RESEARCH REPORT

Impacts of Better Trade Facilitation in Developing Countries

Analysis with a New GTAP Database for the Value of Time in Trade

NATHAN
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www.nathaninc.com

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SUBMITTED BY
Peter Minor and
Marinos Tsigas

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Peter Minor is a principal associate with Nathan Associates Inc. He has been engaged in economic modeling for private and public clients for 15 years. Mr. Minor has been a guest lecturer with the GTAP program in two prior short courses.

Dr. Marinos Tsigas is an economist with the U.S. International Trade Commission. He has produced numerous computable general equilibrium (CGE) studies of U.S. policy and trade for the U.S. government. Dr. Tsigas has also been a major contributor to the development of the GTAP model and the GTAP program, having taught numerous GTAP short courses.

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Introduction

International trade has grown rapidly over the past half-century: global exports grew from $296 billion in 1950 to over $8 trillion in 2005, and their share of GDP rose from 5.5 percent to 19.4 percent (Maddison 2001 and WTO 2007).[1] Trade's growth was facilitated by the drop in average import tariffs on goods from 8.6 percent in 1960 to 3.2 percent in 1995 (Clemens and Williams 2002). Advances in transportation and communication technology have also contributed to trade's growth: since 1951, ton-miles of air cargo shipped worldwide have grown by more than 10 percent per year. Decreased tariffs and faster trade times allow countries to trade an increasingly diverse set of goods, from low value-added bulk commodities to advanced manufactures and highly time-sensitive agricultural products.

Yet trade has not grown and diversified at the same pace everywhere: least developed countries' (LDCs') share of trade growth has lagged behind middle and high-income countries', and LDCs' exports continue to be dominated by low valued-added and primary products. Development experts once saw high tariffs as the primary barrier to LDCs' participation in trade, but have dedicated increasing attention to other barriers in light of the general decline in tariff rates.

In the current round of World Trade Organization (WTO) negotiations, one of the most prominent topics is "trade facilitation"—removal of obstacles to the movement of goods across borders.[2] Numerous studies have shown a strong relationship between fees and time to move goods across borders and trade volumes in developing countries (Djankov et al. 2006 and OECD 2003). For example, Djankov et al.'s study concluded that a one-day delay in trade reduces trade volumes by approximately 1 percent. Most research has also found that "indirect costs" from time delays (i.e., the cost of carrying greater inventories and the cost of depreciation) have a greater effect on trade volumes than "direct costs" (i.e., costs directly incurred to complete paperwork or pay fees (OECD 2003). Researchers have described the relationship between direct and indirect costs as the "iceberg" effect, wherein the direct costs are the tip of the iceberg and the indirect costs are larger but unobserved because they are under the water line (Hertel, Walmsley and Ikatura 2001).

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[1] Values in constant 1990 U.S. dollars.
[2] This is the definition of trade facilitation used by the WTO. See http://www.wto.org/english/thewto_e/glossary_e/glossary_e.htm, accessed April 28, 2008.

Yet despite the recognition of time delays as a major factor limiting trade for developing countries, relatively little has been done to explore the underlying mechanisms. Hummels (2001) illustrated that the value of time in trade varies significantly across U.S. imports of merchandise trade. For example, for certain commodity products (e.g. such as minerals, and nonperishable agriculture such as grains), expediting delivery has only minimal impacts on inventory costs; in other words, these products have low time values. In contrast, many manufactures have much higher time values due to quick depreciation of market value. For example, Hummels found that a one-day delay for apparel products acts as the equivalent of a 0.8 percent ad-valorem tariff. His work suggests that the trade delays are more costly in countries that trade more time-sensitive goods—and the extent of delays has a substantial effect on what countries trade. This paper explores these relationships in greater detail.

In the first section of this report, we introduce several studies that have analyzed the links between trade facilitation and trade volumes. Next we introduce a central facet of our research methodology: a database of tariff equivalents for time in trade that are specific to each product and country. Finally, we use the database in the context of computable general equilibrium (CGE) models to explore the effects of simulated reductions in the time to trade for four groups of countries: low-income sub-Saharan Africa (SSA), all low-income countries, middle income countries, and high-income countries. We find that countries reap the greatest benefits when they reduce time to trade and all other countries make no improvements. The benefits decline when other countries also reduce trade delays. This finding is consistent with supply chain theory, which posits that the advantages of fast delivery times for the fastest deliverer grow as the gap between him and next fastest deliverer grows. In Sub-Saharan Africa, we also find that reducing trade delays increases higher value-added products' share of exports and expands intra-regional trade.

1. International Cross-Border Trade Transaction Costs

Cross border inefficiencies, or trade transaction costs (TTCs) are categorized in two ways:

- *Direct costs*. These are charges that are directly assessed on each transaction, such as customs fees, port handling charges, and informal payments.
- *Indirect costs*, such as the cost of time in trade. For exporters, these include the time to complete all pre-shipment procedures as well as loading cargo, and for importers, it is the time required to take possession of shipments once a ship arrives into the port area.

The importance of direct costs to traders is obvious and quantifiable. Direct charges have been cataloged extensively in case studies (Fox et al. 2002) and systematically in global indicator lists such as The World Bank's *Doing Business* report.

Indirect time costs affect traders in two ways: the cost of carrying inventory and market depreciation. Inventories lead to cash flows foregone when goods are not sold (or used to pay for storage). Inventories may have to be maintained as insurance against volatile demand or uncertain delivery or supply. Market depreciation is a particular concern for goods that rapidly lose value as time passes (e.g., fresh-cut flowers and newspapers). For some products, such as apparel, the potential depreciation cost—and thus the value of time—is high because demand is uncertain: for example, garment retailers do not know which color or styles will sell out at Christmas until consumers indicate their preferences through sales. Therefore, retailers are willing to pay a premium for the ability to specify characteristics and arrange delivery with very short lead times. Similarly, time is valuable for many high-technology products, since consumers place a high value on purchasing those that apply the latest innovations. The number of days required to trade across borders is reported in the *Doing Business Report*.

Two methods have dominated mainstream economists' attempts to gauge the impacts of indirect TTCs: the multiple regression "gravity model" and the CGE model. The gravity model has been favored for its simple data requirements: one needs data on trade flows (the dependent variable) and the factors that may influence them (the independent variables). Numerous studies (e.g., Djankov et al. 2006 and Persson 2007) have indicated that indirect TTCs have a significant effect on trade, with most estimates predicting that a one day reduction in the time to cross borders would result in a 1 percent increase in trade. While the relationships identified in these studies are consistent, some economists criticize their failure to identify the channels by which TTCs affect trade (Hillberry and Hummels 2005). Instead of illuminating linkages in the

supply chains and the economic activities of a country, the studies leave experienced theorists and practitioners to wonder what variables may have been "left out" that might be the true cause of impacts. Djankov et al. (2006) illustrate the dilemma with what appears to be an endless task of dropping and adding variables in an effort to test the models' validity—a daunting task that has no definite conclusion, but instead relies on a preponderance of evidence. While gravity models provide evidence, they are limited in their ability to account for real resource restrictions such as land, labor, and capital, nor do they emphasize economic linkages between sectors, since no specific economic accounting scheme is imposed or enforced.

CGE models provide economists a tool to "test" the boundaries of real resource constraints and the economic linkages among sectors and countries. A CGE model relies on strict accounting relationships and economic linkages modeled through a "social accounting matrix." Economists have only rarely used CGE models to estimate effects of time costs because the model requires costs to be expressed in "typical" cost units, such as dollars, [3] whereas time costs are most frequently recorded in days. Hummels (2001) and Hummels et al. (2007) provided an important advance in this area by estimating ad valorem "tariff equivalents" for the cost of one day in trade for U.S. merchandise imports. Hertel, Walmsley, and Ikatura (2003) adapted the standard GTAP model in their analysis of the Japan-Singapore Free Trade Agreement to accept these time costs as a technical shift in the Armington import demand function[4] and latter the OECD (2003) offered estimates of the impacts on global trade using a CGE model.

One of Hummels' key findings was that the value of time when trading across borders is different for different products. Yet CGE studies employing Hummels' estimates have applied a single, average ad valorem value for the cost of a day in trade (0.5 percent)—regardless of the goods countries actually import and export. The OECD employed a slight variant of this approach by doubling the value for agricultural products—despite the fact that Hummels estimates demonstrated the vast majority of bulk agricultural goods have zero or low time values[5]. These generalizations and perhaps ad hoc assumptions have been necessitated, in part, by the fact that Hummels' (2001) estimates were at a level of aggregation that made correspondence with GTAP sectors and products rough, at best[6].

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[3] These costs can be real or monetary. The modeling of quotas is a good example of how real vs. monetary constraints are incorporated into the model.

[4] Conveniently, and entirely by coincidence, Hummels' estimates of the ad valorem cost of one day in trade were conducted by employing just such an Armington equation, establishing a theoretical link between the estimation procedure and the CGE model.

[5] Although Hummels' estimates for fresh foods and vegetables with a short shelf life were shown to be more than double the average rate, bulk cargos such as grains and fibers demonstrated time values of trade close or equal to zero.

[6] Hummels (2001) estimated the ad valorem equivalent of time at the HS 2-digit level. While this categorization does make important distinctions between commodities, it also suffers from the fact that the HS classification is based on the raw material a good is made from, not the stage of processing. Therefore, HS 2-digit categories for textiles include fibers, yarns, non-finished fabrics, and finished fabrics. Similarly, iron and steel classifications are based on the raw materials—iron ore, ingots, semiprocessed products and further processing. GTAP's product classifications are based, in part, on an IO table and the stages of production are distinguished.

2. Tariff Equivalents for Time in Trade: A New Database

As noted, Hummels (2001) and Hummels et al. (2007) econometrically estimated the willingness of importers to pay for one day of time savings in shipping goods. This "tariff equivalent" was estimated, on a product-by-product basis, as the implied price premium paid for early delivery, adjusted for the difference in cost between air and ocean freight.[7]

Hummels et al. (2007) sought to compare the tariff equivalents of countries' trade delays with the ad-valorem tariffs they face and impose. First, they prepared a database of per day, ad-valorem tariff equivalents for products at the Harmonized Schedule sub-chapter level 4 of specificity (HS4). They then paired the bilateral, sector-specific per day time costs of importing and exporting with measures of the time (in days) to trade across borders, as recorded in the World Bank's *Doing Business* report[8].

Preparing Countries' Tariff Equivalents

Hummels et al.'s tariff equivalents of trade delays counted time in three stages of transit[9]: inland transport, customs processing, and port handling. These values were then trade weighted using the MacMap 2004 database with trade flows corresponding to the direction of trade; for example, export times are export weighted and import times are import weighted. Table 2-1 summarizes the results of this aggregation procedure. The majority of regions and countries illustrate the expected outcome that imports take longer to cross borders than exports. However, for a few high and middle income regions, this correspondence was not maintained. A closer examination of the data shows that the time to clear customs is

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[7] Details of this estimation procedure are provided in Hummels (2001) and Hummels et al. (2007). To prepare his estimates, Hummels used a database of U.S. merchandise imports which indicated trade values, transport costs and shipping mode employed (air or ocean); for the 2007 estimates, he also used a database of worldwide ocean freight times for 2006. Details of the databases and sources are provided in Hummels, Minor, Reisman, and Endean (2007).

[8] *Doing Business*' indicators of the number of days to cross borders are prepared using assumptions about the goods traded. For example, they are from one of three product categories (textiles; apparel and clothing; or coffee, tea, cocoa, and spices), and are traded outside free trade zones. These assumptions should be taken into careful consideration when assessing the indicators' appropriateness for analyses (Bolnick 2007).

[9] They did not include time to complete paperwork, even though this time is included in the *Doing Business* report. The time to complete paperwork can only be roughly correlated with the time to cross borders or "movements" since paperwork is often completed in advance of a good's shipment from a factory in parallel with production. Moreover, many producers maintain standing import and export paper work that covers multiple shipments, reducing the need for paper work on individual shipments.

consistently higher for imports, as expected, but that it is in the handling and inland transport time delays for exports that are raised above imports—if only slightly.

Table 2-1

Time to Export and Import, by Region

	Number of Days to Export*				Number of Days to Import*			
Country \ Region	Inland Transport	Customs	Port Handling	Total	Inland Transport	Customs	Port Handling	Total
HIGH INCOME								
East Asia & Pacific	2.3	1.6	2.2	6.1	1.4	2.1	1.5	4.9
Europe & Central Asia	2.0	1.3	1.7	5.0	1.5	2.0	1.9	5.4
North America	1.8	1.0	1.8	4.6	1.0	2.8	1.2	5.0
MIDDLE INCOME								
Europe & Central Asia	5.0	1.7	2.6	9.3	2.5	3.2	3.2	8.8
Latin America & Caribbean	2.5	3.1	2.5	8.0	2.3	2.7	2.7	7.8
South Africa	2.0	4.0	5.0	11.0	4.0	8.0	3.0	15.0
LOW INCOME								
East Asia & Pacific	2.8	1.4	1.7	5.9	4.1	2.6	2.1	8.8
Europe & Central Asia	8.2	6.4	5.7	20.4	8.0	5.4	12.1	25.5
Latin America & Caribbean	3.5	2.2	3.0	8.7	3.4	4.9	2.3	10.5
Middle East & North Africa	7.6	2.1	2.8	12.6	4.5	5.1	2.5	12.1
South Asia	6.6	3.7	5.2	15.4	4.1	5.9	7.6	17.5
sub-Saharan Africa	6.0	3.6	4.2	13.8	9.7	9.1	6.1	24.8

Source: World Bank Doing Business, Trading Across Borders 2007.

**Number of days to export are export weighted, number of days to import are import weighted.*

Note: several countries in the in the GTAP database did not have corresponding Doing Business data, for example, Luxembourg, Cyprus and Malta did not have data reported in the DB database. In these few cases, we elected to use the regional averages in the place of the missing data. Additionally, a few countries only reported total times. In these cases, data from the new 2008 report were used to augment the database.

The data in Table 2-1 were then multiplied with the bilateral, product-specific, per day, ad valorem costs of time in trade (summarized in Table 2-2). The results are tariff equivalents of the time to cross borders for both imports and exports, by product, and for each bilateral trade flow. Hummels et al. concluded that the tariff equivalents of time delays in importing and exporting from developing countries systematically exceeded tariffs encountered at the borders. They also highlighted an important relationship between higher value added products and the value of time in trade—manufactures with high value added were generally found to have high time values.

Building a Database of per Day Tariff Equivalents at the Sector and Country Levels

Hummels et al. (2007) raised a new question: Are long lead times imposed on exporters and importers in developing countries by lengthy border delays creating a bias for them to export lower value-added and basic commodity products?

To answer this question, a country- and product-specific database of tariff equivalents of time was created at the GTAP 105 country / region and sector levels (57 sectors less non-tradeables). To create this database, we create trade-weighted product-specific (HS4) estimates of the value of time in trading across borders utilizing the MacMap 2004 database[10]. The creation of this database represents a significant output of this paper, since it provides a foundation for the flexible adaptation of the data for other research efforts. For the purpose of our analysis, we further aggregated the data into regional and product groupings. Regional groupings are divided by income level:

- High income
  - East Asia and Pacific
  - Europe and Central Asia
  - North America
- Middle income
  - Europe and Central Asia
  - Latin America and Caribbean
- Low income
  - East Asia and Pacific
  - Europe and Central Asia
  - Latin America and Caribbean
  - Middle East and North Africa
  - South Asia
  - Sub-Saharan Africa
  - South Africa

We also broke the data into sector and product classifications:

- Basic agriculture
  - Cereals, feeds, fibers
  - Livestock, meat and dairy
  - Other agriculture (e.g., oils, sugar)
- Fresh and processed agriculture
  - Vegetables, fruit and nuts
  - Processed food, beverages and tobacco
- Natural resources, oil, gas, fuels and coal

[10] Similarly the MacMap database is used to aggregate the HS6 bilateral protection database to the GTAP country and sector levels.

  - Fish
  - Minerals and forestry
  - Oil, gas, fuels, and coal
- Light, medium and heavy manufactures
  - Apparel
  - Light manufactures (wood products, footwear, leather)
  - Textile yarns and fabric
  - Chemicals
  - Iron and steel
  - Machinery and electric equipment
  - Mineral-based products
  - Motor vehicles, transport equipment and parts
  - Processed nonferrous metals (e.g., gold, silver, platinum, aluminum)
- Services
  - Other services
  - Transport and communication
  - Utilities and construction

Table 2-2 illustrates the importance of creating country- and product-specific values of time in trade. As has been discussed by Hummels (2001), the values exhibit considerable variance between basic agriculture (bulk commodities) with average time cost ranging from 0–0.2 ad valorem per day; fresh agricultural products with a time cost of 1.1 percent per day, and manufactures of generally between 0.4 percent per day and 0.9 percent per day. Each GTAP sector is itself a collection of many products whose time values vary considerably. For example, “textiles” in the GTAP database includes yarns, unfinished fabrics, finished fabrics and even certain knit apparel. This underscores the need to consider not only the GTAP sector, but the underlying country-specific product composition at the HS4 level. There is significant variance by region and income level. For example, the average value of time for vegetables, fruits and nuts is 1.1 percent per day, but the regional values vary from a high of 1.5 percent per day for high-income countries to a low of 0.0 percent for low-income countries. Regional variance is, therefore, the rule. Although Table 2-2 is helpful for illustrative purposes, we use specific bilateral values, by product, in our estimates of the impacts of these time values on the trade of developing countries.

Table 2-2

Trade-weighted Average Tariff Equivalent of Time Savings per Day, by Product, for Exports (%)

Sector	High Income	Middle Income	Low Income	Sub-Saharan Africa	Average
BASIC AGRICULTURE					
Cereals, feeds, fibers	0.0	0.0	0.0	0.0	0.0
Live stock, meat and dairy	0.1	0.0	0.1	0.0	0.1
Other agriculture (oils, sugar, etc.)	0.2	0.1	0.3	0.2	0.2
FRESH AND PROCESSED AGRICULTURE					
Vegetables, fruit and nuts	1.5	0.5	0.0	0.3	1.1
Processed food, beverages and tobacco	0.4	0.4	0.8	0.6	0.4
NATURAL RESOURCE, OIL, GAS, FUELS AND COAL					
Fish	0.1	0.3	0.1	0.1	0.1
Minerals and forestry	0.1	0.2	0.1	1.5	0.1
Oil, gas, fuels, and coal	0.0	0.0	0.0	0.7	0.0
LIGHT, MEDIUM AND HEAVY MANUFACTURES					
Apparel	0.8	0.7	0.8	0.8	0.7
Light manufactures (wood prod, footwear, leather)	0.7	0.8	0.5	0.8	0.7
Textiles yarns and fabric	0.5	0.4	0.4	0.4	0.5
Chemicals	0.5	0.7	0.4	1.4	0.9
Iron and steel	0.9	0.7	0.1	1.4	0.9
Machinery and electric equipment	0.4	0.7	0.8	1.2	0.6
Mineral based products	0.6	1.5	1.3	0.3	0.4
Motor vehicles and transport	0.2	0.9	1.0	1.1	0.4
Processed nonferrous metals (e.g., gold, silver, platinum, aluminum)	2.4	8.9	1.1	0.4	3.5
SERVICES					
Other services	0.0	0.0	0.0	0.0	0.0
Transport and communication	0.0	0.0	0.0	0.0	0.0
Utilities and construction	0.0	0.0	0.0	0.0	0.0

Source: Author's calculations.

3. Economic Impacts of Reducing Time to Trade across Borders

Using the bilateral, product-specific tariff equivalents database, we estimate the impacts on GDP of reducing the time to trade across borders. Earlier papers, including Persson 2007 and the OECD 2003 take on a stylized reduction in the time to cross borders of 10 percent of the gap between the average of all countries and the target countries considered. This approach is predicated on the fact that countries that are at the average or below it will incur greater marginal costs to reduce the time to trade, since they have already made substantial progress. Therefore, it is unlikely they will reduce their time to trade across borders substantially.

This report uses an alternative "stylized" assumption by halving the time to trade across borders for all countries. We prefer this straightforward shock for its ease of interpretation.

To maintain consistency with earlier estimates from CGE models, we use the standard GTAP model, without any adjustments to the model or its closures[11]. We implement the reduction in time costs as the "iceberg" effect introduced by Hertel, Walmsley and Ikatura (2003). This approach allows for product- and region-specific shifting of the Armington demand function, where the function is shifted by the ad valorem tariff equivalent of the reduction of the number of days to cross borders. It can be readily shown that this shifting parameter has the desired effect of lowering the foreign market price by the percentage "shift" in the demand curve[12] with a corresponding change in the quantity demanded. Since the reduction in the market price is simulated as a technical shift, no rebalancing of the database is required. Following the standard analysis of Armington functions, changing import demand and supply is a function of the change in relative prices, demand and substitution elasticities, supply constraints, and trade shares.

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[11] Alternative closures, including an assumption of unlimited unskilled labor in developing countries, and fixing trade balances were tested, but not reported here. The results were not found to be sensitive to these alternative closures.

[12] The technical shifting parameter is referred to in the model as ams(i,r,s) and enters the Armington equation at two points. First in the nested price function reducing pmi(i,r) and then by shifting the demand for the quantity of imports qxs(i,r,s).

GDP Impacts of Reducing the Time to Export by 50 Percent

Table 3-1 illustrates four scenarios that progressively build on each other. In the first scenario, we estimate the impacts on low-income SSA of a 50 percent reduction in total time to export to all countries. The effect on SSA is to increase GDP by 2.2 percent. Other regions are not significantly affected by this reduction. Next, the time to export from all low-income countries, including SSA, is reduced. Exporters in South Asia and Central Asia experience GDP increases of approximately 4 percent. This result follows from the fact that these regions have some of the highest values for time to export. A large proportion of their time to export is derived from time spent on inland trucking to and from ports.

Table 3-1

Change in GDP Resulting from a 50% Reduction in the Time to Export

	Scenario 1—Sub-Saharan Africa	Scenario 2—All Low Income	Scenario 3—Al Low and Middle Income	Scenario 4—All
HIGH INCOME				
East Asia & Pacific	0.0	-0.3	-0.6	0.4
Europe & Central Asia	0.0	-0.4	-0.6	0.1
North America	0.0	-0.4	-0.7	-1.0
MIDDLE INCOME				
Europe & Central Asia	0.0	-0.3	2.8	1.3
Latin America & Caribbean	0.0	-0.3	2.4	0.9
LOW INCOME				
East Asia & Pacific	0.0	1.6	1.4	0.1
Europe & Central Asia	0.0	4.4	4.5	3.0
Latin America & Caribbean	0.0	2.1	2.0	0.5
Middle East & North	0.0	2.2	2.1	1.0
South Asia	0.0	4.0	3.7	2.0
Sub-Saharan Africa	2.2	2.1	2.0	1.1
South Africa	0.0	-0.4	-0.5	1.8

Interestingly, SSA GDP growth is slightly less when all low-income countries reduce their time to trade across borders in contrast to the unilateral reduction by SSA. The conclusion that can be derived from this result is that the "gap" between countries' exporting times is an important factor in determining the impacts from reduced time to cross borders. This result should appeal to supply chain theorists who maintain that lead time as a source of competitive advantage is set by the sector's leaders or best in class. As the gap between the best in class lead times and the average is reduced, the demand for products from the best in class supplier is reduced—since they have lost a substantial factor in differentiating their products by shorter lead times. Finally, in scenario 4, we assume all countries reduce their

export lead times. In this scenario, the increase in SSA GDP is cut in half. Still, the impact on SSA GDP is positive.

Table 3-2
Change in GDP Resulting from a 50% Reduction in the Time to Import

	Scenario 1 Sub-Saharan Africa	Scenario 2 All Low Income	Scenario 3 Al Low and Middle Income	Scenario 4 All Countries
HIGH INCOME				
East Asia & Pacific	0.0	0.0	-0.1	0.0
Europe & Central Asia	0.0	-0.2	-0.3	0.3
North America	-0.1	-0.3	-0.4	-0.8
MIDDLE INCOME				
Europe & Central Asia	0.0	-0.2	1.0	0.6
Latin America & Caribbean	-0.1	-0.2	0.9	0.5
LOW INCOME				
East Asia & Pacific	0.0	0.8	0.7	0.4
Europe & Central Asia	-0.1	2.6	2.5	2.1
Latin America & Caribbean	0.0	0.6	0.6	0.1
Middle East & North	0.0	1.3	1.1	0.3
South Asia	0.0	0.4	0.3	-0.2
Sub-Saharan Africa	4.2	3.8	3.7	2.9
South Africa	0.2	0.0	-0.1	1.1

GDP Impacts of Reducing the Time to Import by 50 Percent

Table 3-2 illustrates the impacts from reducing the time to import by 50 percent. The impacts on SSA are even greater than the 50 percent reduction in the time to export, with an estimated increase in GDP of over 4.2 percent. In scenario two, as other low-income countries also reduce their time to import, the impacts on SSA are lessened somewhat, just as in the case of exports. If all countries reduced their time to import, the benefits to SSA are reduced by approximately 25 percent.

This analysis underscores the importance of taking into account other countries' advances in reducing the time to cross borders when estimating the impacts of any country's or region's reductions.

4. Impact of Trade Facilitation on Export Composition, Prices, and Markets

Many developing countries' exports are concentrated in a few sectors or products with a limited number of market destinations. For most, these products and sectors tend to be of the commodity type, such as extractive minerals and basic agricultural goods. Moreover, these commodity products are subject to high demand and price volatility. This unstable export growth, in turn, is also believed to result in lower incomes for developing countries. The problem of developing countries exporting primarily commodity type products is referred to in the development community as a lack of trade diversification and is a major topic of interest to development experts.

The goal of development experts has been focused on diversifying exports into products other than extractive and commodity-based products and, ideally, into value added products. Early policy attempts at diversification were focused mainly on import substitution schemes, which would, in theory, allow domestic suppliers to develop and eventually export. The success of import substitution schemes has been questionable at best and damaging at worst (Slaughter 2004).

Recent econometric research by Dennis and Sheppard (2007) provided econometric evidence for a strong impact on export diversification resulting from a reduction in direct trade transportation costs. Additional econometric research by Amurgo-Pacheco and Pierola (2008) finds that free trade agreements (FTAs) have a strong correlation with export diversification. However, in both cases, the mechanisms of causation are not explored or otherwise empirically tested. Neither study considers the impacts of indirect trade transaction costs, including the time to trade across borders, which are likely significant components of FTAs.[13]

To explore the potential causal linkages between trade, time and developing country export diversification, we test the hypothesis for SSA that long delays in exporting results in decreased exports of higher value added manufactures and increases the dependence of these countries on basic commodity goods. Specifically, we test the impacts of reducing the time to

[13] Hertel, Walmsley and Ikatura (2003) illustrate that "new age" trade agreements imply as much for reducing trade times and trade facilitation as they do about reductions in tariffs.

export for SSA by 50 percent on the composition of its exports and on the markets to which SSA exports. Again, we use the database of bilateral product- and country-specific tariff equivalents of time to trade across borders.

Impact on sub-Saharan African Export Diversification

Table 4-1 illustrates our commodity and product groups, including basic agriculture; fresh and processed agriculture; natural resources; light, medium, and heavy manufactures; and services. Baselines for each SSA export for 2004 are presented with postsimulation results (i.e., after accounting for the impact of reducing the time to export for SSA by 50 percent).

Table 4-1

Impact of 50% Reduction in the Time to Export on Composition of SSA Exports

	Baseline	Post-Simulation	Change
BASIC AGRICULTURE			
Cereals, feeds, fibers	2.8%	2.6%	-9%
Live Stock, meat and dairy	1.0%	0.9%	-9%
Other agriculture (oils, sugar, etc.)	8.3%	7.9%	-4%
FRESH AND PROCESSED AGRICULTURE			
Vegetables, fruit and nuts	1.9%	2.1%	13%
Processed food, beverages and tobacco	6.7%	6.8%	1%
NATURAL RESOURCE, OIL, GAS, FUELS AND COAL			
Fish	0.2%	0.2%	-5%
Minerals and forestry	9.5%	9.2%	-3%
Oil, gas, fuels, and coal	27.1%	26.6%	-2%
LIGHT, MEDIUM AND HEAVY MANUFACTURES			
Apparel	1.8%	2.3%	24%
Other Light manufactures (furniture, footwear, leather)	3.7%	4.5%	21%
Textiles yarns and fabric	2.1%	2.3%	12%
Chemicals	3.0%	3.8%	25%
Iron and Steel	0.7%	0.9%	26%
Machinery and electric equipment	2.1%	2.6%	21%
Mineral based products	0.5%	0.5%	9%
Motor vehicles and transport	3.3%	3.6%	7%
Processed nonferrous metals (gold, silver, platinum, aluminum etc.)	5.2%	4.6%	-11%
SERVICES			
Other Services	8.1%	7.5%	-8%
Transport and Communication	10.8%	10.1%	-7%
Utilities and Construction	1.1%	1.1%	-5%

Note: Time to export is defined as the average of the time for inland transport, customs clearance, and port handling as reported in the World Bank Doing Business report.

Source: Author's calculations.

The reduction in the time to trade across borders results in increased shares of light, medium and heavy manufactures of between 7 and 26 percent in total exports. At the same time, the shares of basic commodities and natural resources has decline from between -2 and -9 percent. The shares of light manufactures such as apparel, footwear, furniture and leather has grown dramatically, by between 21 and 24 percent. These results are consistent with the hypothesis that long delays to cross borders restrict developing countries potential for diversifying exports, and more importantly, it limits their potential to participate in some of the most dynamic sectors in terms of trade growth.

Impact on sub-Saharan African Export Prices

Export prices for *all* export products rise from a low of 0.4 percent on energy and related products, to 2.4 percent on fish and fish products. The average increase in export prices was 1.6 percent of FOB value. Therefore, the benefits of reduced delays in exporting are enjoyed by every sector.

Impact on sub-Saharan African Export Market Composition

A key aspect of export diversification is the geographic diversity of export markets; many developing countries' exports are concentrated in just a few markets, incurring high market risks to their exports. Table 4-2 illustrates the shares of high-income markets, other countries, (outside SSA) and intra-SSA exports. Of significance, the share of intra-SSA trade increases by 20 percent over the baseline 2004 exports and exports to high income markets decrease by 1.5 percent.

Table 4-2
Change in Destination of SSA Exports due to a 50% Reduction in the Time to Trade

	High Income	Other Countries	Intra-Sub-Saharan Africa
Pre-Simulation Share in Exports	69.1%	22.9%	8.0%
Post-Simulation Share in Exports	68.0%	22.4%	9.6%
Percentage Change in Export Share	-1.5%	-2.4%	20.0%

Source: Author's calculations.

Therefore, in the case of SSA, reducing the time to export increases the share of light, medium, and heavy manufactures in exports and decreases SSA dependence on high-income markets for its exports. Both are oft-cited objectives of export diversification.

5. Conclusions

Numerous CGE studies have used aggregate estimates of the cost of time in trade to estimate impacts of reducing delays in trading across borders. Gravity models have provided evidence of positive correlations between reduced time delays in trade, and higher levels of exports—but have provided little insights as to the economic linkages and sources of causation. Despite evidence by Hummels (2001) that the value of time in trade varies significantly by product and sector, both CGE and gravity models have included only limited product- and sector-specific analysis.[14] Using a newly created database of the per day cost of time at the HS4 level we construct a database of product- and sector-specific estimates of the tariff equivalents of border delays on a country-specific basis. This rich set of time costs in trade creates a basis of analysis whereby the composition of traded products and the markets to which they export are brought more fully into the analysis of measuring impacts of reducing cross border time delays. The wide variety of trade-weighted time-to-trade estimates illustrates the need to consider the composition of products traded by a country in an analysis of the impacts of border delays on trade, production and welfare.

In addition to illuminating the importance of commodity composition when estimating the impacts of reducing the time to trade across borders, the database created for this paper reinvigorates the role of CGE analysis in the area of estimating trade impacts. To date, analysis of trade facilitation's impacts on trade has been dominated by econometric estimates from gravity models—which rely on relatively simple data sets and correlations which provide limited insights into the roles of resource limits, investment and economic linkages between countries and sectors. CGE models, which are based on detailed accounting schemes of resource and economic linkages, are well suited to capture the full flavor of causal linkages. A combination of econometric estimates and CGE studies is more likely to provide a fuller analysis of the country- and sector-specific impacts of reducing the time to trade across borders and should be a staple of policy analysis complementing broader studies of correlations.

Reducing the time to trade across borders can significantly impact a country's economic activity as measured by GDP. However, the impacts for each country must be considered in

[14] Djankov and Freund (2006) utilize Hummels' time to trade estimates to test for time-sensitive goods and their importance in estimating the impacts of time in trade and find a positive correlation. OECD 2003 applies two different values for time to trade, one for agricultural and one for non-agricultural goods.

the context of what other countries do. Unilateral changes are likely to have stronger impact—as a country widens its advantage in terms of lead times, it gains more. However, as other countries close the "gap" the benefits to early movers will be affected—usually negatively, but the impacts depend on which markets and products a country exports to and those of its competitors.

Finally, an analysis of reducing the time to export for SSA by 50 percent results in a greater share of light and medium manufactures and a lower share of basic commodities in exports. Therefore, trade facilitation efforts that reduce export delays could also result in greater export diversification.

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