THE PERFORMANCE OF
WORLD'S LOGISTICS AND THE
WAYS OF ITS IMPROVEMENT
FOR UKRAINE

by

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Kyiv School of Economics

Abstract

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All world countries' trade flows are highly dependent on the quality of logistics services – those who invest into transportation systems' modernization are always one step ahead of those who don't, with no exceptions. However, it is quite hard to tell how exactly such investments will affect the flows in numerical terms. That is among possible reasons why governments hesitate to put more money into their countries' logistics and keep up with the pace of world's progress.

This research focuses on distinguishing the effect of modernization of particular logistics segment with the help of Logistics Performance Index, also referred to as LPI, - a special instrument introduced by World Bank, which demonstrates what is the level of development of country's logistics in 6 different segments. It also discusses about current Ukrainian logistics' state and provides a solid argumentation on why Ukraine should concentrate on its logistic systems' improvements.

We found that focusing on improving the LPI dimensions scores has significant and reliable positive effect on both country's import and export, which allows us to use this result for policies development and implications, particularly for Ukraine.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

1.1. The overall of Ukrainian logistics' performance.

Ukraine has been known as one of the leaders in agricultural production for the decades. Being among the biggest exporters of agri-food to Europe in the latter half of the 20th century, now it has serious problems with internal and external processes.

According to the information of the United States Department of Agriculture, Ukraine is among the top exporters of grain in the world. Moving to sunflower oil export, Ukraine provides other countries with 5.25 MT of oil annually, which was roughly 54% of the 2017/2018 world's total export market.[1] Speaking of development and improvements in this market, there are forecasts that Ukraine will have a total of 60 MT in oilseeds and grain export by 2030.

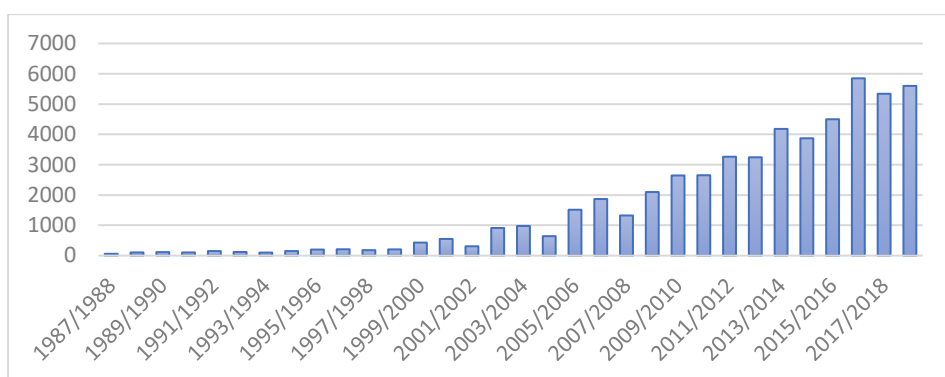[1] https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery;

Figure 1. Ukraine's Sunflower Oil Exports (in 1000 MT). Source: USDA.

However, it is of great importance to say that even with such a high volume of predicted and current exports, farmers lose a lot: ineffective infrastructure and logistics makes them lose millions of dollars annually. As a clear example of that would be the corn exports costs issue – in 2017, the United States of America spent $22 per ton, whereas Ukraine spent $29 per ton. Multiplying the difference between costs of exporting 45 MT of corn, which is a total of Ukrainian corn export in 2017, would show us $315 millions of losses.[2]

As the Ukrainian economy is known to be export-oriented, with a total of $45.7 billion in exports in 2017, which is 47,9% of GDP [3], there is no doubt that the lack of initiative towards renovating the infrastructure may lead to even bigger economic losses in the long-term perspective, and thus directly affecting all Ukrainian citizens' well-being. That is why, in my opinion, taking a closer look at this issue is of great importance and will be a good contribution to the Ukrainian research community.

To provide decent ways of improving this sector, a special set of actions for different fields should be developed and implemented. First, there has to be a clear understanding that the problem exists, and it should be solved. Then,

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[2] Oleg Nivievskiy, Pavlo Martyshev, "Emerging Global Agricultural Superpower and Inefficient Agricultural Logistics in Ukraine";
[3] http://ukrstat.gov.ua/;

divided into groups of challenges related to the different sectors of the problem, it has to be assigned to specialists and eventually sorted out. But although most of the issues are straightforward and widely known by the experts in the field, experts' preferences may vary regarding the solely weighted by everyone importance of the fields to be investigated. To prevent misunderstandings, there must be a universal tool being involved in the analysis that makes it possible for everyone to look at the issue from the same point of view. That is where so-called *LPI*, or *Logistics Performance Index*, might help.

The research questions of this paper - *How will increase in any of the components of LPI affect the trade flows for the countries in the world? How this information can help Ukraine boost its trade flows?*

Speaking of the structure of this paper, Chapter 2 is dedicated to the literature about the importance of infrastructure modernization and experience of using LPI as a major instrument for analysis. Chapter 3 is dedicated for taking a closer look at the methodology along with the model specification, whereas Chapter 4 describes the data, its sources and variables definitions. Chapter 5 provides empirical results and initiates a discussion on them. Chapter 6 sums up the result, makes a conclusion on the research question and briefly discusses possible issues of such estimation approach.

1.2. The description of Logistics Performance Index.

Logistics Performance Index[4] is a World Bank's special ranking system which was introduced in 2007; its purpose is to show the level of performance in different sectors of logistics systems, such as efficiency of the clearance process, quality of trade and transport related infrastructure, ease of arranging competitively priced shipments, competence, and quality of logistics services, ability to track and trace arrangements and timeliness in shipping arrangements.

It has 6 dimensions – *Customs, Infrastructure, International Shipments, Logistics Competence, Tracking & Tracing, Timeliness* – names of which speak for themselves; each of these dimensions represents country's performance in different infrastructural segments and is given a grade in the range from 0 to 5; all of them combined, they turn into a finalized grade, which is referred to as LPI.

There are several reasons why LPI is important and should be used for the type of analysis to be conducted in this paper:

- It was theoretically and empirically proven that LPI significantly helps in developing and implementing efficient governmental policies (Ojala, L., Celebi, D. (2015));

- LPI was proven to have a mediator role in the relationship between Global Competitiveness Index (GCI) and Gross Domestic Product (GDP) (Civelek, M.E., Uca, N., Cemberci, M. (2015));

- LPI also was proven to have a mediator role in the relationship between Corruption Perception Index (CPI) and Foreign Trade Volume (FTV) (Uca, N., Ince, H., Sumen, H. (2016));

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[4] https://lpi.worldbank.org/about;

- As the main instrument, recently it was used in EU members' net export analysis – provided a significant and practically useful result (Garcia, L., Marti, L., Puertas, R. (2014)).

Having mentioned these four major advantages, it becomes clear that using this indicator can significantly help in conducting precise and informative research of infrastructural sectors.

1.3. The performance of Ukraine in the LPI list.

For a better understanding of the situation for Ukraine, it is undoubtedly that comparative analysis is required.

Consider Figure 3, which is a ranking table of 2018's top-10 countries. Germany is the absolute leader with rank #1 and overall LPI score of 4.20. It is followed by Sweden, having rank #2 and 4.05 in LPI score. The rank #3 goes to Belgium, which has 4.04 in an LPI index score. [5]

Country	Year	LPI Rank	LPI Score	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Germany	2018	1	4.20	4.09	4.37	3.86	4.31	4.24	4.39
Sweden	2018	2	4.05	4.05	4.24	3.92	3.98	3.88	4.28
Belgium	2018	3	4.04	3.66	3.98	3.99	4.13	4.05	4.41
Austria	2018	4	4.03	3.71	4.18	3.88	4.08	4.09	4.25
Japan	2018	5	4.03	3.99	4.25	3.59	4.09	4.05	4.25
Netherlands	2018	6	4.02	3.92	4.21	3.68	4.09	4.02	4.25
Singapore	2018	7	4.00	3.89	4.06	3.58	4.10	4.08	4.32
Denmark	2018	8	3.99	3.92	3.96	3.53	4.01	4.18	4.41
United Kingdom	2018	9	3.99	3.77	4.03	3.67	4.05	4.11	4.33
Finland	2018	10	3.97	3.82	4.00	3.56	3.89	4.32	4.28

Figure 2. The Top-10 list of LPI performers. Source: The World Bank Group.

Ukraine was placed #66, having LPI score of 2.83. [6]

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[5] https://lpi.worldbank.org/international/global;
[6] https://lpi.worldbank.org/international/global;

Country	Year	LPI Rank	LPI Score	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Argentina	2018	61	2.89	2.42	2.77	2.92	2.78	3.05	3.37
Ecuador	2018	62	2.88	2.80	2.72	2.75	2.75	3.07	3.19
Kuwait	2018	63	2.86	2.73	3.02	2.63	2.80	2.66	3.37
Iran, Islamic Rep.	2018	64	2.85	2.62	2.77	2.76	2.84	2.77	3.36
Serbia	2018	65	2.84	2.60	2.60	2.97	2.70	2.79	3.33
Ukraine	2018	66	2.83	2.49	2.22	2.83	2.84	3.11	3.42
Egypt, Arab Rep.	2018	67	2.82	2.60	2.82	2.79	2.82	2.72	3.19
Kenya	2018	68	2.81	2.65	2.55	2.62	2.81	3.07	3.18
Malta	2018	69	2.81	2.70	2.90	2.70	2.80	2.80	3.01
Latvia	2018	70	2.81	2.80	2.98	2.74	2.69	2.79	2.88
Kazakhstan	2018	71	2.81	2.66	2.55	2.73	2.58	2.78	3.53

Figure 3. Ukraine's rank in the list of LPI performers. Source: The World Bank Group.

Considering this slightly recent statistics provided by WBO, it becomes obvious that Ukraine underperforms in all the segments monitored by LPI. The worst points were assigned to the *Infrastructure and Customs* sectors, yielding the result that Ukraine needs it to be re-developed the most.

Comparing Ukraine to the top- and mid-ranked countries, one can see a big difference between the observable level of performance. The results are shown in Figure 4.
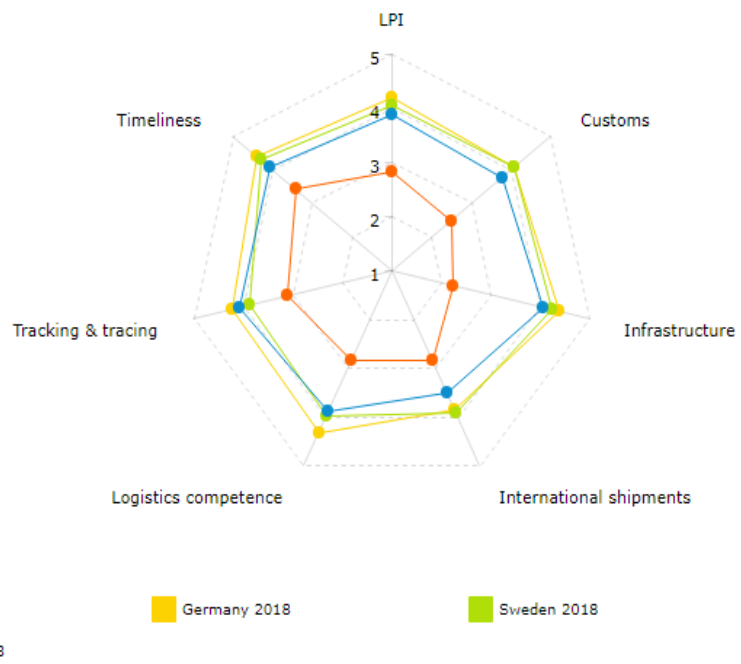
Figure 4. Comparative analysis of Ukraine and top performers, according to the LPI list. Source: The World Bank Group.

In the light of all the points mentioned above, I think it is of great interest to initiate a discussion about different ways of breaking out from the problems related to the state of logistics performance in our country and thus, developing agricultural sector of Ukraine.

LITERATURE REVIEW

Before trying to investigate the modern problems with modern solutions, it is always good to peek at the researches that were conducted in the past. First, it is important because almost all the nowadays' problems were declared and somewhat solved in the past at least dozens of times. The only thing that changes is the scale – issues become bigger and harder to sort out, but the root of it always stays the same. Let's consider an option of looking through the already written articles on the issue observed in this paper and try to find whether we can find any relevant information.

To start with, let's look at the studies which investigated the relationship between infrastructural investments and GDP growth rate. G. Kovács and K. M. Spens (2006) in their paper researched the relationship between the infrastructural investments and GDP growth for the Baltic countries. As a result, they discovered a strong link between the development of an infrastructural system of countries like Estonia, Latvia and Lithuania and their attractiveness for foreign investors. Although mentioned countries are advised not to solely depend on this field, as business relationship can slowly develop even with a poor infrastructural system, developing railroads and other transport facilities are crucial for fulfilling business contracts and promises. That result gives us a possible variable of interest – GDP and its growth, one of which will be used in the estimations.

Moving forward along this course, the one has to pay attention to the results of J. Vilko, B. Karandassov, E. Myller (2011) paper. Authors tried to clarify what is the relationship between the infrastructure, regional accessibility, regional competitiveness, and other less important factors. The main approach that was used is comparative research between countries from the Baltic states' performance and Finland's performance regarding their GDP per capita, logistics systems, and other controlling factors. What they found is that

countries with inefficient or poor infrastructure can only grow if they improve or reorganize their processes for satisfying present demand with modern techniques or technologies. Their contribution to the research community is priceless for Ukrainian case analysis, as most of the logistics systems across the country were inherited from the Soviet Union period and cannot efficiently adapt to the modern world's demand.

What one can see from a latter mentioned paper is a clear relationship between the country growth and the quality and efficiency of the logistics services. Luckily, we have the LPI's Competence and quality of logistics services score, which is a good proxy for quantifying the improvements in logistic services.

For a more detailed overview of the link between transport and economy growth, checking the paper written by F.W.C.J. van de Vooren (2004) is advised. The author focused on the newly developed dynamic model about the economy, transport and other regional features of the countries. It was applied to 40 different regions of the Netherlands and provided a precise long-term simulated calculation for the transport and economy link. As a result, several observed scenarios provided mostly similar conclusions – improving separate parts of logistics systems will significantly increase GDP growth rates in the long-term perspective. And that is where LPI's Quality of trade and transport-related infrastructure score comes into play. It may serve as a good proxy for the transport system state and will be an important part of future estimations.

However, there are always pitfalls in any approach that has been developed, and infrastructural investing is not a conclusion for this rule. S. Guner, E. Coskun (2012) tried to discover a significant relationship between the social factors and economic development of 26 predetermined OECD countries. Authors found out that even if a country decides to increase the amount of investment in the infrastructural development, it will not necessarily mean that logistics performance will grow. For smooth processing of logistics service providers, a list of requirements has to be met, among which are political stability, the efficiency of governmental management, democracy level, etc.

Approaching the most recent papers on the infrastructural (in)efficiency, it is worth mentioning the paper written by L. Martía, R. Puertas and L. García (2013). Authors conducted research based on the data collected from all the 26 EU countries. What they found out is during the period from 2005 to 2010 logistics efficiency was more important to the exporting countries rather than importing countries, and furthermore, this trend kept going in the following years; they also pointed out that ability to track the freight along its way to the point of destination and the competence of workers has been and is still gaining more interest from importers; at last, but not the least important, adapting transport policies to the modern demand, improving other infrastructure should be considered as the benchmarks for countries that want to grow economically.

What is more, the abovementioned paper is among the first ones which used LPI as the main instrument for analyzing the infrastructure improvements' effects.

As we slowly came to one of the first mentions of an LPI in the literature, it is of great interest to discuss its main features that can be used in further studies. N. Uca, H. Ince, H. Sumen (2016) debate whether LPI has an important role of a mediator in the relationship between the Corruption Perception Index (CPI) and Foreign Trade Volume (FTV). Their research resulted in finding a significant correlation between LPI and CPI along with the FTV for the case of Turkey, which makes it an important component and connecting link between these two unrelated indexes.

One year earlier, M. E. Civelek, N. Uca, M. Cemberci (2015) had examined another case of a mediator role for LPI – the relationship between Global Competitiveness Index (GCI) and Gross Domestic Product (GDP) for Turkey. Authors had found out another significant relationship between these three indicators and thus, had allowed researchers to evaluate a country's economic health by observing its LPI overall score.

Combining the latter two results, LPI's importance and appropriateness in different fields of studies should become clear.

One of the most recent studies was made by L. Martía, R. Puertas and L. García (2014). In this paper, authors tried to extend the results they obtained one year earlier and applied their model to the countries from five different regions - Africa, South America, Far East, Middle East, and Eastern Europe. One of the most interesting parts of that research is that the authors used LPI as a primary tool for conducting the analysis. Their main result was as follows: for developing countries, an increase in any of the 6 dimensions of LPI will significantly lead to an increase in trade flows. Furthermore, in the last 5 years, LPI components' scores have become more valuable for a list of countries in Asia, Europe, and Africa, as they provide precise and crucial information for international trade.

METHODOLOGY

The main approach that is to be used in this research is the bilateral gravity model. The general definition of our model of interest is as follows:

$$F_{ij} = G * M_i * M_j * T/D_{ij} , \quad [1]$$

where F_{ij} stands for the trade flows, G is some constant, M_i and M_j stand for the economic dimension of the observed countries, T is the effect of any additional factors that may affect the trade flows between two countries and D_{ij} is the distance between these two countries. It turns into a linear form by employing logarithms:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(M_i) + \beta_2(lnM_j) + \beta_3(lnD_{ij}) + \beta_4 T + \varepsilon_{ij}, \quad [2]$$

That step makes it easy to interpret the model from the econometrical point of view.

In this paper, as was mentioned above, we are interested in finding out whether changes in the LPI score would affect the trade flow of goods and services across all the countries mentioned in the LPI list. Many papers (Hausman et al., 2005; Iwanow and Kirkpatrik, 2009; Martí, L., Puertas, R., & García, L., 2014) in which trade flows were investigated suggest using different classification for the additional factors, and such systems may be summed up as follows:

- *Factors related to the actual potential to export and import;*
- *Factors that show what is the maximum possible volume of export and import of the country;*

- *Other observable factors.*[7]

Having that said, we come to a general look of the model for the research:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_i) + \beta_5(lnLPI_j) + \beta_5 Contig + \beta_6 ComLang +$$
$$\beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol + \beta_9 Curcol +$$
$$\beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij},$$

[3]

where F_{ij} stands for the trade flows, GDP_i and GDP_j, obviously, stand for the GDP of the observed countries, as a proxy for the "expected ability to trade", LPI_i and LPI_j is the LPI score provided by the World Bank, $SharedBorder$ is a dummy variable that represents whether the observed pair of countries share a border, $ComLang$ is a dummy that stands for having official language in common, $EthnicComLang$ is a dummy that shows whether at least 9% of two countries' people speak any common language that is not considered as official, $Colony$ is a dummy that shows whether a country was someone's colony in an observable period of history, $Curcol$ shows whether the country is someone's colony nowadays, $Col45$ shows whether there is a colonial relationship between the countries after 1945, $Smctry$ yields the result of check whether the pair of countries was the same country some time ago in the observable history, T is a dummy that holds country-specific fixed effect which is believed to affect the trade flows and D_{ij} is the distance between the pair of two observed countries.

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[7] Martí, L., Puertas, R., & García, L., 2014. "The importance of the Logistics Performance Index in international trade";

Due to the nature of the analysis we conduct, the approach we use in this study is panel-data estimation for the available years of interest. At this point, we expect all the distinguished variables to have a positive effect on the trade flows, with an exception for the distance – it was observed and empirically proven (Head, K., & Mayer, T., 2014) that distance between countries negatively affects their volume of trading.

As already mentioned, LPI consists of 6 different dimensions, so we are interested in looking at the effect of each of them. However, they are highly correlated, thus including all of them into the equation simultaneously would raise the problem of multicollinearity. So, considering all the assumptions mentioned above, we finally come up with 6 different equations of interest:

For Timeliness:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_{time,i}) + \beta_5(lnLPI_{time,j}) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij},$$

[4]

For Logistics Competence:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_{com,i}) + \beta_5(lnLPI_{com,j}) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij},$$

[5]

For Tracking and Tracing:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_{trac,i}) + \beta_5(lnLPI_{trac,j}) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij},$$

[6]

For Infrastructure:

$$ln\big(F_{ij}\big) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2\big(lnGDP_j\big) +$$
$$\beta_3\big(lnD_{ij}\big)+\beta_4\big(lnLPI_{infr,i}\big)+\beta_5\big(lnLPI_{infr,j}\big) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum\beta_{12}T + \varepsilon_{ij},$$

[7]

For Customs:

$$ln\big(F_{ij}\big) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2\big(lnGDP_j\big) +$$
$$\beta_3\big(lnD_{ij}\big)+\beta_4\big(lnLPI_{cust,i}\big)+\beta_5\big(lnLPI_{cust,j}\big) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum\beta_{12}T + \varepsilon_{ij},$$

[8]

For International Shipments:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_{ship,i}) + \beta_5(lnLPI_{ship,j}) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij}.$$

[9]

For Overall LPI score:

$$ln(F_{ij}) = \beta_0 + \beta_1 ln(GDP_i) + \beta_2(lnGDP_j) +$$
$$\beta_3(lnD_{ij}) + \beta_4(lnLPI_{over,i}) + \beta_5(lnLPI_{over,j}) + \beta_5 Contig +$$
$$\beta_6 ComLang + \beta_7 EthnicComLang + \beta_8 Colony + \beta_9 Comcol +$$
$$\beta_9 Curcol + \beta_{10} col45 + \beta_{11} Smctry + \sum \beta_{12} T + \varepsilon_{ij}.$$

[10]

As can be seen, the only change in the formulas is the chosen LPI component – such approach will let us accurately distinguish the effect of each of the component, and overall score in the final equation, on the trade flow without invoking the multicollinearity issue.

DATA DESCRIPTION

For this research, several publicly available databases will be used. The first one is the *World Bank's public databases*, the second is the *UN Comtrade database,* and the last, but not the least important is *CEPII.*[8]

The years of interest would be 2012, 2014 and 2016, as they are the most recent ones for which there has not been done any analysis yet.

Having to collect the data on the GDPs for the countries, we get the most recent information on this concern from *the World Bank*. Another use of this database is the LPI scores collection.

To observe the trade flows between countries, we have to refer to the *UN Comtrade* databases. Particularly, we want to investigate the overall monetary value of imported and exported goods between countries in 2012, 2014 and 2016.

To include the distance between countries into the equation, we have to collect the data from *CEPII*; in this paper's approach, the straight-line distance between the capitals of the countries will be referred to as such. Although this method may not be the most accurate one, it is quite reliable, according to the numerous studies (Yang, S., & Martinez-Zarzoso, I., 2014; Head, K., & Mayer, T., 2014).

All in all, after collecting the data, we expect to have $n*n*T$ observations, where n stands for the number of countries participating in the analysis, and T is the number of years which are to be analyzed.

When mentioning the country-specific fixed effect, it is worth mentioning what is exactly the approach that was used in this paper to generate them. As was pointed out above, the dataset has a specific set of dummy variables for keeping

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[8] Centre d´Etudes Prospectives et d´Informations Internationales;

the country's special features and options while analyzing its trade flows. To keep it simple, these are binary variables for each country in the list which has a value of 1 if the country's name is X and 0 otherwise. These variables generated for each country being on both Reporter and Partner sides. Including them into the model is expected to give much more precise results compared to if they were not in the model's variables list. Obviously, including all 262 "dummies" into the regression results' report is not going to work well from the point of view of comprehending the outcome of estimations, thus we omit reporting them in the finalized regression reports.

As *UN Comtrade* information may be not full since some countries do not report their import and export flows or report inaccurate information, we expect to have a missing or corrupted information which will affect the results of estimations. This is what exactly what happened – in this study, we will work with 131 countries instead of approximately 150 that are mentioned in the LPI list.

Table 1. Description of the variables and expected effect.

Variable	Description	Expected Effect
LPI, Tracking dim.	LPI Score Dimension, stands for Ability to track and trace consignments.	Positive
LPI, Timeliness dim.	LPI Score Dimension, stands for Timeliness of shipments in reaching destination within the scheduled or expected delivery time.	Positive
LPI, Customs dim.	LPI Score Dimension, stands for Efficiency of the clearance process by border control agencies.	Positive
LPI, Infrastr. dim.	LPI Score Dimension, stands for Quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology).	Positive
LPI, Compet. dim.	LPI Score Dimension, stands for Ease of arranging competitively priced shipments.	Positive
LPI, Quality dim.	LPI Score Dimension, stands for Competence and quality of logistics services (e.g. transport operators, customs brokers).	Positive
LPI, Overall dim.	LPI Overall score, calculated as the average of 6 dimensions listed above.	Positive
GDP, current $US bill.	Country's current GDP presented in current $US billions.	Positive
Distance, in km.	Distance between the capitals of countries presented in kilometers.	Negative

Table 1. - CONTINUED

Variable	Description	Expected Effect
Contingency	Dummy, 1 for countries having shared border.	Positive
Official Common Language	Dummy, 1 for pairs having official common language.	Positive
Ethnical Common Language	Dummy, 1 for pairs having a language that is spoken by at least 9% of population and is not considered as official.	Positive
Colony	Dummy, 1 for pairs ever being in a colonial relationship.	Positive
Common Colonizer	Dummy, 1 for pairs having common colonizer post 1945.	Positive
Current Colony	Dummy, 1 for pairs currently being in a colonial relationship.	Positive
Colony post 1945	Dummy, 1 for pairs being in a colonial relationship post 1945.	Positive
Same Country	Dummy, 1 for pairs ever being the same country in the past.	Positive

Chapter 5

EMPIRICAL RESULTS

5.1. Exports Part of the Analysis.

We start with the analysis of the export part of the trade flows between the countries.

As was previously mentioned, we use 6 different regressions for the panel data in order to precisely distinguish the effect of different LPI segments' changes. Thus, we will have 6 different results to be described and analyzed.

For convenience, they are divided into 2 different tables.

As can be seen in Table 2, all the results we got from the first part of results follow the basic economic logic – we did expect the effect of value of GDP, sharing the border, having a common language on both official and ethnical levels, etc. to have a positive effect on the volume of export. Distance is, as expected, negatively affect the trade flows – the farther the country, the lower chance there will be a settled deal on the goods and services exchange.

Switching to the LPI effect, we see the following picture: when it comes to ability to track and trace the freight, our data shows a significant effect of the Partner's LPI score, which says that with 1% increase in Tracking and Tracing score we get 0.193% increase in the exports flow, whereas the same score represents no significant effect. The result we got for the Partner is significant on the 5% significance level, which means the result is quite reliable for further analysis. This result is quite intuitive – no one wants its freight to get lost in the depth of the ocean, or simply to be stolen with no trace of thieves, thus if countries invest in the tracking systems, it is likely that the deal will be settled, and goods will be exported.

Moving on to the *Timeliness* segment, we can observe something we did not expect to see in this study - a significant negative effect of both Reporter and Partner's LPI scores – as can be seen, increase by 1% in the Reporter's LPI

Timeliness segment score yields the 0.229% decrease in the exports, which is quite odd – the only explanation for that is the questionable quality of data and countries' inaccuracy in reporting crucial economic indicators; nevertheless, with every 1% increase in the Partner's score, on average, we get 0.159% increase in the volume of exports. Speaking of results, increase in *Timeliness* segment means there will be less time spent for the freight to get from point A to point B, so it is obvious that it will boost the export flow – people never liked spending their time on unreasonable waiting.

Speaking of *Customs Efficiency* segment, we see that our data yields no significant result on the volume of exports; however, Partner's LPI score shows a positive sign, which demonstrates the positive, although insignificant relationship between the trade flow and *Customs Efficiency* score. Due to the insignificance of the results, there is not much to be analyzed.

Table 2. Results of the regression for the Tracking and Tracing, Timeliness, and Customs Efficiency (Exports Part).

Variables	(1) Tracking and Tracing	(2) Timeliness	(3) Customs Efficiency
Distance	-1.576***	-1.576***	-1.576***
	(0.0291)	(0.0291)	(0.0291)
* LPI Score for Reporter	-0.00167	-0.229**	-0.0624
	(0.0784)	(0.0896)	(0.0859)
* LPI Score for Partner	0.193**	0.159*	0.105
	(0.0791)	(0.0903)	(0.0799)
Reporter's GDP	0.338***	0.375***	0.349***
	(0.0620)	(0.0639)	(0.0624)
Partner's GDP	0.190***	0.190***	0.201***
	(0.0606)	(0.0608)	(0.0608)
Contingency	0.497***	0.496***	0.497***
	(0.149)	(0.149)	(0.149)
Having Common Official Language	0.618***	0.618***	0.618***
	(0.0921)	(0.0921)	(0.0920)
Having Common Eth. Language	0.294***	0.294***	0.294***
	(0.0920)	(0.0920)	(0.0920)
Ever Having Colonial Relationships	0.103	0.102	0.102
	(0.177)	(0.177)	(0.177)
Common Colonizer post 1945	0.557***	0.557***	0.557***
	(0.0792)	(0.0792)	(0.0792)
Currently Being in a Colonial Rel.	-4.277*	-4.277*	-4.277*
	(2.537)	(2.537)	(2.537)
Colonial Relationships post 1945	1.245***	1.245***	1.245***
	(0.211)	(0.211)	(0.211)
Ever Being the Same Country	0.872***	0.872***	0.872***
	(0.201)	(0.201)	(0.201)
Constant	7.726***	7.071***	7.338***
	(1.943)	(1.947)	(1.960)
Observations	31,450	31,450	31,450
R-squared	0.7788	0.7788	0.7908
Country FE	YES	YES	YES

Notes: * is the fill-in for the variables in the columns' headers.

Now, moving to another 3 dimensions, which are shown in Table 3, we see that there are less significant relationships – only one among 6 different coefficients. We see that there is a highly significant relationship between the Partner's *Shipments Competitiveness* LPI segment and the exports flow; we can

state that with 1% increase in this dimension leads to 0.207% increase in the exports. Analyzing the result, we can say that the opportunity to choose the best option in different metrics among the service providers is of no doubt an important part of settling a deal, thus increasing the LPI score in that dimension must significantly increment in the exports.

It is also worth mentioning that 5 out of 6 show positive, although insignificant, result in an observed positive relationship. All other variables show a highly significant positive effect except for the dummy showing colonial relationship after 1945 and the distance, which was all along expected to negatively influence the trade flows.

Table 3. Results of the regression for the Services Quality, Shipment Competitiveness, and Infrastructure Quality (Exports Part).

Variables	(4) Services Quality	(5) Shipment Compet.	(6) Infrastruct. Quality
Distance	-1.576***	-1.576***	-1.576***
	(0.0292)	(0.0291)	(0.0291)
* LPI Score for Reporter	0.0391	0.0245	0.0886
	(0.110)	(0.0906)	(0.0910)
* LPI Score for Partner	-0.129	0.207**	0.0663
	(0.0981)	(0.0887)	(0.0818)
Reporter's GDP	0.346***	0.335***	0.336***
	(0.0629)	(0.0640)	(0.0615)
Partner's GDP	0.218***	0.187***	0.205***
	(0.0602)	(0.0607)	(0.0601)
Contingency	0.496***	0.498***	0.497***
	(0.149)	(0.149)	(0.149)
Having Common Official Language	0.618***	0.617***	0.618***
	(0.0920)	(0.0920)	(0.0920)
Having Common Eth. Language	0.294***	0.294***	0.294***
	(0.0920)	(0.0920)	(0.0920)
Ever Having Colonial Relationships	0.102	0.103	0.103
	(0.177)	(0.177)	(0.177)
Common Colonizer post 1945	0.556***	0.557***	0.557***
	(0.0792)	(0.0792)	(0.0792)
Currently Being in a Colonial Rel.	-4.277*	-4.277*	-4.276*
	(2.537)	(2.537)	(2.536)
Colonial Relationships post 1945	1.246***	1.244***	1.245***
	(0.211)	(0.211)	(0.211)
Ever Being the Same Country	0.873***	0.872***	0.873***
	(0.201)	(0.201)	(0.201)
Constant	7.122***	7.856***	7.455***
	(1.953)	(1.986)	(1.927)
Observations	31,450	31,450	31,450
R-squared	0.7788	0.7788	0.7988
Country FE	YES	YES	YES

Notes: * is the fill-in for the variables in the columns' headers.

At last, we want to take a look at the *LPI Overall score* effect on the Exports trade flow. As we already mentioned, we expect to observe a significant positive effect of increase in Overall LPI score on the volume of Exports, and this is exactly what we see – as shown in Table 4, with a 1% increase in Partners' score, on average between all countries in our list of interest, we are to watch significant 0.411% increase in Exports.

Speaking of Reporter's score, it did not provide us with any significant result, but its effect has positive sign, which creates a solid ground for discussion on whether, with additional and accurate information and more years of observations for countries, it will show positive and significant effect on the Exports trade flow.

And the last, but not the least important note would be on other variables that are used in the model – each of them either behaves in the way it was expected to, or it shows unexpected negative, but insignificant result, i.e. *Currently Being in a Colonial Rel.* variable. This result is a good matter for future investigations.

Table 4. Results of the regression for the Overall Logistics Performance Index score (Exports Part).

Variables	Overall effect on Exports
Distance	-1.517***
	(0.0343)
LPI Overall Score for Reporter	0.0717
	(0.207)
LPI Overall Score for Partner	0.411**
	(0.167)
Reporter's GDP	0.314***
	(0.0689)
Partner's GDP	0.217***
	(0.0654)
Contingency	0.447**
	(0.174)
Having Common Official Language	0.517***
	(0.121)
Having Common Eth. Language	0.367***
	(0.123)
Ever Having Colonial Relationships	0.205
	(0.198)
Common Colonizer post 1945	0.534***
	(0.0956)
Currently Being in a Colonial Rel.	-3.767
	(2.188)
Colonial Relationships post 1945	1.237***
	(0.232)
Ever Being the Same Country	0.881***
	(0.269)
Constant	6.841***
	(2.151)
Observations	26,162
R-squared	0.7767
Country FE	YES

5.2. Imports Part of the Analysis.

Having exports part analyzed, now we have to move to the second but not least important part of this study. Now we look at the Imports trade flow and how does LPI score affect this segment of the international trade.

All results are shown in Table 4 along with other descriptive statistics. Again, we do the same transformation to the description of the results and divide them into two part.

We observe much better (from the statistics and econometrics point of view) result as we analyze the regression outcome. The Reporter's LPI dimensions scores show a highly significant effect on the Import of the country.

Speaking of numbers, the 1% increase in *Tracking and Tracing* dimension of the Reporter means that import will increase by 0.406%. Moving on, the boost of 1% in Reporter's *Timeliness* segment implies 0.458% increase for imports flow. And the last, but not the least, is the *Customs Efficiency* – increase in that dimension by 1% shows a significant effect on 0.202% rise in the imports.

However, Partners' LPI dimensions, along with the GDP, show no significant effect on the observed trade flow. All other variables show an expected effect on Import's trade value.

Table 5. Results of the regression for the Tracking and Tracing, Timeliness, and Customs Efficiency (Imports Part).

Variables	(1) Tracking and Tracing	(2) Timeliness	(3) Customs Efficiency
Distance	-1.407***	-1.407***	-1.407***
	(0.0290)	(0.0290)	(0.0290)
* LPI Score for Reporter	0.406***	0.458***	0.202**
	(0.0819)	(0.0925)	(0.0908)
* LPI Score for Partner	0.00176	-0.0900	-0.114
	(0.0868)	(0.0954)	(0.0908)
Reporter's GDP	0.210***	0.203***	0.234***
	(0.0671)	(0.0675)	(0.0675)
Partner's GDP	0.0764	0.0999	0.0939
	(0.0691)	(0.0699)	(0.0693)
Contingency	0.370**	0.371**	0.370**
	(0.148)	(0.148)	(0.148)
Having Common Official Language	0.667***	0.667***	0.667***
	(0.0880)	(0.0880)	(0.0881)
Having Common Eth. Language	0.221**	0.221**	0.221**
	(0.0894)	(0.0894)	(0.0894)
Ever Having Colonial Relationships	0.134	0.133	0.133
	(0.146)	(0.146)	(0.146)
Common Colonizer post 1945	0.705***	0.705***	0.706***
	(0.0771)	(0.0771)	(0.0771)
Currently Being in a Colonial Rel.	-3.230	-3.230	-3.231
	(2.535)	(2.535)	(2.535)
Colonial Relationships post 1945	1.171***	1.172***	1.172***
	(0.193)	(0.193)	(0.193)
Ever Being the Same Country	1.026***	1.026***	1.026***
	(0.203)	(0.203)	(0.203)
Constant	14.68***	14.24***	13.96***
	(2.136)	(2.133)	(2.141)
Observations	34,051	34,051	34,051
R-squared	0.7891	0.7898	0.7867
Country FE	YES	YES	YES

Notes: * is the fill-in for the variables in the columns' headers.

Moving on to the last part of the analyzed coefficients, we again observe the strong positive significant relationship between Reporter's LPI scores and the Imports trade values. Results of the regressions are presented in Table 5.

More precisely, 1% in the *Services Quality* dimension guarantees 0.285% boost in the Imports flow. Which is understandable - if the logistics services are efficient and have strong stability and reliability in doing their job, it is always a pleasure to do business with such countries.

Speaking of *Shipment Competitiveness,* 1% increment in this segment appear to make import trade flow grow by 0.462%. The last observed metric, *Infrastructure Quality* demonstrates the effect of 0.333% boost in imports for every 1% increase in that dimension. As first segment's effect was explained in the previous subchapter, we omit repeating it in this part and focus on the last dimension – if seaports, storages, and other logistics facilities are easy-to-reach, it is much likely that people will give their preference towards such "well-equipped" partner's services, and that argument is proven by the result we got.

Table 6. Results of the regression for the Services Quality, Shipment Competitiveness, and Infrastructure Quality (Imports Part).

Variables	(4) Services Quality	(5) Shipment Compet.	(6) Infrastruct. Quality
Distance	-1.407***	-1.407***	-1.407***
	(0.0290)	(0.0291)	(0.0290)
* LPI Score for Reporter	0.285**	0.462***	0.333***
	(0.114)	(0.103)	(0.0944)
* LPI Score for Partner	-0.0741	-0.126	-0.126
	(0.118)	(0.0937)	(0.0963)
Reporter's GDP	0.234***	0.199***	0.228***
	(0.0676)	(0.0681)	(0.0667)
Partner's GDP	0.0828	0.0838	0.0938
	(0.0694)	(0.0701)	(0.0685)
Contingency	0.370**	0.371**	0.370**
	(0.148)	(0.148)	(0.148)
Having Common Official Language	0.667***	0.667***	0.667***
	(0.0880)	(0.0881)	(0.0881)
Having Common Eth. Language	0.221**	0.221**	0.221**
	(0.0894)	(0.0894)	(0.0894)
Ever Having Colonial Relationships	0.133	0.134	0.134
	(0.146)	(0.146)	(0.146)
Common Colonizer post 1945	0.705***	0.705***	0.705***
	(0.0771)	(0.0771)	(0.0771)
Currently Being in a Colonial Rel.	-3.232	-3.232	-3.229
	(2.535)	(2.535)	(2.535)
Colonial Relationships post 1945	1.172***	1.172***	1.172***
	(0.193)	(0.193)	(0.193)
Ever Being the Same Country	1.026***	1.026***	1.026***
	(0.203)	(0.203)	(0.203)
Constant	14.11***	14.82***	14.00***
	(2.152)	(2.171)	(2.114)
Observations	34,051	34,051	34,051
R-squared	0.7687	0.7877	0.7867
Country FE	YES	YES	YES

Notes: * is the fill-in for the variables in the columns' headers.

Speaking of the Overall LPI score increase effect on the trade flows, there are interesting findings to discuss, too. As presented in Table 7, although both coefficients are insignificant, one can notice that Partner's LPI score has "plus" sign by its effect's side in the regression, and thus giving us some space for discussing the argument that, in the long-run and with more variation in the data on LPI scores, we expect to observe a significant positive effect on the Import trade flow.

Other variables behave as was expected and suggested by the literature: all controls have positive effects on the volume of imports, with an exception for the distance between countries' capitals – it is all along observed that long distance is a negative factor for developing powerful trading systems between countries. There is, again, unexpected effect of the *Currently Being in a Colonial Rel.* variable, but, just as before, it shows no significance after test.

Table 7. Results of the regression for the Overall Logistics Performance Index score (Imports Part).

Variables	Overall effect on Imports
Distance	-1.361***
	(0.0333)
LPI Overall Score for Reporter	-0.110
	(0.186)
LPI Overall Score for Partner	0.0328
	(0.184)
Reporter's GDP	0.166**
	(0.0688)
Partner's GDP	0.131*
	(0.0753)
Contingency	0.258
	(0.170)
Having Common Official Language	0.515***
	(0.112)
Having Common Eth. Language	0.360***
	(0.116)
Ever Having Colonial Relationships	0.632***
	(0.0918)
Common Colonizer post 1945	0.239
	(0.171)
Currently Being in a Colonial Rel.	-2.965
	(2.158)
Colonial Relationships post 1945	1.216***
	(0.219)
Ever Being the Same Country	1.033***
	(0.273)
Constant	14.55***
	(2.300)
Observations	26,162
R-squared	0.7863
Country FE	YES

5.3. How is this important for Ukraine?

After deep analysis of the results for a term of 4 years, we see that for the entire list of the countries which are mentioned in the World Bank's LPI score rating, there is a proof that if country focuses on improving its different aspect and fields of the logistics quality, efficiency, and infrastructure, it will surely lead to positive changes in the Exports and Imports flow. So, how can that help Ukraine?

Let's come back to Ukraine's rating in the LPI list. As was mentioned before, it was placed #66, having overall LPI score of 2.83. Now let's experiment with a little example.

As for 2018, Ukraine's Exports valued 47.334 mils. $US. If, for example, Ukraine focused on shrinking the duration of shipment from point A to point B and increased its *Timeliness* dimension score by 1%, it could potentially increase their exports by approximately 98 mils. $US. Isn't that a solid argument that something has to be done about Ukrainian logistics systems?

Such an experiment can be held on any other LPI dimension of interest, and it will most probably lead to an expected positive relationship.

All-in all, this study, being based on the almost entire number of countries in the world, shows that no matter to which region this or that country belongs, one may expect a significant positive effect from focusing on improving country's LPI score in any of 6 available dimensions.

In the light of all mentioned above, this study asserts a high relevance and importance for Ukrainian international trade reality and can be possibly used in the government's policy implications related to the infrastructural improvements and reorganizations.

CONCLUSIONS AND POSSIBLE ISSUES TO ADDRESS

In this study, we analyzed the relationship between the Logistics Performance Index (LPI) and expected country's trade flow, both Import part and Export part. For this as a goal, we used an extended gravity model, which was built around 6 different dimensions of LPI and other classical control variables.

In literature, there were always discussions about the relationship of country's logistics infrastructure and its competitiveness compared to other market participants. Many researchers proved that, regarding the fast pace of world's progress, countries should focus on their logistic system's efficiency, quality and other important dimensions to keep their place in the Import and Export performers' list.

Naturally, as world progresses, a lot of new instruments for controlling country's logistics performance are being developed and implemented. One of them is Logistics Performance Index, which gives a valuable opportunity to look at country's performance from a point of 6 different dimensions and covers all possible ways in which transportation systems can be improved.

The main idea of this study was to check whether improvement of country's LPI score would increase its trade flows and, thus, its GDP. From what the one can find in the literature, we expect to have a significantly positive effect of improving score in any of 6 dimensions of LPI on the trade flows, regardless of the region to which country belongs. What is more, we expect to observe the same positive effect when we speak of LPI Overall score, which is, simple as it is, the average of all 6 dimensions combined.

To say less but to say more, we see what we expected. Although not across the entire dataset analysis, we see that LPI dimensions' increase has a significant effect on both exports and imports trade flows.

The extended gravity model has proved its usefulness in the type of analysis that was conducted in this research. All the effects of different economic metrics demonstrated expected positive values, and negative for the distance.

The LPI dimensions fit the model well and show that, indeed, all countries may rely on the positive change in the Export and Import if they focus on improving their LPI scores.

But what is worth noting, there is an unexpected negative effect of Timeliness segment of LPI score's improvements, which is a good subject for future investigations on the matter.

The results we got in this study hold a significant relevance and importance for Ukraine, as it is placed #66 on the LPI rating, which yields that there is still a lot to improve in Ukrainian logistics systems; luckily, international experience is the valuable source of knowledge from which our country can learn.

What has to be mentioned is that there are still many improvements that can be applied to the model and the dataset we used in this research.

Missing observations are the most crucial part of possible issues with estimations. A lot of countries fail to report many economic indexes, which sometimes makes it much harder to distinguish the precise effect of the variables of interest on the dependent metric.

Another issue is inaccurate information. It happens quite often that different sources, although representing information on the same index, report different values, which, again, makes it harder to tell whether the result is precise and reliable.

The last issue that is worth noting in this study is a limited time frame – LPI was introduced in 2007 and is updated every 2 years. In this analysis, we picked a 2012-2016 period, which all-in-all gave us 3 years of observations. Although it might be enough to make a strong conclusion, one may argue that for a more accurate analysis, more years of observations must be included into the dataset.

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APPENDIX A.

DESCRIPTIVE STATISTICS

Table 8. Descriptive statistics of the data.

Variable	Obs.	Mean	Std. Dev	Min	Max
Trade Value, $US mil. (Imports)	51876	885.7342	7701.046	0	486296
Trade Value, $US mil. (Exports)	51876	862.9053	7904.816	0	397099
LPI, Tracking dim.	49518	2.871196	0.6432505	1.513605	4.377678
LPI, Timeliness dim.	49518	3.257324	0.5988288	1.665079	4.795714
LPI, Customs dim.	49518	2.699696	0.6099268	1.285714	4.20779
LPI, Infrastr. dim.	49518	2.764617	0.695879	1.272487	4.439356
LPI, Compet. dim.	49518	2.85419	0.5287899	1.571429	4.235
LPI, Quality dim.	49518	2.833324	0.6098296	1.428571	4.27905
LPI, Overall dim.	49518	2.853974	.5436195	1.598322	4.225967

Table 6. – CONTINUED

Variable	Obs.	Mean	Std. Dev	Min	Max
GDP, current $US bill.	51221	522.9121	1861.141	.9100262	18624.48
Distance, in km.	51876	7598.348	4402.24	105.1806	19812.04