Decisive Aspects in International Trade

Paloma Bernal Turnes, Ricardo Ernst

Georgetown University, Washington D.C., USA

Abstract

This article explores how investments in logistics infrastructures have a direct effect on international trade. We measure and test the association between logistics capacity and trade flows is also mediated by logistics efficiency, and by the time and the costs to reach market destination. Finally, we review the state of world trade, and discuss the rest of the latent variables that play a part in our structural equation modeling.

Introduction

The world economy is presently experiencing recession and trade slowdown. In 2011, world trade showed some recovery from its sharp decline of 2009 and 2010. Prior to this crisis, the general pattern in growth in world trade indicated that growth in value exceeded growth in volume, both in exports and imports.

Physical trade flows have changed dramatically during the past twelve years. The construction of new logistics networks, the improvement of procedures for trade and transport, and the investment in transport infrastructure and technologies, have assured the emergence of new trade nodes.

This paper is focused on transportation infrastructure. The most dynamic countries have spurred economic growth through international trade, which has been supported by ports' improved capacity to handle the traffic of containers from land to sea transport. Indeed, logistics have become the biggest driver of China´s trade growth. This country has invested the most in transportation (approximately 9% of the GDP yearly during 2004-2010).

Indeed, the core goal of this research is based on logistics. This paper attempts to analyze the direct effects of logistics infrastructure capacities to boost international trade flows, and also to study the subsequent effects on other variables that also have an influence on international business. These other variables include such as logistics efficiency, time to reach destination, and costs.

Research Problem, Objectives and Plan

This study complements the literature in many important ways regarding how infrastructures and logistics performance, and the time and costs to trade abroad, improve international trade flows. First, there is a theoretical gap in the literature regarding how the infrastructures increase the international trade flows. Although maritime infrastructures are critical for international shipments, it is recognized (Arvis and Shepherd 2011) that maritime infrastructures have been under-studied in this respect: the interconnectivity of terrestrial and air jointly with maritime infrastructures is very important in increasing the volume of international trade.

Second, the logistics performance in international trade has been understated by scientists. The quality of the infrastructures and logistics services, combined with the ability of track and trace consignments, has been studied to predict the impact on the time needed to allocate products in foreign market (Devlin and Yee 2005, Zhang and Fligliozzi 2010). Thus, the quality of logistics services and efficient customs procedures moderate positively the effect that logistics investments have on time to trade internationally (Heskett 1977, Bowersox and Daugherty 1987, Langley and Holcomb 1992, Handfield and Withers 1993, van der Veeken and Rutten 1998, Taylor et al. 2004, Arvis et al. 2011, Kohn et al. 2011).

Third, we highlight that there is a lack of studies regarding how the time to reach a destination can affect the costs, and subsequently the international trade flows. To reach the final destination abroad is not only a question of distance (Hummels 2001, Baier and Bergstrand 2007).

Fourth, we emphasize the role of cost to trade internationally. Tariffs certainly have a strong impact on international trade (Baier and Bergstrand 2007, Hoekman and Nicita 2011, Khan and Kalirajan 2011); nevertheless, other costs have a stronger distinct influence on international trade, once trade liberalization has reduced the tariff rates in the richest countries (Tempest 1996, Jain 1999, Limao and Venables 2001, Anderson and Wincoop 2004, Khan and Kalirajan 2011, Liu and Xin 2011).

Finally, the ultimate goal of this research is to discover the direct and indirect associations of logistics with international trade. In other words, the structural equation modeling methodology applied provides us with information about the stand-alone effect of infrastructures in fostering trade flows, but also unearths the role in this association through the intervention of other variables that are associated with international trade.

Developing the Research Model and Hypotheses

It has been found that the investment in logistics infrastructures (roads, ports, aiports, sewers and water supply facilities) fosters economic growth (Nguyen and Tongzon 2010). In truth, many studies provide strong evidence that infrastructures predict international trade (Fawcett et al. 1997, Limao and Venables 2001, Arvis et al. 2012).

We assume that the relationship between logistics infrastructures and international trade is contingent on both time and cost to trade abroad (Cole and Maxwell 2003, Selig and Preacher 2009). Based on the above discussion, the following hypotheses are posited:

Hypothesis 1 (H1): The higher the investment infrastructures in logistics, the greater the variability of doing international trade flows.

Hypothesis 2 (H2): The higher the investment infrastructures in logistics, the greater the variability to logistic chain efficiency.

The customs and inspection process, the quality of logistics services, the capacity of infrastructures, and the ability to handle the consignments not only have an impact on the logistics efficiency, but also cause transit time costs (Heskett 1977, Bowersox and Daugherty 1987, Langley and Holcomb 1992, Handfield and Withers 1993, van der Veeken and Rutten 1998, Taylor et al. 2004, Devlin and Yee 2005, Kohn et al. 2011).

Some studies offer evidence that infrastructures and countries´ geography are significant in determining international transport costs (Limao and Venables 2001). Also, we assume that the relationship between logistics efficiency and international trade is contingent on time and cost to trade abroad (Cole and Maxwell 2003, Selig and Preacher 2009). Development of

transportation and logistics industry results in a better quality service and more services available to customers, including multimodality and door-to-door delivery. These improvements reduce the time needed to ship goods abroad. In parallel, operations with economies of scales and the use of technology in information management, ship guilding, and cargo handling and tracking, have lowered transport costs. This encourages international trade by facilitating traders reducing the costs of exporting and importing. On the other hand, logistics efficiency could affect the international trade flows reducing the technical barriers to export and import. Therefore, we hypothesize the following:

Hypothesis 3 (H3): The better the logistic chain efficiency from origin to destination in international flows, the less the propensity the variability in time needed to export and import.

It is increasingly important to consider the time needed to reach the destination to explain logistic costs, rather than just the distance between the countries of origin and arrival (Hummels 2001, Baier and Bergstrand 2007). We assume that the relationship between time and international commerce is contingent on costs to trade. In brief, costs to trade abroad moderate negatively the inverse relationship between the time to reach destination abroad and the trade volume flows. The contingent effect should be measured and tested but this association will not be included in our conceptual model (Cole and Maxwell 2003, Selig and Preacher, 2009):

Hypothesis 4 (H4): The longer the time needed to export and import, the greater the variability of costs to trade abroad.

The primary focus of cost to trade is to speed up the international goods flows. The difficulty to measure and assign the total cost of international business has been one of the main topics covered in the literature (Khan and Kalirajan 2011).

Hypothesis 5 (H5): The higher the international trade costs, the less the propensity of doing international trade flows.

Methodology

The empirical data for performing this research were gathered mainly from the database WITTS of The World Bank, and data collected by the International Monetary Fund, The United Nations Conference on Trade and Development, and the World Economic Forum. They refer to the year 2010. The original sample size included 156 countries, in which 15 cases of the sample were deleted because their gaps were higher than 75% of the data asked. To test the hypothesis, we employed structural equation modeling (SEM) with the maximum likelihood robust estimation method, using the model illustrated in Figure 1 as the base model. The base model formulation was developed following the next steps: model specification, model identification, model estimation, testing model fit, and model respecification. We estimated by structural equation modeling two conceptual models after the MI estimation: one based on all data available (formed by 156 countries); and one where we had deleted the cases with large gaps (141 countries). We use the Chi-squared test to compare both conceptual models, and we chose the one that showed a higher model fit.

The methodology for testing the intervening associations that was used in this research covers the causal-steps-strategy (Baron and Kenny 1986), the product-of-coefficients technique (Sobel 1982), and the bootstrapping re-sampling (Efron 1982, Bollen and Stine 1990, MacKinnon et al. 2004). The second technique applied to test the mediator effect is the Sobel test (Sobel 1982).

Results

The model provides a satisfactory fit to the data ($\chi2(82)=144.6$, $p<0.001$; goodness-of-fit index [GFI]=0.89, confirmatory fit index [CFI]=0.970; incremental fit index [IFI]=0.970; and root mean square error of approximation [RMSEA]=0.06, indicating the uni-dimensionality of the measures (Anderson and Gerbing, 1988). Additionally, all factor loadings were highly significant ($p<0.001$), and the composite reliabilities of all constructs exceed the 0.8 benchmark (Bagozzi and Yi 1988).

The results indicate that all parameters are significant in the conceptual model. Hypothesis H1 predicted a positive direct association between infrastructures investments and international trade. The relationship between the investment in logistics infrastructures and international trade is mediated by change in the efficiency in logistics, the variation in time to trade abroad and the alteration in costs to trade abroad. Model comparisons to test exclusively initial constructs are detailed in Table 2. This indirect effect suggest that a country´s level of investments in logistics infrastructures has a positive impact on its change in logistics efficiency, and that change in efficiency predicts reductions in the time needed to reach destination. These reductions subsequently diminish costs to trade abroad, which in turn predicts growth in international trade (LI ➔ LE➔ T ➔ C➔IT).

Thus, 33% ($\beta=0.33$, $p<0.001$) of international trade variability depends on logistics infrastructures. One part out of five (20,22%) of that variability in international trade is caused by the single mediator effect of the costs to trade abroad. This result means that when a country significantly invests in infrastructures, that leads to reduction in the costs to export and import product. Thus, 20.20% ($\beta=0.0666$, $p <0.001$) of international trade spread is due to that costs reduction mediation, and the remaining 79.80% ($\beta=0.26$, $p <0.001$) is due merely to the improvement in infrastructures.

Conclusions

The main conclusion of this research are the following. First, the model that better fit the data is the model which assess that logistics infrastructures has a positive impact, by one hand on international trade directly, and in the other hand, on its change in logistics efficiency, and that change in efficiency predicts reductions in the time needed to reach destination. These reductions subsequently diminish costs to trade abroad, which in turn predicts growth in international trade (LI ➔ LE➔ T ➔ C➔IT). The fitness measures supports this assessment.

Second, our conceptual model provide the most important source of information in this research. Then, the association among variables that increases international trade most is the one that provokes (33%) of its variability with the following twofold outcome (Model 2). On one hand, investments in logistics infrastructures help to increase logistics efficiency. Thanks to this effect, the time to reach destination decreases, which provokes reductions in costs to trade abroad and subsequently fosters international trade LI➔LE➔T➔C➔IT). These indirect effects represent 27.89% of the variability of international trade. On the other hand, the investment in logistics infrastructures has a strong direct effect (62.11%) on international trade (LI➔IT). Thus, 94% of logistics efficiency variability is explained by logistics infrastructures, and when this effect occurs, 56% of time variability is inversely explained by logistics efficiency. Also, thanks to improvements in logistics efficiency and infrastructure investments, 65% of the variability of costs to trade is explained by the time reduction. Subsequently, 27% of the variability of

international trade is inversely explained by costs to trade if the previous effects occur. On the other hand, with just the improvements in logistics infrastructures, it is explains 23% of the variability of international trade.

The findings suggest that the variables that better explain new patterns on international trade are the investment in logistics infrastructures and cost to trade. The more variability in international trade occurs with the effects of both variables.

Limitations and Further Research

One limitation of this study is the small "universe" that is the aim of the study, which provides also a small and weak sample size to apply structural equation modeling. This research has dealt not only with the obstacles of data gaps, but also with some issues that modify the interpretation of results, like landlocked countries (one out five of the countries are landlocked) in terms of ship connectivity, or special political situations such as wars. Other disadvantages about the sample include the difficulties of standardized data of some few items.

This study suggests several topics for future research. The first topic might be the accurate calculation of costs to trade goods abroad. Although, some authors have studied deeply the different type of costs that implies to trade abroad, there remain accounting difficulties. It remains difficult to determine which destination markets generate less costs to trade abroad in a competitive approach from business enterprises. A second topic might be to study the main bottlenecks (either bureaucratic or physical) that impede the reduction of time to trade abroad.

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Appendix I. List of the Countries Used in the Model.

Albania	Guatemala	Niger
Algeria	Guinea	Nigeria
Angola	Guinea-Bissau	Norway
Argentina	Guyana	Oman
Armenia	Haiti	Pakistan
Australia	Honduras	Panama
Austria	Hong Kong, SAR, China	Papua New Guinea
Azerbaijan	Hungary	Paraguay
Bahamas, The	Iceland	Peru
Bahrain	India	Philippines
Bangladesh	Indonesia	Poland
Belgium	Iran, Islamic Rep.	Portugal
Bolivia	Ireland	Qatar
Bosnia and Herzegovina	Israel	Romania
Brazil	Italy	Russian
Cambodia	Jamaica	Rwanda
Cameroon	Japan	Sao Tome and Principe
Canada	Jordan	Saudi Arabia
Chile	Kenya	Senegal
China	Korea, Rep.	Serbia
Colombia	Kuwait	Singapore
Congo, Dem. Rep.	Latvia	Slovak Rep.
Costa Rica	Lebanon	Slovenia
Cote d'Ivoire	Liberia	Solomon
Croatia	Libya	South Africa
Cuba	Lithuania	Spain
Cyprus	Luxembourg	Sri Lanka
Czech Rep.	Macedonia	Sweden
Denmark	Madagascar	Switzerland
Djibouti	Malawi	Syrian Arab Rep.
Dominica	Malaysia	Taiwan
Dominican Rep.	Maldives	Tanzania
Ecuador	Mali	Thailand
Egypt, Arab Rep.	Mauritania	Togo
El Salvador	Mauritius	Tunisia
Eritrea	Mexico	Turkey
Estonia	Moldava	Turkmenistan
Ethiopia	Mongolia	Uganda
Fiji	Montenegro	Ukraine
Finland	Morocco	United Arab Emirates
France	Mozambique	United Kingdom
Gabon	Myanmar	United States
Gambia, The	Namibia	Uruguay
Georgia	Nepal	Uzbekistan
Germany	Netherlands	Venezuela
Ghana	New Zealand	Vietnam
Greece	Nicaragua	Yemen, Rep.

Appendix II. Measurement Items and Validity Assessment

		SFL_1	SFL_2	p-$Value_2$
Logistics Infrastructures α_2 = 0.683 CR=0.67 AVE=0.643				
DD3	Percentage of paved roads	0.59	0.59	0.001
INF1	Air connectivity	0.68	0.69	0.001
INF2	Shipment connectivity	0.66	0.65	0.001
Logistics Efficiency α_2 = 0.728 CR=0.975 AVE=0.97				
AA3	Quality of trade and transport related infrastructure (e.g., ports, railroads, roads, information technology)	0.97	0.97	0.001
A5	Competence and quality of logistics services (e.g., transport operators, customs brokers)	0.96	0.98	0.001
A6	Ability to track and trace consignments	0.97	0.96	0.001
Time to Trade Abroad α_2 = 0.976 CR_2 =0.977 AVE_2 =0.97				
CC1	Number of days to import 2010	0.96	0.95	0.001
CC2	Number of days to export 2010	0.99	0.99	0.001
AA9	Lead Time to Import 2010 = Number of days	0.15 Dropped	0	0.001
Costs to Trade Abroad α_2 = 0.732 CR_2 =0.970 AVE_2 =0.97				
BB2	Average of the applied tariff rates, including preferential rates that the rest of the world applies to each country.	0.13 Dropped	0	0.001
BB4	Cost to export (US$ per container).	0.95	0.94	0.001
BB5	Cost to import (US$ per container)	0.99	1.00	0.001
International Trade α_2 = 0.881 CR=0.953 AVE=0.872				
F1	Imports of goods and services (% of GDP).	0.93	0.93	0.001
F2	Exports of goods and services (% of GDP).	0.91	0.91	0.001
F5	M+X/gdP $1000^{E5=}$ E5/1000000000	0.96	0.96	0.001