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**Working Paper**

## Integrating landlocked developing countries into international trading system through trade facilitation

ARTNeT Working Paper Series, No. 84

**Provided in Cooperation with:**

Asia-Pacific Research and Training Network on Trade (ARTNeT), Bangkok

*Suggested Citation:* Kharel, Paras; Belbase, Anil (2010) : Integrating landlocked developing countries into international trading system through trade facilitation, ARTNeT Working Paper Series, No. 84, Asia-Pacific Research and Training Network on Trade (ARTNeT), Bangkok

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Asia-Pacific Research and Training Network on Trade  
Working Paper Series, No. 84, September 2010

## Integrating Landlocked Developing Countries into international trading system through trade facilitation

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## *Executive summary*

This study empirically investigates how the quality of trade facilitation (both on-the-border and behind-the-border factors) in landlocked developing countries (LLDCs) and in their transit countries impacts LLDC trade. It uses an augmented gravity model incorporating trade facilitation variables. Two sets of gravity models are estimated, one to explain LLDC exports and the other to explain LLDC imports. The main contribution of this study is the consideration of trade facilitation environment in both LLDCs and transit countries.

Two sets of trade facilitation variables are used: the logistics performance index (LPI) and its six indicators; and two aggregate governance indicators combining, respectively, all and three of the six governance indicators developed by Daniel Kaufmann, Aart Kraay and Massimo Mastruzzi for the World Bank.

The results are partly in line with a priori expectations and partly contrary to the same. The study finds that besides traditional gravity variables such as distance, contiguity and economic size, colonial relationship, existence of common colonizer and common official language, and tariff—all of which have expected sign and are significant—logistics performance in LLDC and in their transit gateway countries also significantly affect LLDC exports. The distance coefficient ranges from -1.41 to -1.6, which is higher than in most gravity studies, while the tariff coefficient ranges from -2.33 to -2.65. This indicates that despite the reduction in transportation costs due to technological advancements and the global fall in tariff barriers, distance and tariffs still matter for LLDC exports.

The results suggest that improvement in the logistics performance in LLDCs and their transit gateway countries can boost LLDC exports. Where significant, transit-country coefficients are lower than exporter coefficients for LPI and its sub-components, implying that improvement in LLDCs' own logistics performance in its various dimensions is as critical as improvement in transit-country logistics performance. A one percent improvement in the LPI score of an LLDC is associated with, on average, ceteris paribus, a 2.84 percent to 3.27 percent increase in its exports, while the corresponding impact of the same improvement in the LPI score of transit country(ies) ranges from 1.10 percent to 1.20 percent. Improvement in the competence of the local logistics industry in LLDCs is found to have the biggest impact on LLDC exports. A particularly interesting finding is that improving the efficiency of clearance at the customs/border in LLDCs is more important than doing the same in transit countries as far as boosting LLDC exports is concerned. But non-customs-related aspects of trade facilitation in transit countries, such as ease and affordability of arranging international shipments and transport and information technology infrastructure, remain important areas needing reform to help increase LLDC exports.

However, aggregate governance performance in LLDCs is found to have an impact on LLDC exports out of line with a priori expectations—a result that needs to be investigated in future studies.

An important policy implication flowing from the results is that international assistance for improving the trade performance of LLDCs, as envisaged by the Almaty Programme of

Action, endorsed by the United Nations General Assembly, should focus on improving the trade facilitation environment in both the LLDCs and their transit neighbours. The local logistics industry in LLDCs, and the ease and affordability of arranging international shipments and logistics-related transport and information technology infrastructure in transit countries should receive high priority. International and regional development agencies should scale up support for the creation and implementation of efficient transit transport regimes at the regional level based on global good practices for a meaningful integration of LLDCs into the global economy. Along with improvements on the trade facilitation front, as tariffs maintained by LLDC trade partners are found to be a barrier to LLDC exports, ways need to be also explored to reduce tariffs on products of export interest to LLDCs.

In the models explaining LLDC imports, geographic and cultural variables, economic mass and colonial ties are found significant, as is tariff. In fact, tariff is found to have a greater impact on imports relative to exports (though at a lower level of statistical significance). Distance, contiguity, and official language have a greater impact on imports than on exports of LLDCs, whereas the reverse is true for the variables economic mass, colonial relationship and common colonizer. One policy implication is that LLDCs should rationalize their tariff structures, which will help bring about a more efficient resource allocation, leading to increased specialization and export competitiveness. In contrast, the impact of LLDC trade facilitation, as measured by improvements in LPI and its sub-components, on LLDC imports is found to be insignificant, mostly. While this result merits further investigation, one can hypothesize that it may be explained by the import structure of LLDCs, dominated by products such as necessities and certain luxury items that not much sensitive to trade costs. If this is the case, then improvements in LLDC trade facilitation environment would imply improved trade balance of LLDCs, as exports would increase. However, the study shows transit-country logistics performance and aggregate governance performance to impact LLDC imports in a direction opposite to a priori expectations. This remains an issue for further investigation.

## Introduction

The 31 landlocked developing countries (LLDCs) are widely dispersed around the globe<sup>1</sup>. Despite their location on four continents, all 31 LLDCs share common problems of geographical remoteness and high transport costs in international trade transactions. But they also have a common goal, namely the integration of their economies into the global trading system in a way that would enable them to reap more benefits from international trade (UNCTAD 2005).

According to the United Nations (UN), LLDCs, as a group, are among the poorest developing countries. They face tremendous challenges to growth and development due to a wide range of factors, including weak institutional and productive capacities, small domestic markets, and high vulnerability to external shocks, as well as poor physical infrastructure and remoteness from world markets (UNCTAD 2005). Sixteen of the LLDCs, or more than half, also belong to the category of least-developed countries (LDCs). Lack of territorial access to the sea, remoteness and isolation from world markets result in substantially higher transportation costs for LLDCs and reduce their competitiveness in international trade<sup>2</sup>.

Since tariffs have been lowered in several rounds of multilateral trade negotiations, the simplification and the harmonization of international trade procedures are of even greater importance to LLDCs than to other countries, because of their need to pass much of their merchandise trade through at least one transit country. The trade-hindering effect of long distances is compounded by an inadequate transport infrastructure, both in the LLDCs and in their neighbouring transit countries. A low density of roads and railway lines, and congested ports and generally weak infrastructure maintenance in LLDCs and many of their transit partners are serious obstacles to efficient trade transactions (UNCTAD 2005).

Chowdhury and Erdenebileg (2006), describing why geography matters and LLDCs are at a disadvantage vis-à-vis coastal countries, argue that a lack of direct access to the sea, isolation from major economic centres, inadequate transport infrastructure and cumbersome transit procedures combine to hamper the ability of LLDCs to grow successfully, especially through the well-worn path of international trade. They contend that high transport costs discourage trade in goods and services, and LLDC transport costs are high because of remoteness and isolation from major markets, lack of direct access to the sea, infrastructure deficiencies within LLDCs, and use of multimodal transportation. An important factor contributing to high CIF/FOB margins for LLDCs is the greater economic and political risks they face, considering their absolute dependence on transit neighbours for trade flows; the uncertainty of inland road conditions and customs clearance inevitably means higher insurance premiums in addition to basic transport costs (Chowdhury and Erdenebileg 2006).

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<sup>1</sup> 15 are located in Africa, 12 in Asia, 2 in Latin America and 2 in Central and Eastern Europe.

<sup>2</sup> *Ad valorem* trade costs, covering freight and insurance costs for exports, are higher in LLDCs (12.9 percent) than in other developing countries (8.1 percent) and developed countries (5.8 per cent), owing to high transit costs and risks associated with exports from LLDCs. See UNCTAD (2003).

Faye *et al.* (2004) identify four types of dependence of LLDCs on transit neighbours that are important in explaining the poor development and trade performance of LLDCs: dependence on neighbours' infrastructure; dependence on sound cross-border political relations; dependence on neighbours' peace and stability; and dependence on neighbours' administrative practices.

Gravity model has become the workhorse for estimating and explaining trade flows. However, use of trade facilitation variables is still limited, and gravity model-based research explaining LLDCs' trade flows particularly using trade facilitation variables is rarer still.

Limão and Venables (1999) show that that improving an LLDC's own infrastructure and the transit country's infrastructure from the median to the twenty-fifth percentile would reduce the cost penalty of landlockedness from 46 percent to 32 percent and 36 percent respectively. If both countries' infrastructure is enhanced at the same time, then the penalty drops even further, to 26 percent. Such improvements and cost reductions would raise the LLDC's volume of trade considerably — by 8 percent with improvements in its own infrastructure; by 2 percent with improvements in transit country infrastructure; and by 11 percent in the event of a simultaneous improvement.

Assessing the benefits of trade facilitation, Wilson, Mann and Otsuki (2005) develop four measures of trade facilitation—port efficiency, customs environment, regulatory environment and service sector infrastructure (proxied by the Internet and e-commerce use by business)—and use them in a gravity model to show that increased trade in manufacturing goods from trade facilitation improvements in all four areas yields increases in both exports and imports. Improvement in all four forms of trade facilitation of the 'below-average' countries 'halfway' to global average yields an increase in global trade of US\$377 billion. The gains are largely through export expansion and the most important ingredient in achieving these gains, particularly to the OECD market, is a country's own trade facilitation reform efforts. Comparing South-South trade with South-North trade, the former is more affected by tariffs than the latter. The customs environment of importing country, the regulatory environment of both exporting country and importing country and the service sector infrastructure of exporting country are important factors influencing South-South trade. The study also showed that for landlocked countries, ports are as important for both import and export as in non-landlocked countries while for island countries, ports are more important for their import and less important for their export compared to non-island countries.

Djankov, Freund and Pham (2006) found that each additional day that a product is delayed prior to being shipped reduces trade by more than one percent—or each day is equivalent to a country distancing itself from its trade partners by about 70 km on average. They also control potential endogeneity using a sample of landlocked countries and instrument for time delays with export times that occur in neighboring countries—showing that a one percent increase in export times in landlocked countries reduces trade by about one percent. They also find that delays have an even greater impact on exports of time-sensitive goods, such as perishable agricultural products.

Persson (2007) assessed the potential benefits from trade facilitation in terms of increased trade flows on average and specifically for the six regional groups of ACP countries negotiating

Economic Partnership Agreements with the EU. Their results suggest that time delays on the part of the exporter and the importer generally significantly decrease trade flows, but also that this effect is not constant, in the sense that the elasticity of trade with respect to border delays declines at higher levels of time requirements. On average, lowering border delays in the exporting country by one day from the sample mean would yield an export-increasing effect of about 1 percent, while the same reduction in the importing country would increase imports by about 0.5 percent. Significant negative effects are also found of both export and import transaction costs for most EPA groups, and the effects tend to be at least as large as the average or larger.

Duval and Utoktham (2009) analyze the impact of behind the border business performance on trade flows among 37 countries, i.e., countries from Southeast, South, North, and Northeast Asia, OECD countries, as well as Brazil, Russia and South-Africa, through gravity models, using two sets of indicators to capture behind-the-border business performance—average of each country's rank in nine of the 10 areas of Doing Business (excluding trading across borders); and values of three Doing Business Indicators, namely Getting Credit (credit information index), Protecting Investors (disclosure index), and Enforcing Contracts (number of procedures). They also use the cost of import/export from factory to seaport (available in the Doing Business Report) as an explanatory variable in their models. They confirm that measures aimed at reducing the behind and at-the-border cost of exporting, such as reductions in customs and port fees and charges, and improvements in transport infrastructure and logistics services, can be expected to have a significant impact on trade. They find that a 5 percent reduction in the cost of moving goods from the factory floor to the deck of a ship at the nearest port is found to increase exports by 4 percent or more. However, their study also reveals that improving the domestic business (investment) environment may have an impact on export competitiveness of a magnitude similar to the trade and transport facilitation measures. In particular, they find that simplifying domestic contract enforcement procedures in Asian developing countries to the OECD average may increase exports by up to 27 percent. Similar improvements in credit market information in Asia may increase exports by up to 16 percent. The study also finds evidence that achieving similar performance levels across the range of trade and business facilitation areas, i.e., having a more integrated approach to trade and business facilitation, could significantly increase trade competitiveness. Gains from improvements in business regulatory coherence in Asia could generate an additional 3 percent average increase in bilateral exports for countries of the region.

Weerahewa (2009), using a gravity model to estimate the gains that can be acquired from improving trade facilitation in South Asia, focusing on exports of food and agricultural commodities, finds that trade facilitation variables have significant effects on exports of different products, in varying degrees, depending upon the proxy used – Logistics Performance Index (LPI) and trade costs (Doing Business Report). The study finds that LPI has large positive effects on the value of exports of all the product categories. The estimates for trade costs are negative and significant. Improving trade costs and logistics performance in South Asian countries up to the average values of the best performer in South Asia brings down trade costs by over 17 percent, resulting in an increase in the value of agricultural trade of 18 percent and 27 percent respectively.



Our study seeks to empirically investigate how the quality of trade facilitation (both on-the-border and behind-the-border factors) in LLDCs and in their transit countries impacts LLDC trade. We use an augmented gravity model incorporating trade facilitation variables.

## *Methodology and data*

Gravity models are being used extensively to explain trade flows between countries. Drawing an analogy with Newton's theory of gravity, the basic, traditional gravity model argues that bilateral trade flows increase with the product of economic sizes and decreases with geographical distance. One of the most commonly used gravity model derived from solid micro-foundations is the model due to Anderson and Van Wincoop (2003 and 2004). Besides physical distance and economic mass, factors affecting trade costs (e.g., tariffs, trade facilitation indicators, non-tariff barriers, colonial ties, common language, etc) are also used as other determinants of bilateral trade flows.

We estimate two sets of gravity models, one for LLDC exports and the other for LLDC imports.

Equation 1

$$\begin{aligned} \ln X_{ij} = & \alpha + \beta_1 \ln(1 + \text{Tariff} / 100) + \beta_2 \ln(\text{GDP}_i * \text{GDP}_j) + \beta_3 \ln(\text{dist}_{ij}) \\ & + \beta_4 \text{Dcontig} + \beta_5 \text{Dcomcol} + \beta_6 \text{Dcol} + \beta_7 \text{Dcomlang} + \beta_8 \text{TF}_i + \varepsilon_{ij} \end{aligned}$$

Equation 2

$$\begin{aligned} \ln M_{ij} = & \alpha + \beta_1 \ln(1 + \text{Tariff} / 100) + \beta_2 \ln(\text{GDP}_i * \text{GDP}_j) + \beta_3 \ln(\text{dist}_{ij}) \\ & + \beta_4 \text{Dcontig} + \beta_5 \text{Dcomcol} + \beta_6 \text{Dcol} + \beta_7 \text{Dcomlang} + \beta_8 \text{TF}_j + \varepsilon_{ij} \end{aligned}$$

The dependent variable is natural logarithm of merchandise exports or imports of LLDCs. Trade value is in current US\$ for the year 2008. Trade data are sourced from UNCOMTRADE through the World Integrated Trade Solution (WITS). As direct export/import data are not available for all LLDCs, mirror data are used instead for all of them—that is, imports (exports) of partner countries from (to) an LLDC are considered as that LLDC's exports (imports).

We consider only positive trade flows. There are 2,628 bilateral pairs with positive exports and 2,355 pairs with positive imports. There are 144 export destinations and 139 import sources for LLDCs. However, data constraint (with respect to GDP and trade facilitation variables) enables us to consider only 26 LLDCs (as opposed to 31 LLDCs), 110 export destinations and 130 import sources. As a result, there are 1,706 observations for the gravity models for exports and 1,682 observations for the gravity models for imports (Tables 1 and 2).

We use nominal GDP, sourced from the World Bank's World Development Indicators. GDP figures for 2008 are used where available. Where not available, figures for 2007 and 2006 are used.

We use simple average bilateral tariffs available from TRAINS database, accessed through WITS. Data unavailability means that not all tariff data are for the year 2008. Tariff data for 2007 and 2006 are used where 2008 data are not available.

Bilateral distance is simple distance between the most populated cities, sourced from CEPII database. Data for dummy variables—contiguity, common language (official), colony and common colonizer—are also taken from CEPII database.

### ***Trade facilitation (TF)***

We augment the gravity equation with the World Bank's 2007 logistics performance index (LPI)<sup>3</sup> and its indicators for LLDCs.<sup>4</sup> LPI data are available for 27 of 31 LLDCs<sup>5</sup>.

The six<sup>6</sup> components of the LPI are:

- Efficiency of the clearance process by customs and other border agencies
- Quality of transport and information technology infrastructure for logistics
- Ease and affordability of arranging international shipments
- Competence of the local logistics industry
- Ability to track and trace international shipments
- Timeliness of shipments in reaching destination

These indicators capture on-the-border as well as behind-the-border barriers to trade. Their values range from 1 to 5, with higher values indicating better performance. The logistics performance of LLDCs is generally below average (Table 3). While Paraguay (rank 71), Uganda (83), Macedonia (90) and Malawi (91) fare relatively better among the LLDCs, the rest rank among the bottom 50 of the 150 countries for which LPI data are available, with Afghanistan ranking last. Except for the LLDCs in Sub-Saharan Africa (where non-LLDCs also have comparatively poor performance), the performance of LLDCs in terms of the LPI and its six components is generally worse than that of their respective regions.

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<sup>3</sup> World Bank. 2007. Connecting to Compete – Trade Logistics in the Global Economy: The Logistics Performance Index and Its Indicators 2007. Washington, D.C.: The World Bank.

<sup>4</sup> Initially, we also considered using the Global Economic Forum's Enabling Trade Index and its components to capture the trade facilitation situation as it is more comprehensive than LPI in that it includes most LPI components, trade-related indicators in the World Bank's Doing Business survey and a host of other indicators based on quantitative and qualitative data. However, as we found that the Enabling Trade Index does not cover 10 LLDCs and many of the transit countries, we decided not to use it.

<sup>5</sup> The LLDCs for which LPI data are not available are Central African Republic, Botswana, Swaziland, and Turkmenistan.

<sup>6</sup> The seventh area of performance—domestic logistics costs—is dropped from the composition of LPI as it was found to be uncorrelated to the other areas in the LPI.

We also augment the model with trade facilitation conditions in transit countries, which we try to capture by their own LPI and associated indicators. Most LLDCs depend upon more than one country for transit to carry out their foreign trade. For simplicity, we consider as transit countries “gateway” transit countries identified by the World Bank<sup>7</sup>. Nine LLDCs have a single “gateway” country, while 20 have multiple “gateway” countries. The above-mentioned World Bank’s list does not mention any gateway country for two LLDCs—Moldova and Macedonia. For these two, we consider all its bordering neighbours as transit countries. The transit-country trade facilitation variables for LLDCs that have multiple transit countries are calculated as a simple average of the values observed for all the transit countries, except in certain cases. In cases where an LLDC is trading with a non-LLDC bordering country, where available, the LPI score for the partner is used. In cases where both importer and exporter are LLDC and contiguous, the average of their own LPI scores is used. In cases where both importer and exporter are LLDC but they are not contiguous, the average of their transit-country LPI scores is used. This adjustment rests on the assumption that bordering countries’ bilateral trade is conducted without third-country transit.

We also introduce governance indicators as additional explanatory variables to explain LLDC import/export flows. They can also be interpreted as trade facilitation variables. We use the six governance indicators for the year 2008 developed by Daniel Kaufmann, Aart Kraay and Massimo Mastruzzi for the World Bank—voice and accountability, political stability/no violence, government effectiveness, regulatory quality, rule of law, and control of corruption. Their values are approximately in the range of -2.5 to 2.5, with higher values indicating better performance. The six indicators are combined into a single aggregate indicator (*gov\_ag*), and three of the indicators—regulatory quality, rule of law, and control of corruption—into another single indicator (*gov\_ag3*) through principal component analysis. We do not use transit governance indicator for reasons explained in the next section.

We observe variation among the 26 LLDCs in variables such as GDP, exports, imports, LPI and its six components, and the two aggregate governance indicators (Table 4). There is also variation in the transit-country trade facilitation variables among LLDCs. LLDCs are a heterogeneous lot and the attempt here is to exploit the heterogeneity to estimate the impact of trade facilitation performance in LLDCs and their transit countries on LLDC trade.

## *Estimation*

The model is estimated using STATA 10 software. We estimate the models through ordinary least squares, using robust estimator, and importer/exporter fixed effects to control for multilateral resistance. In addition to the traditional gravity equation variables (tariff, distance, GDP, contiguity, common language (official), colony and common colonizer), we run the models using various combinations of trade facilitation variables (LPI index and its six components; and aggregate governance indicators). For the export (import) flow model, the use

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[http://siteresources.worldbank.org/INTTLF/Resources/Transit\\_Project\\_Brochure.pdf?resourceurlname=Transit\\_Project\\_Brochure.pdf](http://siteresources.worldbank.org/INTTLF/Resources/Transit_Project_Brochure.pdf?resourceurlname=Transit_Project_Brochure.pdf)

of importer (exporter) fixed effects means partner trade facilitation variables are dropped. Correlation between the explanatory variables is checked to avoid multicollinearity. In particular, strong correlation between governance transit variable and LPI transit variable has led us to use only LPI transit variable to capture transit-country trade facilitation situation.<sup>8</sup> All standard errors are robust.

## *Results*

### LLDC exports

Fourteen models are estimated with the logarithm of exports of LLDCs as dependent variable (Tables 5 and 6). While traditional gravity equation variables—distance, GDP, tariff, contiguity, common language (official), colony and common colonizer—are common to all 14 models, LPI and its six components are used separately, with seven models using the aggregate governance indicator *gov\_ag* and the remaining seven using the aggregate governance indicator *gov\_ag3*. The number of observations in all the models is 1,706. The total number of partner countries of LLDCs in the sample is 110. The coefficient of determination ranges from 0.34 to 0.359.

### **Geographic and cultural variables, economic mass, and colonial ties**

Distance, product of economic mass (GDP), contiguity, common official language, colonial relationship and common colonizer have expected signs and are statistically significant (at 1 percent or 5 percent level) in all 14 models. The value of the distance coefficient ranges from -1.414 to -1.594, implying that a 1 percent increase in distance with partners, *ceteris paribus*, is associated, on average, with an increase in LLDC exports by 1.4 percent to 1.6 percent. It means distance matters for LLDC exports. The value of the coefficient on product of GDP ranges from 1.251 to 1.338, implying that when the product of LLDC and partner country GDP increases by 1 percent, *ceteris paribus*, LLDC exports on average increase by 1.25 percent to 1.34 percent. The contiguity coefficient ranges from 1.31 to 1.64, implying that contiguity with partner increases LLDC exports, on average, *ceteris paribus*, by a huge 270.62 percent to 415.52 percent. Sharing of a common official language increases LLDC exports, on average, *ceteris paribus*, by 63.07 percent to 94.06 percent. Likewise, having colonial relationship with the partner at one time increases LLDC exports, on average, *ceteris paribus*, by 244.53 percent to 300.68 percent. Similarly, having a common colonizer with the partner increases LLDC exports, on average, *ceteris paribus*, by 349.97 percent to 478.34 percent. These show that LLDCs, on average, tend to trade more with countries that are geographically closer or contiguous, economically large, and with which they share cultural affinity (common official language) and/or had colonial links (colonial relationship/common colonizer).

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<sup>8</sup> Running auxiliary equations regressing transit LPI variables and transit governance variables separately on other explanatory variables of the gravity model, we get higher coefficient of determination in the case of transit governance variables and hence drop them in favour of transit LPI variables.

## **Tariff**

Tariff coefficient bears the expected sign in all the models, but at only 10 percent significance level. It ranges from -2.333 to -2.654, implying that a decline in the landed price of LLDC exports by 1 percent (due to a decline in tariff) increases LLDC exports, on average, *ceteris paribus*, by 2.3 percent to 2.65 percent. This suggests that despite the fall in tariffs globally, tariff is still a barrier to LLDC exports (although the level of significance level, 10 percent, is not high). This may be because tariffs are still high on products exported by LLDCs. Sectoral gravity models could give a better picture.

## **Trade facilitation**

The composite LPI index (of LLDCs) is significant (at 1 percent) and has expected sign. In the two models (Models 1 and 2) where this index is used, the coefficients are 3.269 and 2.836. This means that improvement in the overall logistics performance of LLDCs, as reflected in a 1 percent increase in the LPI index, is associated with an increase in LLDC exports, on average, *ceteris paribus*, by 2.84 percent to 3.27 percent. In the same two models, transit LPI is also significant (at 5 percent), with coefficients 1.104 and 1.203. This means that improvement in the overall logistics performance of transit countries, as reflected in a 1 percent increase in the LPI index, is associated with an increase in LLDC exports, on average, *ceteris paribus*, by 1.1 percent to 1.2 percent. However, both the aggregate governance indicators (of LLDCs) – *gov\_ag* as well as *gov\_ag3* – are significant but with unexpected sign. The negative, significant values of the two governance coefficients – used separately in Models 1 and 2 – imply that improvement in the governance situation in LLDCs is associated, *ceteris paribus*, with a decrease in LLDC exports. In fact, the two governance variables also take on negative, significant coefficients in nine other models, where they are used in combination with each of the six components of LPI index (*Gov\_ag* is insignificant in three models). The unexpected results on the governance front require further investigation.

All six LPI components have significant coefficient with expected sign for LLDC exporters. The competence of the local logistics industry component of LPI has the highest coefficient (3.275-3.494), followed by the ease and affordability of arranging international shipments (2.661-2.95), the quality of transport and information technology infrastructure (2.854-2.962), efficiency of the clearance process by customs and other border agencies (2.112-2.578), the ability in tracking and tracing of international shipments (1.094-1.428), and timeliness of shipments in reaching destination (1.057-1.392).

The transit-country LPI components are significant for all but customs and tracking/tracing. The ease and affordability of arranging international shipments component of LPI has the highest coefficient (1.74-1.866), followed by the quality of transport and information technology infrastructure (1.538-1.6), timeliness of shipments in reaching destination (1.168-1.296), and competence of the local logistics industry (1.188-1.231). In particular, the competence of local logistics industry in the exporting country is far more important than that in the transit countries.

Where significant, transit-country coefficients are lower than exporter coefficients for LPI and its sub-components, implying that improvement in LLDCs' own logistics performance is as critical as improvement in transit-country logistics performance. A particularly interesting finding is that improving the efficiency of clearance at the customs/border in LLDCs is more important than doing the same in transit countries as far as boosting LLDC exports is concerned. But non-customs-related aspects of trade facilitation in transit countries, such as transport and information technology infrastructure, remain important areas needing reform to help increase LLDC exports.

## LLDC imports

Fourteen models are estimated with the logarithm of imports of LLDCs as dependent variable (Tables 7 and 8). The explanatory variables are the same as in the models with LLDC exports as dependent variable discussed above. The number of observations is 1,682. The total number of partner countries of LLDCs in the sample is 130. The coefficient of determination is 0.45.

### **Geographic and cultural variables, economic mass, and colonial ties**

The variables distance, product of GDP, contiguity, colonial relationship, common colonizer and common official language all have expected sign and are significant (at 1 percent level). The distance coefficient ranges from -1.738 to -1.786, higher in absolute value than that for exports. The economic mass coefficient ranges from 0.804 to 0.856, lower than that for exports. The contiguity coefficient ranges from 1.551 to 1.637, higher than that for exports. The coefficient on common official language ranges from 0.691 to 0.729, higher than that for exports. The coefficient on colonial relationship ranges from 1.096 to 1.129, lower than that for exports. The coefficient on common colonizer ranges from 1.210 to 1.254, lower than that for exports. These results suggest that distance, contiguity, and official language have a greater impact on imports than on exports of LLDCs, whereas the reverse is true for the variables economic mass, colonial relationship and common colonizer.

### **Tariff**

Tariff coefficient also has expected sign and is significant (at 1 percent level). It ranges from -3.172 to -3.747, higher than for exports. This suggests that tariff is a greater barrier to LLDC imports than LLDC exports (although the tariff coefficient for exports should be interpreted with caution, because of the lower significance level of 10 percent).

### **Trade facilitation**

LPI of LLDCs as well as all but one of its six components (the exception being transport and information technology infrastructure) appear insignificant. Though significant only at 10 percent level, the coefficient of transport and information technology infrastructure component

of LPI of LLDCs is 0.543, indicating that improvements in LLDC infrastructure may lower the cost of importing and thereby increase LLDC imports. The insignificance of overall LPI and five of its components needs further research. Nonetheless, one may hypothesize that this may be explained by the structure of LLDC imports, which may not so sensitive to trade costs. Some 25 percent of LLDC imports as a group are food items and fuels (average for 2006-2008).<sup>9</sup> Likewise, LLDCs' manufacture imports, which account for just above 69 percent of their imports as a group (average for 2006-2008), may be dominated by necessities as well as certain "luxury" items, which are not much sensitive to trade costs. If this hypothesis is true, the implication would be that improved LLDC trade facilitation may be associated with improved trade balances of LLDCs, most of which have persistent merchandise trade deficits.

Transit-country LPI and all but one of its six components appear significant with unexpected, negative sign. One component, infrastructure, is insignificant. This unexpected result requires further investigation. Similarly, while one aggregate governance indicator (gov\_ag) appears insignificant, the other one, gov\_ag3, appears consistently significant with unexpected, negative sign. The latter also needs further investigation.

### *Summary, conclusion, and policy implications*

We use augmented gravity models on a sample of LLDCs that take into account the LPI and its sub-components and two aggregate governance indicators. We find that besides traditional gravity variables such as distance, economic size, contiguity, colonial relationship, existence of common colonizer, common official language and tariff—all of which have expected sign and are significant—logistics performance in LLDC and in their transit gateway countries also significantly affect LLDC exports. We also find that tariffs maintained by partner countries are still a barrier to LLDC exports. However, aggregate governance performance in LLDCs is found to have an impact on LLDC exports out of line with a priori expectations—a result that needs to be investigated in future studies.

These results suggest that improvement in the logistics performance in LLDCs and their transit gateway countries can boost LLDC exports. Where significant, transit-country coefficients are lower than exporter coefficients for LPI and its sub-components, implying that improvement in LLDCs' own logistics performance in its various dimensions is as critical as improvement in transit-country logistics performance. The areas of LLDC logistics performance in order of importance are: competence of the local logistics industry, ease and affordability of arranging international shipments, quality of transport and information technology infrastructure, efficiency of the clearance process by customs and other border agencies, ability in tracking and tracing of international shipments, and timeliness of shipments in reaching destination. The same for transit gateway countries are: ease and affordability of arranging international shipments, quality of transport and information technology infrastructure, timeliness of shipments in reaching destination, and competence of the local logistics industry. A particularly interesting finding is that improving the efficiency of clearance at the customs/border in LLDCs is more important than doing the same in transit countries as far as boosting LLDC exports is concerned.

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<sup>9</sup> Figure calculated from UNCTAD Handbook of Statistics.

But non-customs-related aspects of trade facilitation in transit countries, such as transport and information technology infrastructure, remain important areas needing reform to help increase LLDC exports.

An important policy implication flowing from the results is that international assistance for improving the trade performance of LLDCs, as envisaged by the Almaty Programme of Action, endorsed by the United Nations General Assembly, should focus on improving the trade facilitation environment in both the LLDCs and their transit neighbours. The local logistics industry in LLDCs, and the ease and affordability of arranging international shipments and logistics-related transport and information technology infrastructure in transit countries should receive high priority. International and regional development agencies should scale up support for the creation and implementation of efficient transit transport regimes at the regional level based on global good practices for a meaningful integration of LLDCs into the global economy. Along with improvements on the trade facilitation front, as tariffs maintained by LLDC trade partners are found to be a barrier to LLDC exports, ways need to be also explored to reduce tariffs on products of export interest to LLDCs.

In the models explaining LLDC imports, geographic and cultural variables, economic mass and colonial ties are found significant, as is tariff. In fact, tariff is found to have a greater impact on imports relative to exports (though at a lower level of statistical significance). Distance, contiguity, and official language have a greater impact on imports than on exports of LLDCs, whereas the reverse is true for the variables economic mass, colonial relationship and common colonizer. One policy implication is that LLDCs should rationalize their tariff structures, which will help bring about a more efficient resource allocation, leading to increased specialization and export competitiveness. In contrast, the impact of LLDC trade facilitation, as measured by improvements in LPI and its sub-components, on LLDC imports is found to be insignificant, mostly. While this result merits further investigation, one can hypothesize that it may be explained by the import structure of LLDCs, dominated by products such as necessities and certain luxury items that not much sensitive to trade costs. If this is the case, then improvements in LLDC trade facilitation environment would imply improved trade balance of LLDCs, as exports would increase. However, the study shows transit-country logistics performance and aggregate governance performance to impact LLDC imports in a direction opposite to a priori expectations. This remains an issue for further investigation.



## *Limitations*

This study has a number of limitations. It does not consider zero trade flows, although they account for over 65 percent of bilateral pairs (two-way trade) between 31 LLDCs and the 236 countries listed by WITS. An attempt to include zero trade flow observations using Heckman's two-stage sample selection models on two-way trade was abandoned as it did not yield meaningful results. Due to multicollinearity, fixed effects cannot be used with the Heckman sample selection method in our case—the model simply does not run. Moreover, when two-way trade flows are used in a single model, the interactive term used to capture the LLDC status of the reporter/partner does not give useful results. Hence, separate equations were used for exports and imports.

The estimated models do not address the potential endogeneity problem stemming from the possibility that trade values can affect trade facilitation variables, used as explanatory variables in the models. Selection of an appropriate instrumental variable to address the problem is an area of further research.

The method devised to construct variables to capture transit-country logistics performance is rather crude and hence the results should be taken as indicative. Ideally, we need data on the actual transit routes used by LLDCs for their bilateral trade with different countries and the cost, time and other aspects of transit. Likewise, further research is required for capturing aggregate governance in an indicator. The unexpected signs with respect to coefficients of transit-country logistics performance for imports and LLDC governance variables for both imports and exports call for further investigation.

The trade data are mirror statistics, not data reported by LLDC themselves. Tariff and GDP variables are also constrained by data availability. Better data would make the results more reliable.

The analysis is for aggregate trade flows. The aggregate results tend to mask the peculiarities of different trade sectors. Hence, running sectoral gravity models is a worthwhile area for future research.

## References

- Anderson, James E. and Eric Van Wincoop. 2004. Trade Costs. *Journal of Economic Literature*, 42(3), 691-751.
- Anderson, James E., and Eric VanWincoop. 2003. Gravity with Gravitas: A Solution to the Border Puzzle.
- Anwarul K. Chowdhury and Sandagdorj Erdenebileg. 2006. *Geography against Development: A Case for Landlocked Developing Countries*. United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS).
- Djankov, Simeon, Caroline Freund and Cong S. Pham. 2006. *Trading on Time*. Washington, D.C.: The World Bank.
- Duval, Yann and Chorthip Utoktham. 2009. Behind the Border Trade Facilitation in Asia-Pacific: Cost of Trade, Credit Information, Contract Enforcement and Regulatory Coherence. Bangkok: ARTNeT.
- Faye, Michael L., John W. McArthur, Jeffrey D. Sachs and Thomas Snow. 2004. The Challenges Facing Landlocked Developing Countries. *Journal of Human Development* Vol. 5, No. 1, March 2004.
- Jeevika Weerahewa. 2009. Impact of Trade Facilitation Measures and Regional Trade Agreements on Food and Agricultural Trade in South Asia. Bangkok: ARTNeT.
- Limão, Nuno, and Anthony J. Venables. 1999. "Infrastructure, Geographical Disadvantage and Transport Costs." Policy Research Working Paper 2257, The World Bank, December 1999.
- Maria Persson, 2007. Trade Facilitation and the EU-ACP Economic Partnership Agreements. *The American Economic Review*, 93(1), 170-192.
- UNCTAD. 2003. Challenges and Opportunities for Further Improving the Transit Systems and Economic Development of Landlocked and Transit Developing Countries, UNCTAD/LDC/2003/8, Geneva.
- UNCTAD. 2005. International Ministerial Meeting of Landlocked Developing Countries. Effective Participation of Landlocked Developing Countries (LLDCs) in the Multilateral Trading System. Report by the UNCTAD Secretariat, 1 July.
- Wilson, John S., Catherine L. Mann and Tsunehiro Otsuki. 2005. Assessing the Benefits of Trade Facilitation: A Global Perspective. Oxford: Blackwell Publishing Ltd.

## ***Annex***

**Table 1: Exporter LLDCs in export flow models**

<b>Country</b>	<b>Frequency</b>	<b>Percent</b>
Afghanistan	80	4.69
Armenia	70	4.10
Azerbaijan	77	4.51
Bhutan	38	2.23
Bolivia	74	4.34
Burkina Faso	52	3.05
Burundi	48	2.81
Chad	49	2.87
Ethiopia(excludes Eritrea)	83	4.87
Kazakhstan	74	4.34
Kyrgyz Republic	56	3.28
Lao PDR	63	3.69
Lesotho	44	2.58
Macedonia, FYR	70	4.10
Malawi	79	4.63
Mali	68	3.99
Moldova	67	3.93
Mongolia	58	3.40
Nepal	75	4.40
Niger	66	3.87
Paraguay	81	4.75
Rwanda	54	3.17
Tajikistan	58	3.40
Uganda	85	4.98
Uzbekistan	66	3.87
Zambia	71	4.16
Total	1,706	100.00

**Table 2: Importer LLDCs in import flow models**

<b>Country</b>	<b>Frequency</b>	<b>Percent</b>
Afghanistan	65	3.86
Armenia	88	5.23
Azerbaijan	82	4.88
Bhutan	24	1.43
Bolivia	81	4.82
Burkina Faso	53	3.15
Burundi	55	3.27
Chad	36	2.14
Ethiopia(excludes Eritrea)	97	5.77
Kazakhstan	74	4.40
Kyrgyz Republic	53	3.15
Lao PDR	44	2.62
Lesotho	33	1.96
Macedonia, FYR	77	4.58
Malawi	72	4.28
Mali	79	4.70
Moldova	64	3.80
Mongolia	62	3.69
Nepal	56	3.33
Niger	77	4.58
Paraguay	72	4.28
Rwanda	70	4.16
Tajikistan	47	2.79
Uganda	88	5.23
Uzbekistan	53	3.15
Zambia	80	4.76
Total	1,682	100.00

**Table 3: LPI scores for LLDCs and their regions**

	LPI rank	LPI	Customs	Infrastructure	International shipments	Tracking and tracing	Domestic logistics costs	Timeliness
<b>South Asia</b>		2.3	2.06	2.07	2.28	2.32	3.12	2.73
Afghanistan	150	1.21	1.3	1.1	1.22	1.25	1	1.38
Nepal	130	2.14	1.83	1.77	2.09	2.08	2.33	2.75
Bhutan	128	2.16	1.95	1.95	2.06	2.18	2.27	2.57
<b>Europe/Central Asia</b>		2.59	2.39	2.39	2.61	2.55	2.97	3.04
Armenia	131	2.14	2.1	1.78	2	2.11	2.22	2.63
Kazakhstan	133	2.12	1.91	1.86	2.1	2.05	2.19	2.65
Tajikistan	146	1.93	1.91	2	2	1.9	1.67	2.11
Uzbekistan	129	2.16	1.94	2	2.07	2.15	2.08	2.73
Kyrgyz Republic	103	2.35	2.2	2.06	2.35	2.35	2.38	2.76
Moldova	106	2.31	2.14	1.94	2.36	2.21	2.5	2.73
Macedonia, FYR	90	2.43	2	2.29	2.67	2.33	2.5	2.83
Azerbaijan	111	2.29	2.23	2	2.5	2	2.38	2.63
<b>Sub-Saharan Africa</b>		2.35	2.21	2.11	2.36	2.31	2.98	2.77
Burundi	113	2.29	2.2	2.5	2.5	2.5	2	2
Burkina Faso	121	2.24	2.13	1.89	2.67	2.33	2.13	2.25
Ethiopia	104	2.33	2.14	1.88	2.43	2	1.83	3.67
Lesotho	108	2.3	2.4	2	2.5	2.2	1.83	2.83
Mali	109	2.29	2.17	1.9	2.23	2.21	2.38	2.88
Malawi	91	2.42	2.25	2.13	2.56	2.56	2	3
Niger	143	1.97	1.67	1.4	1.8	2	2	3
Rwanda	148	1.77	1.8	1.53	1.67	1.67	1.6	2.38
Chad	142	1.98	2	1.8	1.83	1.82	1.91	2.56
Uganda	83	2.49	2.21	2.17	2.42	2.55	2.33	3.29
Zambia	100	2.37	2.08	2	2.4	2.44	2.8	2.5
Zimbabwe	114	2.29	1.92	1.87	2.27	2.21	2.64	2.85
<b>Latin America and Caribbean</b>		2.57	2.38	2.38	2.55	2.58	2.97	3.02
Bolivia	107	2.31	2	2.08	2.42	2.17	2.38	2.81
Paraguay	71	2.57	2.2	2.47	2.29	2.63	2.67	3.23
<b>East Asia and Pacific</b>		2.58	2.41	2.37	2.64	2.53	3.04	3.01
Lao PDR	117	2.25	2.08	2	2.4	2.29	1.89	2.83
Mongolia	136	2.08	2	1.92	2.5	1.8	2	2.25

*Source: World Bank. 2007. Connecting to Compete – Trade Logistics in the Global Economy: The Logistics Performance Index and Its Indicators 2007. Washington, D.C.: The World Bank.*

**Table 4: Summary statistics of LLDC data**

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Exports (US\$1000)	26	4646420.00	11100000.00	73317.53	53600000.00
Imports (US\$1000)	26	4851402.00	7459238.00	172899.10	38300000.00
Trade balance (US\$1000)	26	-204981.60	5107742.00	-10800000.00	15300000.00
GDP (US\$)	26	15700000000.00	25700000000.00	1160000000.00	132000000000.00
LPI rank_LLDC	26	117.31	21.17	71.00	150.00
LPI_LLDC	26	2.19	0.27	1.21	2.57
LPI_customs_LLDC	26	2.03	0.22	1.30	2.40
LPI_infrastructure_LLDC	26	1.94	0.29	1.10	2.50
LPI_international shipments_LLDC	26	2.23	0.34	1.22	2.67
LPI_logistics competence_LLDC	26	2.15	0.30	1.25	2.63
LPI_tracking/tracing_LLDC	26	2.13	0.37	1.00	2.80
LPI_timeliness_LLDC	26	2.66	0.45	1.38	3.67
Gov_ag_LLDC	26	-1.58	1.05	-4.20	0.21
Gov_ag3_LLDC	26	-1.16	0.73	-3.02	0.15
LPI_rank_transit	26	79.30	31.69	24.00	145.00
LPI_transit	26	2.63	0.37	1.94	3.53
LPI_customs_transit	26	2.40	0.38	1.64	3.22
LPI_infrastructure_transit	26	2.45	0.39	1.92	3.42
LPI_international shipments_transit	26	2.68	0.36	2.00	3.56
LPI_logistics competence_transit	26	2.64	0.43	2.00	3.54
LPI_tracking/tracing_transit	26	2.61	0.42	1.82	3.71
LPI_timeliness_transit	26	3.04	0.37	2.30	3.78

**Table 5: Summary statistics of variables used in export flow models**

Variable	Obs	Mean	Std. Dev.	Min	Max
Log of exports	1706	6.27	3.74	-6.91	15.86
Log of product of GDP of exporter and importer	1706	48.87	2.10	42.38	55.89
Log of (1+tariff/100)	1706	0.05	0.08	0.00	1.40
Contiguity (dummy)	1706	0.03	0.17	0.00	1.00
Common official language (dummy)	1706	0.12	0.33	0.00	1.00
Colony (dummy)	1706	0.01	0.12	0.00	1.00
Common colonizer (dummy)	1706	0.08	0.27	0.00	1.00
Log of distance	1706	8.58	0.74	5.05	9.87
Log of LPI_LLDC	1706	0.78	0.15	0.19	0.94
Log of LPI_customs_LLDC	1706	0.70	0.12	0.26	0.88
Log of LPI_infrastructure_LLDC	1706	0.65	0.17	0.10	0.92
Log of LPI_international shipments_LLDC	1706	0.79	0.18	0.20	0.98
Log of LPI_logistics competence_LLDC	1706	0.75	0.16	0.22	0.97
Log of LPI_tracking/tracing_LLDC	1706	0.74	0.21	0.00	1.03
Log of LPI_timeliness_LLDC	1706	0.97	0.19	0.32	1.30
Log of gov_ag3_LLDC	1706	-1.18	0.70	-3.02	0.15
Log of gov_ag_LLDC	1706	-1.62	1.01	-4.20	0.21
Log of LPI_transit	1706	0.96	0.13	0.66	1.26
Log of LPI_customs_transit	1706	0.86	0.16	0.49	1.20
Log of LPI_infrastructure_transit	1706	0.88	0.15	0.50	1.23
Log of LPI_international shipments_transit	1706	0.97	0.13	0.69	1.27
Log of LPI_logistics competence_transit	1706	0.96	0.15	0.69	1.26
Log of LPI_tracking/tracing_transit	1706	0.94	0.15	0.51	1.31
Log of LPI_timeliness_transit	1706	1.10	0.12	0.76	1.42







**Table 7: Summary statistics of variables used in import flow models**

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Log of imports	1682	7.43	3.30	-4.20	16.40
Log of product of GDP of exporter and importer	1682	48.94	2.05	42.68	55.89
Log of (1+tariff/100)	1682	0.10	0.06	0.00	0.34
Contiguity (dummy)	1682	0.03	0.17	0.00	1.00
Common official language (dummy)	1682	0.14	0.35	0.00	1.00
Colony (dummy)	1682	0.01	0.12	0.00	1.00
Common colonizer (dummy)	1682	0.08	0.27	0.00	1.00
Log of product of GDP of exporter and importer	1682	48.94	2.05	42.68	55.89
Log of (1+tariff/100)	1682	0.10	0.06	0.00	0.34
Log of distance	1682	8.55	0.74	5.05	9.87
Log of LPI_LLDC	1682	0.78	0.14	0.19	0.94
Log of LPI_customs_LLDC	1682	0.70	0.12	0.26	0.88
Log of LPI_infrastructure_LLDC	1682	0.65	0.17	0.10	0.92
Log of LPI_international shipments_LLDC	1682	0.79	0.17	0.20	0.98
Log of LPI_logistics competence_LLDC	1682	0.76	0.16	0.22	0.97
Log of LPI_tracking/tracing_LLDC	1682	0.75	0.20	0.00	1.03
Log of LPI_timeliness_LLDC	1682	0.98	0.19	0.32	1.30
Log of gov_ag3_LLDC	1682	-1.13	0.66	-3.02	0.15
Log of gov_ag_LLDC	1682	-1.55	0.95	-4.20	0.21
Log of LPI_transit	1682	0.95	0.13	0.66	1.26
Log of LPI_customs_transit	1682	0.85	0.16	0.49	1.20
Log of LPI_infrastructure_transit	1682	0.88	0.14	0.50	1.23
Log of LPI_international shipments_transit	1682	0.97	0.13	0.69	1.27
Log of LPI_logistics competence_transit	1682	0.95	0.15	0.60	1.26
Log of LPI_tracking/tracing_transit	1682	0.93	0.15	0.51	1.31
Log of LPI_timeliness_transit	1682	1.09	0.12	0.76	1.42

**Table 8: Results of gravity models with log of imports as dependent variable**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Log of distance	-1.738***	-1.771***	-1.738***	-1.765***	-1.753***	-1.786***	-1.745***	-1.776***	-1.749***	-1.783***	-1.734***	-1.761***	-1.743***	-1.771***
	0.0952	0.0967	0.0953	0.0966	0.0953	0.0966	0.0954	0.0971	0.0959	0.0974	0.0951	0.0961	0.0948	0.0958
Log of product of GDP	0.838***	0.829***	0.830***	0.826***	0.854***	0.851***	0.843***	0.839***	0.856***	0.853***	0.819***	0.804***	0.849***	0.830***
	0.05	0.0499	0.0503	0.0502	0.0492	0.0491	0.0498	0.0497	0.0491	0.049	0.0538	0.0536	0.0523	0.0523
Log of (1+tariff/100)	-3.724***	-3.505***	-3.640***	-3.479***	-3.492***	-3.172***	-3.535***	-3.258***	-3.620***	-3.352***	-3.638***	-3.399***	-3.747***	-3.710***
	1.064	1.066	1.045	1.041	1.083	1.092	1.052	1.062	1.082	1.088	1.04	1.045	1.101	1.088
Contiguity (dummy)	1.623***	1.573***	1.622***	1.587***	1.599***	1.552***	1.596***	1.551***	1.620***	1.569***	1.619***	1.573***	1.637***	1.590***
	0.319	0.32	0.319	0.32	0.32	0.321	0.319	0.32	0.321	0.321	0.317	0.317	0.319	0.32
Common official language (dummy)	0.702***	0.708***	0.707***	0.709***	0.709***	0.716***	0.715***	0.722***	0.698***	0.706***	0.715***	0.729***	0.697***	0.691***
	0.184	0.183	0.184	0.183	0.184	0.182	0.183	0.182	0.184	0.182	0.182	0.181	0.184	0.184
Colony (dummy)	1.122***	1.112***	1.129***	1.117***	1.104***	1.096***	1.126***	1.114***	1.113***	1.103***	1.128***	1.114***	1.128***	1.129***
	0.313	0.311	0.313	0.31	0.315	0.314	0.314	0.314	0.314	0.311	0.312	0.309	0.314	0.311
Common colony (dummy)	1.236***	1.230***	1.254***	1.247***	1.212***	1.217***	1.239***	1.237***	1.220***	1.210***	1.243***	1.237***	1.243***	1.249***
	0.213	0.213	0.212	0.212	0.214	0.213	0.213	0.212	0.216	0.215	0.213	0.212	0.212	0.211
Log of LPI_LLDC	0.0977	0.422												
	0.397	0.396												
Log of LPI_transit	-0.893**	-0.748*												
	0.404	0.396												
Gov_ag_LLDC	0.0435		0.0327		0.068		0.04		0.0593		0.0295		0.0437	
	0.0623		0.0575		-0.0572		0.0628		0.06		0.0643		0.0563	
Gov_ag3_LLDC		-0.203**		-0.173**		-0.206***		-0.192**		-0.206**		-0.188**		-0.193**
		0.0882		0.0832		0.0796		0.0884		0.0835		0.0893		0.0819
Log of LPI_customs_LLDC			-0.125	0.204										
			0.463	0.467										
Log of LPI_customs_transit			-0.851***	-0.772**										
			0.322	0.32										
Log of LPI_infrastructure_LLDC					0.432	0.543*								
					0.305	0.301								
Log of LPI_infrastructure_transit					-0.546	-0.41								
					0.391	0.382								
Log of LPI_international shipments_LLDC							-0.0208	0.233						



