Does Distance Still Matter for Agricultural Trade?

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Acknowledgment

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Abstract:

This paper quantifies the average effect of distance on bilateral agricultural trade using a large sample of countries. We focus on identifying time-varying effects of distance on trade to test whether the marginal effect has gradually diminished in recent years; to do this, we use a sample that includes more than 200 countries and spans the period 1995-2013. A variety of robustness checks and model specifications are used. The results suggest that the "distance effect" significantly explains bilateral agricultural trade flows.

Résumé

Cet article quantifie l'effet moyen de la distance sur le commerce agricole bilatéral utilisant un large échantillon de pays. Nous nous concentrons sur l'identification des effets variables dans le temps de la distance sur le commerce pour tester si l'effet marginal a progressivement diminué au cours des dernières années; pour ce faire, nous utilisons un échantillon comprenant plus de 200 pays et couvrant la période 1995-2013. Un ensemble de tests de robustesse et une large gamme de spécifications du modèle sont utilisés. Les résultats suggèrent que l' « effet distance » explique de manière significative les flux commerciaux agricoles bilatéraux.

1. Introduction

Bilateral distance remains one of the main obstacles to stronger bilateral trade links between African countries, despite recent efforts to increase regional integration and further the modernization of communication infrastructure. This paper focuses on to what extent transportation and informational costs, proxied by bilateral distance between the supply and demand markets, shape bilateral trade intensity.

We focus agricultural trade rather than total trade for several reasons. First is the importance of agricultural trade in overall trade in the region. Second, functioning agricultural markets have the potential to reduce food shortages and food insecurity when agricultural production is supported by increased domestic and foreign demand. Finally, agricultural trade can increase the diversification of agricultural markets for both exporters and importers, leading to an increase in welfare.

The agricultural sector is one of the main channels for employment generation and poverty reduction in developing countries. As demonstrated by Christiaensen et al. (2011), agriculture is significantly more effective than other sectors in reducing extreme poverty. Furthermore, focusing on Africa's manufacturing exports can be misleading, given the very high foreign value added embodied in these products. This implies limited domestic spillovers into the real economy. In addition, most of the papers that examine whether the "distance effect" has died in trade gravity models use total exports as the main dependent variable without distinguishing by products (Buch et al., 2004; Brun et al, 2005; Carrère and Schiff, 2005; Blum and Goldfarb, 2006 and Huang, 2007), thus neglecting the existence of possible heterogeneities at the product level. One exception is Berthelon and Freund (2008), who study the distance impact on the trade of a highly disaggregated sample of goods and find that homogeneous products are twice as likely to have become more distance-sensitive compared with differentiated goods.

While global technological change has reduced tangible trade costs, it is also still possible that sectors with high trade costs will continue to exhibit a strong negative distance elasticity. Agriculture constitutes one of these sectors, as it includes perishable goods; this could explain why certain agricultural exports may be strongly sensitive to distance costs. This is in line with the recent literature examining how distance elasticity varies with the degree of product homogeneity. Some goods became more substitutable, making it optimal to purchase a greater fraction of any given product from nearby countries, presumably those with lower transport costs. Berthelon and Freund (2008) find that goods that have experienced increases in their elasticity of substitution have also experienced increases in the magnitude of their distance elasticity, although these effects are small in magnitude. A more significant result is that homogeneous goods are more likely to have experienced an increase in the magnitude of the distance coefficient than differentiated goods. Overall, the results imply that substitutable goods and goods with high trade costs are more likely to have increases in the elasticity of distance. This can apply particularly to agricultural products.

It is also increasingly important to understand the effects of the many regional trade agreements involving developing countries that have been established over the past decade, particularly for agricultural products. Such agreements could lead to a gradual increase in the marginal and negative effects of distance on bilateral trade flows suggesting that trade flows with neighbors increase faster because of new regional agreements. However, not all trade products will react symmetrically to these reduced transaction costs (lower tariffs or transportation costs). Some products (e.g. agricultural products) can be more sensitive to the opening of neighboring markets compared to other products. In such a scenario, the effect of distance on bilateral trade of these products will be increasingly negative.

Finally, some regions of the developing world, such as sub-Saharan Africa have become important sources of arable land sales to foreign investors, including for large-scale agricultural purposes (Arezki et al., 2015). As foreign investors move into Africa and boost exports of agricultural products to the rest of the world (thereby using Africa in their supply chain network), this could result in an increase in the average distance for agricultural trade, thereby weakening the negative coefficient of distance on trade in the gravity model.

This paper takes advantage of trade data available in the new and comprehensive BACI database on trade developed by CEPII. This database covers more than 200 countries and about 5000 products at the HS6 level from 1995 to 2013. The paper will quantify the average effect of bilateral distance on bilateral agricultural trade using a large sample of countries and focusing on sub-Saharan Africa. We will then focus on identifying time-varying effects of the distance on trade to test whether the marginal effect has gradually diminished over recent years and whether the distance effect is particularly different for agricultural products. A variety of robustness checks and model specifications are used. The results suggest that the "distance effect" remains substantial and explains a significant part of bilateral agricultural trade flows.

The recent literature on the distance elasticity of trade has led to interesting results. Disdier and Head (2008) conducted one the most comprehensive study of the distance puzzle, examining 1,467 distance effects estimated in 103 papers in a meta-analysis. They find that the estimated negative impact of distance on trade has remained persistently high since the middle of the last century.

Omitted variable bias could also explain the distance puzzle. For example, if transaction costs are higher in countries with poor institutions, falling communications costs will result in a lesser reduction in trade costs (François and Manchin, 2007). Rising distance costs could also be due to the fixed-cost component of trade costs falling more rapidly than the variable component (Brun et al., 2005) or to the handling of zeroes in the data (if zero trade flows are positively correlated with distance, then ignoring zero trade flows could result in a spurious distance puzzle; Felbermayr and Kohler, 2006).

Carrere and de Melo (2009) further highlight that the distance puzzle — the surprising finding that the volume of trade has become increasingly sensitive to distance — is driven by low-income countries, which increasingly trade with geographically closer partners. In other words, the estimates of the elasticity of

trade to distance only increase over time for low-income countries; this result is robust when regional agreements are controlled for or when an Africa-specific effect is examined.

We contribute to this literature by using disaggregated export data focusing on agricultural trade rather than total exports to pin down the dynamic effects of distance on trade.

The structure of this paper is as follows. Section 2 presents and discusses the methodology and data used. Section 3 reports and discusses the results, and Section 4 concludes.

2. Empirical Framework

Baseline Specifications

The most popular model in the empirical trade literature which has been found to explain a significant proportion of bilateral trade flows is the gravity model. This model relates trade flows to geographical distance between countries and others variables, such as countries' sizes (GDPs), common language, colonial links, etc.

The basic gravity model in log-linear form is specified as follows:

$$ln(Xij, t) = a + f31 * ln(Yi, t) + f32 * ln(Yj, t) + f33 * ln(Dij) + f34 * ln(Mijt) + u_{it} + n_{jt} + E_{ijt}$$

$$(1)$$

where $X_{ij,t}$ are agricultural exports from country i to country j at time t; $Y_{i,t}$ and $Y_{j,t}$ are the GDPs of country i and j, respectively, at time t; D_{ij} is the distance between the capital cities of the two countries; M_{ijt} is the matrix of control variables; and u_{it} and n_{jt} are exporter-time and importer- time fixed effects.

It is worth noting that the model in Equation 1 can be re-written to allow for time-varying parameters through repeated cross-sectional estimations for each period t. This would help derive the path for the marginal effect of the distance on agricultural trade from repeated cross-sectional regressions for each year:

$$ln(Xij, t) = a_t + f3_{1t} * ln(Yi, t) + f3_{2t} * ln(Yj, t) + f3_{3t} * ln(Dij) + f3_{4t} * ln(Mijt) + u_i + n_j + E_{ijt}$$

$$(2)$$

The estimation of gravity models such as (1) or (2) faces a number of challenges.

The Zeroes

First is the bias due to omitted variables; second is the potential sample selection bias due to the high concentration of zero values in the dependent variable (when bilateral trade flows are almost nonexistent between a non-negligible number of country pairs). We propose solutions based on two different estimators recently used in the literature: OLS and pseudo-Poisson Maximum Likelihood estimator (PPML).[1]

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[1] The PPML is suitable to avoid the heteroskdasticity problem due to log linearization and the concentration of zeroes.

Multilateral Resistance

Naïve empirical applications of gravity equations are often criticized because the estimated coefficients seem to be overestimated (see Anderson and van Wincoop, 2003; Feenstra, 2004). Indeed, exports depend not only on bilateral trade costs but also on bilateral trade costs relative to a measure of both countries' trade costs to all other countries – the so-called multilateral resistance. To control for the multilateral resistance, we can use a mix of country-time fixed effects. However, because the model is actually amended to be estimated on repeated yearly cross-sectional specifications, we control for the exporter and the importer fixed effects to reduce the bias due to unobservables.

Robust Identification of Time-varying Parameters

Several approaches can be used to estimate the time-varying estimates of the effect of distance on bilateral agricultural exports. First, we can use the full sample and recover the time-varying marginal effects through various interaction terms of distance interacted with year-specific dummies. Second, the time-varying estimates of the effect of distance can be identified by resorting to repeated cross-sectional estimates for each period. The advantage of this approach is that it allows for a full heterogeneity of the model insofar as the effects of all explanatory variables are also estimated for each period and not just the coefficient of the distance variable is allowed to vary every year. This is particularly relevant when it comes to controlling for the time-varying effect of regional trade agreements (RTAs) on bilateral trade over time to reduce any confounding bias with the distance effects. Given the large sample we use in this paper, the second approach seems feasible and appears more flexible. It is also easier to implement when using the PPML estimator, which is found to provide more robust estimates under panel gravity specifications (Silva and Tenreyro, 2010).

Data

One important contribution of this paper is a view of the effect of bilateral distance on agricultural trade within Africa by taking advantage of the information on agricultural trade available in the BACI dataset. The dataset consists of annual trade by product observations covering the period 1995 to 2013.[2] The dependent variable is the level of agricultural exports within a country pair. We control for both countries' GDPs and per capita GDPs that are used as a proxy of economic masses and economic development levels. We also control for the presence of regional trade agreements at the country pair-level using data provided by Jeffrey Bergstrand (Database on Economic Integration Agreements, September 2015); these agreements are expected to boost bilateral trade. All other control variables (geographical distance, common currency,

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[2] It is worth pointing out that some intra-African trade data remains sparse and data quality might still be an issue despite efforts by the CEPII team to assemble a comprehensive trade database.

landlocked status, and common language) are taken from GeoDist of CEPII. Agricultural exports are aggregated by summing up HS6 categories 01–04, 07–11, and 16–22.[3]

3. Econometric Results

This section begins by presenting the effect of distance on food exports. We explore the effects from various subsamples and compare the estimates with what we find in Africa south of the Sahara.

Average Effects

Table 1 presents the results of our econometric estimations for the unrestricted world sample of exporters and importers, for the Sub-Saharan African exporters, Latin America exporters, and Asian exporters using the PPML estimator.

Table 1. Determinants of food exports. PPML estimates, 1995-2013

	(1) World	(2) i=SSA	(3) i=SSA; j=SSA	(4) i=LAC	(5) i=Asia
Bilateral distance, log	-0.864***	-1.035***	-0.624***	-0.992***	-0.856***
GDP of exporter, log	(-97.09) 0.918***	(-13.08) 0.864***	(-6.891) 1.757**	(-30.95) 1.260***	(-15.93) 1.770***
GDP of importer, log	(6.301) 1.917***	(3.231) 2.257***	(1.979) 1.197*	(4.123) 1.768***	(4.604) 1.855***
	(22.66)	(9.146)	(1.659)	(10.17)	(6.028)
GDP per capita of exporter, log	-0.151	-0.688*	-1.188	-0.675**	-0.651
	(-0.919)	(-1.664)	(-1.003)	(-2.067)	(-1.368)
GDP per capita of importer, log	-0.513***	-1.851***	-0.613	-0.661***	-1.111***
	(-5.602)	(-6.733)	(-0.715)	(-3.491)	(-3.397)
Common language dummy	0.204***	0.142**	0.0682	0.344***	0.672***
Common border dummy	(8.789) 0.693***	(2.205) 1.087***	(0.368) 1.029***	(5.774) 0.416***	(3.845) 1.239***
Colonial link dummy	(28.31) 0.414***	(6.749) 1.366***	(7.224)	(6.680) 0.679***	(18.90) 0.941***
Regional trade agreement dummy	(15.23) 0.276***	(16.78) 0.733***	1.375***	(9.579) 0.259***	(4.794) 0.600***
	(14.60)	(7.514)	(5.421)	(8.578)	(8.952)
Exporter-time and Importer-time FE	Yes	Yes	Yes	Yes	Yes
Observations	249,437	24,537	3,670	31,146	27,763
R-squared	0.805	0.751	0.709	0.912	0.935
Robust z-statistics in parentheses.					
*** p<0.01, ** p<0.05, * p<0.1					

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[3] These include: live animals, meat, fish, dairy, edible vegetables, fruits, coffee, tea, spices, cereals, milling products, and foodstuffs.

The results show a remarkable stability of the effect of distance on exports when we change the sample according to the origin of the exporter. The distance variable has a negative and statistically significant point estimate that hovers between -0.9 and -1.0. One exception is column 3, which focuses only on sub-Saharan Africa's food exporters and importers. The distance coefficient drops by 40 percent to -0.6 in this column, which is consistent with the view that within Africa, distance is less of a concern for food exports given that most countries within sub-regions export similar agricultural products and thus comparative advantages are less prevalent for these products.

Another explanation for the results in column 3 could be related to foreign direct investment (FDI) in Africa's agricultural sector. To the extent that foreign land acquisition in Africa for large-scale agriculture boosts exports of agricultural products to the rest of the world (the website Land Matrix reports that the bulk of Africa's production from FDIs is exported and that more than 50 percent of the exports goes back to the country of origin of the multinational corporation), this can result in an increase in the average distance to agricultural trade, thereby weakening the negative coefficient of distance on trade in the gravity model. Recent surges of arable land sales to foreign investors in Africa are very likely to be a plausible explanation (Arezki et al., 2015).

One question that remains is whether the average effect of distance on agricultural trade has been constant over time or has risen because of trade institutional arrangements and other factors. The next section focuses on estimating time-varying distance coefficients.
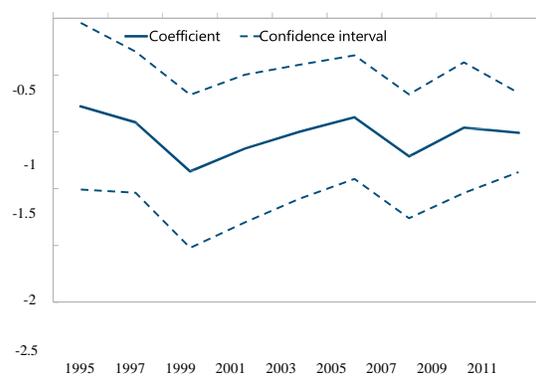
Time-varying Coefficients

This section reports the estimation results of Model 2 in which time-varying coefficients are estimated. We use four different samples to test the dynamics of the distance coefficient: the whole sample and then samples of African exporters, Latin American exporters, and Asian exporters. The results are shown in Figure 1. Time-varying point estimates show a remarkable stability over time and across regions, with estimates hovering around -0.8 and -1.0. The negative distance effect on agricultural exports is broadly similar across regions and has not vanished over the years.

Figure 1. Impact on agricultural exports: Time-varying distance coefficients
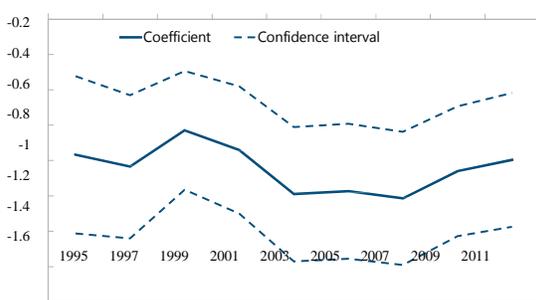
Time-varying distance coefficients: World Sample
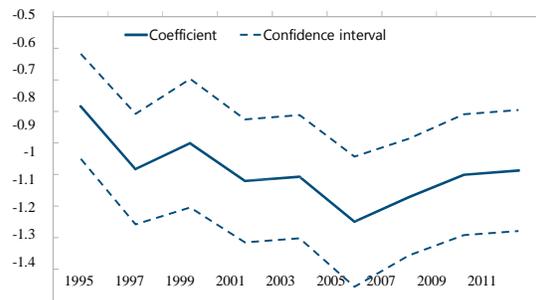(PPML estimates on repeated cross-sectional data)
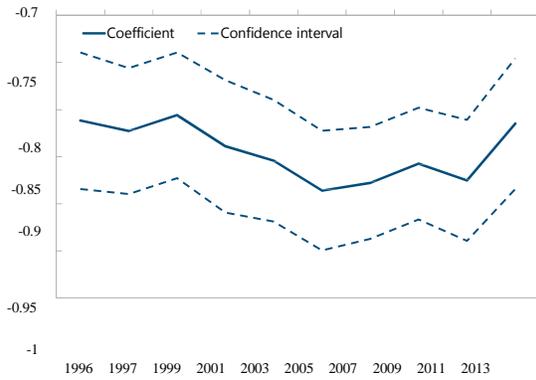
Time-varying distance coefficients: Exporter=SSA
(PPML estimates on repeated cross-sectional data) 0

Time-varying distance coefficients: Exporter=LAC
(PPML estimates on repeated cross-sectional data) 0

Time-varying distance coefficients: Exporter=Asia
(PPML estimates on repeated cross-sectional data)

## 4. How Specific Are Food Exports for the "Distance Puzzle"?

This section examines the differences in the sensitivity of food exports to distance by disaggregating by product categories and by regions. One interesting reason to examine the "composition" effect in the "distance puzzle" is that agricultural exports, in contrast to other commodities (oil or metals) or other manufacturing goods (such as textiles), are more perishable and thus more sensitive to distance. An alternative explanation could be that these products are also more sensitive to time which is ultimately correlated with distance as well. Hummels and Schaur (2013) find higher time values for automotive goods and for foods and beverages, when examining the effects of shipment time on trade. In the case of foods and beverages, where storability is particularly important, the authors argue that firms respond to long shipment times by making more frequent shipments on airplanes.

One could therefore argue that the explanation of the higher distance effect on overall trade found in the literature has nothing to do with trade costs or RTAs but rather with trade composition. If this were to be true, one would then find that the distance effect is larger and more statistically significant for a certain type of product than for others; this should hold irrespective of the region of the export origin, assuming that products which are defined as distance-sensitive are relatively homogenous between regions. We proceed in several steps to test for the product composition effect. First, we examine to what extent the average effect of distance is lower for non-food exports in the global sample. Second, we verify whether the differences in point estimates between the products are broadly similar across regions.

From the BACI database, we construct a "non-commodity products" category, which is defined as total exports minus all commodities (e.g. fuel, metals, and agricultural exports). Due to sample coverage, the regressions can only reasonably be performed on a yearly basis for the global sample and the Asia exporter sample. The results shown in Figure 2 point to a clear difference between the distance effect on agricultural products and its effect on non-commodity exports. The distance puzzle is greater for agricultural exports, as expected, and this result holds even after factoring in the time-varying effects of regional trade agreements on bilateral exports.

Figure 2. Testing for a "composition effect" in the distance puzzle

Time-varying distance coefficients: World Sample
(PPML estimates on repeated cross-sectional data)
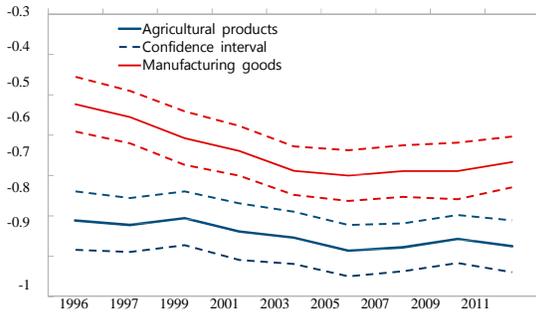
Time-varying distance coefficients: Exporter=Asia
(PPML estimates on repeated cross-sectional data) 0
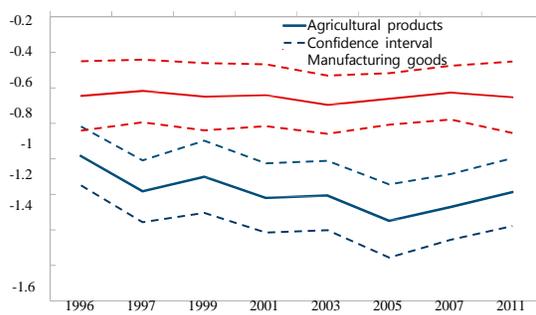
5. Conclusion

This paper has reexamined the role of distance to trade on export performance. It has focused on the time-variability of the distance effect and has considered a disaggregation across products with a focus on agricultural exports. The results are two-fold. First, the distance effect is stronger for agricultural exports compared to other commodities. Second, the distance effect has not vanished over time. These results are robust to model specifications that controlled for other gravity determinants of exports, including regional trade agreements.

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