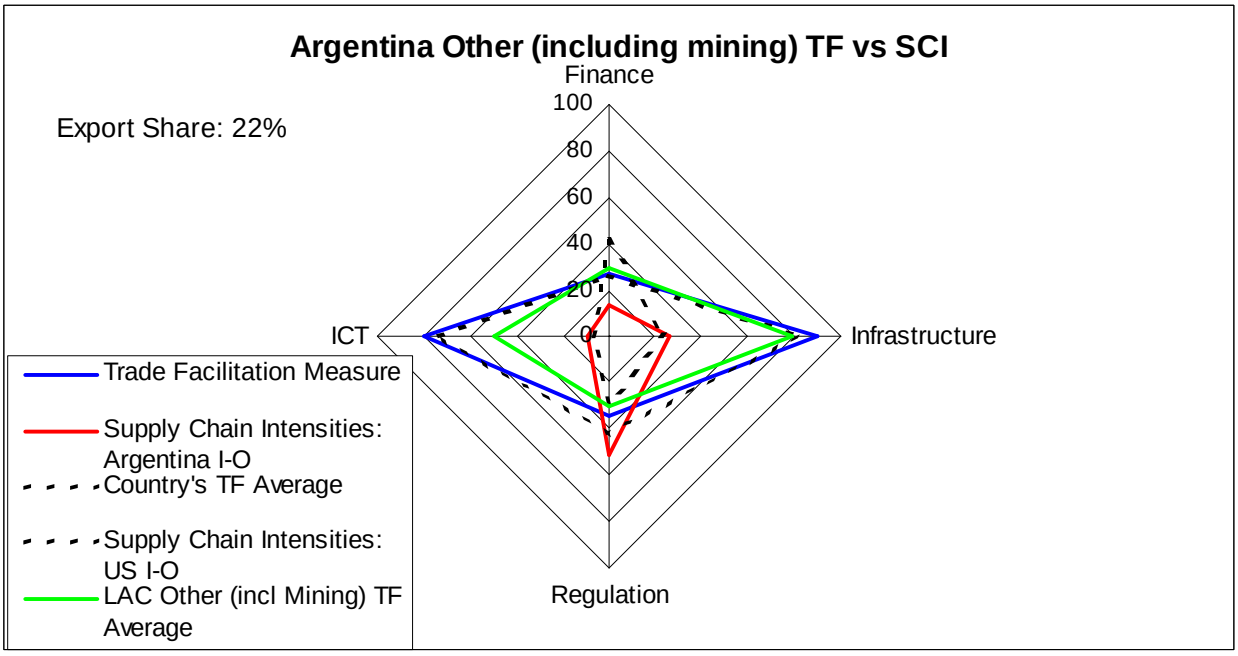
Appendix 5: Benchmarking Product-Specific Trade Facilitation, Supply-Chain Intensity, and Trade Importance

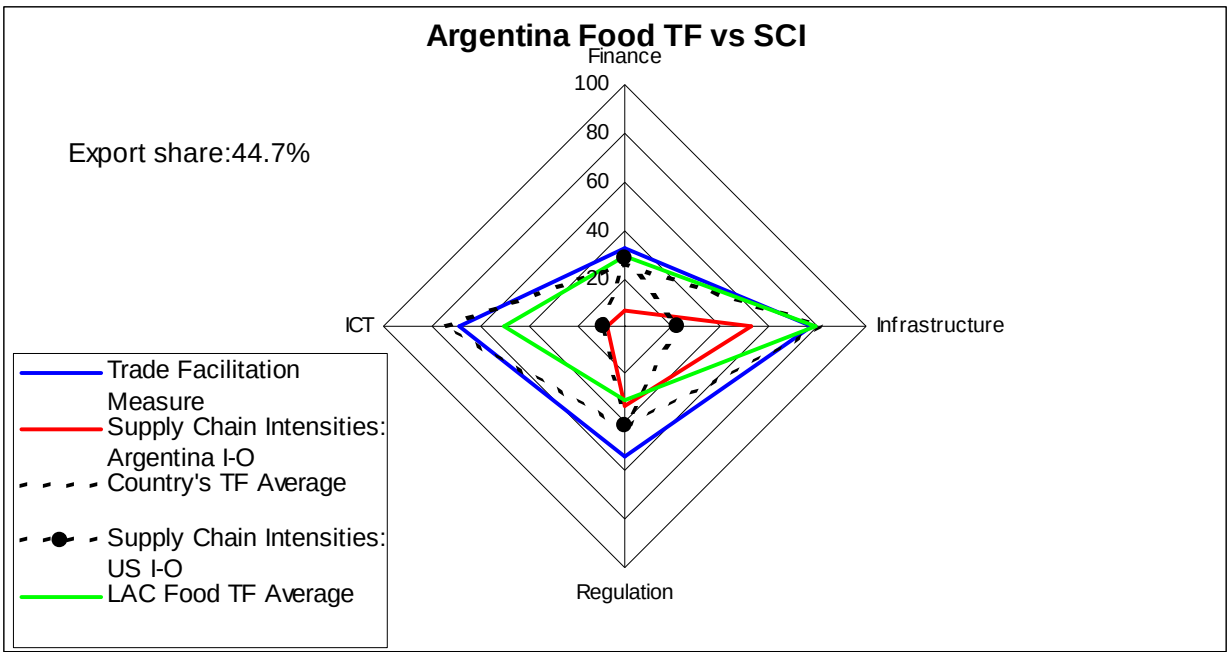
Appendix Figures: Argentina

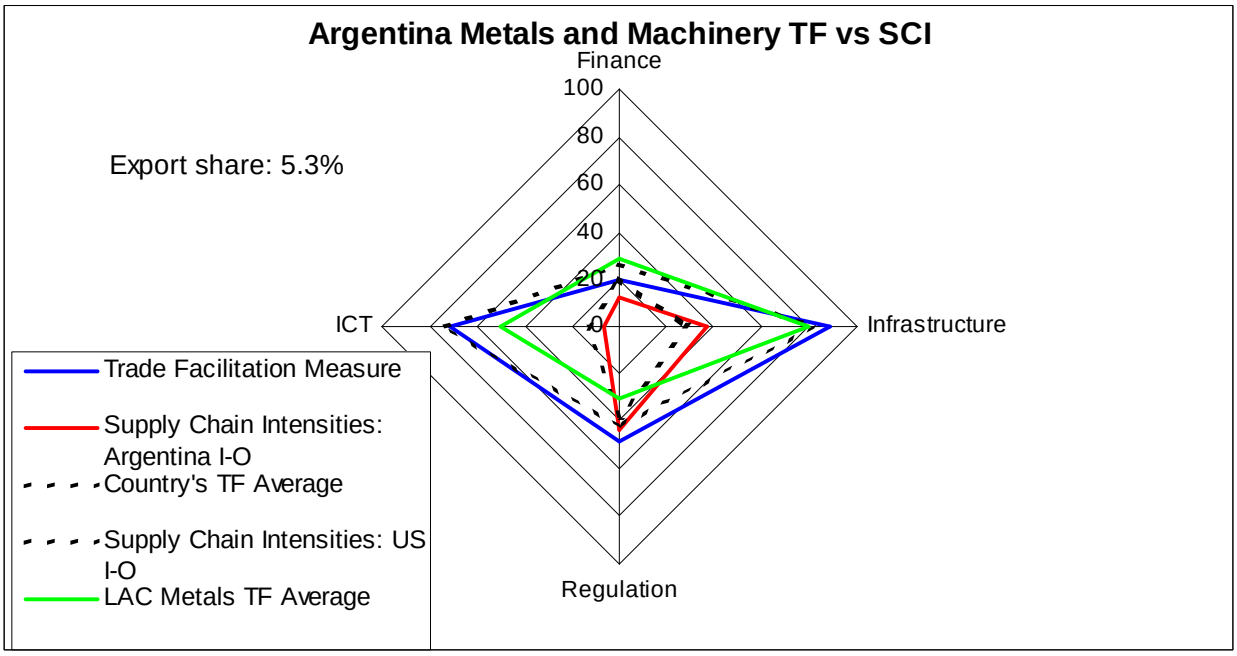


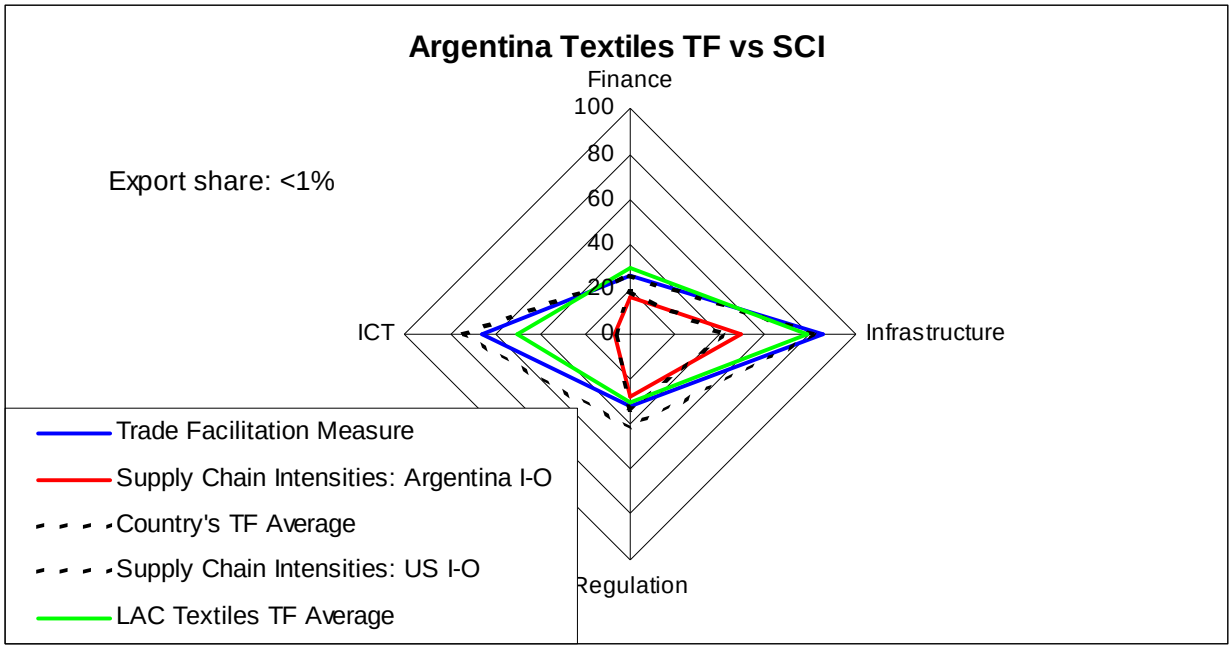



Argentina Other Manufacturing TF vs SCI
Export share: <1%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: Argentina I-O
Country's TF Average
Supply Chain Intensities: US I-O
LAC OthMfg TF Average

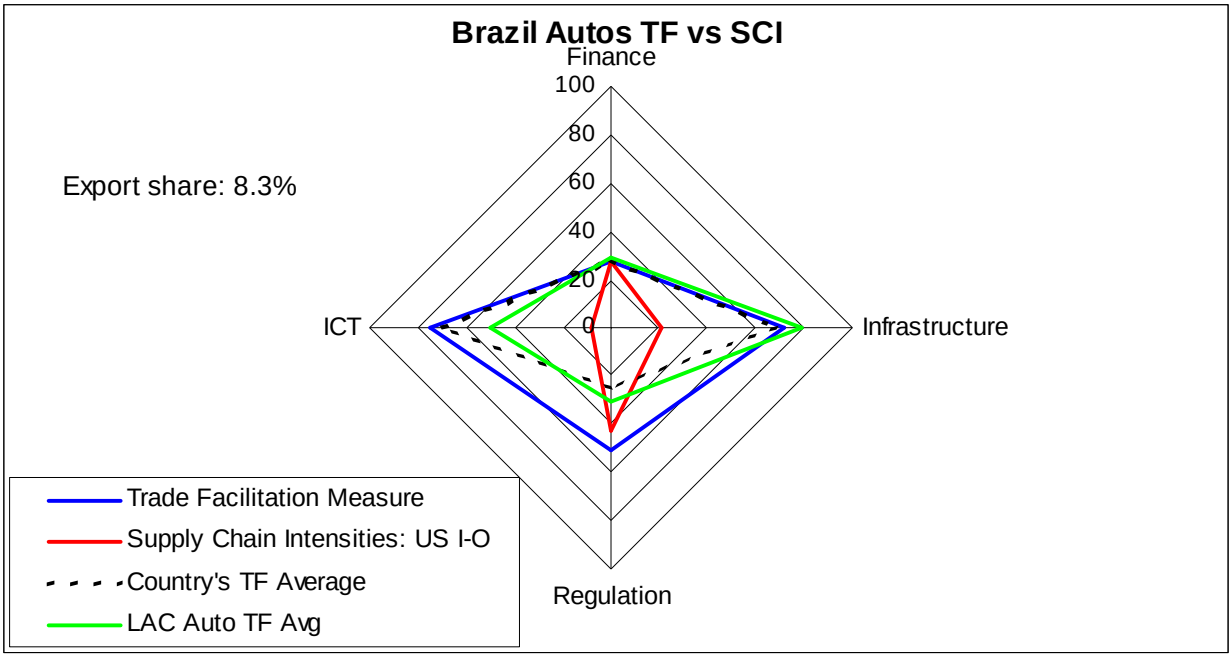

Argentina Other (including mining) TF vs SCI
Export Share: 22%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: Argentina I-O
Country's TF Average
Supply Chain Intensities: US I-O
LAC Other (incl Mining) TF Average

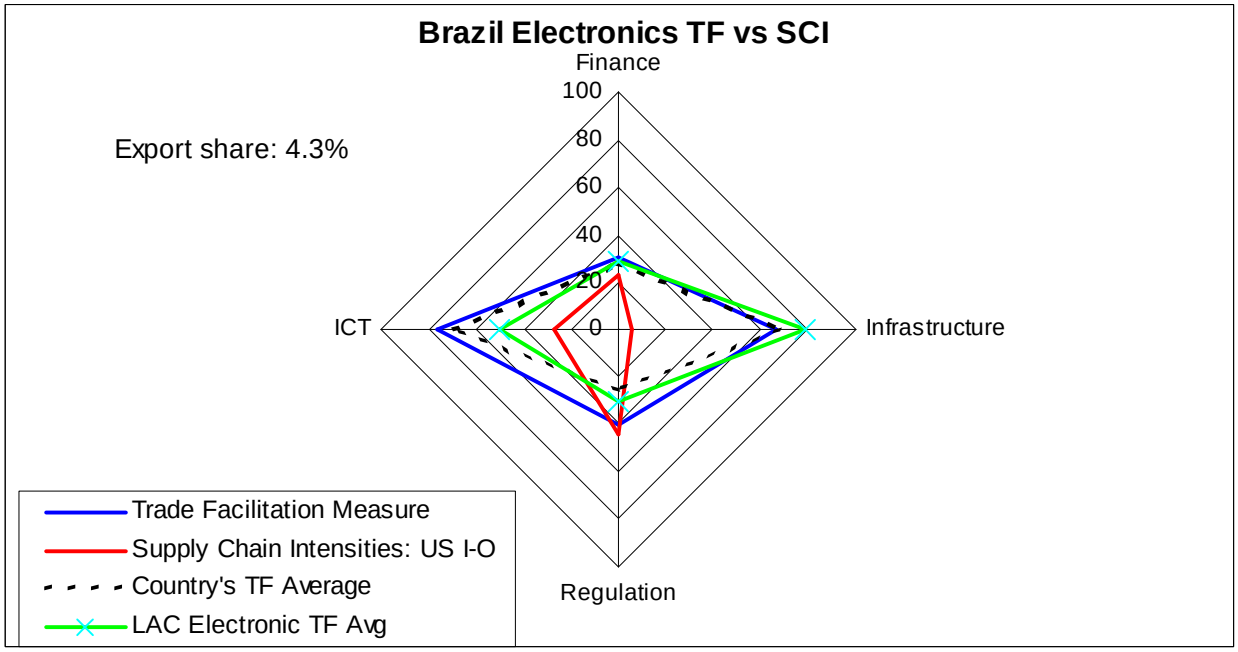

Argentina Food TF vs SCI
Export share:44.7%
Finance
100
80
60
40
20
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: Argentina I-O
Country's TF Average
Supply Chain Intensities: US I-O
LAC Food TF Average

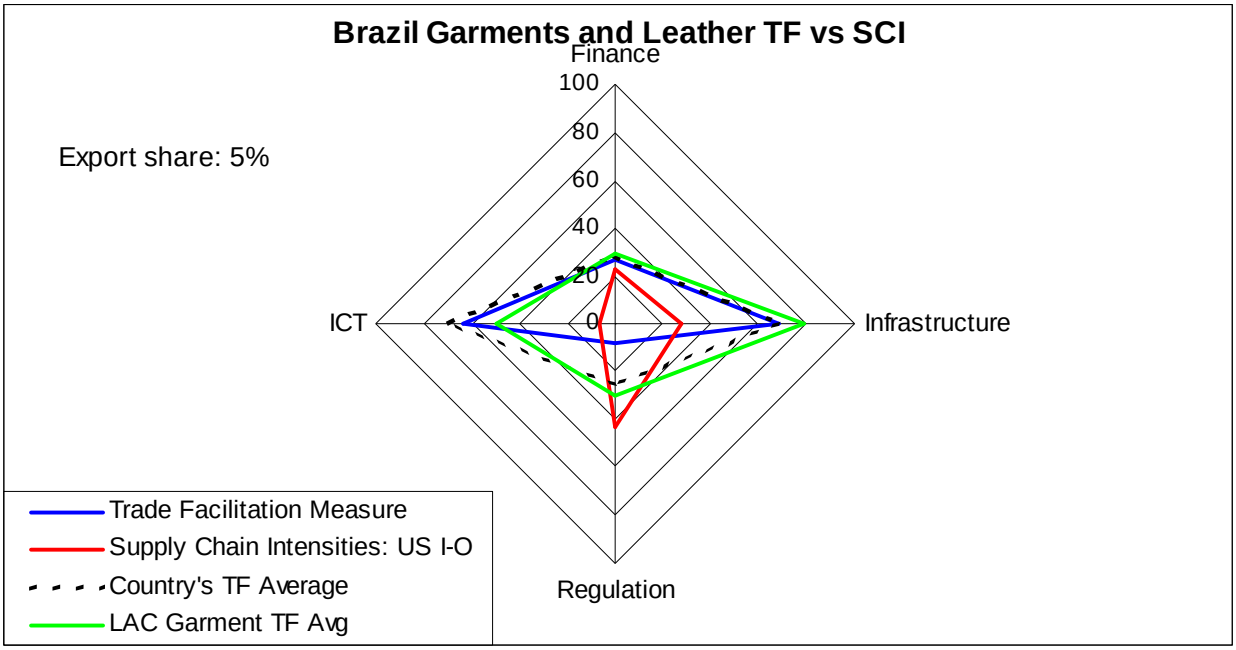

Argentina Metals and Machinery TF vs SCI
Export share: 5.3%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: Argentina I-O
Country's TF Average
Supply Chain Intensities: US I-O
LAC Metals TF Average

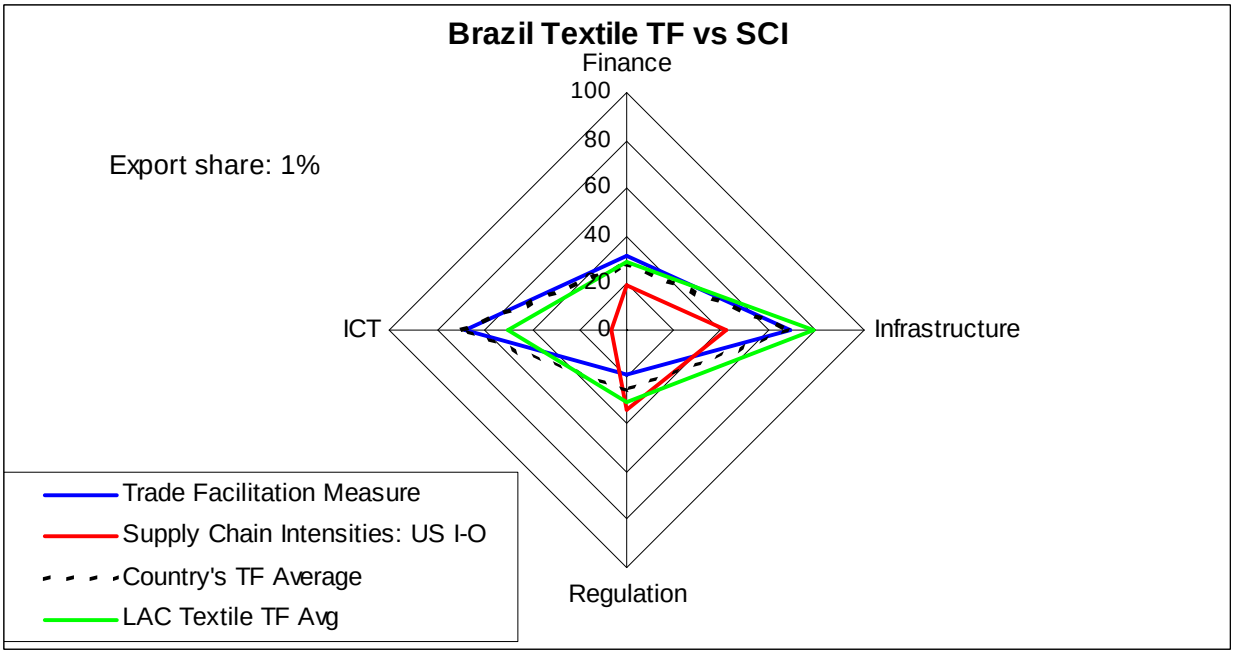

Argentina Textiles TF vs SCI
Export share: <1%
Finance
100
80
60
40
20
0
Infrastructure
Regulation
ICT
Trade Facilitation Measure
Supply Chain Intensities: Argentina I-O
Country's TF Average
Supply Chain Intensities: US I-O
LAC Textiles TF Average

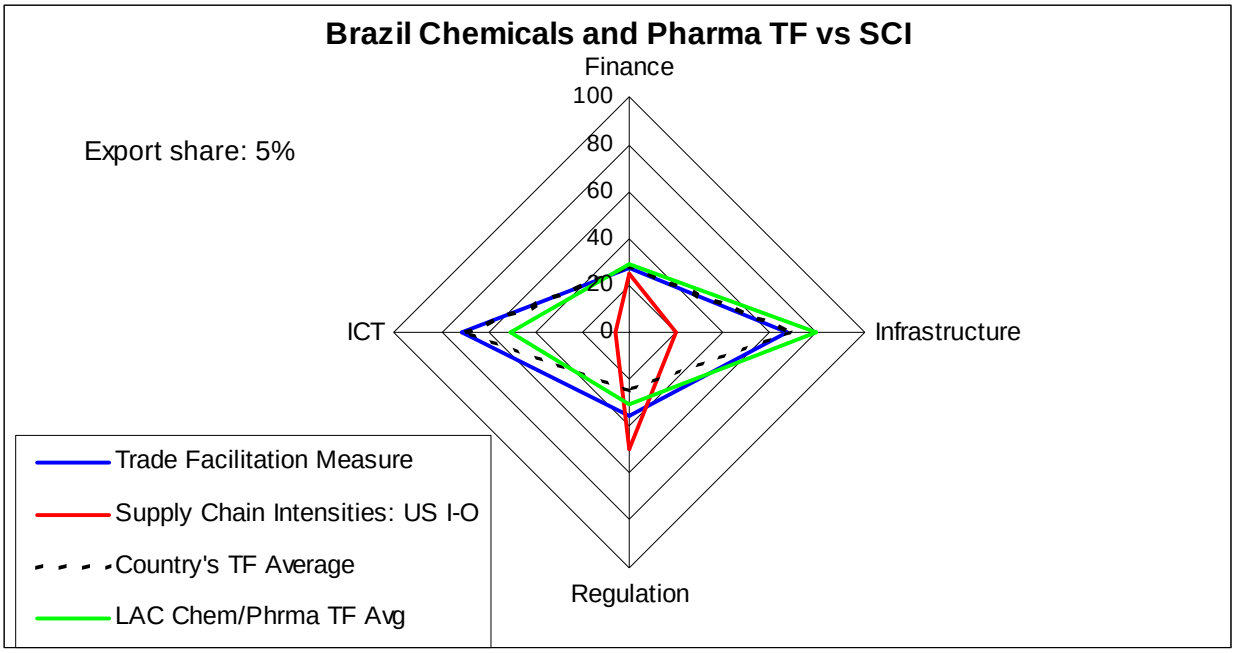
Appendix Figures: Brazil

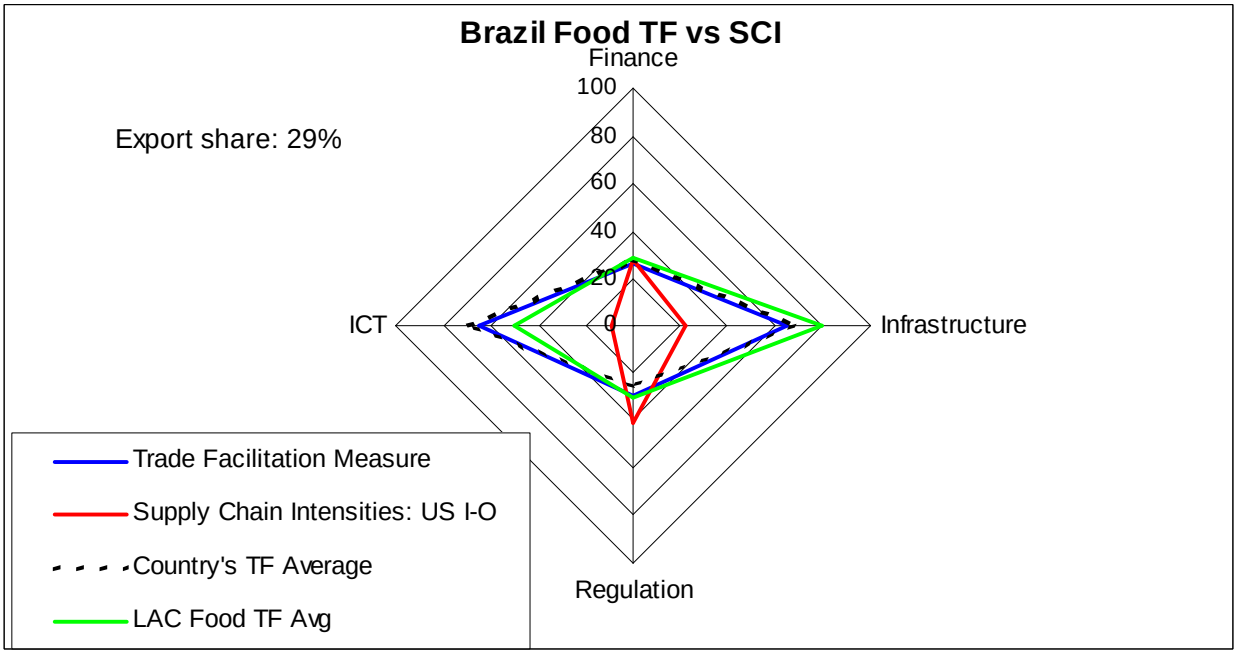


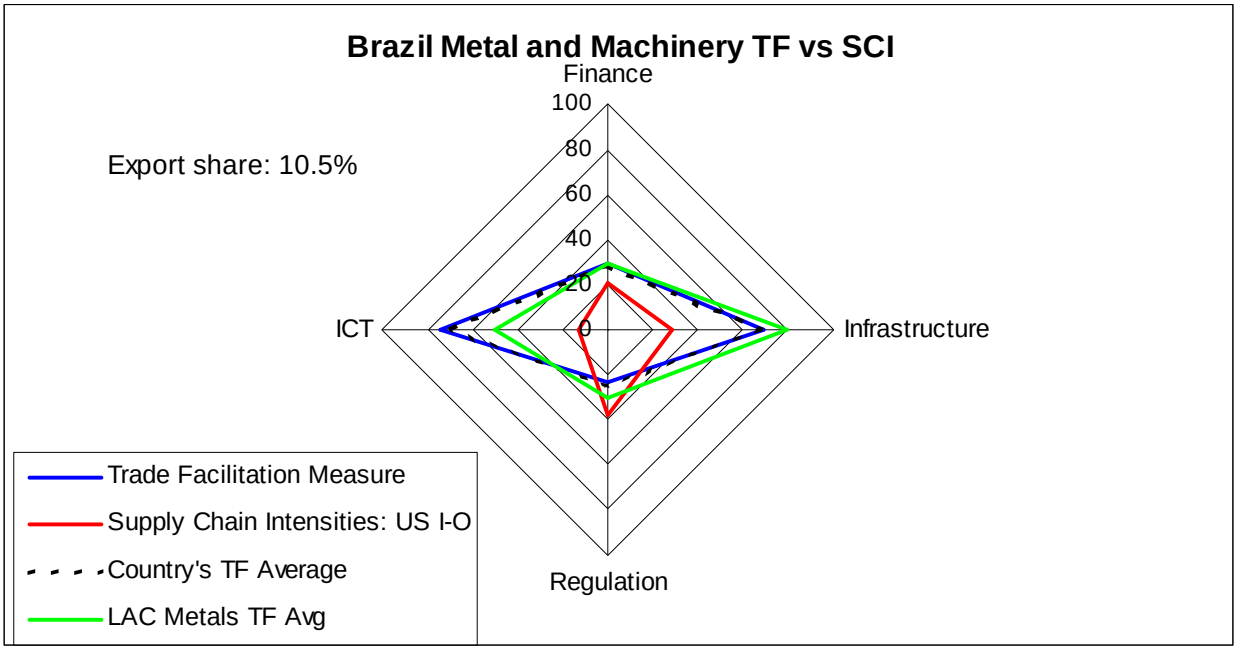


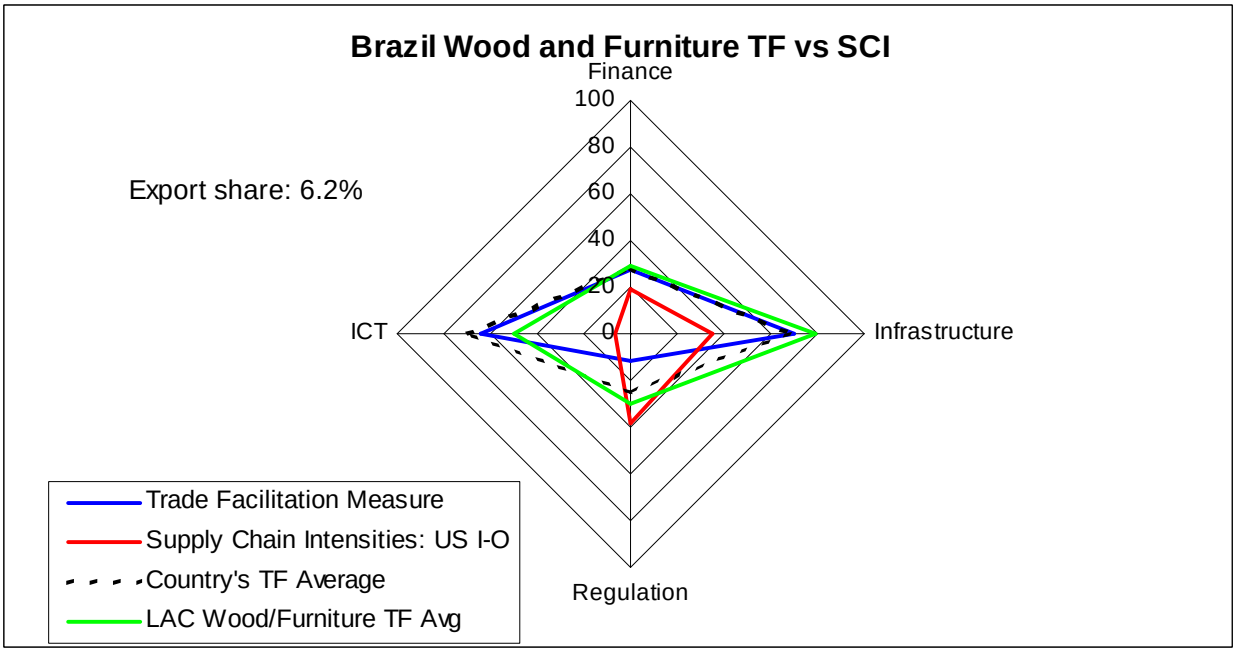

Brazil Garments and Leather TF vs SCI
Export share: 5%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Garment TF Avg


Brazil Textile TF vs SCI
Export share: 1%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Textile TF Avg

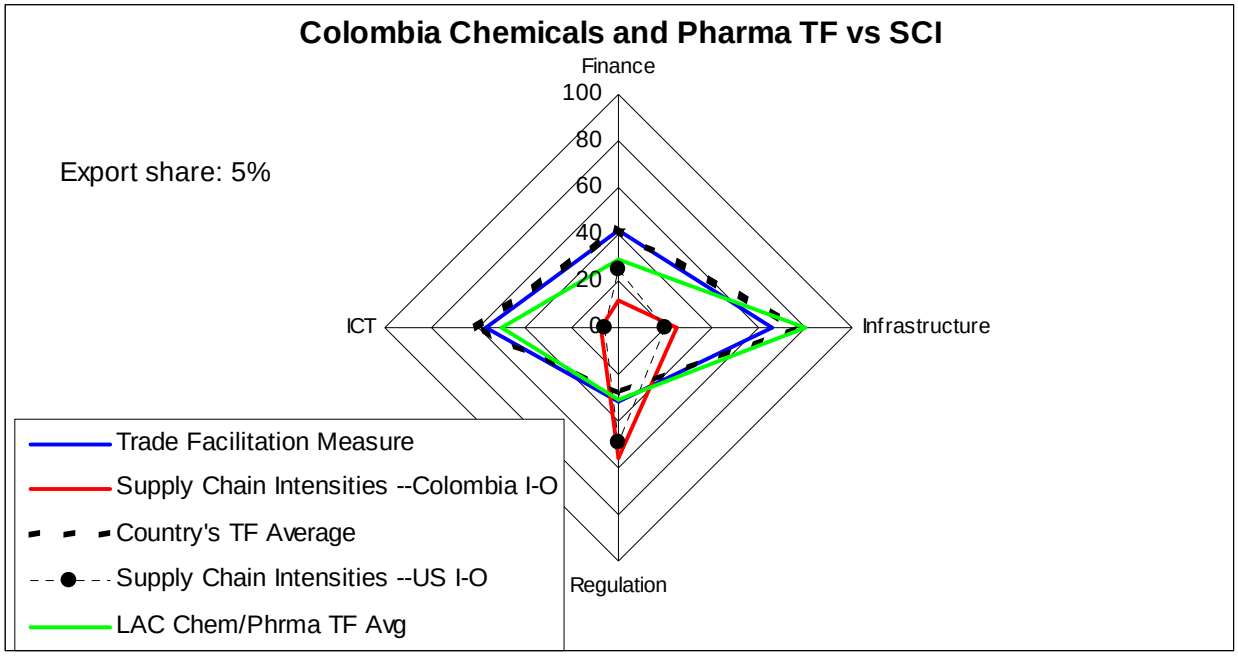

Brazil Chemicals and Pharma TF vs SCI
Export share: 5%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Chem/Phrma TF Avg

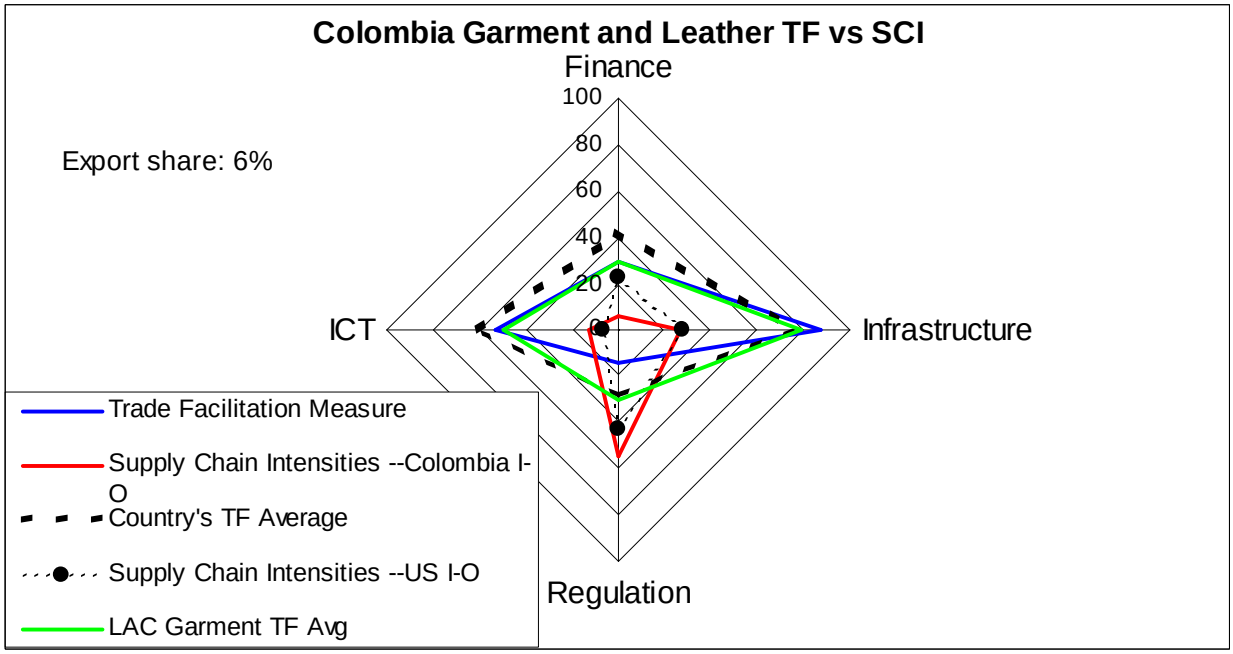

Brazil Food TF vs SCI
Export share: 29%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Food TF Avg

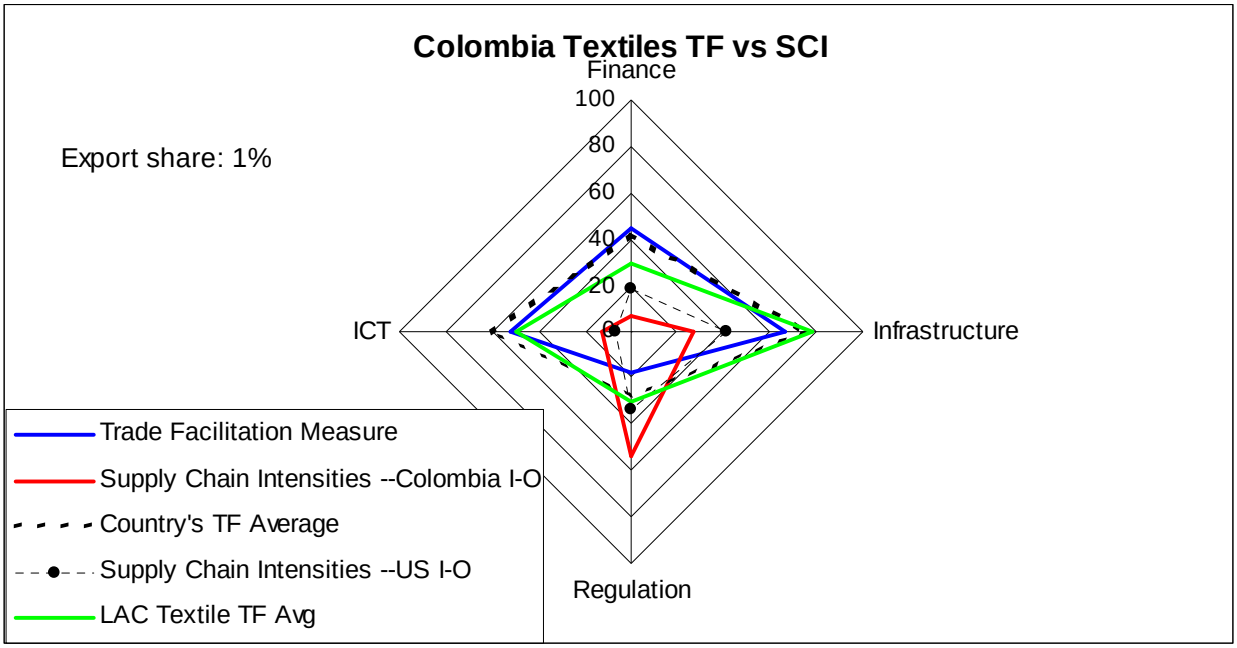

Brazil Metal and Machinery TF vs SCI
Finance
100
80
60
40
20
0
Export share: 10.5%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Metals TF Avg

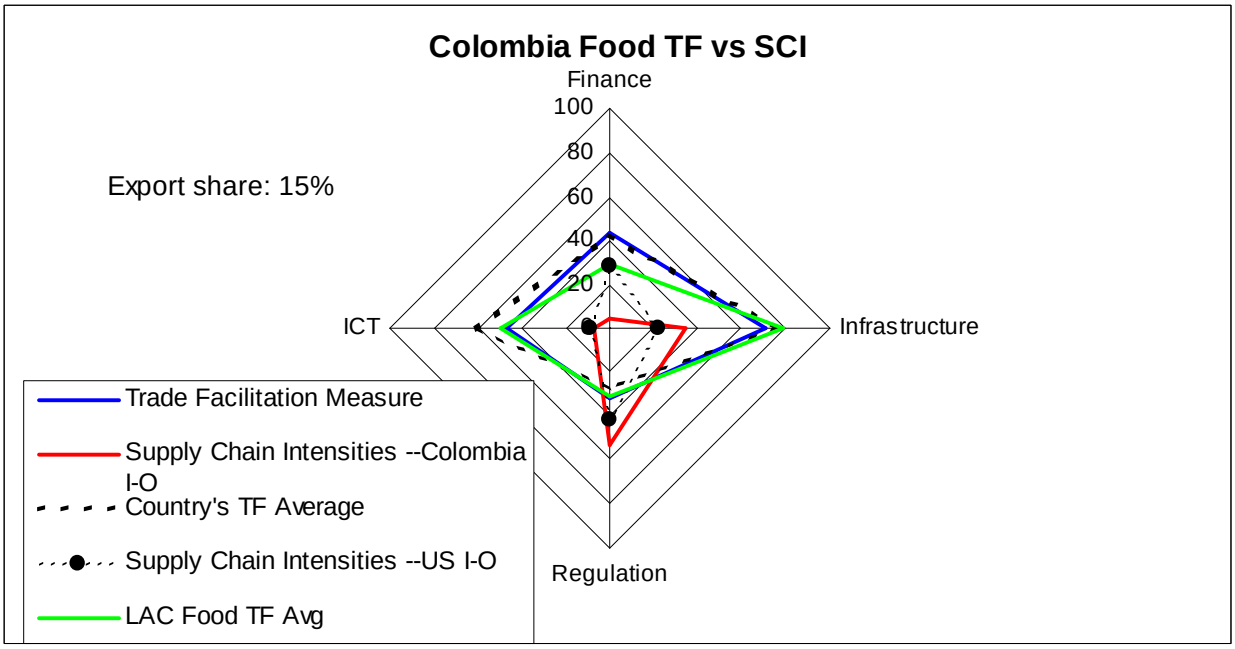

Brazil Wood and Furniture TF vs SCI
Finance
100
80
60
40
20
0
Export share: 6.2%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities: US I-O
Country's TF Average
LAC Wood/Furniture TF Avg

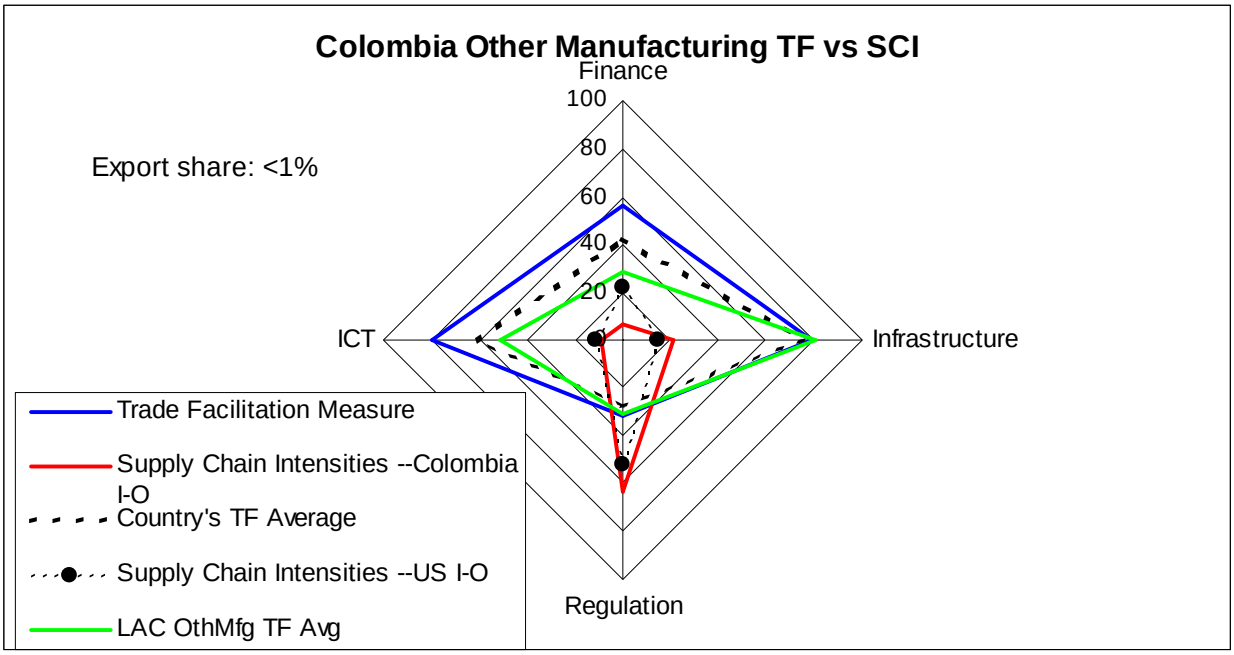
Appendix Figures: Colombia

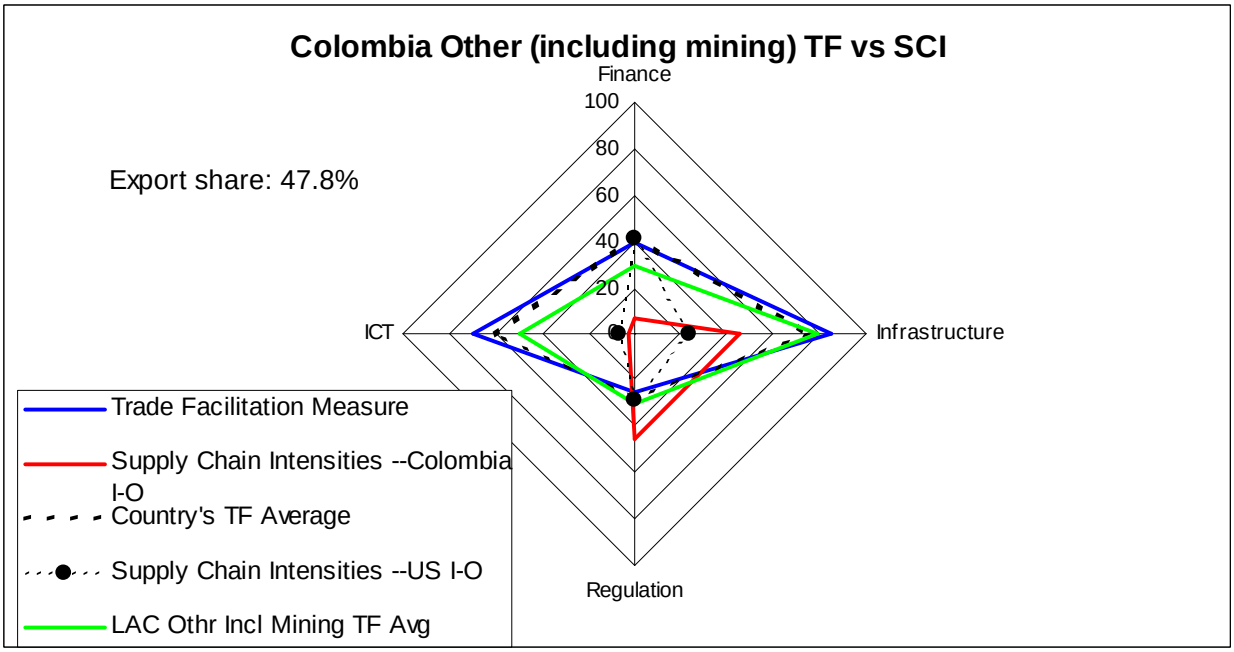




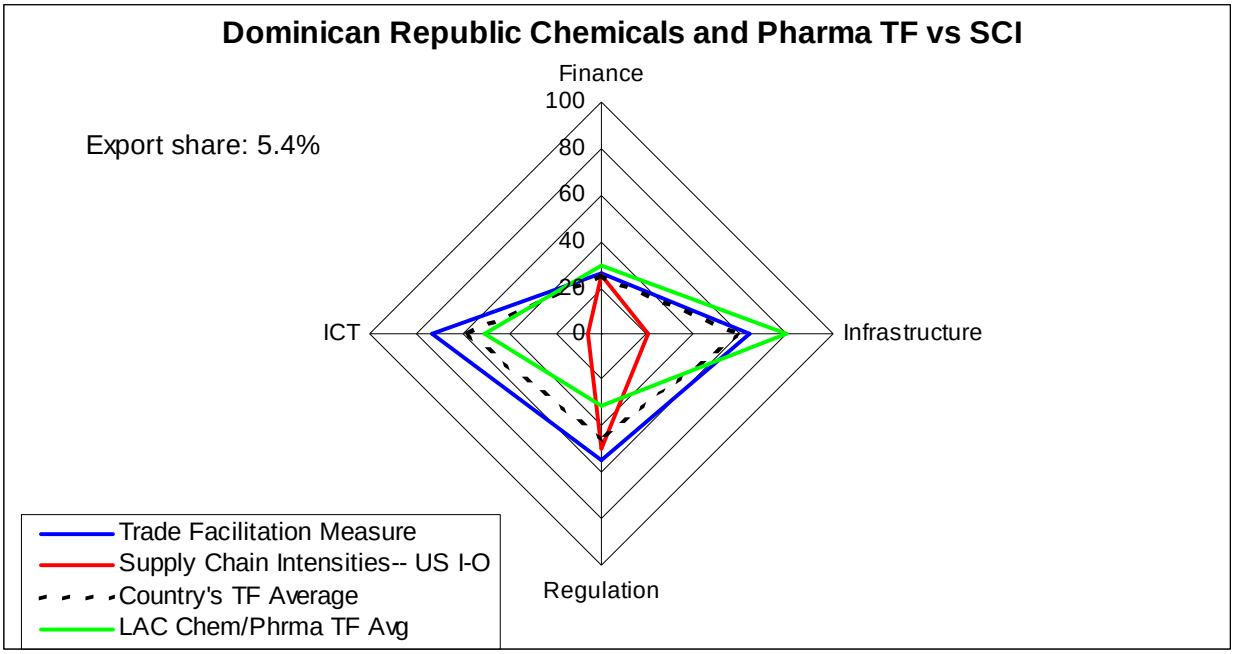

Colombia Textiles TF vs SCI
Export share: 1%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities --Colombia I-O
Country's TF Average
Supply Chain Intensities --US I-O
LAC Textile TF Avg

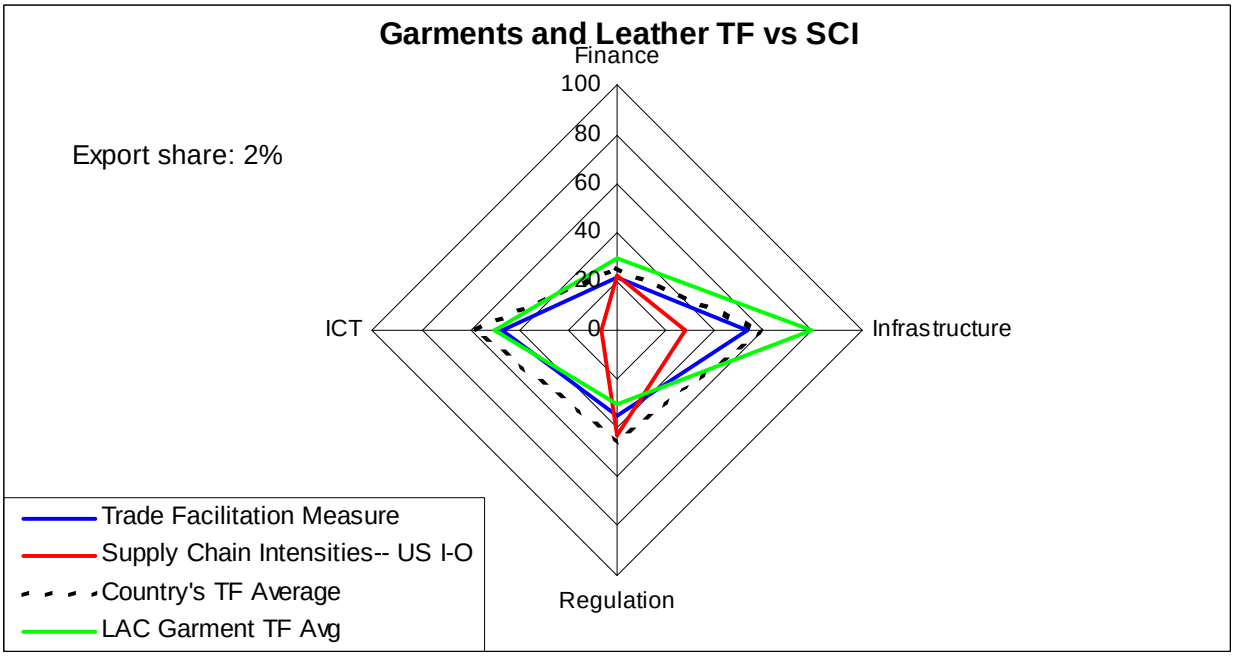

Colombia Food TF vs SCI
Export share: 15%
Finance
100
80
60
40
20
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities --Colombia I-O
Country's TF Average
Supply Chain Intensities --US I-O
LAC Food TF Avg

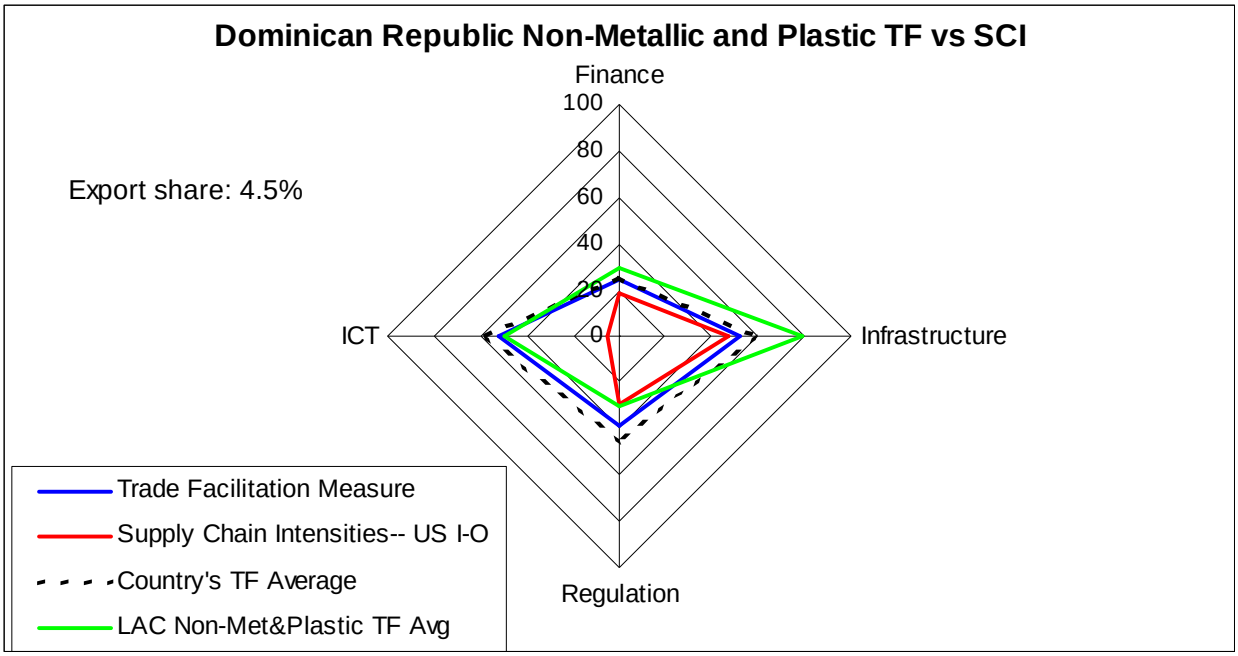

Colombia Other Manufacturing TF vs SCI
Export share: <1%
Finance
100
80
60
40
20
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities --Colombia I-O
Country's TF Average
Supply Chain Intensities --US I-O
LAC OthMfg TF Avg

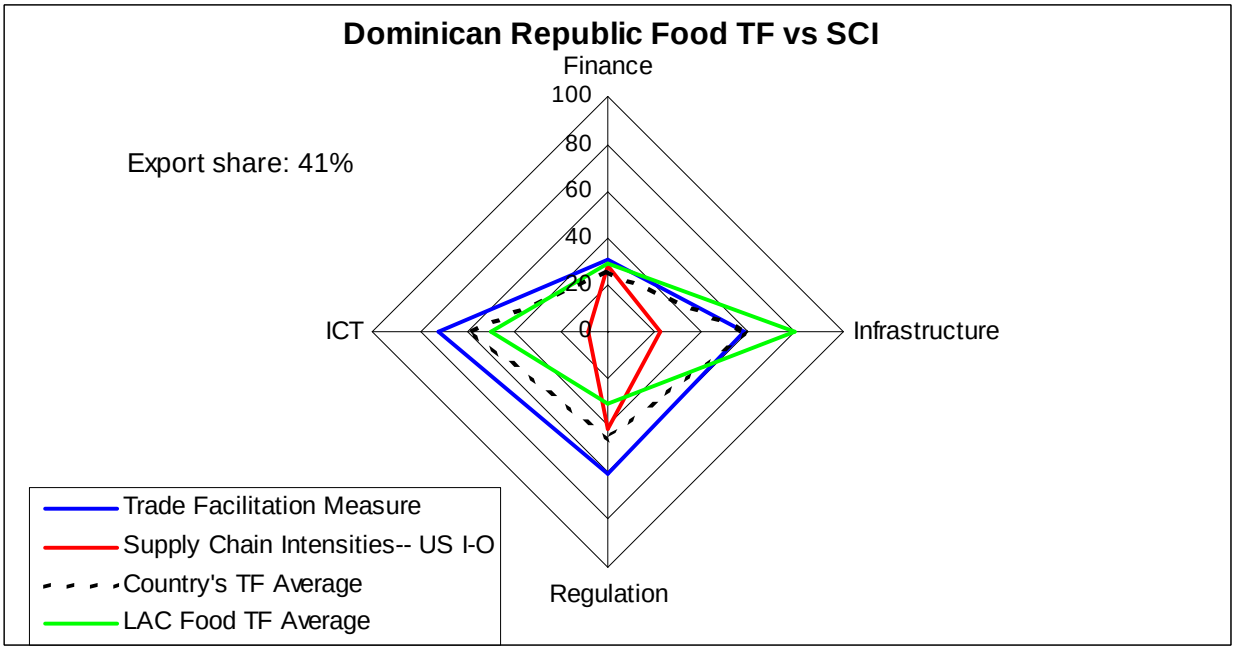

Colombia Other (including mining) TF vs SCI
Export share: 47.8%
Finance
100
80
60
40
20
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities --Colombia I-O
Country's TF Average
Supply Chain Intensities --US I-O
LAC Othr Incl Mining TF Avg

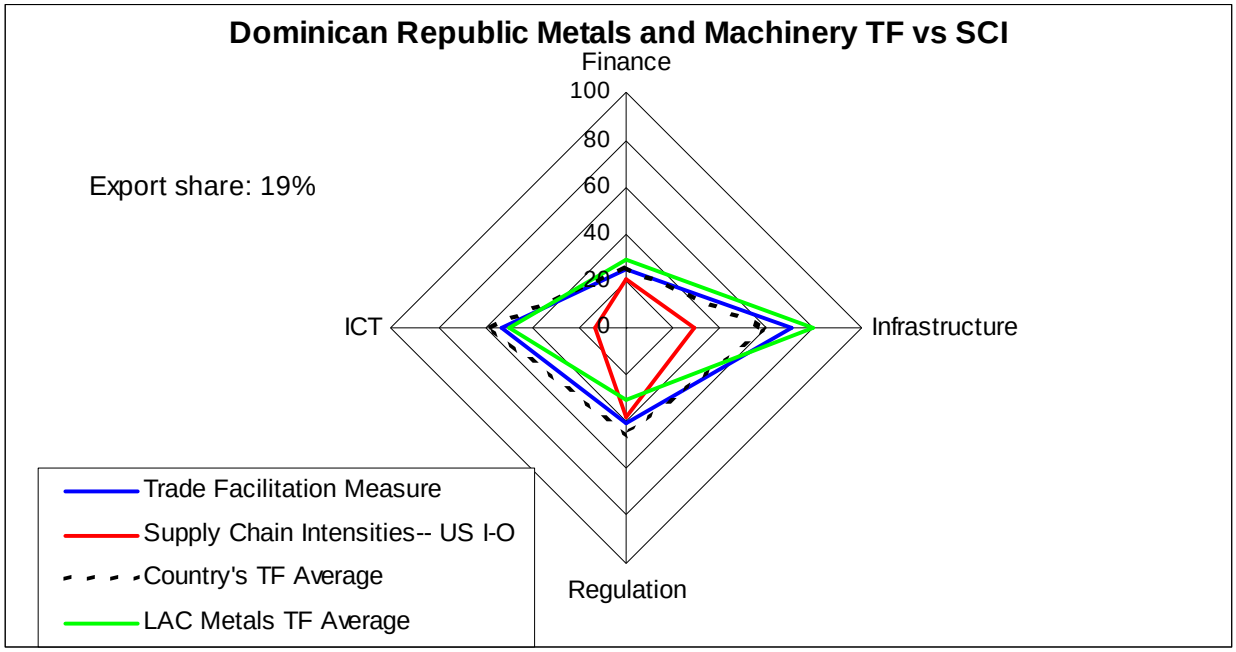
Appendix Figures: Dominican Republic

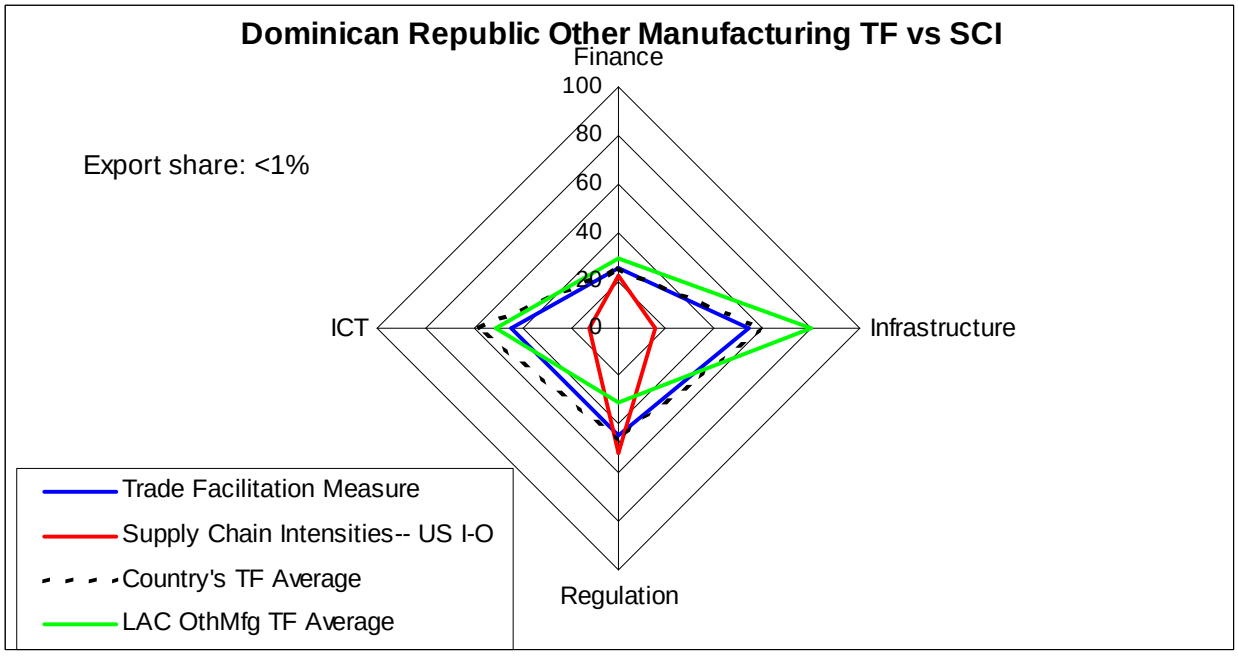




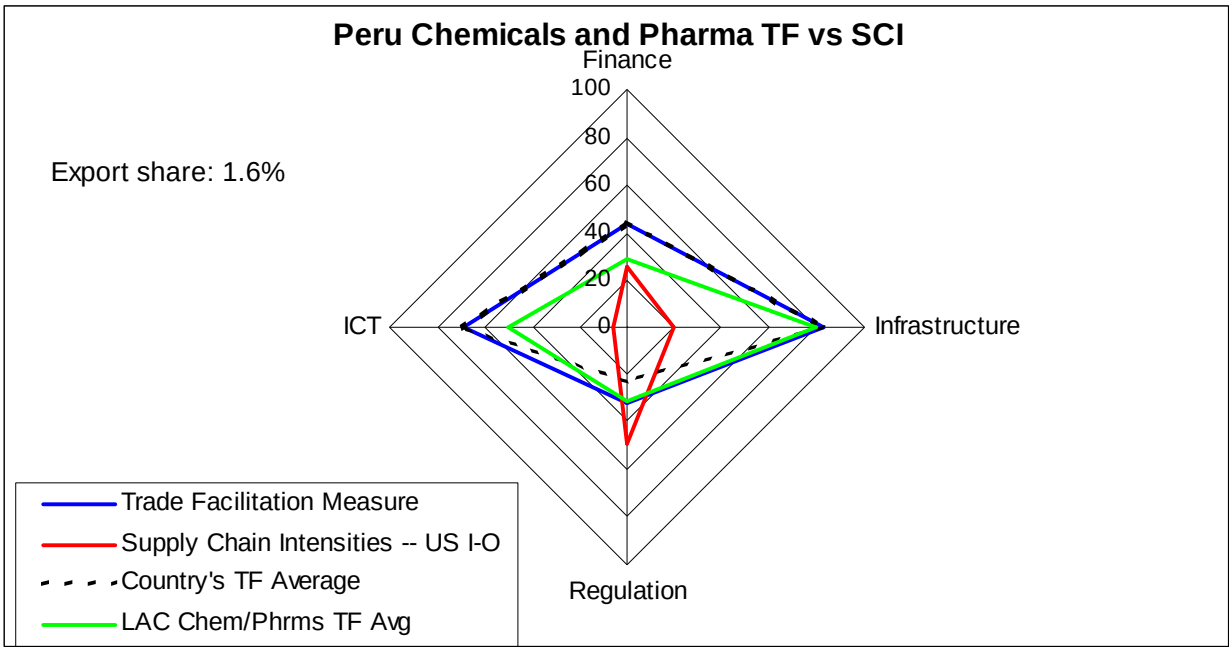

Dominican Republic Non-Metallic and Plastic TF vs SCI
Export share: 4.5%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities-- US I-O
Country's TF Average
LAC Non-Met&Plastic TF Avg

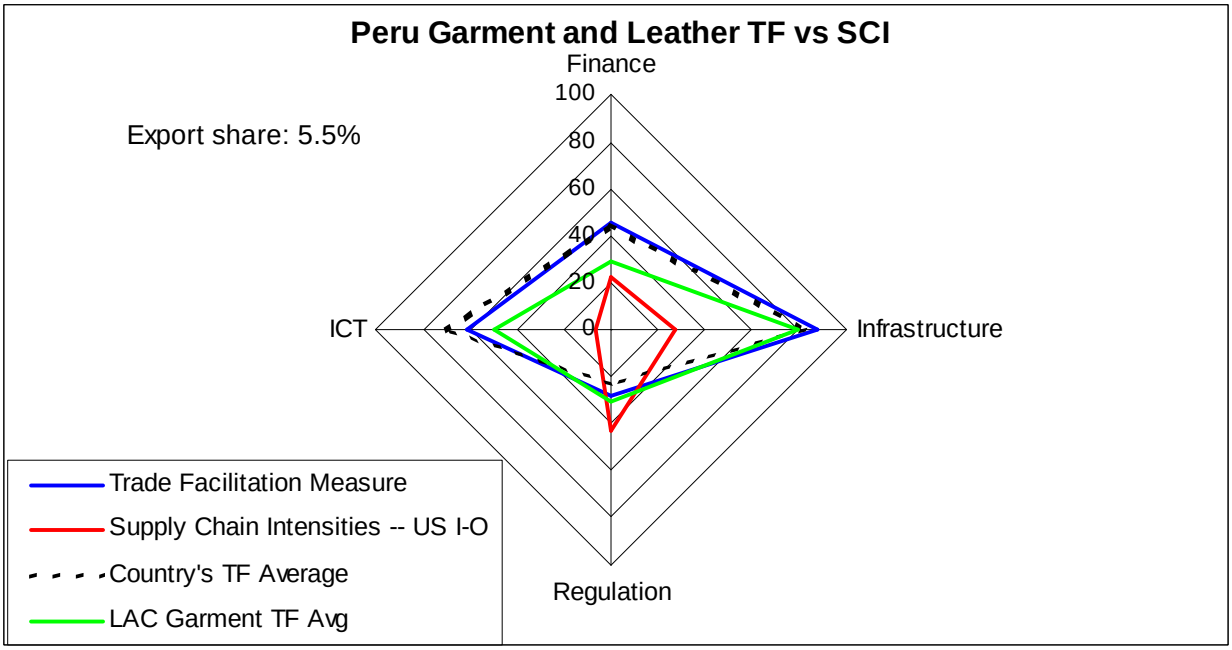

Dominican Republic Food TF vs SCI
Export share: 41%
Finance
100
80
60
40
20
0
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities-- US I-O
Country's TF Average
LAC Food TF Average

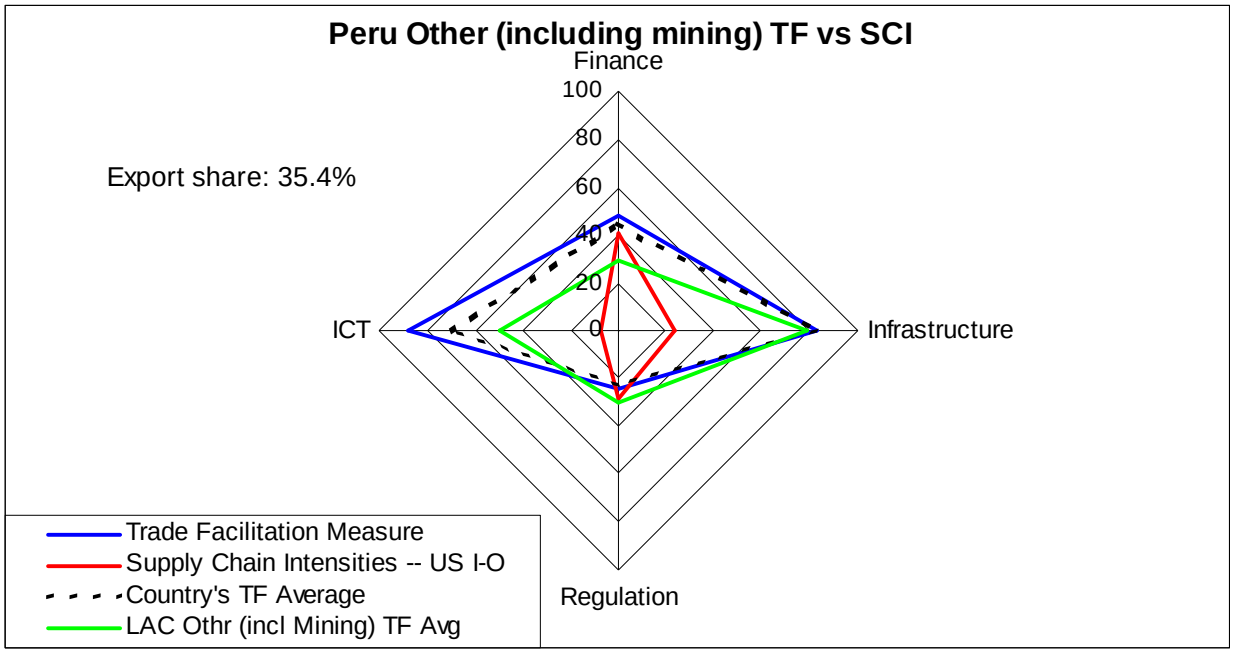

Dominican Republic Metals and Machinery TF vs SCI
Finance
100
80
60
40
20
0
Export share: 19%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities-- US I-O
Country's TF Average
LAC Metals TF Average

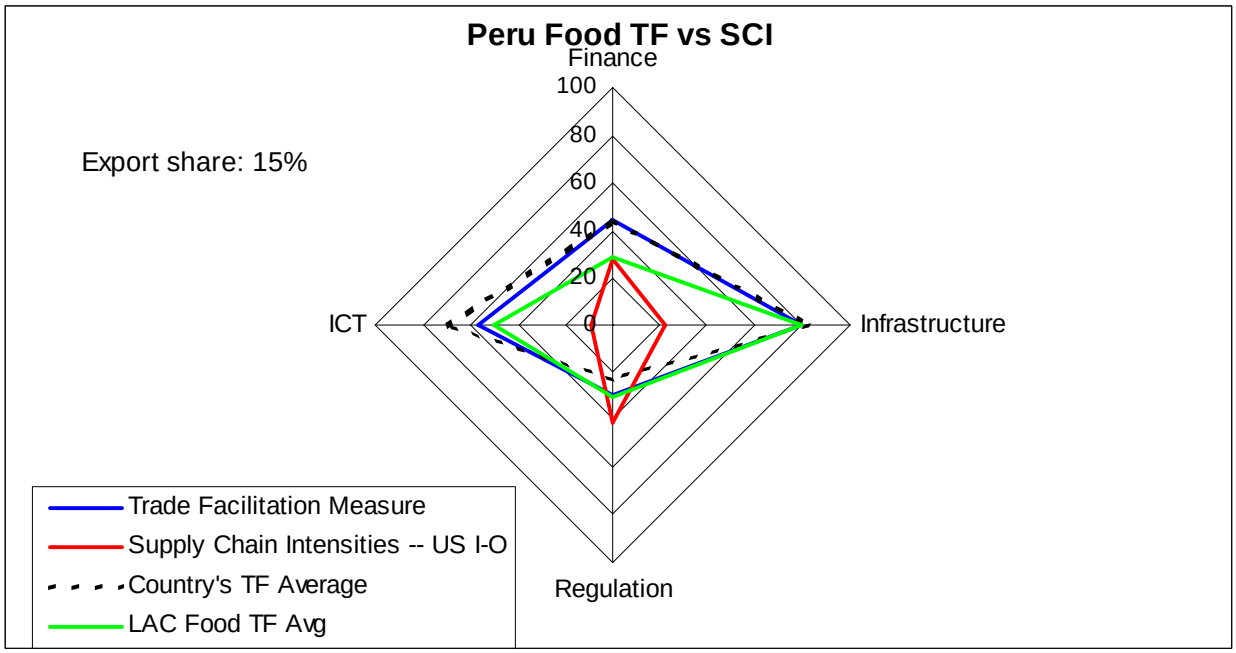

Dominican Republic Other Manufacturing TF vs SCI
Finance
100
80
60
40
20
0
Export share: <1%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities-- US I-O
Country's TF Average
LAC OthMfg TF Average

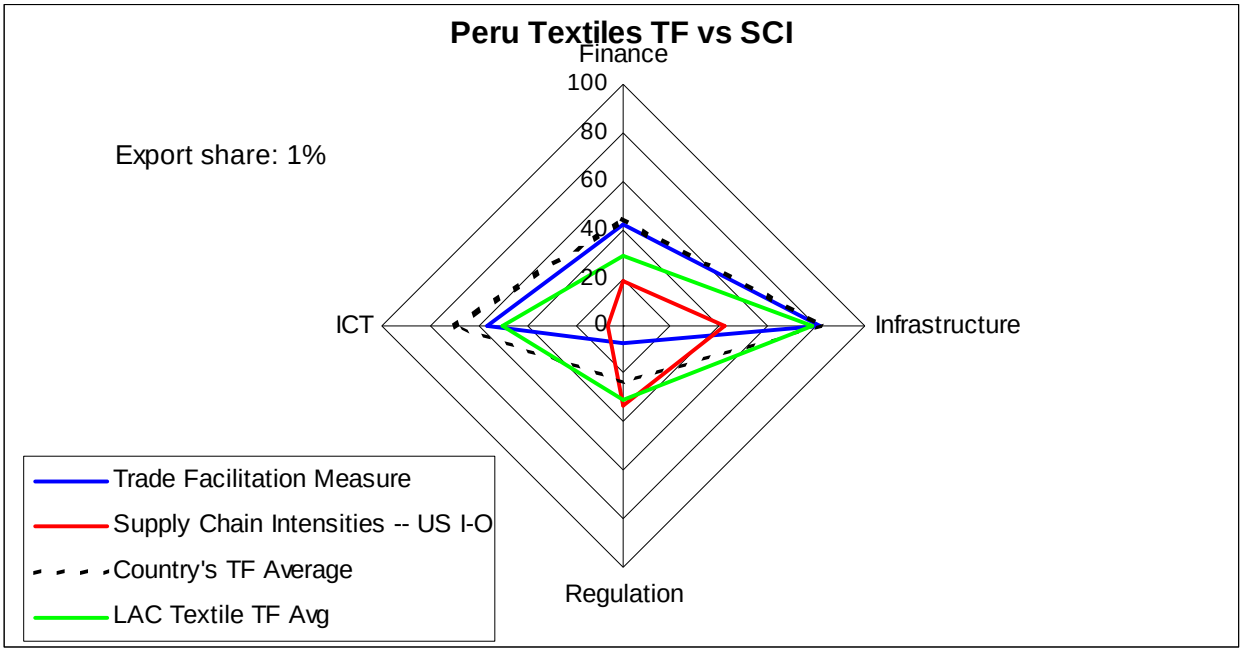
Appendix Figure: Peru






Peru Other (including mining) TF vs SCI
Finance
100
80
60
40
20
0
Export share: 35.4%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities -- US I-O
Country's TF Average
LAC Othr (incl Mining) TF Avg


Peru Food TF vs SCI
Finance
100
80
60
40
20
0
Export share: 15%
ICT
Infrastructure
Regulation
Trade Facilitation Measure
Supply Chain Intensities -- US I-O
Country's TF Average
LAC Food TF Avg


Peru Textiles TF vs SCI
Finance
100
80
60
40
20
0
Infrastructure
Regulation
ICT
Export share: 1%
Trade Facilitation Measure
Supply Chain Intensities -- US I-O
Country's TF Average
LAC Textile TF Avg

Appendix 6: Details of the Gravity Model

6.1Gravity Model Results: Elasticity of trade with respect to trade facilitation

The methodology used by WMO to model cross-border trade and to estimate the effect of trade facilitation on trade flows is a 'gravity model' of bilateral trade flows. This econometric analysis of the factors that generate bilateral trade patterns included the standard variables such as GDP and per capita income of the bilateral trading partners, as well as distance between the countries, various trade agreements and common cultural foundations, tariffs, and then finally the variables relevant for the trade facilitation analysis.[14]

There are some differences between the TF measures in this Report and the ones used in WMO. Principally, of course, they did not have product-specific TF measures. In addition, the observations on TF and trade patterns used for the analysis come from 2000 or 2001. However, if the econometric relationships are stable over time, then these elasticities are still valid for today's data.[15] That said, the economy-wide WMO TF metrics follow a similar rubric and are designed similarly as averages of multiple inputs into each TF area: port/transport efficiency, customs environment (which included measures of corruption), regulatory environment (both stringency and adherence), and e-business usage (what this Report calls ICT). Finance was not included in the WMO analysis as a TF area.

Table 5 displays the overall regression results from the model. The model was run using ordinary least squares (OLS) with robustness test determining the validity of the use of TF indicators vs. generalized fixed effects. The coefficients for the four trade facilitation measures are significant and the estimated coefficients differ for the different trade facilitation indicators. Overall, the analysis confirmed that trade facilitation involves more than reducing the cost of transport—although that factor is quite important. From a policy perspective, these differences in estimated elasticities of trade flows with respect to different measures of trade facilitation implies that different approaches to trade facilitation may differentially affect exports of individual countries as well as of all countries in the sample.

Before considering trade facilitation issues, it is worthwhile to look at the results for a well-known and quantifiable barrier to trade—tariffs. Tariffs have a significant and expected negative effect (coefficient of –1.2) on trade. This means, if the global average tariff rate fell from 8.5% to 7.5%, overall bilateral trade flows would increase by 1.2 percent. This is a useful benchmark figure against which to compare the TF elasticities.

'Port Efficiency' of both the importer and the exporter is positively associated with trade, implying that better ports increases trade flows. The coefficient is higher for exporters than for importers (0.9 vs. 0.3), suggesting that when exporter port efficiency improves,

[14] See WMO for a complete discussion of the gravity model and the specification.
[15] An updated version of the WMO gravity model is beyond the scope of this Report, but a version is being prepared for Latin America by Esteban Ferro as part of his PhD dissertation.

the country's own and global trade gets a bigger boost. This also suggests that port improvements are balance-of-payments improving.

'Customs environment' also has a significantly positive effect on trade, with an elasticity of about 0.47. This definition of customs environment focuses on imports. For econometric reasons, the elasticity of trade with respect to the exporter's 'outbound customs' environment is not estimated.

'Regulatory environment' of the importer and exporter also have a positive and significant effect on trade as expected with coefficients of 0.28 and 0.62, respectively. The higher coefficient for the exporter implies that greater regulatory adherence to international standards has a greater impact on exports than on imports.

Finally, *'e-business usage'* [16]has a positive and significant effect on trade. The elasticity of exporter's e-business usage is the highest among all trade facilitation measures (1.94). This suggests that the boost to own exports of improved ICT exceeds all other TF improvements. Based on the supply-chain and TF analysis in Part 2, the elasticity of e-business usage may seem high, given that ICT appeared from the I-O matrixes to be not a very large input to the supply chain for most products. But there may be positive externalities from ICT usage that are not fully captured in the supply-chain intensities. Indeed an examination of correlations between the regulation and ICT TF measures used in Part 2 suggest important synergies between web-transactions, ISO certification, and external audit. Moreover, the role for ICT, despite its small share of domestic production, to raise economic productivity is now well established; so the likelihood that this is true for trade facilitation as well seems quite reasonable.[17]

Table 6.1 Overall Regression Results: Coefficients for Scenario

	Coef.	Std. Err.
Constant	-10.641***	1.558
Tariff	-1.155***	0.318
Port Efficiency of Importing Country	0.307*	0.163
Port Efficiency Exporting Country	0.924***	0.148
Customs Environment of Importing Country	0.472**	0.199
Regulatory Envornment of Importing Country	0.281*	0.144
Regulatory Envornment Exporting Country	0.620***	0.132
E-Business of Importing Country	0.729***	0.224
E-Business Exporting Country	1.943***	0.216
Adjusted R-squared	0.758	
Number of the observations	7,904	

[16] Similar to the *ICT infrastructure and usage* in the current Report.

[17] For the role of ICT in the US economy, see Mann (2006), which also briefly summarizes research on ICT's role in Europe and developing economies. This source also has an extensive review of the literature on the research on the role for ICT in productivity and economic growth. The most important conclusion from that research is that the majority of the gains to ICT come not from buying the equipment and software (which is what is incorporated in the I-O matrix), but from the changes in business activities and workplace practices that can be induced by ICT if the marketplace and regulatory environment are conducive to economic transformation. .

/1/ additional variables from gravity model suppressed. See WMO(2005)

References

Mann, C.L. and co-authors:

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