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Trade Costs in the Developing World

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Abstract

The authors use newly collected data on trade and production in 178 countries to infer estimates of trade costs in agriculture and manufactured goods for the 1995–2010 period. The data show that trade costs are strongly declining in per capita income. Moreover, the rate of change of trade costs is largely unfavorable to the developing world: trade costs are falling noticeably faster in developed countries than in developing ones, which serves to increase the relative isolation of the latter. In particular, Sub-Saharan African countries and low-income countries remain subject to very high levels of trade costs. In terms of policy implications, the analysis finds that maritime transport connectivity and logistics performance are very important determinants of bilateral trade costs: in some specifications, their combined effect is comparable to that of geographical distance. Traditional and non-traditional trade policies more generally, including market entry barriers and regional integration agreements, play a significant role in shaping the trade costs landscape.

This paper is a product of the International Trade Department, Poverty Reduction and Economic Management Network. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at jarvis1@worldbank.org.

Trade Costs in the Developing World: 1995 – 2010

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1. Introduction

In an increasingly globalized and networked world, trade costs matter as a determinant of the pattern of bilateral trade and investment, as well as of the geographical distribution of production. Although tariffs in many countries are now at historical lows, the evidence suggests that trade costs remain high. One well-known estimate based on an exhaustive review of research findings suggests that representative rich country trade costs might be as high as 170% ad valorem—far in excess of the 5% or so accounted for by tariffs (Anderson and Van Wincoop, 2004). Trade costs in the developing world are likely to be even higher, as tariffs and non-tariff barriers remain substantial, as do other sources of trade costs such as poor infrastructure and dysfunctional transport and logistics services markets, both of which contribute to high transport costs facing importers and exporters.

Box 1: What are Trade Costs?

Most theories of international trade include trade costs as the set of factors driving a wedge between export and import prices. Trade costs can be fixed in the sense that they are paid once in order to access a market, or variable in the sense that they must be paid once for each unit shipped. Our focus in this paper is on variable trade costs, but as we note below, the methodology we apply can also be interpreted in terms of fixed costs with alternative theoretical underpinnings.

Anderson and Van Wincoop (2004) provide a comprehensive review of the literature on trade costs. They find a "headline" number of 170% ad valorem for a typical developed country. This number is based on the following breakdown: 21% transport costs, 44% border related trade barriers, and 55% wholesale and retail distribution costs (2.70 = 1.21*1.44*1.55). Of the 44% ad valorem equivalent of border related trade barriers, only 8% relates to traditional trade policies such as tariffs. The remainder is composed of a 7% language barrier, a 14% currency barrier (due to the use of different currencies), a 6% information cost barrier, and a 3% security barrier. All numbers are based on representative evidence for developed countries. We expect the numbers in developing countries to be much higher, but the same basic pattern is likely to be repeated: traditional trade policies like tariffs are dwarfed by the other sources of trade costs, which still represent a significant drag on the international integration of markets.

Trade costs are therefore of great importance from a policy perspective, all the more so since they are an important determinant of a country's ability to take part in regional and global production networks. Many countries are eager to reap the benefits that such networks can bring, including trade- and investment-linked technological spillovers and stronger employment demand in manufacturing. Ma and Van Assche (2011), for example, find that upstream and downstream trade costs are important determinants of China's export processing trade, which is a typical part of a global or regional production network. Understanding the sources of trade costs, and in particular the types of policies that can reduce them, is thus a key part of discussions over production networks going forward.

Despite the importance of trade costs as drivers of the geographical pattern of economic activity around the globe, most contributions to their understanding remain piecemeal. Typically, the trade costs literature focuses on identifying one or more previously understudied elements and demonstrating that they have a significant impact on bilateral trade flows as captured through the standard gravity model of international trade. We refer to that approach as “bottom up”, in the sense that it starts from the fundamental factors believed to influence trade costs and can ultimately produce an estimate of the overall level of trade costs facing exporters and importers by summing the parts together. To date, only Anderson and Van Wincoop (2004) have undertaken such a summing exercise, and their total number cited above—170% ad valorem—is of major economic significance.

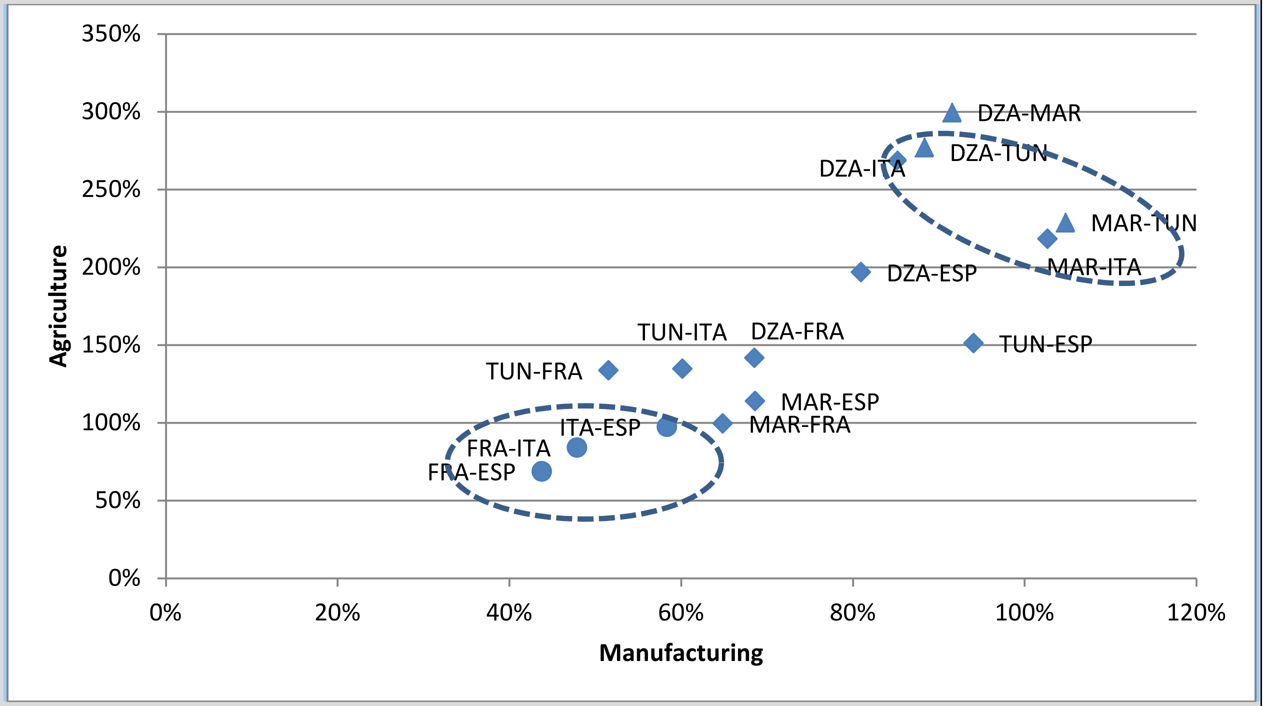
More recently, another strand of the literature has turned the gravity model on its head in order to obtain “top down” estimates of trade costs, by inferring them from the observed pattern of production and trade across countries (Novy, 2012). This paper follows such an approach, and extends existing work by focusing on trade costs in the developing world over the period 1995-2010. Existing “top down” measures of trade costs have been computed for major economies for which data on production and trade are readily available, but ours is the first contribution to include a wide range of both developing and developed countries. Our database includes 178 countries, compared with a maximum of 27 covered by Jacks et al. (2011).

The database is available at http:// data.worldbank.org/data-catalog/trade-cost

Box 2: Trade Costs and Country Dialogue—The Case of the Maghreb

The proposed dataset scales up recent experiments to use trade costs data as a tool for policy making at the World Bank (Arvis and Shepherd, Forthcoming) and UN ESCAP (Duval and De, 2011; Duval and Utoktham, 2011; and Duval and Utoktham, Forthcoming). For instance, two of the authors have been involved in a project designing a program in trade facilitation and regional infrastructure for the countries in the Maghreb in North Africa (Algeria, Libya, Mauritania, Morocco, Tunisia). These countries trade very little between themselves (3-5 % of their trade).

Comparison of bilateral trade costs for Maghreb countries (2007)



Source: authors

The Maghreb countries have significantly higher costs among themselves than do those of the northern shore of the Mediterranean (twice as high for manufactured goods, three times as high for agricultural products). Furthermore, intra-Maghreb trade costs remain significantly higher than for trade with the northern countries of the Mediterranean, even though the distances are shorter. Within the framework of a liberal trade policy such as that of the Arab Maghreb Union (AMU) or of the Arab Free Trade Area (GAFTA), trade costs result primarily from logistical and facilitation constraints (including some border closures), combined with the impact of non-tariff restrictions. In fact the data show that most countries have (naturally) invested first in facilitating North-South trade with EU countries. In the preparation of the program with the AMU and the countries in 2011-12, the analysis did help highlight that the high costs over relatively small distances (for the central countries Morocco, Algeria, Tunisia) had to be addressed to boost implementation of integration measures in the areas of border management, logistics services, infrastructure, and reduction of NTMs.

Our paper also adds to the literature by disaggregating trade into two macro-sectors, agriculture and manufacturing. Existing estimates largely use total trade only, without providing any sectoral details (e.g., Jacks et al., 2011). An exception is Chen and Novy (2011), who use industry-level data, but they only cover European countries and thus do not address the issue of trade costs in the developing world. Although it would obviously be desirable to extend the sectoral classification even further, we explain in Section 3 that data constraints for many developing countries are formidable when it comes to obtaining the disaggregated production data that our approach requires.

Following Chen and Novy (2011), we also provide a decomposition of our "top down" measure of trade costs into a range of component parts. We extend their work by applying such a decomposition of trade costs to data for developing countries, whereas they use data for the European Union only. In addition, we also include a range of other possible sources of trade costs, including air and maritime transport connectivity, logistics, trade facilitation, and behind-the-border regulatory barriers.

Our paper provides at least three new pieces of evidence. First, we find that trade costs—including intra-regional trade costs—are much higher in the developing world than they are for developed countries. This finding is in line with, but much broader than, Kee et al. (2009), who show that tariff rates as well as selected non-tariff barriers in developing countries generally remain higher than in the developed world. Our analysis, however, takes in the full range of trade costs, not just the selection of measures considered by Kee et al. (2009). For instance the observation is also consistent with the now prevalent notion that there are huge differences in how efficiently logistics of trade and facilitation are implemented (Arvis et al., 2012).

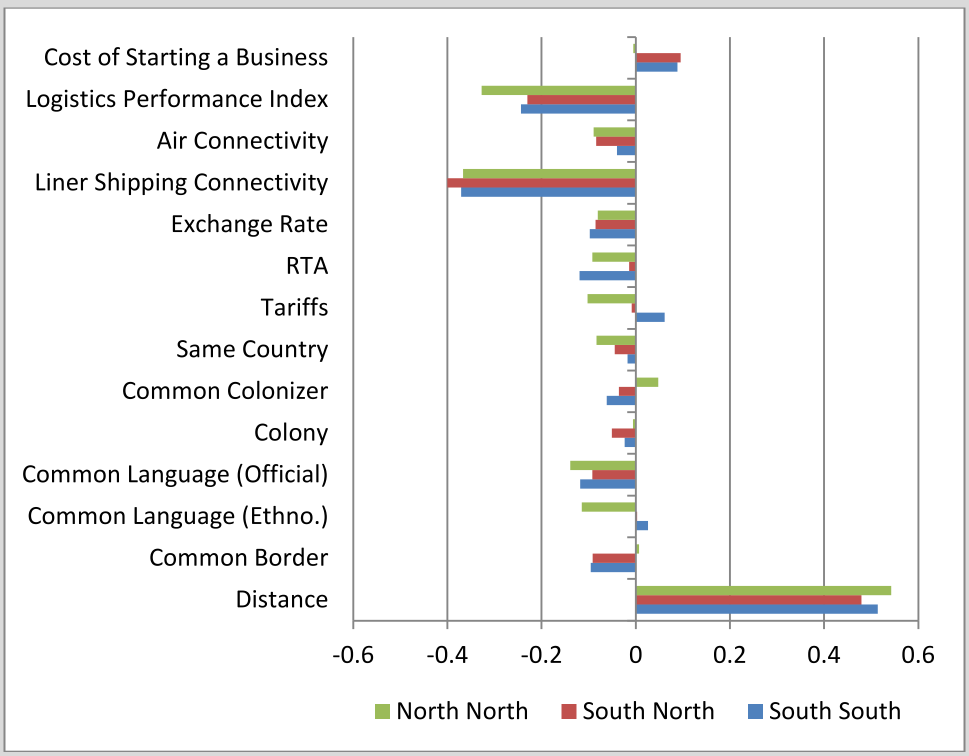
Second, we find some evidence of a trend towards lower trade costs in at least some parts of the developing world, but the rate of change is slower than it has been among developed countries, and it is starting from a much higher baseline. The net result is thus that although developing countries are becoming more integrated into the world trading system in an absolute sense, their relative position is nonetheless deteriorating because the rest of the world is moving more quickly. The objective of preventing the marginalization of developing countries in world trade therefore remains far from having been achieved, and attention will need to be redoubled in areas such as aid for trade going forward. Given that traditional trade policies have not changed much in the developed world over at least the last part of our sample period, the difference between the results for developing and developed countries is perhaps due in large part to the "technology" of trade: logistics and trade facilitation. Of course, experiences vary greatly from one developing region to another, and we indeed find that East Asia and the Pacific is experiencing changes in trade costs of a completely different nature from what is happening in Sub-Saharan Africa.

Third, the econometric decomposition of the trade costs generated by the model shows that in addition to traditional sources of trade costs, such as tariffs and transportation charges, a range of additional factors are now affecting the pattern of trade and production in the developing world. Two sets of measures stand out. One is trade facilitation and logistics performance, in line with the conjecture in the previous paragraph. Our results indicate that the combined effect of maritime transport connectivity and logistics performance plays a role similar to, or even greater than, geographical distance in determining trade costs. This is an important finding from a policy perspective, since it suggests that a significant part of the trade isolation of some developing countries may be due to policy factors within their governments' control. The second group of factors is the group of so-called “behind-the-border” measures, in the sense of deep regulatory and institutional features of countries that affect all firms operating there and do not necessarily discriminate in law—although they usually do in fact—against foreign firms. Issues such as barriers to entry loom large as sources of trade costs for developing countries, and thus highlight the need for the trade policy agenda to expand and deepen in the future.

Box 3: The Sources of Trade Costs

In what follows, we use econometric methods to decompose trade costs into their component parts, covering as many observable factors as possible. We include geographical and historical factors, as well as traditional trade policies such as tariffs and RTA membership, logistics and trade facilitation performance, connectivity, and behind-the-border regulatory barriers. Our estimates can be used to provide indications of the relative sensitivity of trade costs to changes in each factor. In line with the gravity model literature, we find that distance remains an important determinant of trade costs for all country groups. In addition, maritime transport and logistics performance have a strong impact on trade costs.

Sensitivity of Trade Costs in Manufactured Goods to Listed Factors (2005)



Note: Figure presents standardized regression coefficients (betas) from the models described in Table 9.

Against this background, the paper proceeds as follows. The next section introduces our methodology for measuring trade costs, and situates it within the broader gravity model literature. Section 3 presents our dataset and discusses the main issues faced in compiling it. The first part of section 4 provides some initial results on trade costs in the developing world, focusing on differences across countries, sectors, and time periods. To better understand the determinants of trade costs, the second part of Section 4 conducts an econometric decomposition based on standard gravity data as well as relevant policy variables. Section 5 concludes with a discussion of policy implications.

2. Measuring Trade Costs

The applied international trade literature has traditionally focused on using the gravity model to identify particular factors, such as geographical distance, as sources of trade costs. The literature is necessarily piecemeal, with each paper dealing with at best a sub-set of the factors believed to influence trade costs. This approach has two drawbacks. The first is that it does not produce an overall estimate of the level of trade costs between countries, of the type that is frequently included in theoretical models of trade. Second, inclusion of some variables but not others immediately gives rise to concerns about omitted variables bias, to the extent that omitted trade costs are correlated with variables included in the model.

Another strand of the literature has focused on the problem of aggregating product-line measures of trade policies into summary measures—Trade Restrictiveness Indices—that satisfy desirable criteria. The World Bank has produced a number of such measures, including tariff (TTRI) and non-tariff barriers (OTRI) (Kee et al., 2009). Although useful indicators of trade policy settings, these TRIs suffer from the limitation that they are "bottom up" measures: they take account of those sources of trade costs included in the datasets used to build them, but not other potential sources. For instance, the OTRI relies heavily on TRAINS and other datasets of non-tariff measures, which are well known to provide only partial coverage at best. Furthermore, these indices leave out other major sources of trade costs, such as transport costs, and differences in cultural or legal heritage between countries which magnify the costs of doing business across borders.

The only attempt to unify the literature on the various determinants of trade costs is Anderson and Van Wincoop (2004). Those authors review a variety of papers and sum together the trade costs found to result from a range of factors including tariffs and non-tariff measures, transport costs, and domestic distribution costs. Their approach is again "bottom up", in the sense that it builds up an estimate of the overall level of trade costs based on assumptions as to what the likely components of the total are. Their representative figure for a typical developed country is 170%, which consists of 21% transportation costs, 44% border-related trade barriers, and 55% wholesale and retail distribution costs (2.70 = 1.21 * 1.44 * 1.55). Given that the same authors report average industrialized country tariffs of around 5%, we can see that the overall level of trade costs is likely to be more than an order of magnitude different from the applied rates of protection that trade economists are used to dealing with.

Novy (2012), following Head and Ries (2001), takes a different approach to trade costs, starting from a "top down" perspective.[2] In other words, he derives an all-inclusive measure of trade

[2] Anderson and Yotov (2010) also adopt what could be termed a "top down" approach to calculating internal relative to multilateral trade costs for Canadian provinces. They focus, however, on a measure they call "constructed home bias", which represents the degree to which each province trades with itself relative to a

costs based on the observed pattern of trade and production, without the need to work up from individual policy measures as in other work. His methodology is simple, and is based on the standard gravity equation familiar from the applied international trade literature. Although a similar measure can be derived from any gravity model that can be estimated consistently with exporter and importer fixed effects, we focus on the special case of the Anderson and Van Wincoop (2003) "gravity with gravitas" model, which is the benchmark in much applied work. We do not derive the model in full, because its structure is well known and is set out in detail in Anderson and Van Wincoop (2003). It is important to note, however, that this approach to measuring trade costs reflects the deep geometry of the gravity model, and does not depend on an assumption of CES preferences, which is the basis of the Anderson and Van Wincoop (2003) model. It is possible to start from much more general assumptions, such as those used in the regional science literature, and still arrive at the same result provided that the relationship between trade costs and trade follows the same basic form.

Considering two countries, i and j, we can write down four gravity models for intra- and international trade:

$$(1)\ X_{ij} = \frac{Y_i E_j}{Y}\left(\frac{\tau_{ij}}{\Pi_i P_j}\right)^{1-\sigma}$$

$$(2)\ X_{ji} = \frac{Y_j E_i}{Y}\left(\frac{\tau_{ji}}{\Pi_j P_i}\right)^{1-\sigma}$$

$$(3)\ X_{ii} = \frac{Y_i E_i}{Y}\left(\frac{\tau_{ii}}{\Pi_i P_i}\right)^{1-\sigma}$$

$$(4)\ X_{jj} = \frac{Y_j E_j}{Y}\left(\frac{\tau_{jj}}{\Pi_j P_j}\right)^{1-\sigma}$$

where: X represents trade between two countries (i to j or j to i) or within countries (goods produced and sold in i and goods produced and sold in j); Y represents total production in a country; E represents total expenditure in a country; and τ represents "iceberg" trade costs. The two terms Π and P represent multilateral resistance. From the expressions:

$$(5)\ \Pi_i^{1-\sigma} = \sum_{j=1}^{C}\left\{\frac{\tau_{ij}}{P_j}\right\}^{1-\sigma}\frac{E_j}{Y}$$

frictionless benchmark. From an international policy standpoint, it is bilateral trade costs—rather than internal ones—that are more relevant, and so we focus on them rather than constructed home bias here.

$$(6)\ P_{\mathrm{j}}^{1-\sigma} = \sum_{i=1}^{C} \left\{\frac{\tau_{ij}}{\Pi_i}\right\}^{1-\sigma} \frac{Y_i}{Y}$$

we can see that outward multilateral resistance Π captures the fact that trade flows between i and j depend on trade costs across all potential markets for i's exports, and that inward multilateral resistance *P* captures the fact that bilateral trade depends on trade costs across all potential import markets too. The two indices thus summarize average trade resistance between a country and its trading partners.

Novy (2012) shows that some simple algebra makes it possible to eliminate the multilateral resistance terms from the gravity equations, and in so doing derive an expression for trade costs. Multiplying equation (1) and equation (2), and then equation (3) and equation (4) gives:

$$(7)\ X_{ij}X_{ji} = \frac{Y_iE_j}{Y}\frac{Y_jE_i}{Y}\left(\frac{\tau_{ij}\tau_{ji}}{\Pi_iP_j\Pi_{\mathrm{j}}P_i}\right)^{1-\sigma}$$

$$(8)\ X_{ii}X_{jj} = \frac{Y_iE_i}{Y}\frac{Y_jE_j}{Y}\left(\frac{\tau_{ii}\tau_{jj}}{\Pi_iP_i\Pi_{\mathrm{j}}P_j}\right)^{1-\sigma}$$

Dividing equation (7) by equation (8) eliminates terms and allows us to derive an expression for trade costs in terms of intra- and international trade flows:

$$(9)\ \left(\frac{X_{ij}X_{ji}}{X_{ii}X_{jj}}\right)^{\frac{1}{1-\sigma}} = \frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}}$$

Taking the geometric average of trade costs in both directions and converting to an ad valorem equivalent by subtracting unity gives:

$$(10)\ t_{ij} = t_{ji} = \left(\frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1$$

Our final measure of trade costs t_{ij} thus represents the geometric average of international trade costs between countries i and j relative to domestic trade costs within each country. Intuitively, trade costs are higher when countries tend to trade more with themselves than they do with each other, i.e. as the ratio $\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}$ increases. As the ratio falls and countries trade more internationally than domestically, international trade costs must be falling relative to domestic trade costs. Because trade costs are derived from a ratio with trade flows in the denominator, country pairs that do not trade at all record infinite trade costs. Such observations are treated as missing in our dataset.

t_{ij} provides a useful summary indicator of the level of trade costs between countries i and j. Importantly, it is a "top down" measure, in the sense that it uses theory to infer trade costs from the observed pattern of trade and production across countries. Unlike the "bottom up" measures referred to above, it includes all factors that contribute to the standard definition of iceberg trade costs in trade models, namely anything that drives a wedge between the producer price in the exporting country and the consumer price in the importing country. Trade costs as we have defined them therefore include both observable and unobservable factors. Tariffs and traditional non-tariff measures are only one component of the overall measure, which also includes transport costs, behind-the-border barriers, and costs linked to the performance of trade logistics and facilitation services. It is important to note that since our measure of trade costs is based on mathematical operations and theoretical identities, it is not subject to the usual problems that plague econometric estimates, such as omitted variable bias or endogeneity bias.

In light of its structure, a measure like t_{ij} needs to be interpreted cautiously for a number of reasons. First, it is the geometric average of trade costs in both directions, i.e. those facing exports from country i to j and those facing exports from country j to country i. From a policy perspective, it is therefore impossible to say without further analysis whether a change in trade costs between two countries is due to actions taken by one government or the other, or both together. More broadly, further analysis is required—such as the decomposition undertaken below—before it is even possible to identify the sources of trade costs and their relative contributions to the overall number. Trade costs measured in this way therefore need to be interpreted as an all-inclusive estimate, while recognizing that only part of the total will be amenable to direct policy action by governments.

A second limitation on the extent to which t_{ij} can be interpreted for policy purposes is that it measures international relative to domestic trade costs. Strictly speaking, a change in t_{ij} might be due to a change in either component, or both simultaneously. As a result, it is again difficult to disentangle the effects of particular policy actions without further analysis. This link between domestic and international trade costs also raises particular issues of interpretation for policies that are de jure non discriminatory between foreign and domestic firms, but are applied in a de facto discriminatory way. Examples include product standards and other regulations, for which the information costs are greatly reduced for domestic firms due to their assumed familiarity with the national regulatory system. Such measures are captured by t_{ij} because of its all-inclusive nature, but the precise effects on international versus domestic trade costs can be difficult to identify.

Third, the interpretation of t_{ij} depends to some extent on the theoretical model from which it is derived. In the Anderson and Van Wincoop (2003) model, trade costs are variable only, which means that t_{ij} can be given a standard "iceberg" interpretation. In other models of trade with fixed costs as well, such as Chaney (2008), a similar expression for trade costs can be derived, but it represents a mixture of fixed and variable components.

Following on from this point is the fact that the numerical value of t_{ij} is sensitive to the choice of parameter value for σ, the elasticity of substitution. A related point has been made in the recent gravity literature (e.g., Anderson and Van Wincoop, 2004), but the choice of parameter value largely remains an issue of assumption rather than measurement. Moreover, the possibility that different countries and sectors might exhibit different elasticities gives some cause for concern at the level of interpreting t_{ij} across countries and through time. Nonetheless, on the assumption that the elasticity is indeed constant, the choice of parameter value only affects the level of ad valorem trade costs, not their relative values across countries and through time. Indexing trade costs on a base country-year combination reduces the problem of sensitivity to negligible proportions, although it does not totally eliminate it as trade costs are a non-linear function of the elasticity of substitution.

Fourth, a measure of trade costs like t_{ij} is not, in practice, immune from price (unit value) effects. In this paper, as in previous published work, we stay as close as possible to the theory. This approach means that price changes are already netted out by the procedure that removes the two multilateral resistance terms from the model. Those terms are both price indices that represent the appropriate "deflators" for GDP and trade values. In practice, of course, trade values may change at a different rate from output values, particularly if only relatively high quality goods are traded. In light of this concern, changes in t_{ij} need to again be interpreted cautiously, due to their potential to conflate unit price and volume effects.

The Novy (2012) methodology has been applied in a number of published papers, though none has the geographical, sectoral, or temporal scope of the present one. Jacks et al. (2008) use it to track trade costs in the first wave of globalization (1870-1914) using data on GDP and total trade flows for major economies. More recently, the same authors have applied the same technique to examine the role of changes in trade costs as drivers of trade booms and busts in major economies over the long term (Jacks et al., 2011). Similarly, Chen and Novy (2011) analyze trade costs among European countries using detailed trade and production data that distinguish between sectors, and in addition provide an econometric decomposition of trade costs that highlights the role played by factors such as distance, non-tariff measures, and membership in particular European initiatives, such as the Schengen Agreement. Although we deal only with merchandise trade, Miroudot et al. (2012) apply the same methodology to services trade; however, there sample is much more restricted than ours, due to the general lack of availability of high quality data on services trade.

3. Data Treatment

This section describes the main sources used in construction of our trade costs dataset, covering production and export data. We also outline the main treatments applied to the raw data in order to construct the final dataset. After assembling all components, our dataset covers up to 178 countries for the period 1995-2010. In sectoral terms, we cover total trade, as well as distinguishing between trade in agricultural products and trade in manufactured goods.

As noted above, trade costs in this paper are measured using the following formula (Novy, 2012):

$$(11)\ t_{ij} = t_{ji} = \left(\frac{\tau_{ij}\tau_{ji}}{\tau_{ii}\tau_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1$$

To implement it in practice, we need data on the value of bilateral trade in each direction (X_{ij} and X_{ji}), and data on intra-national trade in each country (X_{ii} and X_{jj}). The former data are readily available from standard sources, but the latter are more difficult to obtain. Importantly, since the models behind the trade costs formula do not allow for input-output relationships among sectors, intra-national trade needs to be measured as gross shipments, not value added (which subtracts intermediate inputs). Our approach, discussed in more detail below, is to use national accounts data and to proxy intra-national trade by total production less total exports. To deal with missing observations, we use linear interpolation to calculate trade costs for country-sector-year combinations where the dataset contains empty values.

3.1. International Trade Data

Our bilateral trade data are sourced from the Comtrade database, accessed via the World Bank's WITS server. We use reported export data rather than import (mirror) data because it is important for the consistency of our trade costs measures that trade values be measured at FOB, not CIF, prices. The original data are reported in the 1988/1992 Harmonized System classification scheme, and we convert them to the ISIC Rev. 3 classification using a concordance built into WITS. Total trade represents the total of agriculture and manufactured goods exports, whereas agriculture represents the total of ISIC sectors A and B and manufactured products cover ISIC sector D. These definitions correspond to the relevant sectoral definitions in the national accounts. Activities such as mining are therefore excluded from our analysis. All trade data are expressed in value terms in nominal US dollars, so no further conversions are necessary.

The main issue that arises in our trade data is in relation to re-exports. To apply the Novy (2012) formula for trade costs, we need each country's "true" (i.e., net) exports. Our dataset is therefore based on Comtrade's reported net exports for each country pair, but we are aware that not all countries properly account for re-exports in the original data. In 2012, for example, only 15% of country pairs reported bilateral re-exports for total trade. Many of these instances of missing observations in fact represent zeros, but it is not always the case. For three countries where re-exports are known to be large but unreported in Comtrade—Singapore, Belgium, and Luxembourg—we make a further adjustment using data from other sources. For Belgium and Luxembourg, we adjust exports using the net to gross export ratio for the year 2000 reported by the CPB Netherlands Bureau for Economic Policy Analysis. A similar adjustment is made for Singapore using the CEIC database.

3.2. Gross Output and Value Added Data

The most challenging part of this exercise from a data point of view is obtaining information on gross domestic shipments, i.e. production made and sold within each country. Our starting point is the United Nations National Accounts Database. That source provides total output on a gross shipments basis disaggregated by ISIC sector for up to 124 countries. We use these data whenever available, converting them to US dollars using the nominal exchange rate applied by the World Development Indicators to convert GDP from local currency into US dollars.

When gross output data are unavailable, we take an alternative approach. We obtain data on value added by ISIC aggregate—agriculture and manufactures—from the World Development Indicators, in US dollars. Where value added data are missing from the World Development Indicators, we fill them in using the UN National Accounts Database, converting from local currency to US dollars in the same way as above. Value added data cannot be directly used in the calculation of trade costs because they net out intermediate goods and therefore tend to understate the level of production. We therefore apply a scaling up factor equal to the average sectoral ratio between value added and gross output for those countries where both sets of data are available. The average ratios we find in the data are 1.82 (agriculture) and 3.42 (manufacturing). Multiplying these ratios by the value added data allows us to produce estimated gross output data for the remaining countries in our dataset. In all cases, we compute total gross output as the sum of manufactured goods and agriculture.

The final stage in the treatment of these data is to calculate the value of domestic shipments, i.e. intra-national trade. To do this, we follow the existing literature in taking the gross output data—actual and estimated—and subtracting the total value of exports to the rest of the world from the Comtrade data, to give the amount of total production that was both made and consumed domestically. We therefore implicitly assume that all such production was shipped domestically.

3.3. Parameter Assumptions

As noted above, calculations of the level of trade costs are sensitive to the choice of parameter value for the intra-sectoral elasticity of substitution. We follow Novy (2012) in assuming that the elasticity is constant across sectors, countries, and years. In all calculations, we therefore set it equal to eight, which represents about the mid-point of available estimates. In any case, as noted above, it is only the level of ad valorem equivalent trade costs that is sensitive to this assumption. It does not have any impact on inferences we draw as to changes in trade costs across countries and time periods. In particular, as Novy (2012) shows, index numbers based on the trade costs ratio—which we also report—are relatively insensitive to the choice of parameter assumption.

For practical purposes, as long as the elasticity of substitution is large its value is not so relevant, and a change of it amounts to a change of scale, for all pairs of economies. Indeed for a large elasticity σ the following elementary logarithmic approximation holds well for trade ratios which can be significantly far from one:

$$(12)\ t_{ij} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \approx \frac{1}{2(\sigma-1)} * Log\left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)$$

4. Results and Discussion

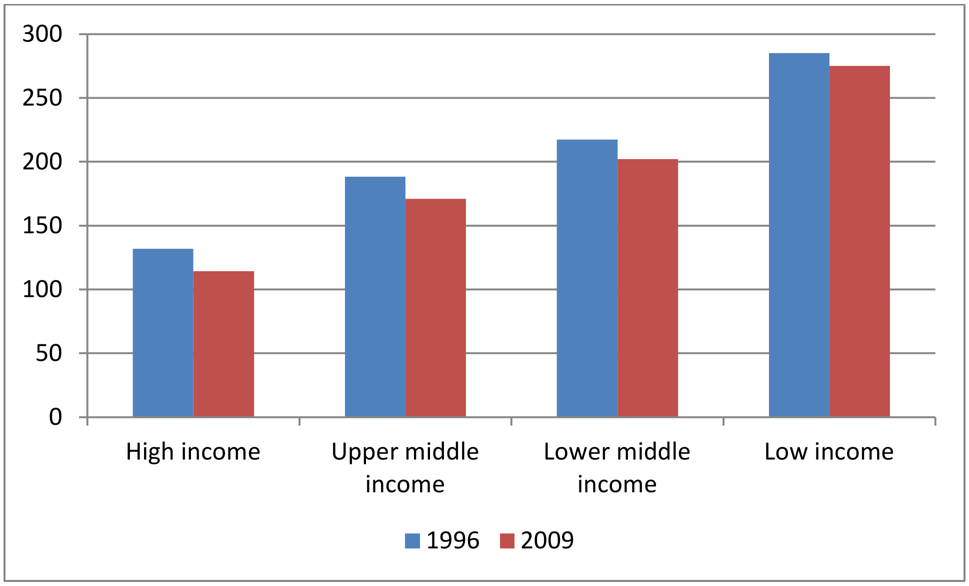
4.1. Descriptive Analysis

To give an idea of the evolution of trade costs in the developing world over recent years, we examine averages by World Bank income group and region. In doing so, we are careful to use a constant sample for all calculations, i.e. we only include country-sector combinations for which trade costs can be calculated or interpolated for all years in the sample. To maximize the number of countries included in this way—91 for manufactured goods and 96 for agriculture—we eliminate the first and last years of the full sample to focus on the period from 1996 to 2009. Finally, we avoid additional composition effects by using the current (2012) World Bank income group classification and applying it to all years in the sample. China, for example, is thus considered an upper middle income country for the full sample period, although it belonged to a different group at the beginning of the sample.

To present average trade costs, it is important to choose a reasonable partner region. A number of choices are available. We have elected not to use the rest of the world as a comparator region because the composition of the "world" in terms of country pairs with active trade flows varies within the sample, and averages could therefore be subject to potentially misleading composition effects. Instead, we calculate simple average trade costs vis-à-vis the ten largest importers in 2010 based on data in our sample. We exclude three countries—Belgium; the Netherlands; and Hong Kong SAR, China—that are known to have large proportions of re-exports in their total trade, but which do not accurately net out those flows in the data they report to Comtrade, as discussed above. Our partner region therefore consists of the following ten countries (in size order), which represent a broad geographical and economic cross-section of the global trading economy: the USA, China, Germany, France, Japan, the UK, Italy, Canada, Korea, and Mexico. It is important to note that trade costs with respect to this group represent a useful indicator of a country's performance vis-a-vis the world as a whole, but the figures are indicative only, and detailed analysis would need to be based on a consideration of data at the bilateral level in order to deal with regional and geographical particularities.

Figure 1 presents results for manufactured goods disaggregated by World Bank income group. The figure reported for each income group is the simple average of trade costs vis-à-vis the ten largest importers. One important stylized fact is immediately apparent: trade costs are sharply decreasing in per capita incomes, and this dynamic is quite consistent across all four income groups defined by the World Bank. In 2009, trade costs for low income countries were on average around 2.5 times higher than those in high income countries. Although the performance of the upper and lower middle income groups is broadly comparable, the gaps between those two groups and the high and low income groups is quite marked. Trade costs in the low income group are particularly high, at around 275% ad valorem in 2009. This finding reflects previous work on tariffs and non-tariff measures, which has consistently found that levels of policy protection are similarly decreasing in per capita income (Kee et al., 2009). Our finding is broader, however, because our measure of trade costs captures a much wider range of factors. It highlights the ongoing relative isolation of low income countries from the world trading system, and we go on to investigate below the potential causes of high trade costs including both policy and non-policy (natural) factors. Clearly, these results suggest that further efforts are necessary to prevent the marginalization of low income countries from the world trading system, for example through aid for trade initiatives.

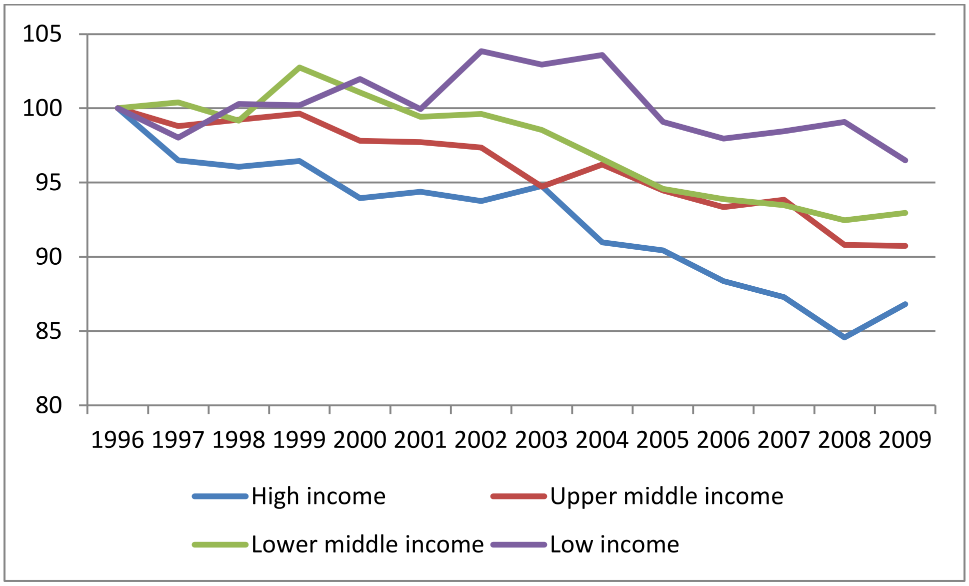
Figure 1: Trade costs are sharply decreasing in per capita income.



Note: Figure shows average trade costs for manufactured goods with respect to the 10 largest importing countries, by World Bank income groups, 1996 and 2009, percent ad valorem equivalent.

Figure 1 shows that trade costs for manufactured goods are generally headed downwards in all income groups over the sample period, although the rate of reduction differs. Since trade costs are bounded below by unity—with domestic and international trade costs being equal—this finding implies that there will eventually be convergence among income groups, but it may be achieved very slowly due to the different rates of change we currently observe. This finding lines up well with the general observation that trade to GDP ratios have been increasing around the world over recent years. To investigate this issue more thoroughly, Figure 2 presents the same data with trade costs for each group normalized to equal 100 in 1996. The lines thus represent proportional changes in trade costs over the sample period. Although trade costs are indeed falling across the board, they are doing so much faster in high income economies than in low income ones. In the former group, trade costs in 2009 were nearly 15% lower than in 1996, but in the latter group—which started from a much higher baseline—they had fallen by less than five percent. Given the relative divergence this finding suggests between high and low income countries, we conclude that although low income countries are becoming more integrated into the world trading system in an absolute sense, they are actually losing ground in relative terms because they are doing so much more slowly than other countries. Again, the case for initiatives such as aid for trade—which seek to integrate low income countries more tightly into the global trading system—clearly have much more work to do in the future to reverse this trend.

Figure 2: Trade costs are falling more slowly in low income countries than in other groups.

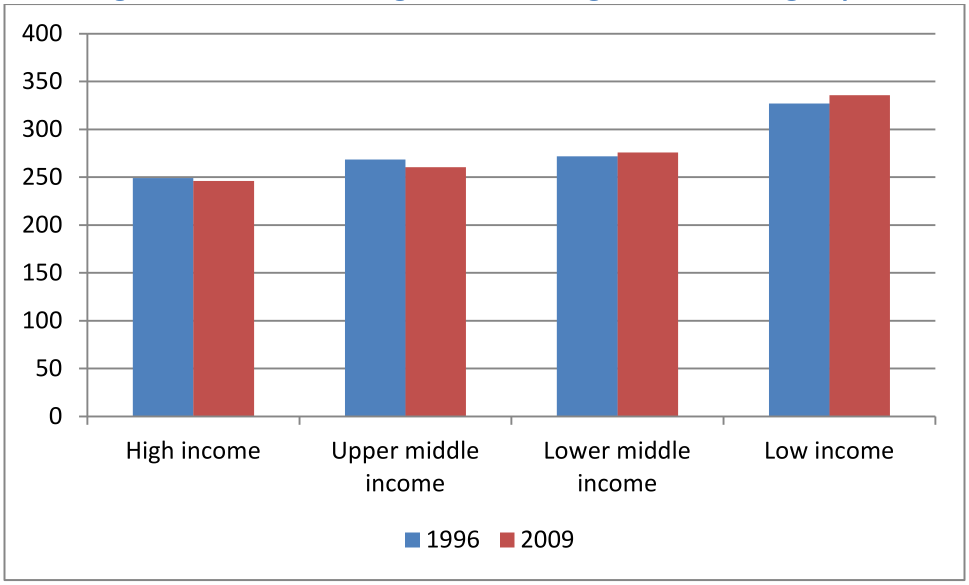


Note: Figure shows average trade costs for manufactured goods with respect to the 10 largest importing countries, by World Bank income groups, 1996-2009, 1996=100.

The two previous figures have presented some clear stylized facts for trade in manufactured goods. The situation for agriculture (Figures 3 and 4) is much murkier, however. First, trade costs are high across the board in agriculture, but once again, they are much higher in low income countries than elsewhere. Even in high income countries, the average ad valorem equivalent in 2009 was 246%, which is more than twice as high as the comparable number for manufactured goods. In low income countries, trade costs in agriculture were 336% ad valorem in 2009, or about 20% higher than for manufactured goods. Since natural factors driving trade costs are broadly similar across the two sectors—except, for example, for differences in the implications of geographical distance due to perishability—it is likely that the bulk of the explanation for the sharp differences between agriculture and manufactured goods, particularly in high income countries, relates to policies. Indeed, previous work has shown that rates of tariff and non-tariff protection are much higher in agriculture than in manufactured goods (Kee et al., 2009). Although there have been some efforts to integrate agricultural markets on a regional basis, those efforts—such as the EU common market—have often resulted in highly distortionary policies vis-a-vis the rest of the world, which would be reflected in our data since we do not drill down further into income groups or regions than the relevant World Bank classifications.

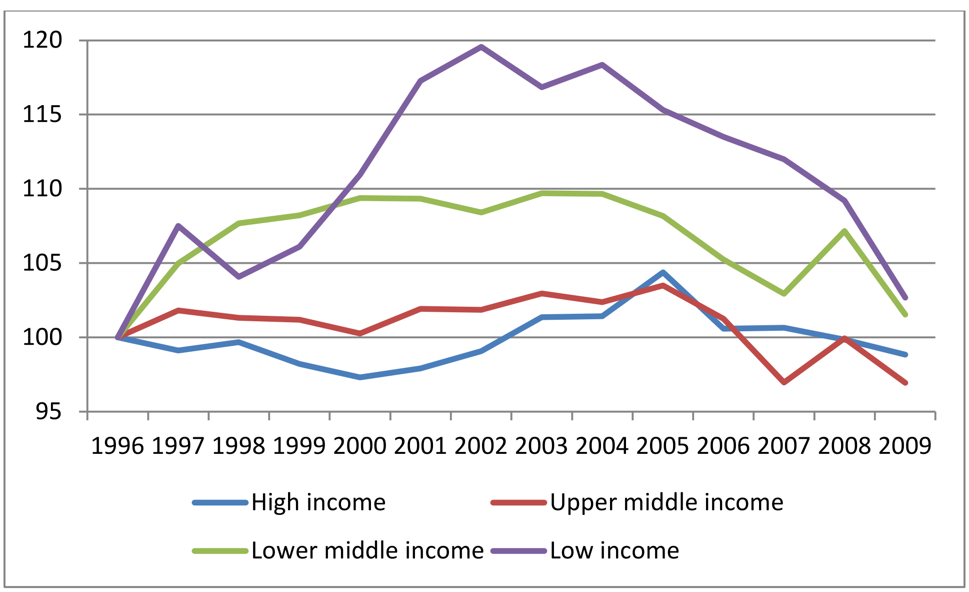
In terms of the rate of change of trade costs (Figure 4), the picture is very different from the one in manufactured goods: trade costs are basically the same at the beginning and end of the sample period, although there is evidence of some increase in the low income group in the middle of the period. The largest percentage change in our data is for the upper middle income countries, where trade costs were just over three percent lower in 2009 than in 1996—a negligible reduction. Integration of agricultural markets can therefore be seen to be lagging far behind that of manufactured goods markets, despite the commodity market boom of recent years.

Figure 3: Trade costs in agriculture are high in all income groups.



Note: Figure shows average trade costs for agricultural products with respect to the 10 largest importing countries, by World Bank income groups, 1996 and 2009, percent ad valorem equivalent.

Figure 4: Trade costs in agriculture are not falling over time.

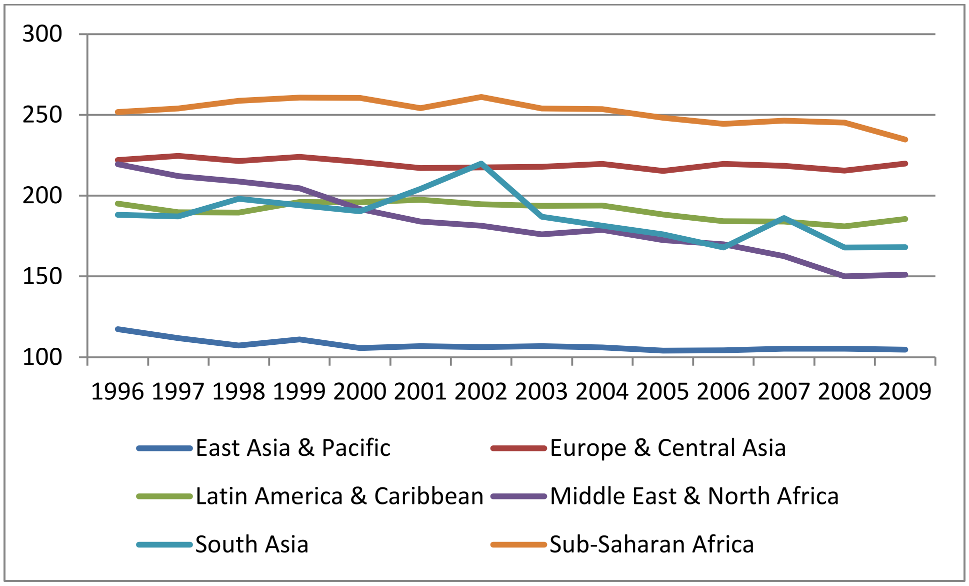


Note: Figure shows average trade costs for agricultural products with respect to the 10 largest importing countries, by World Bank income groups, 1996-2009, 1996=100.

The evolution of trade costs in low income countries—with an increase early in the sample period followed by a substantial decrease—is worthy of further analysis. In particular, it would be interesting, but not currently feasible, to parse out the part of that change that comes from changes in domestic trade costs versus that part that comes from changes in international trade costs. It might be that distortionary domestic policies such as subsidies increase domestic production to above-normal levels for some period before export incentives have an effect. Such a pattern could conceivably explain the observed pattern on the basis of constant international trade costs, because trade costs as we are reporting them are the ratio of international to domestic trade costs. Such a possibility is intriguing, but cannot be further investigated within the limits of currently available data and methods.

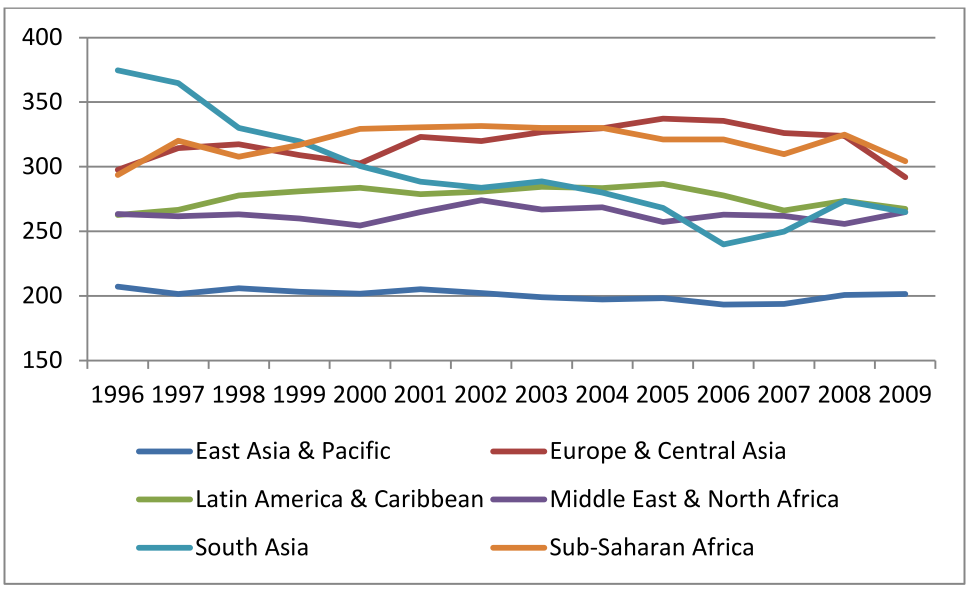
In addition to breaking the results out by income group, it is also useful to disaggregate them by World Bank region. Following the World Bank classification scheme, we therefore exclude high income countries from our regional groupings. Figure 5 shows results for manufactured goods, and Figure 6 provides the same information for agricultural products. In both cases, cross-regional differences are relatively stable over time, particularly at the extremes: trade costs in both sectors are much lower in East Asia and the Pacific (105% for manufactures and 201% for agriculture in 2009) than in Sub-Saharan Africa (235% and 305% respectively). In manufactured goods, trade costs have fallen substantially over recent years in East Asia and the Pacific (by 11%), South Asia (by 11%, but from a high baseline), and the Middle East and North Africa (by 32%). In agriculture, by contrast, trade costs are basically static in all regions except South Asia, where they have fallen dramatically (nearly 30%). The figures for the Middle East and North Africa in manufactured goods and South Asia in agriculture are very large, and should therefore be interpreted cautiously. Although they provide evidence of substantial changes underway in the trading environments of those regions, more detailed work will be required to relate these observations to changes in policy and non-policy factors that influence trade costs.

Figure 5: Trade costs for manufactured goods are much lower in East Asia than in other regions.



Note: Figure shows average trade costs for manufactured goods with respect to the 10 largest importing countries, by World Bank regions, 1996-2009, percent ad valorem equivalent.

Figure 6: Trade costs in agriculture are also lower in East Asia, but performance is more comparable across regional groups than in manufacturing.



Note: Figure shows average trade costs for agricultural products with respect to the 10 largest importing countries, by World Bank regions, 1996-2009, percent ad valorem equivalent.

Thus far, we have focused on the trade costs of various groups of countries vis-à-vis a constant comparator group, namely the top ten global importers. These results can therefore be considered as relating to extra-regional trade costs. We can also use the dataset to obtain information on intra-regional trade costs, i.e. the costs facing particular groups of countries as they trade among each other as opposed to with the rest of the world. Intra-regional trade costs are important from a development perspective, as they are linked to the idea of South-South trade, which has become a more important force in the world economy in the wake of recovery from the global financial crisis of 2008-2009 (Hanson, 2011).

Tables 1 and 2 present trade costs matrices summarizing both intra- and inter-regional performance in manufacturing and agriculture respectively. Countries are divided up by World Bank income group. As for the preceding analysis, we focus on stable groups over time so as to avoid composition effects. We present data for 2009, which is the latest year for which we have broad data availability. All results represent simple averages across countries within income groups.

Results for manufactured goods in Table 1 highlight two important stylized facts. First, trade costs facing South-South trade are much higher than trade costs affecting North-North trade. (We consider the South to include all middle- and low-income economies.) Trade within or between Southern income groups is subject to substantially higher costs than trade among Northern countries. This result reflects recent work on tariffs and non-tariff measures (Kowalski and Shepherd, 2005; Kee et al., 2009), and shows that there is still much governments can do to promote South-South trade in the future by lowering trade costs wherever feasible.

The second point to emerge from Table 1 is that for upper middle income countries, it is often less costly to trade with high income countries than it is to trade among themselves. Since many of the most important emerging markets are in this income group, our results reinforce the importance of liberalizing tariff and non-tariff measures, and improving trade facilitation in those markets. Interestingly, this dynamic is not true for lower-middle income and low-income countries, where within-group trade costs are lower than between-group trade costs. One explanation for this result could be that we observe relatively little trade among low-income countries in the dataset, which means that the sample for calculating average costs is biased. In particular, it is biased away from distant low-income country pairs, which tend not to trade at all. Alternatively, it could be evidence that South-South preferential agreements are starting to bear some fruit by reducing trade costs facing developing countries. The issue of regional integration is one that we return to below in the context of our econometric model.

Table 1: South-South trade costs in manufacturing are much higher than North-North trade costs.

	High income	Upper middle income	Lower middle income	Low income
High income	*130.39*			
Upper middle income	184.32	*197.63*		
Lower middle income	230.10	215.73	*218.89*	
Low income	288.91	256.08	254.45	*216.55*

Note: Table shows average trade costs for manufactured goods among World Bank income groups, 2009, percent ad valorem equivalent.

Table 2 presents similar results for agricultural products. Again, we see that South-South trade is generally subject to much higher costs than North-North trade, and that trade costs in agriculture are generally much higher than those in manufacturing. The only exception is the figure for trade among low-income countries, which is much lower than for other directions of trade. This result is surprising, and is perhaps due to composition effects, in the sense that only a subset of low-income countries report all the data we need to calculate trade costs measures. To the extent that reporting bias favors inclusion in the sample of those countries most reliant on trade, it may be that trade costs are somewhat understated for low income countries.

Table 2: South-South trade costs are also generally higher than North-North trade costs in agriculture.

	High income	Upper middle income	Lower middle income	Low income
High income	*205.85*			
Upper middle income	252.59	*248.83*		
Lower middle income	276.57	275.98	*286.39*	
Low income	322.09	331.08	288.86	*165.03*

Note: Table shows average trade costs for agricultural products among World Bank income groups, 2009, percent ad valorem equivalent.

As with the extra-regional trade costs results, we can also break out intra- and inter-regional trade costs by World Bank region. This classification excludes high income countries from the analysis. Table 3 shows results for manufactured goods, and Table 4 shows results for agriculture. In both cases, we find that East Asia and the Pacific has the lowest intra-regional trade costs of any developing region, although costs are much higher—around double—in agriculture compared with manufacturing. There is a substantial gap between East Asia and the Pacific and the next region (the Middle East and North Africa in the case of manufacturing), which suggests that there is a substantial source of best practice in East Asia with regard to reducing trade costs. This finding is in line with the generally greater reliance of East Asian economies on international trade, a factor which has probably done much to enable their rapid economic growth over recent decades. Interestingly, the neighboring region of South Asia has the highest intra-regional trade costs in both sectors. Indeed, trade costs vis-à-vis East Asia are lower than trade costs within South Asia itself. This result reflects the relative lack of regional integration in South Asia, due to both political and economic factors. There is clearly much work for policymakers in that region to do to reduce trade costs facing their exporters and importers.

Table 3: Trade costs for manufactured goods are lower between South Asia and East Asia than within South Asia itself.

	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	South Asia	Sub-Saharan Africa
East Asia & Pacific	*79.96*					
Europe & Central Asia	217.95	*141.63*				
Latin America & Caribbean	218.25	286.04	*170.40*			
Middle East & North Africa	213.23	179.34	281.70	*119.77*		

South Asia	121.38	216.35	234.58	143.60	*243.46*	
Sub-Saharan Africa	238.28	319.79	316.39	232.89	188.30	*182.49*

Note: Table shows average trade costs for manufactured goods among World Bank regions, 2009, percent ad valorem equivalent.

Table 4: Intra- and extra-regional trade costs are higher in agriculture than in manufacturing.

	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	South Asia	Sub-Saharan Africa
East Asia & Pacific	*167.48*					
Europe & Central Asia	259.25	*223.21*				
Latin America & Caribbean	300.66	339.64	*236.13*			
Middle East & North Africa	334.57	219.94	329.27	*205.23*		
South Asia	189.42	308.63	310.08	247.93	*386.10*	
Sub-Saharan Africa	381.45	296.99	322.75	294.37	293.52	*243.28*

Note: Table shows average trade costs for agricultural products among World Bank regions, 2009, percent ad valorem equivalent.

4.2. Decomposition of Trade Costs

In addition to providing descriptive statistics showing the pattern of trade costs across countries and through time, our dataset can also be used to examine the factors that contribute to the levels of trade costs observed around the world. We follow Chen and Novy (2011) in using a regression approach to analyze the determinants of bilateral trade costs. We include a wide range of variables familiar from the gravity model literature, covering both policy and "natural" factors. As in Chen and Novy (2011), we focus on factors that are primarily sources of international, as opposed to domestic, trade costs. Since one of the variables of interest—the World Bank's Air Connectivity Index (Arvis and Shepherd, 2011)—is only available for a single year, we perform a pure cross-sectional regression. To maximize data availability, we take data on trade costs for 2005. Data for other time-varying variables are for 2005, or the closest available year. Full details of data and sources are in Table 5. Since our trade costs data are a bilateral geometric average, we transform independent variables that are uni-directional by taking the geometric average of the two directions. For the same reason, we retain only one "direction" for each bilateral pair. In other words, the unit of analysis is the country dyad, and we ensure that each dyad is represented only once in the regression sample, not twice as would be expected in a model in which direction matters, such as the standard gravity model. We estimate regressions using two samples: all available countries (columns 3 and 4 in Tables 6 and 7, and columns 2 and 4 in Table 8), and all non-landlocked countries (columns 1 and 2 in Tables 6 and 7, and columns 1 and 3 in Table 8). The reason for splitting the sample in this way is that we are interested in identifying the effect of maritime connectivity on trade costs, but it only makes sense to undertake such an exercise for countries with direct maritime access. The split-sample approach makes it possible for us to identify the effect of maritime connectivity as well as (separately) the effect of being landlocked.

Using the data set out in Table 5, our regression equation takes the following form (where e is a standard error term) and is estimated by OLS:

$$
\begin{aligned}
(13)\ \log(trade\ costs_{ij}) &= b_0 + b_1 \log(distance_{ij}) + b_2 common\ border_{ij} \\
&+ b_3 common\ language\ ethno._{ij} + b_4 common\ language\ official_{ij} \\
&+ b_5 colony_{ij} + b_6 common\ colonizer_{ij} + b_7 same\ country_{ij} \\
&+ b_8 landlocked_{ij} + b_9 \log(1 + tariff_{ij}) + b_{10} RTA_{ij} \\
&+ b_{11} \log(exchange\ rate_{ij}) + b_{12} \log(LSCI_{ij}) + b_{13} \log(ACI_{ij}) \\
&+ b_{14} \log(LPI_{ij}) + b_{15} \log(entry\ costs_{ij}) + e_{ij}
\end{aligned}
$$

Table 5: Data and sources

Variable	Definition	Year	Source
ACI	Geometric average of country i's and j's scores on the Air Connectivity Index.	2007	World Bank
Colony	Dummy variable equal to unity if countries i and j were ever in a colonial relationship.	na	CEPII
Common Border	Dummy variable equal to unity if countries i and j share a common land border.	na	CEPII
Common Colonizer	Dummy variable equal to unity if countries i and j were colonized by the same power.	na	CEPII
Common Language (Ethno.)	Dummy variable equal to unity if countries i and j share a common language (ethnographic basis).	na	CEPII
Common Language (Official)	Dummy variable equal to unity if countries i and j share a common official language.	na	CEPII
Distance	Great circle distance between the two principal cities of countries i and j.	na	CEPII
Entry Costs	Geometric average of the cost of starting a business in country i and country j.	2005	Doing Business
Exchange Rate	Geometric average of the average official USD exchange rate of country i and country j (LCU per USD).	2005	World Development Indicators
Landlocked	Dummy variable equal to unity if countries i and j are both landlocked.	na	CEPII
LPI	Geometric average of country i's and j's scores on the Logistics Performance Index.	2007	World Bank
LSCI	Geometric average of country i's and j's scores on the Liner Shipping Connectivity Index.	2005	UNCTAD
RTA	Dummy variable equal to unity if countries I and j are members of the same RTA.	2005	De Sousa (Forthcoming)
Same Country	Dummy variable equal to unity if countries i and j were ever part of the same country.	na	CEPII
Tariff	Geometric average of unity plus the trade-weighted average effectively applied tariff applied to i to j's exports and by j to i's exports.	2005	TRAINS
Trade Costs	See main text.	2005	Authors

Regression results are presented in Table 6 (manufactured goods) and Table 7 (agriculture). Taking manufactured goods first, columns 1 and 3 show that all trade cost variables have the expected signs and sensible magnitudes based on the gravity model literature: distance, tariffs, and market entry costs all tend to increase trade costs in a statistically significant way, while geographical contiguity, common language, a colonial relationship, a common colonizer, belonging to the same country, being members of an RTA, a weaker exchange rate (more local currency units per USD), better maritime and air connectivity, and stronger logistics performance are all associated with lower trade costs. There are some differences in statistical significance between the two columns, however: tariffs and a common ethnographic language only have statistically significant coefficients in the full sample regression, whereas air connectivity only has a statistically significant coefficient in the sample excluding landlocked countries. Interestingly, after controlling for other factors, the dummy for landlocked countries is not statistically significant in the full sample regression, which suggests that other factors—including policy—may be at the root of the high trade costs seen in landlocked countries (Arvis et al., 2011; Borchert et al., 2012).

From a policy perspective, it is important to try and measure the relative contributions of different factors to overall trade costs. We do this in two ways. The first, in Table 6 columns 2 and 4, is by presenting standardized regression coefficients (betas). These coefficients show the change in standard deviations of the dependent variable brought about by a one standard deviation increase in each of the independent variables.[3] It is therefore possible to compare betas from one variable to another even though the units of measurement of each variable are different.

Comparing betas brings out a number of interesting points. The first is that geography remains an extremely important determinant of overall trade costs. In line with the gravity model literature which finds that the "death of distance" hypothesis has been greatly exaggerated (e.g., Disdier and Head, 2008), we find that a one standard deviation increase in bilateral distance is associated with about a 0.4 to 0.5 standard deviation increase in trade costs for manufactured goods. In terms of beta coefficients, distance has the strongest impact on bilateral trade costs of any factor considered in the model excluding landlocked countries, and it has the second strongest impact in the full sample regression. The effects of other geographical variables are smaller, but still significant. It should be also noted that the value we found for the elasticities of the log of distance are in the low range (0.2-0.3) of the values estimated in the empirical trade literature following traditional gravity modeling. One likely explanation is that the inverse gravity model is by construction a fixed effects gravity model where the totals in lines and columns in the trade matrix are the total output or demand by country. It has been suggested (Arvis and Shepherd, 2013) that consistent estimation implies the use of Poisson Pseudo-ML, which in turn is known to generate lower elasticities than traditional OLS (Santos Silva and Tenreyro, 2006).

The second point to emerge from the beta coefficients in Table 2 is that two areas that are amenable to policy interventions—maritime connectivity and logistics performance—are also highly significant determinants of trade costs. A one standard deviation improvement in liner shipping connectivity is associated with a 0.4 standard deviation decrease in trade costs, which is an effect only slightly weaker than that of geographical distance. For logistics performance, a one standard deviation improvement in the World Bank's Logistics Performance Index (LPI) is associated with a trade cost reduction of 0.2 standard deviations in the limited sample model and 0.5 standard deviations in the full sample model. Part of the reason for the difference between these two figures is that the LPI is correlated with UNCTAD's Liner Shipping Connectivity Index, and so the full sample regression captures part of that effect in the stronger coefficient. In any case, the important point to take away from these results from a policy perspective is that reforms in areas such as infrastructure, the regulation of core services sectors such as maritime transport and logistics, and private sector development can have significant benefits for countries in terms of lowering trade costs. There is thus a strong role for the "technology" behind trade transactions in driving trade costs around the world. Given that policy barriers have not fallen much in recent years in the developed world, it is likely that these technological factors are responsible for the majority of the observed faster fall in trade costs in the developed world compared with the developing world.

Third, our results suggest that non-tariff measures and other non-traditional forms of trade policy are particularly important determinants of trade costs, and they now play a stronger role than tariffs in determining performance. The beta coefficient for tariffs is much smaller in absolute

[3] These "beta" coefficients are thus simply the regression coefficients divided by the standard deviation of the corresponding independent variable.

value than for membership in an RTA, which suggests that new generation RTAs that go beyond tariff cuts to deal with non-tariff measures and particularly behind-the-border barriers are important ways of reducing trade costs. The importance of behind-the-border barriers is further highlighted by the role played by market entry costs as measured by the World Bank's Doing Business project: again, a one standard deviation decrease in market entry costs has a much larger impact on trade costs than a one standard deviation cut in tariffs. A final piece of evidence highlighting the importance of non-tariff measures is that our observable trade cost proxies only account for around 50% to 60% of the observed variation in trade costs. The rest is due to unobservables, including non-tariff measures. Although it is impossible due to lack of data to quantify the proportion of the unexplained variance that is due to non-tariff measures and the proportion that is statistical noise, it is likely that non-tariff measures play a substantial role.

Table 7 presents results for agricultural products. Results are identical to those for manufactured goods, except that some coefficients are statistically insignificant. This is the case for common colonizer, tariffs, membership of an RTA, and the Air Connectivity Index. Otherwise, all variables have coefficients with the expected signs and magnitudes. Comparing coefficients suggests that trade costs in agriculture are less sensitive to geographical distance than those in manufacturing, and the same is true for maritime transport connectivity and logistics performance. This result sits well with the intuition that agricultural products are often traded in bulk as commodities, which means that they are traded more slowly than manufactured goods that are increasingly part of high-speed international production networks. This factor also explains why air transport connectivity is an important factor in trade costs affecting manufactured goods, but not agriculture: only a very small amount of total agricultural trade, such as cut flowers and some fruits and vegetables, moves by air, and such trade is generally limited to North-North and North-South trade.

The beta coefficients for agriculture show that trade costs are particularly sensitive in relative terms to geographical distance, as well as maritime connectivity, logistics performance—which undoubtedly captures part of the maritime connectivity variable—as well as, interestingly, entry costs. It is likely that Doing Business entry costs are in this case proxying market entry barriers that take the form of non-tariff measures for which specific data are not available. Non-tariff measures are highly prevalent in agriculture, and this result reinforces their importance. An additional indication of the importance of non-tariff measures is the noticeably lower R2 for agricultural products as compared with manufactured goods, which indicates that a significant part of the variation in trade costs is being driven by factors outside the model, surely including various types of non-tariff measures.

Table 6: Regression results for manufacturing using log(trade costs) as the dependent variable.

	(1) Regression Coefficients	(2) Betas	(3) Regression Coefficients	(4) Betas
Log(Distance)	0.304***	0.468	0.247***	.386
	(0.000)		(0.000)	
Common Border	-0.318***	-0.100	-0.481***	-.161
	(0.000)		(0.000)	
Common Language (Ethno.)	0.024	0.018	-0.093***	-.064
	(0.433)		(0.002)	
Common Language (Official)	-0.156***	-0.106	-0.080**	-.052
	(0.000)		(0.015)	
Colony	-0.161***	-0.037	-0.301***	-.063
	(0.007)		(0.000)	
Common Colonizer	-0.072**	-0.037	-0.125***	-.063
	(0.028)		(0.000)	
Same Country	-0.135	-0.028	-0.121*	-.029
	(0.193)		(0.070)	
Landlocked			0.056	.015
			(0.239)	
Log(Tariff)	0.104	0.011	0.205*	.022
	(0.421)		(0.083)	
RTA	-0.128***	-0.073	-0.130***	-.077
	(0.000)		(0.000)	
Log(Exchange Rate)	-0.024***	-0.085	-0.016***	-.055
	(0.000)		(0.000)	
Log(LSCI)	-0.382***	-0.411		
	(0.000)			
Log(ACI)	-0.058***	-0.043	-0.028	-.022
	(0.009)		(0.196)	
Log(LPI)	-0.962***	-0.230	-1.997***	-.458
	(0.000)		(0.000)	
Log(Entry Costs)	0.036***	0.071	0.040***	.074
	(0.000)		(0.000)	
Constant	4.626***		5.251***	
	(0.000)		(0.000)	
Observations	2519		3719	
R2	0.594		0.493	

*Note: Estimation is by OLS. P-values based on robust standard errors are reported in parentheses. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). See Table 5 for variable definitions and sources.*

Table 7: Regression results for agricultural products using log(trade costs) as the dependent variable.

	(1) Regression Coefficients	(2) Betas	(3) Regression Coefficients	(4) Betas
Log(Distance)	0.182***	0.374	0.148***	0.320
	(0.000)		(0.000)	
Common Border	-0.228***	-0.110	-0.357***	-0.193
	(0.000)		(0.000)	
Common Language (Ethno.)	-0.054	-0.052	-0.129***	-0.119
	(0.215)		(0.001)	
Common Language (Official)	-0.080*	-0.071	-0.014	-0.012
	(0.080)		(0.731)	
Colony	-0.147***	-0.052	-0.247***	-0.084
	(0.001)		(0.000)	
Common Colonizer	0.007	0.004	0.012	0.008
	(0.850)		(0.682)	
Same Country	-0.173**	-0.051	-0.157***	-0.057
	(0.044)		(0.004)	
Landlocked			0.142**	0.042
			(0.036)	
Log(Tariff)	0.140	0.029	0.048	0.009
	(0.186)		(0.639)	
RTA	-0.049	-0.038	-0.038	-0.032
	(0.135)		(0.151)	
Log(Exchange Rate)	-0.014**	-0.060	0.001	0.004
	(0.021)		(0.858)	
Log(LSCI)	-0.218***	-0.274		
	(0.000)			
Log(ACI)	-0.036	-0.032	0.077***	0.075
	(0.267)		(0.006)	
Log(LPI)	-0.235*	-0.068	-0.895***	-0.258
	(0.079)		(0.000)	
Log(Entry Costs)	0.060***	0.148	0.043***	0.102
	(0.000)		(0.000)	
Constant	4.797***		5.566***	
	(0.000)		(0.000)	
Observations	1552		2121	
R2	0.321		0.284	

*Note: Estimation is by OLS. P-values based on robust standard errors are reported in parentheses. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). See Table 5 for variable definitions and sources.*

An alternative way of presenting the information in Tables 6 and 7 is by using semi-partial R2s. A variable's semi-partial R2 is the proportion of the observed variation in the dependent variable that it accounts for, after controlling for the influence of the other variables in the model. For example, the semi-partial R2 of log(distance) is equal to the difference between R2 for the baseline model with all variables, and R2 for an alternative model with all variables except log(distance). The difference between the model R2 and the sum of all the semi-partial R2s is the proportion of the observed variance in the dependent variable that is attributable to common variation among the independent variables. The idea of presenting semi-partial R2s is to give an impression of the quantitative importance of different factors in accounting for the overall variation we observe in trade costs around the world. We prefer this measure to the additive decomposition of R2 proposed by Novy and Chen (2011) because it results in strictly positive contributions that have a simple interpretation, whereas the latter method can result in some cases in negative variance contributions that do not have any substantive interpretation.

Table 8 presents results. Qualitatively, they reinforce the impressions drawn from the analysis of the beta coefficients. In manufacturing, we find that distance, maritime connectivity, and logistics performance account for the greatest proportion of the observed variance in trade costs of any of our independent variables. The same variables also play an important role in agriculture, as do Doing Business market entry costs. In both cases, it is important to note that common variation among the independent variables is a very important source of the observed variation in trade costs.[4] In other words, when countries perform well on one observable trade cost factor, they also tend to perform well in others. The policy implication that flows from this finding is that a broad-based approach to reform, which takes account of the strong interconnections among the various sources of trade costs, is likely to be more effective than a piecemeal approach.

Table 8: Semi-partial R2s for bilateral trade costs (% of observed variation accounted for by each variable independently of the others).

	(1)	(2)	(3)	(4)
	Manufacturing		Agriculture	
Log(Distance)	11.280	7.250	6.530	4.460
Common Border	0.720	1.880	0.820	2.570
Common Language (Ethno.)	0.010	0.120	0.090	0.460
Common Language (Official)	0.350	0.080	0.160	0.000
Colony	0.130	0.380	0.250	0.670
Common Colonizer	0.110	0.330	0.000	0.010
Same Country	0.060	0.070	0.200	0.260
Landlocked		0.020		0.170
Log(Tariff)	0.010	0.040	0.080	0.010
RTA	0.380	0.410	0.100	0.070
Log(Exchange Rate)	0.500	0.220	0.240	0.000
Log(LSCI)	9.640		4.240	
Log(ACI)	0.100	0.020	0.060	0.260

[4] This finding implies that some level of multicollinearity is present in our regressions. However, the consequences of multicollinearity—inflated standard errors—are preferable to those of omitted variable bias—inconsistent and biased estimates—and so we prefer to keep all variables in the models.

Log(LPI)	1.840	10.310	0.160	3.050
Log(Entry Costs)	0.230	0.270	0.860	0.430
Covariance	*34.040*	*27.900*	*18.310*	*15.980*

Note: See Table 5 for variable definitions and sources.

To better understand the determinants of trade costs in the developing world, we re-run the regressions from Tables 6 and 7 using split samples, and limiting the exercise for clarity's sake to the sample excluding landlocked countries, so that all policy variables are included. We separately identify South-South, South-North, and North-North trade in Table 9. We define the North as being all high income countries, and the South as being all other countries. A number of interesting features emerge from the split sample results. First, we see that the coefficient on tariffs is only positive and statistically significant in the case of South-South trade. This finding is consistent with the continued existence of relatively high traditional trade policy barriers affecting South-South trade, and is in line with previous work (e.g., Kowalski and Shepherd, 2005). Interestingly, the coefficient on the RTA dummy is only negative and statistically significant for South-South trade in manufactured goods and North-North trade in agricultural products. This finding suggests that some efforts at promoting South-South trade by signing preferential agreements may be bearing fruit—however, this effect is only true for manufactures, and does not extend to agriculture, where liberalization is frequently limited under South-South RTAs.

Second, we find that transport and logistics performance are important for all types of trade, but that the strength of the effects differs according to the direction. South-South trade in manufactures is more sensitive than other directions of trade to liner shipping connectivity, while the same is true for South-North trade in agricultural products in the case of air connectivity. This latter finding probably reflects the rise of trade in non-traditional agriculture such as horticultural products and fruits and vegetables, which are highly perishable and need to be transported quickly. In the case of logistics, the coefficient is strongest in absolute value for North-North trade, which highlights the importance of just-in-time management techniques and production networking in those countries.

Finally, entry costs appear to be a particularly important source of trade costs in South-South and South-North trade relations.[5] To the extent that Doing Business data on the costs of starting a business proxy for the fixed costs of market entry (as in Helpman et al., 2008), our result is indicative of the importance of dealing with entry barriers as part of the trade policy reform process in developing countries. Although tariffs and other variable cost barriers remain significant in South-South and South-North trade relations, it will be necessary for policymakers going forward to pay attention to a broader range of factors, including regulatory measures that give rise to fixed cost barriers that keep foreign companies out of markets.

Table 10 presents semi-partial R2s for the split-sample regressions, which allow us to identify factors that are particularly important drivers of trade costs in the three directions of trade under consideration. First, it is striking that distance is a much more important determinant of trade costs in trading relations involving the South than it is for North-North trade. In part, this might

[5] Future work could expand our efforts on entry costs by including variables similar to the OECD's Indicators of Product Market Regulation once they become available for a wide range of countries. Currently, however, their use would severely restrict our estimation sample, and so we prefer the Doing Business data.

reflect the shorter distances on average between many Northern countries, but it could also be a function of better transport infrastructure and services that make distance less of a barrier to North-North trade. This hypothesis is strengthened by the fact that maritime transport connectivity is also a more important determinant of trade costs in South-South and South-North trade than it is for North-North trade. In part, this finding might be due to differences in the mode of transport used for trade transactions, but it could also reflect a relative lack of connectivity in the South that tends to inflate trade costs.

Table 9: Split sample regression results using log(trade costs) as the dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)
	South-South		South-North		North-North	
	Manufacturing	Agriculture	Manufacturing	Agriculture	Manufacturing	Agriculture
Log(Distance)	0.304***	0.225***	0.335***	0.182***	0.311***	0.246***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Common Border	-0.246***	-0.077	-0.417**	-0.498***	0.020	-0.209
	(0.000)	(0.257)	(0.024)	(0.001)	(0.910)	(0.165)
Common Language (Ethno.)	0.034	0.074	0.004	-0.167***	-0.138	-0.207*
	(0.454)	(0.243)	(0.924)	(0.003)	(0.199)	(0.060)
Common Language (Official)	-0.157***	-0.109	-0.142***	-0.045	-0.191	-0.136
	(0.001)	(0.124)	(0.007)	(0.447)	(0.142)	(0.266)
Colony	-0.137	-0.227***	-0.206**	-0.120*	-0.014	0.022
	(0.246)	(0.001)	(0.012)	(0.065)	(0.920)	(0.857)
Common Colonizer	-0.103***	0.022	-0.079	-0.075	0.131	0.216*
	(0.002)	(0.633)	(0.272)	(0.222)	(0.470)	(0.061)
Same Country	-0.061	-0.278***	-0.439	0.332	-0.598***	-0.416***
	(0.500)	(0.005)	(0.513)	(0.217)	(0.000)	(0.007)
Log(Tariff)	0.576***	0.339**	-0.077	0.190	-1.598*	-0.465
	(0.002)	(0.030)	(0.675)	(0.154)	(0.060)	(0.331)
RTA	-0.210***	0.018	-0.024	-0.020	-0.116	-0.169*
	(0.000)	(0.721)	(0.565)	(0.680)	(0.256)	(0.050)
Log(Exchange Rate)	-0.026***	-0.023***	-0.027***	-0.014	-0.031	0.056*
	(0.000)	(0.002)	(0.000)	(0.157)	(0.147)	(0.071)
Log(LSCI)	-0.375***	-0.225***	-0.366***	-0.187***	-0.329***	-0.119
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.139)
Log(ACI)	-0.062*	-0.010	-0.123***	-0.152***	-0.132	-0.111
	(0.070)	(0.870)	(0.000)	(0.000)	(0.113)	(0.167)
Log(LPI)	-1.356***	-0.684***	-1.315***	-0.884***	-1.923***	-2.532***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Entry Costs)	0.061***	0.062***	0.055***	0.093***	-0.003	0.023
	(0.000)	(0.009)	(0.000)	(0.000)	(0.949)	(0.689)
Constant	4.818***	4.901***	4.511***	5.059***	5.597***	6.808***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1300	756	1040	655	179	141

R2	0.604	0.322	0.553	0.362	0.635	0.635

*Note: Estimation is by OLS. P-values based on robust standard errors are reported in parentheses. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%). See Table 5 for variable definitions and sources.*

The second key finding from Table 10 is that logistics performance is a significant source of variation in overall trade costs. It is generally the second or third most important determinant of trade costs, as measured by semi-partial R2s. With the exception of North-North trade, logistics performance is more important as a determinant of trade costs in manufactured goods sectors than in agriculture. It is a particularly significant source of variation in South-South trade costs. The policy implication is that improving logistics performance could be a useful tool in lowering South-South trade costs and boosting trade in that direction, particularly in manufactured goods.

Finally, common variation among the sources of trade costs plays an important role in determining the overall pattern of variation, and the effect is particularly strong in North-North trade. This observation suggests that successfully lowering trade costs tends to happen through action on a number of fronts simultaneously. This finding sits well with that of Arvis et al. (2012), who show that the top logistics performers around the globe tend to perform consistently strongly in a range of areas, which differentiates them from the next group of partial performers.

Table 10: Semi-partial R2s for bilateral trade costs (% of observed variation accounted for by each variable independently of the others).

	(1)	(2)	(3)	(4)	(5)	(6)
	South-South		South-North		North-North	
	Manufacturing	Agriculture	Manufacturing	Agriculture	Manufacturing	Agriculture
Log(Distance)	12.160	9.830	13.520	6.370	6.950	5.330
Common Border	0.600	0.130	0.590	1.820	0.000	0.340
Common Language (Ethno.)	0.010	0.110	0.000	1.070	0.440	1.100
Common Language (Official)	0.290	0.210	0.350	0.060	0.580	0.330
Colony	0.050	0.320	0.240	0.190	0.000	0.010
Common Colonizer	0.320	0.020	0.110	0.140	0.180	0.460
Same Country	0.020	0.910	0.150	0.190	0.540	0.340
Log(Tariff)	0.340	0.370	0.010	0.190	0.570	0.370
RTA	0.980	0.010	0.010	0.020	0.300	0.700
Log(Exchange Rate)	0.710	0.790	0.560	0.210	0.340	1.070
Log(LSCI)	9.550	4.510	9.480	3.200	4.960	0.710
Log(ACI)	0.100	0.000	0.510	1.140	0.630	0.500
Log(LPI)	3.500	1.310	2.680	1.590	3.150	4.640
Log(Entry Costs)	0.530	0.700	0.570	2.100	0.000	0.060
Covariance	*31.240*	*12.980*	*26.520*	*17.910*	*44.860*	*47.540*

Note: See Table 5 for variable definitions and sources.

5. Conclusion and Policy Implications

In this paper, we have used newly collected data on international trade and production to infer estimates of trade costs for up to 178 countries over the period 1995-2010. Our estimates distinguish between trade in manufactured goods and trade in agricultural products. In both cases, we find that the absolute levels of trade costs are significant in ad valorem equivalent terms: at least 100% in manufactured goods, and in excess of 200% for agriculture. Our results suggest that although the international economy has integrated considerably in recent decades, there remain potentially large unexploited gains to be reaped from further reducing the wedge between export and import prices.

From a development point of view, our results are significant because they show that trade costs fall disproportionately on developing countries. Not only do low income countries face high absolute levels of trade costs, but their position is not improving relative to other income groups: in fact, trade costs are falling much faster in the developed world than they are in the developing world in manufactured goods; by contrast, the situation remains static in agriculture. Similarly, we find considerable disparity among developing countries with some regions—particularly East Asia and the Pacific—exhibiting much lower levels of trade costs than others, such as Sub-Saharan Africa. A clear implication of our research is there is much for developing countries to learn from each other in terms of the set of policies that work effectively to reduce trade costs.

In addition to mapping out the level and direction of change of trade costs in the developing world over recent decades, we also use econometric methods to decompose trade costs into various policy and geographical/historical components. A key finding is that transport, trade facilitation, and logistics matter for trade costs: UNCTAD's Liner Shipping Connectivity Index and the World Bank's Logistics Performance Index are together a more important source of variation in trade costs than is geographical distance, and the effect is particularly strong for trade relations involving the South. Along the same lines, we find that RTAs have a significant effect in reducing trade costs even after controlling for tariffs, which indicates that new generation RTAs that include non-tariff measures and behind the border regulatory measures may be bearing fruit.

Given the level and direction of change of trade costs, their reduction should remain a key policy priority for developing countries, in particular low income countries and those in Sub-Saharan Africa. Our findings suggest that special attention should be paid to transport, logistics performance, and trade facilitation, which have the potential for highly significant impacts on trade costs. Our work therefore reinforces recent policy research highlighting the role of logistics as a driver of trade and competitiveness outcomes (Arvis et al., 2012). Most importantly, our econometric work confirms that current policy settings in a variety of areas contribute to the ongoing marginalization of some countries from the international trading system, and that it is not just a matter of geographical isolation. Although geography clearly matters for trade costs and trade performance more generally, it is by no means the only determinant of national success and connectivity to regional and global markets. Our findings therefore strengthen recent work showing that higher trade costs in landlocked countries, for example, are at least partly related to policies at the national, corridor, or sub-regional level that could, in principle, be reformed by governments and regional economic communities (Arvis et al., 2011; Borchert et al., 2012). We expect that future research using more detailed policy data, for example covering restrictions on the supply of trade-related services, could go further in identifying the types of reforms that might be most productive going forward.

Finally, the dataset can be a powerful tool for practitioners and policymakers, in combination with other methodologies, data sources, and expertise on the ground. As exemplified in Box 2, the dataset makes it easy to compare trade costs across different pairs of countries and map the constraints a country or a group of countries faces when integrating globally or among themselves. The model provides quantitative benchmarks for the two sectors (agriculture and manufacturing). The model cannot directly isolate the source of trade costs at a disaggregated level (one country or one pair), but only for adequate samples of countries. However combining trade costs data with specific knowledge on trade facilitation, logistics, non-tariff measures, trade policy, and the composition of bilateral trade, provides a comprehensive diagnosis and can help prioritize reform packages according to impact. This might be especially useful for regional integration policies.

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