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The Role of Trade Facilitation in Central Asia

A Gravity Model

ABSTRACT: *With a decrease in formal trade barriers, trade facilitation has come into prominence as a policy tool for promoting trade. In this paper, we use a gravity model to examine the relationship between bilateral trade flows and trade facilitation. We also estimate the gains in trade derived from improvements in trade facilitation for the Central Asian countries. Trade facilitation is measured through the World Bank's Logistic Performance Index (LPI). Our results show that there have been significant gains in trade as a result of improving trade facilitation in the Central Asian countries. These gains in trade vary from 28 percent in the case of Azerbaijan to as much as 63 percent in the case of Tajikistan. Furthermore, intraregional trade has increased by 100 percent. Among the different components of the LPI, we find that the greatest increase in total trade comes from improvement in infrastructure, followed by logistics and efficiency of customs and other border agencies.*

As formal trade barriers, tariff as well as nontariff, have come down, issues related to trade facilitation have caught the attention of policymakers. The World Trade

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Organization (WTO) defines trade facilitation as "the simplification and harmonization of international trade procedures, including the activities, practices, and formalities involved in collecting, presenting, communicating, and processing data and other information required for the movement of goods in international trade."[1] More generally, trade facilitation refers to the ease of moving goods across borders: efficient customs administration and other agencies, quality physical infrastructure as well as telecommunications, and a competent logistics sector. The importance of trade facilitation has also been recognized within the framework of the WTO, and negotiations were launched on trade facilitation in July 2004. This paper analyzes the impact of trade facilitation measures on trade flows with a focus on Central Asia.[2]

One challenge for all the Central Asian countries has been to generate sustainable economic growth by reducing reliance on natural resources and diversifying their economies by introducing manufacturing activities through a process of structural transformation (Felipe and Kumar 2010a). This challenge is all the harder to confront because the Central Asian countries are all landlocked. Lack of a coastline increases the time and cost of transportation, as well as the dependence on the quality of the infrastructure network across the region as a whole, particularly that of the neighboring countries. As the Central Asian countries strive to diversify their manufacturing base and seek markets beyond their own borders, it is imperative that an enabling environment comprising (but not limited to) a good infrastructure network, efficient customs and other agencies, and a well-developed logistics industry are made available to facilitate trade across borders. Improvement in trade facilitation measures translates into gains in trade; the latter in turn contribute to income growth, which enhances human development (Wilson et al. 2003). It is in the context of the overall impact on economic growth that trade assumes importance.

In this paper, we examine the relationship between bilateral trade flows and trade facilitation, and estimate the gains in trade from improvements in trade facilitation in the Central Asian countries. We estimate the gains in trade using a gravity model of bilateral trade flows rather than relying on a computable general equilibrium approach. A key issue relates to the definition and measurement of trade facilitation. In this paper we use the World Bank's Logistic Performance Index (LPI) (Arvis et al. 2007) as a measure of trade facilitation.

Our results show that significant gains in trade have resulted from improving trade facilitation in Central Asian countries. These gains in trade vary from 28 percent in the case of Azerbaijan to as much as 63 percent in the case of Tajikistan. Furthermore, intraregional trade has increased by 100 percent. Overall, while exports have increased more than imports, most of the gains in total trade have come from imports.

The LPI also allows us to identify the effect of different components of trade facilitation. We find that the greatest increase in total trade has come from improvement in infrastructure, followed by logistics and efficiency of customs and other border agencies.[3]

The rest of this paper provides a brief discussion of the previous work on gravity models as well as the work on the role of trade facilitation; discusses the estimation strategy and key estimation issues, and provides an overview of the data. It then presents the results as well as estimates of the gains in trade derived from improvement in trade facilitation in Central Asia and discusses policy implications in conclusion.

Literature Review

Gravity models are a widely used empirical approach to model bilateral trade flows. The first empirical attempt to explain trade flows by the market size of the trading partners and the distance between them goes back to Tinbergen (1962) and Pöyhönen (1963).[4] In addition, the standard specification of the gravity model estimation involves the gross domestic product (GDP) per capita (to account for intra-industry trade and level of income); a measure of remoteness (this captures the idea that it is the relative cost of trading that matters); and adjacency and geographic characteristics, such as being landlocked. In this paper, we add a variable to examine the impact of trade facilitation on bilateral trade flows. Recent developments in the literature focus on choosing the correct estimation procedure. We discuss some of the estimation issues in the next section.[5]

In general, past studies on trade facilitation using different measures than this paper does (either incorporating all the possible dimensions of trade facilitation or focusing on the specific components) show that gains in trade are made by improving trade facilitation. In particular, instead of using one comprehensive measure of trade facilitation, Wilson et al. (2003, 2005) include different measures from a variety of sources to incorporate different components of trade facilitation. Djankov et al. (2006) use time taken to export and import (from the World Bank's "Doing Business" survey) to measure the ease of moving goods from a firm's warehouse to a ship. And Hertel and Mirza (2009) use the World Bank's LPI (Arvis et al. 2007), as we do in this paper, to capture the quality of trade facilitation. The LPI and its subcomponents provide a comprehensive picture of the different aspects of trade facilitation, ranging from customs procedures to logistics costs, and from infrastructure quality to competency of the domestic logistics industry. The LPI has therefore been used to provide the first cross-country assessment of the logistics gap.

However, this study and that of Hertel and Mirza (2009) have important differences. First, we tackle the problems arising from zero-trade observations directly by using a sample selection estimation procedure. Hertel and Mirza (2009) do not include zero-trade observations in their sample.[6] Hertel and Mirza's method might result in biased estimates arising from sample selection, an issue which we discuss in the next section. Second, while looking at the different components of the LPI, we incorporate them into the same equation, whereas Hertel and Mirza (2009) estimate a different equation for each component. This allows us to compare the effectiveness of the different components of the LPI directly. Third, we use

2005 data for 140 countries, whereas Hertel and Mirza (2009) use 2001 data and a sample of 95 countries.

Estimation Methodology and Data

The gravity model that we estimate is as follows:

$$\ln(T_{ij}) = \beta_0 + \beta_1 \ln(d_{ij}) + \beta_2 \ln(GDP_i) + \beta_3 \ln(GDP_j) + \beta_4 \ln(GDPpc_i) + \beta_5 \ln(GDPpc_j) + \beta_6 \ln LPI_i + \beta_7 \ln LPI_j + \beta_8 Landlocked_i + \beta_9 Landlocked_j + \beta_{10} Border_{ij} + \beta_{11} \ln remote_i + \beta_{12} \ln remote_j + \varepsilon_{ij},$$

where i denotes the exporter and j denotes the importer. The variables are defined as follows. The dependent variable, T_{ij}, is the bilateral trade flow in manufacturing products from country i to country j.[7] The variable d_{ij} is the distance between countries i and j. Size is captured by the GDP of the exporting (importing) country, represented by GDP_i (GDP_j), while $GDPpc_i$ ($GDPpc_j$) is the GDP per capita of the exporting (importing) country. LPI_i (LPI_j) is the logistics performance index of the exporter (importer). We are most interested in the coefficients of the LPI, our measure of trade facilitation. *Landlocked* is a dummy variable that equals 1 if either the exporting (i) or the importing (j) country is landlocked, and 0 otherwise. *Border* is also a dummy variable; it equals 1 if the trading partners share a common border, and 0 otherwise.[8] Except for the indicator variables, all the other variables used are in logarithm.

In a seminal paper, Anderson and van Wincoop (2003) argue that bilateral trade is determined by *relative* trading costs. In other words, it is not just the distance between the two countries that matters; the bilateral distance *relative* to the distance of the pair from their other trading partners also matters. One way to control for the relative trading cost or the multilateral resistance term is to use importer and exporter fixed effects. The main focus of this paper is to study the impact of trade facilitation, which is measured at the country level. Using importer and exporter fixed effect will wipe out the effect of trade facilitation due to perfect multicollinearity. Therefore, we instead control for remoteness using the $remote_i$ ($remote_j$) variable for the exporting (importing) country. Remoteness is defined as the GDP-weighted average distance to all the other countries.

A key issue in estimating gravity models is how to deal with zero bilateral trade, which is observed in approximately 30 percent of our sample. This is important both theoretically and econometrically.[9]

In this paper, following Martin and Pham (2008), we use the Heckman maximum likelihood (ML) estimator and use common language, colonial ties, and common colonizer as the exclusion restrictions. Common language captures the cost related to cultural and linguistic barriers between two countries. A firm exporting to a foreign country with connections from the past is likely to face lower fixed costs of entry into that country, as it does not incur large adjustment costs arising from the unfamiliarity and insecurity related to transaction contingencies. All three are

indicator variables. Common language takes the value 1 if importer and exporter share a common language and 0 otherwise. If the importer (or exporter) colonized its trading partner, then colonial ties equals 1 and 0 otherwise, and if both importer and exporter shared a common colonizer then common colonizer equals 1, and 0 otherwise.

Data

The data used in this paper come from a variety of sources. The key data on bilateral trade flows comes from Gaulier and Zignago (2008) for 2005. BACI data[10] contains bilateral trade-flow data for almost 5,000 products (six-digit Harmonized System) and 200 countries. BACI data is based on the Comtrade database. Our key results are based on bilateral trade flows of manufactured goods corresponding to Standard International Trade Classification (SITC) Rev. 2 categories 5 to 8 except two-digit codes.[11] Given the data availability for other countries, especially the LPI, we are left with 140 countries. This results in 19,460 observations. According to the documentation accompanying the BACI data set, data does not include trade flows below $1,000. Consequently, after aggregating manufacturing trade flows, any trade flow less than $1,000 is treated as zero trade.

We use GDP and GDP per capita for 2004 to avoid any reverse causality concerns, and both are measured in purchasing power parity (PPP) terms. They are taken from the World Development Indicators. Remoteness, measured in kilometers, is calculated as the GDP-weighted average distance to all other countries. *Landlocked*, common border, common language, colonial ties, and colonizer come from the French Center for Prospective Studies and International Information (CEPII).

The key variable of interest in this paper is the measure of trade facilitation. We use the World Bank's Logistic Performance Index (Arvis et al. 2007). We use the overall LPI as well as examine the impact of its components separately. The LPI is a composite measure comprised of seven components: efficiency of customs and other border agencies, quality of transport and information technology (IT) infrastructure, ease and affordability of international shipments, competence of the local logistics industry, ability to track and trace, domestic logistics costs (this component is not used in the overall LPI as reported), and timeliness of shipments in reaching destination. The LPI is provided on a five-point scale.

Various components of the LPI are highly correlated, and any specification that includes all six components (domestic logistics is not used) will suffer from multicollinearity problems (Felipe and Kumar 2010b). This will result in some of the components being statistically insignificant or having a perverse sign. To avoid this problem, we aggregate the components into three categories: customs efficiency, infrastructure, and logistics. Customs efficiency and infrastructure correspond to efficiency of customs and other border agencies, and quality of transport and IT infrastructure, respectively. Logistics is a simple average of ease and affordability

of international shipments, competence of local logistics industry, and the ability to track and trace.

Table 1 presents the summary statistics. The average trade flow within Central Asia is almost thirty-six times smaller than that of the whole world and countries in this region are well below the world average for the LPI and its components. In our sample of 140 countries, there are 28 landlocked countries, 7 of which are the Central Asian countries.[12]

Results

Estimation Results

Table 2 shows the results obtained from the estimation of our gravity model. Estimates from the Heckman ML estimation, our preferred estimator, are presented in column 4. Columns 1 and 2 show the ordinary least squares (OLS) estimates obtained by applying our gravity model to the truncated sample and the censored OLS model in logarithms (with 1 added to all values of the dependent variable to avoid the log-of-zero problem). Column 3 presents the results from the Tobit estimation, which replaces zero-trade values in the sample with the minimum of the sample. Comparing the coefficients in columns 1 and 2 with those in column 3 confirms that in the case of a sample containing zero-trade values, standard estimation procedures are likely to have a downward bias on the estimated coefficients.

Column 4 presents the main results of the paper. Our results are in line with the results found previously in the literature. Specifically, decrease in distance by 1 percent increases trade by 1.56 percent. The size of the trading partners positively affects trade flows. While GDP per capita of the exporter has a positive and statistically significant impact on trade flows, GDP per capita of the importer does not have any impact. Landlocked exporters (importers) trade 25 percent (38 percent) less than coastal exporters (importers). Countries with a common border trade 2.4 times more than countries that do not share a common border. In other words, having a common border is equivalent to a reduction in distance of about 3,147 km (evaluated at the mean distance). Remoteness of the exporter has a positive and statistically significant impact on trade flows. Other things being equal, if country A is 1 percent farther from the rest of the world than country B is, A's exports to (imports from) a common third country C will be higher than those of B by 0.43 percent (1.13 percent).

Our key variable of interest is the LPI. We find that improving the trade facilitation (LPI) of the exporting country by 1 percent increases exports by 5.5 percent and has a higher impact on trade flows: improving the trade facilitation (LPI) of the importing country by 1 percent boosts imports by only 2.8 percent.[13]

We also examine the impact of the individual components of the LPI. As discussed in the preceding section, because of potential multicollinearity, we use three categories of the LPI—customs, infrastructure, and logistics. Estimation results are

Table 1. **Summary Statistics** (averages shown)

	(1) Overall	(2) Central Asia
Bilateral trade	$333 million	$9.2 million
Distance (bilateral)	7,353 km	2,033 km
GDP	$373 billion	$37.2 billion
GDP per capita	$10,896	$3,250
LPI	2.743	2.153
Customs	2.551	2.041
Infrastructure	2.581	1.946
Logistics	2.725	2.133
Remoteness	7,920 km	6,687 km
Number landlocked countries	28	7
Number of trading pairs		
Contiguous	432	12
Common language	1,590	2
Colonial ties	266	0
Common colonizer	1,546	30

Source: Authors' calculations based on BACI, CEPII, and World Bank.

Notes: Common language data is from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). According to this database, Kazakhstan and Kyrgyzstan are the only two countries in the Central Asia Regional Economic Cooperation (CAREC) region that share a common official language: Russian. The database lists up to three official languages in cases where more than one language is spoken. If any of these official languages are shared by any other country, then the two are said to have a common language. Even if one were to use the language actually spoken by the people as a variable, only in the case of Kazakhstan and Kyrgyzstan would at least 20 percent of the population speak a common language.

Data on common colonizers is from CEPII. This database defines common colonizer in fairly general terms. Two countries are said to have colonial ties if, independently of their level of development, one has governed the other over a long period of time and has contributed to the current state of its institutions. Thus, if two countries have had colonial ties with a common third country, they are said to have a common colonizer. In the case of the CAREC countries (except Afghanistan, provinces of the People's Republic of China, and Mongolia), because some of them were formed from the Soviet Union, they are regarded as having a common colonizer because of the common influence from the Soviet period.

presented in column 5. Coefficients on other variables are qualitatively similar to the benchmark result reported in column 4.

As expected, the customs efficiency of the exporter has no impact on trade flows. It is the customs efficiency of the importer, where all the documentation takes places, that matters. Our results show that an improvement of 1 percent in the

Table 2. **Gravity Model**

Dependent variable: Log of bilateral trade flows (manufacturing sector)

	(1)	(2)	(3)	(4)	(5)
	OLS: truncated sample	OLS: log(1 + Trade)	Tobit	Heckman ML estimation	
Log distance	–1.53***	–1.43***	–1.78***	–1.56***	–1.55***
	(0.03)	(0.03)	(0.04)	(0.03)	(0.028)
Log GDP—exporter	1.03***	1.01***	1.34***	1.07***	1.06***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.013)
Log GDP—importer	0.73***	0.74***	0.99***	0.75***	0.76***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.013)
Log GDPpc—exporter	0.03	0.13***	0.24***	0.05**	–0.02
	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)
Log GDPp—importer	–0.00	0.04*	0.06*	0.002	–0.02
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Log LPI—exporter	5.33***	6.30***	6.83***	5.46***	
	(0.16)	(0.15)	(0.20)	(0.15)	
Log LPI—importer	2.60***	3.58***	4.38***	2.77***	
	(0.15)	(0.15)	(0.20)	(0.14)	
Common border	0.87***	1.05***	0.83***	0.87***	0.90***
	(0.12)	(0.17)	(0.20)	(0.12)	(0.12)
Landlocked—exporter	–0.26***	–0.44***	–0.60***	–0.29***	–0.24***
	(0.05)	(0.04)	(0.07)	(0.05)	(0.05)

Landlocked—importer	−0.47***	−0.42***	−0.56***	−0.48***	−0.45***
	(0.05)	(0.05)	(0.07)	(0.05)	(0.05)
Log remoteness—exporter	0.44***	0.27***	0.23**	0.43***	0.36***
	(0.08)	(0.09)	(0.11)	(0.09)	(0.09)
Log remoteness—importer	1.13***	0.85***	0.98***	1.13***	1.11***
	(0.09)	(0.09)	(0.12)	(0.09)	(0.09)
Log customs—exporter					−0.001
					(0.26)
Log customs—importer					1.04***
					(0.26)
Log infrastructure—exporter					3.09***
					(0.28)
Log infrastructure—importer					0.86***
					(0.27)
Log logistics—exporter					2.19***
					(0.26)
Log logistics—importer					0.75***
					(0.25)
Observations	13,525	19,460	19,460	19,460	19,460
Censored observations	5,935	5,935	5,935	5,935	5,935

Notes: Common language, colony, and colonial ties are used as exclusion restrictions for Heckman ML estimation (Constant is included but not shown). *** Statistically significant at 1 percent; ** statistically significant at 5 percent; * statistically significant at 10 percent.

customs efficiency of the importing country improves trade flows by 1.04 percent. On the exporter side, it is infrastructure that seems to have the greatest impact on trade flows, followed by the logistics of the exporting country. For the importing country, customs efficiency is the most important factor, though infrastructure and logistics do have a positive and statistically significant impact on trade flows.

The estimation results discussed above suggest that trade facilitation plays a very significant role in enhancing trade flows. Further, different aspects of trade facilitation affect trade differently. In the next section, we quantify the gains in trade from improvements in trade facilitation.

A "What-If" Exercise

To quantify the effects of improvements in trade facilitation we do a simple "what-if" exercise. The gravity model results discussed above show that trade facilitation has a statistically significant trade-enhancing effect. In this section we show that the gains are economically significant as well. We quantify the potential increase in trade (both total trade and intraregional trade) derived from improving the overall LPI as well as from improving the different components of the LPI. This will shed light on differences in benefits from various aspects of trade facilitation and inform policymakers about gains from different kinds of trade facilitation measures.

Table 1 shows that trade facilitation in Central Asia, as measured by the LPI, is among the poorest in the world and far below the average. Some of the trade facilitation measures, especially those related to infrastructure, are costly and time consuming to implement. As a result, improvement in trade facilitation and its various components in the Central Asian countries may happen in a phased manner rather than as a one-off improvement in trade facilitation. The design of the exercise follows Wilson et al. (2003). The exercise estimates the effect on total trade of increasing the LPI of all the Central Asian countries (as exporters and importers), placing it *up to halfway* between each country's actual LPI and the average of all the countries in the sample. Consequently, the extent of the improvement in the LPI differs across the different countries. For example, Tajikistan, which has the lowest LPI, sees the highest improvement. Kyrgyzstan, which has the highest LPI among the Central Asian countries, has the smallest increase in its LPI.

Further, the estimated gains in trade are calculated taking into account improvements in a country's LPI as an exporter, and also considering the improvement in its trading partners' index. Note that the gravity equation contains the LPI of both the exporter and the importer. For example, Azerbaijan's exports increase as a result of improving its trade facilitation but also as a result of the improvement in the trade facilitation of its trading partners (i.e., those importing from Azerbaijan) in Central Asia.[14]

Table 3 shows that significant gains are made in total trade (exports plus imports) with the rest of the world by improving the overall LPI: overall trade of the Central

Table 3. **Gains in Total Trade from Improvement in Overall LPI** (in percent)

	(1) Change in total trade	(2) Due to exports	(3) Due to imports
Armenia	49.2 (15.3)	25.5	23.7
Azerbaijan	28.4 (9.6)	3.2	25.2
Kazakhstan	46.8 (14.3)	16.6	30.2
Kyrgyzstan	34.1 (16.0)	12.3	21.8
Mongolia	50.8 (23.5)	18.6	32.2
Tajikistan	62.5 (15.7)	11.2	51.3
Uzbekistan	46.6 (11.7)	20.3	26.3

Note: Values in parentheses are increases in total trade as share of GDP in 2005.

Asian countries increases by 44 percent. Tajikistan's total trade increases by as much as 63 percent, Mongolia's by 51 percent; Armenia's by 49 percent; Kazakhstan's and Uzbekistan's by 47 percent; Kyrgyzstan's by 34 percent; and Azerbaijan's by 28 percent. Increase in total trade as a result of increase in imports is higher, as shown in Table 3. This is because imports constitute a larger share of total trade than exports do. However, column 4 of Table 2 shows that exporters' estimated coefficients on their LPI are higher than those of importers. This is reflected in the change in exports and imports seen separately (Table 4). As expected, exports increase more than imports: Central Asia's exports increase by 74 percent and imports by 36 percent.

We also calculate the gains in intraregional trade and find that Central Asian intraregional trade (from improvements in the LPI) increases by as much as 100 percent (by construction, both Central Asian intraregional exports and imports increase by 100 percent). The change in Central Asian intraregional trade for all seven countries is shown in Table 5 (Table 6 shows the changes in exports and imports).

Use of the LPI as a measure of trade facilitation allows us to look at the different aspects of the trade facilitation agenda such as customs efficiency, infrastructure, and logistics. Table 2, column 5, shows the estimated coefficients for the different

Table 4. **Change in Total Exports and Imports from Improvement in Overall LPI** (in percent)

	As exporter	As importer
	Change in total exports	Change in total imports
Armenia	72	37
	(7.9)	(7.4)
Azerbaijan	54	27
	(1.1)	(8.5)
Kazakhstan	76	39
	(5.1)	(9.2)
Kyrgyzstan	62	27
	(5.8)	(10.2)
Mongolia	81	42
	(8.6)	(14.9)
Tajikistan	105	57
	(2.8)	(12.9)
Uzbekistan	73	37
	(5.1)	(6.6)

Note: Values in parentheses are increases in exports or imports as share of GDP in 2005.

Table 5. **Gains in Central Asian Intraregional Trade from Improvement in Overall LPI** (in percent)

	(1) Change in total trade	(2) Due to exports	(3) Due to imports
Armenia	108.8	52.6	56.3
Azerbaijan	95.3	26.7	68.6
Kazakhstan	100.8	49.0	51.8
Kyrgyzstan	88.0	51.7	36.3
Mongolia	115.2	4.0	111.2
Tajikistan	115.8	3.7	112.1
Uzbekistan	103.5	70.2	33.3

components using the gravity model. We estimate the gains in trade by repeating the same "what-if" exercise discussed above except that this time each of the three components, in the case of the Central Asian countries, are improved to equal half of the distance between the actual value of the component and the sample average

Table 6. **Change in Central Asian Intraregional Exports and Imports from Improvement in Overall LPI** (in percent)

	As exporter	As importer
	Change in exports to Central Asian countries	Change in imports from Central Asian countries
Armenia	109	109
Azerbaijan	88	98
Kazakhstan	107	95
Kyrgyzstan	84	95
Mongolia	111	115
Tajikistan	137	115
Uzbekistan	104	103

Table 7. **Gains in Total Trade from Improvement in Different Components of LPI** (in percent)

	(1)	(2)	(3)
	Infrastructure	Customs	Logistics
Armenia	33.6	6.9	17.2
Azerbaijan	14.1	6.9	7.8
Kazakhstan	24.4	12.8	14.7
Kyrgyzstan	19.7	7.8	10.4
Mongolia	22.4	10.4	15.3
Tajikistan	18.1	14.5	20.6
Uzbekistan	21.3	11.5	16.7

Note: Each cell shows the increase in total trade (exports + imports) from improvement in different components of LPI.

for the respective component. Table 7 shows the gains from trade. The largest gains in total trade come from improvement in infrastructure, followed by logistics and then improvement in the customs efficiency of customs and other border agencies. However, one has to keep in mind the cost aspect, time taken to complete, and ease of implementation. Regional infrastructure will bring the maximum gains, but the time taken to complete infrastructure projects, costs involved, and political economy issues of cross-border infrastructure projects need to be factored in. Improving customs efficiency, though it results in smaller gains, may be easier to do as it relies largely on domestic reforms that are less costly to implement.

Conclusions and Policy Implications

Using a standard gravity model of bilateral trade flows, augmented to include a measure of trade facilitation, we show that trade facilitation has a positive and statistically significant impact on bilateral trade flows. We also look at the different components of trade facilitation. Our results show that, on the exporter side, infrastructure has the greatest impact on trade flows; and on the importer side, customs efficiency has the greatest impact on trade flows.

Our focus in this paper has been on the gains in trade in the case of the Central Asian countries. These countries are ranked the lowest in terms of trade facilitation on the basis of the World Bank's cross-country LPI. Overall trade in the Central Asian countries increases by 44 percent from improvements in the LPI, and Central Asian intraregional trade doubles. The increase in exports is greater than the increase in imports. However, because the share of imports in total trade is higher, increased imports contribute more to the increase in total trade. In terms of the different components, infrastructure improvements lead to the largest gains in trade, followed by logistics and then customs. However, the gains should be weighed against the ease of implementation. For example, from a short-term perspective, improvements in customs efficiency are easier and cheaper to implement than improvements to infrastructure. However, though improvements in customs efficiency may deliver quicker results, infrastructure is very important from the perspective of Central Asian countries, especially given their landlocked nature. Developing regional infrastructure will provide transport corridors for trade within and outside the region, help reduce trading time, and further integrate countries in the region as well with the rest of the world.

Notes

1. http://gtad.wto.org/trta_subcategory.aspx?cat=33121/.

2. For purposes of our analysis, the Central Asian region includes Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan as well as Armenia, Azerbaijan, and Mongolia.

3. In the working paper version (Felipe and Kumar 2010b), we also show how the role of trade facilitation differs within the manufacturing sector.

4. Anderson (1979) and Anderson and van Wincoop (2003) provide theoretical foundations for the gravity model, confirming its usefulness in empirical testing of bilateral trade flows.

5. An alternative to using the gravity model approach is to use computable general equilibrium (CGE) models to estimate the gains in trade made from improved trade facilitation. CGE models involve modeling trade facilitation as a reduction in the costs of international trade or an improvement in the productivity of the international transportation sector (Wilson et al. 2003).

6. Their sample comprises ninety-five countries, which translates into 8,930 bilateral trading pairs. The number of observations they report is only 3,614.

7. We also estimate the model using total trade and find that our results are qualitatively similar. However, we restrict ourselves to bilateral trade in manufactured products because trade facilitation measures for enhancing trade in natural resources are unlikely to be the same as for

manufactured goods. For example, a gas pipeline will be used exclusively for exporting gas, whereas improvements in domestic logistics will help the manufacturing sector at large.

8. We do not consider the issue of "closed borders" or the "quality of the border," that is, countries that share a border but might close it for trading purposes because of disputes or are unable to use it because of geographic difficulties (e.g., mountains).

9. Theoretically, an observation of zero trade might reflect the absence of any trade between country pairs rather than missing information. If the zero-trade data were randomly distributed, there would be little need to worry about the issue. However, as argued in Felipe and Kumar (2010b), zero trade does not seem to be randomly distributed. Dropping zero-trade observations could lead to selection bias. In other words, one needs to correct for the sample selection problem, as zero-trade observations might be conveying important information. Econometrically, it is well known that zero values for the dependent variable can create large biases (Tobin 1958), and the choice of the estimation procedure therefore becomes important. Past studies using gravity models suggest different ways of treating zero-trade observations (for further discussion, see Felipe and Kumar 2010b).

10. In this paper, the data set is referred to by its French acronym, BACI (Basis for Analyzing International Trade).

11. Category concordance obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and Jon Haveman (www.macalester.edu/research/economics/page/haveman/Trade.Resources/tradeconcordances.html) and used, with modifications, to map HS-6 to SITC Rev.2 (four-digit).

12. In our sample, we observed 19,460 instances of bilateral trade. In 432 of these instances, the trading partners share a common border; in 1,590 of them, the partners share a common language; in 266, one trading partner colonized the other; and in 1,546, the partners share a common colonizer. Out of forty-two trading relationships in Central Asia, twelve have a common border, two share a common language, none had colonial ties with their partners, but thirty of them (all the trading pairs excluding Mongolia) shared a common colonizer. We use the CEPII definition of colonizer and common language (available at www.cepii.fr/distance/geo_cepii.xls).

13. We also estimate a specification with an additional variable, log of tariffs (results not shown). The data on most favored nation (MFN) tariffs is taken from CEPII's MacMap database. Tariffs at the product level are averaged using the corresponding share in total imports by country A from country B. We lose a significant number of observations as a result of the lack of data on tariffs, and lose the "square matrix" nature of our sample as well. We no longer have 139 trading partners for each country. However, our results continue to hold qualitatively even in the reduced sample.

In the working paper version (Felipe and Kumar 2010b), we show the results using total trade, rather than trade in manufactured goods, as the dependent variable. Results using total trade as the dependent variable are qualitatively similar to the ones obtained using trade in manufactured goods only. The difference lies in the magnitude of the coefficients of our variables of interest, namely the LPI of the exporter and the importer.

14. Azerbaijan benefits from improvements in the LPI of its trading partners in Central Asia only because the LPI is assumed to change only for Central Asian countries.

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