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Export Potentials of Pakistan: Evidence from the Gravity Model of Trade

[1] Yasir Tariq Mohmand
[2] Aneel Salman
[3] Khurrum S. Mughal
[4] Muhammad Imran
[5] Nedim Makarevic

[1] COMSATS Institute of Information Technology, Islamabad, Pakistan
E-mail: yasir.t.mohmand@gmail.com
[2] COMSATS Institute of Information Technology, Islamabad, Pakistan
E-mail: aneelsalman@gmail.com
[3] COMSATS Institute of Information Technology, Islamabad, Pakistan
E-mail: khurrum.mughal@gmail.com
[4] IQRA University, Islamabad, Pakistan
E-mail: imraneco@yahoo.com
[5] Embassy of Bosnia and Herzegovina in Pakistan, Pakistan
E-mail: nmakarevic.science@gmail.com

Abstract

In this study, the gravity model of trade is used to analyze the export environment of Pakistan. As clear from trade data, Pakistan's share in world exports is marginal and imports dominate the trade balance. The inability of diversification both in terms of products and markets is regarded as the main cause behind this trade deficit. This research highlights the main influencing factors affecting the export environment of Pakistan. The results of the gravity equation are used to calculate the export potentials of Pakistan with its partner countries. The results suggest Pakistan still has plenty of export potential with most of the partner countries and as such Pakistan can possibly reduce or control the trade deficit by targeting these countries.

Keywords: international trade, Pakistan, gravity model.

Introduction

Most trade theories try to find answer to the qualitative question of the trade performance of a country. Trade performance can be divided into three sub categories, i) How much a country trades? ii) What does it trade? and iii) With whom it trades? The answer to this question can vary across countries, owing to policy objectives against which the foreign trade of a country is being analyzed. In recent years, the controversy over globalization and particularly trade openness has made need for quantitative research and comprehensive policy information and analysis even more necessary. The increasing debate is over that whether the benefits of trade exceed the costs associated with it. Concerns regarding the distributional consequences of trade reforms have also been expressed.

For sound policy formulation, the policy makers need to have access to comprehensive and credible information and analysis on the potential results of implemented or to be implemented trade policies. Such kind of information and analysis is required for various stages of policy implementation due to the reason that effects might differ as policy matures. These determining factors of trade and potential trade partners and markets can be highlighted using a detailed empirical research through the estimation of the gravity model of trade. The gravity model is used as a workhorse for analyzing international trade [1] because data for it is widely available, the model has high explanatory power, and there are established standard practices that facilitate the work of researchers.

Similar to the Newtonian theory of gravitation, Jan Tinbergen [2] stated that the magnitude of bilateral trade flows among countries can be explained by a law called the "gravity equation", where countries trade in proportion to their respective GDPs and proximity. The stability of the gravity equation and its ability to account for bilateral trade flows prompted many new researches in this field to analyze the effects of different economic, social and cultural factors on the bilateral trade of countries. Some of the most prominent uses of this model exist in the modeling of Free Trade Agreements (FTA) effects on trade flows.

Located in South Asia, Pakistan is a semi industrialized developing country which in last 64 years, have gone through various levels of growth like prosperity, decline and recovery (Figure 1). The manufactured exports of Pakistan in the 1960s were more than those of Indonesia, Malaysia and Thailand combined [3]. Pakistan's economy had also survived through various international catastrophes like Asian financial crisis, economic sanctions, global recession of 2001 – 2002 etc and showed incredible resilience. Pakistan has also suffered from difficult relations with neighboring India resulting into multiple conflicts, extensive domestic political disputes, a massive influx of immigrants from the neighboring country Afghanistan and being the frontline state in War in Afghanistan and the War on Terror, high population growth rate.

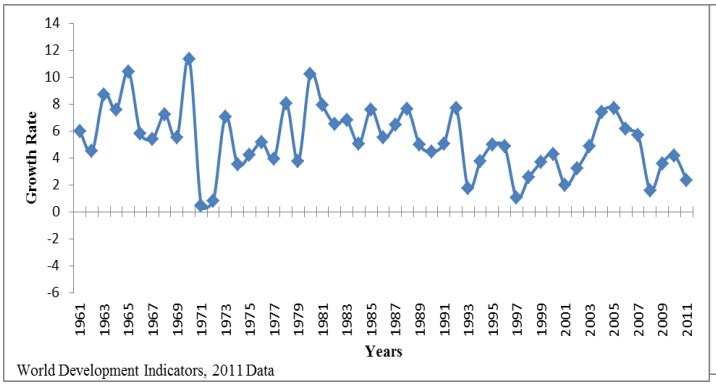

Figure 1. GDP Growth Rate Pattern

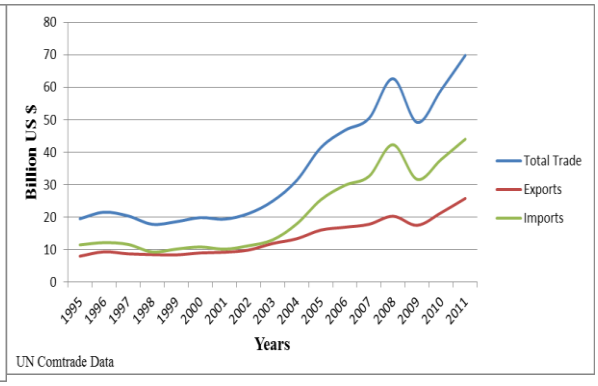

Figure 2: Pakistan Trade Data

The exports of Pakistan are primarily dominated by unprocessed or semi processed goods. These include agricultural products, like textiles, cotton, food processing, sea food and leather products. The bilateral trade of Pakistan has increased from more than 19 billion US $ in 1995 to almost 70 billion US $ in 2011 (Figure 2). However, evident from Figure 2 is the fact that imports of Pakistan have increased considerably compared to exports and as a result, Pakistan is facing a trade deficit of more than 18 billion US $ in the year 2011. The term trade deficit is not new for Pakistan. Data from the United Nations Comtrade database reveals Pakistan of having trade deficit for as far as the year 1973. There can be two reasons for the mounting trade deficit. The major export products of Pakistan, more than 80 percent of the total exports, fall in the SITC category of Food and live animals (SITC 0), manufactured goods classified chiefly by material (SITC 6) and miscellaneous manufactured articles (SITC 8). This shows that the exports of Pakistan are highly concentrated in few types of commodities and are not diversified enough. This goes beyond the types of commodities issue and the data shows that the major export destinations of Pakistan has not changed much as well since last two decades with the exception of China.. More than 80 % of the total exports are directed towards only 26 countries and at the same time losing markets rapidly. Exports to the near South Asian countries, especially the neighboring countries of India

and Iran are minimal. As a result of this trend of concentrated exports categories and markets, trade environment of Pakistan is extremely vulnerable to instabilities emanating from fluctuations in world prices, the socio political instabilities of the partner countries, and also the factors affecting the export promotion like poor infrastructure, out dated technology, non-tariff hurdles posed by the importer country, limited trade financing, etc. As such, this research primarily unveils the export scenario of Pakistan and export partners in an attempt to identify the factors influencing the bilateral trade of the country. Furthermore, the gravity model of trade is applied to the data and it is examined whether this model correctly explains Pakistan trade and trade partners. The results of the gravity model are then used to identify the potential trade partners of Pakistan, so as to provide policy makers with in-depth and accurate information for future policy making. Remaining paper is organized as follows: Section 2 contains explanation of the gravity model of trade, and review of literature on its theoretical underpinnings as well as empirical analysis, Section 3 discussed the sample data and its sources and the estimates, Section 4 discussed the results and finally Section 5 consists of conclusions deduced from our analysis.

The Gravity Model of Trade

The gravity model of trade has been extensively applied in international economics and to analyze the trade patterns of countries since its introduction by Tinbergen [2] and Poyhonen [4]. However, at first the gravity model was thought of only a depiction of an empirically stable relationship between the size of the economies, the distance between them and the amount of their trade. More popular theories at that time were the Ricardian Model and Heckscher-Ohlin (HO) model. The Ricardian model relies on differences in technology across different countries to explain the trade patterns between them whereas the HO model relies on differences in factor endowments among countries. But, because of the tremendous empirical success of the gravity model and the ability of the model to explain trade flow prompted many researchers to find theoretical justifications for it. A classical treatment of the gravity model was put forward by Linnemann [5], where partial equilibrium model of trade was estimated adding a variable to the model to reflect the trade flow constitution. Similarly, Leamer [6] added impact of income and population hence modifying the model. Anderson [7] developed a model using Armington assumption (where goods were differentiated by country of origin) and where consumers have preferences defined over all the differentiated products. Bergstrand [8, 9, 10] made several attempts in order to explore the theoretical determination of trade by employing Constant Elasticity of Substitution (CES) and monopolistic competition model. Helpman and Krugman [11] derived the gravity model under the assumption of increasing returns to scale in production. Deardorff's [12] research proved that gravity model is consistent with Hecksher-Ohlin trade theory. Another particularly important contribution to this field has been Anderson and van Wincoop's [13] paper, in which the authors showed that relative trade costs are very important if the gravity model is to be well-specified. The different applications of the gravity model provided with the explanation of the vast empirical applications possibilities of this model.

The following equation (1) gives a simple mathematical representation of the gravity model:

$$X_{ij} = CY_i^{\beta} Y_j^{\gamma} D_{ij}^{\delta} \quad (1)$$

Where
X_{ij} = export of country *i* towards country *j*,
Y_i = GDP of country *i*
Y_j = GDP of country *j*,
D_{ij} is the geographical distance between countries *i* & *j*

C, β, γ and δ are the coefficients which need to be derived empirically. A log-linear transformation of equation (1) makes its convenient for estimation using regression analysis, therefore, after the transformation we can write equation (2).

$$X_{ij} = \alpha + \beta ln(Y_i) + \gamma ln(Y_j) + \delta ln(D_{ij}) \quad (2)$$

Equation (2) is taken as the standard gravity model. However, many recent studies have included a number of variables in the standard gravity model, which are generally used to proxy trade costs among countries. These include and are not limited to dummies for islands, landlocked countries, adjacency, and also cultural variables in the form of common language, colonial history, and common religion[14, 15, 16, 17, 18, 19]. The assumption here is that transport cost increases with distance and further that it would be higher for landlocked countries and islands. Additionally it is assumed that the transport cost would be lower for neighboring countries. Similarly, cultural variables are used to capture information costs. Another common use of the gravity model is the impact assessment of regional trade agreements[20, 21, 22, 23]. These dummy variables are represented by a vector of variables Z_{ij} included in equation (2) along with an error term ε_{ij} representing other left out variables. Thus equation (2) can be written in a more general form as equation (3).

$$(X_{ij}) = \alpha + \beta ln(Y_i) + \gamma ln(Y_j) - \delta ln(D_{ij}) + \lambda Z_{ij} + \varepsilon_{ij} \quad (3)$$

1. The Model, Sample and Data

In order to construct the model, a sample of 142 countries is considered. Trade of Pakistan with these countries accounts for more than 80 % of the total trade and hence can be considered to be a representative of the whole trade. The time period under study is 17 years, from 1995 – 2011. Equation (3) is modified for this particular study and hence the resultant equation becomes:

$$(X_{ijt}) = \alpha_0 + \beta_1 ln(GDP_{it}) + \beta_2 ln(GDP_{jt}) + \beta_3 ln(D_{ij}) + \beta_4(B_{ij}) + \beta_5(RTA_{ijt}) + \beta_6(R_{ij}) + \beta_7(Lang_{ij}) + \beta_8 ln(TRGDP_{it}) + \beta_9 ln(TRGDP_{jt}) + \varepsilon_{ij} \quad (4)$$

Where

X_{ijt}	Export of country *i* to country *j* in year *t*.
GDP_{it}	GDP of country *i* in year *t*.
GDP_{jt}	GDP of country *j* in year *t*.
D_{ij}	Weighted distance between country *i* and *j*.
B_{ij}	Border, dummy variable, which is given a value of 1 if country *i* and *j* shares a common border or a value of 0 otherwise.
RTA_{ijt}	Dummy variable representing Regional Trade Agreement between country *i* and country *j* in year *t*.
R_{ij}	Religion, a dummy variable, given a value of 1 if country *i* and *j* have common religion or 0 otherwise.
$Lang_{ij}$	Common language, a dummy variable which is given a value of 1 if country *i* and *j* shares a common official language or a value of 0 otherwise.
$TRGDP_{it}$	Trade – GDP ratio of country *i* in year *t*.
$TRGDP_{jt}$	Trade – GDP ratio of country *j* in year *t*.
ε_{ij}	Error term.

As explained before, GDP and distance variables in the equation are the standard gravity model variables. GDP is used to proxy the economic size of the trading partners. Theoretically it is assumed that larger the country size (size represented by GDP) the more it would trade. So if two countries have larger GDP, their trade would be higher. Hence this variable is expected to have positive significant impact on trade. The variable Distance captures transportation cost between the countries *i* & *j*, which in our case is Pakistan and its trading partner. Greater distance would simply mean greater transportation cost, hence the variable is appear with negative significant sign. A dummy variable named Border has been added which has a value of 1 if countries share a border. Countries with shared border have higher chances of stronger bilateral trade relations. Due to this it may be assumed that Border may have a significant positive impact on bilateral trade. RTA is another dummy variable which has been used to see the impact of Regional Trade Agreement on the trade of member countries. The variable has a value of 1 if country *i* and country *j* has a RTA and 0 otherwise. Since the sole purpose of a Trade Agreement is bolstering trade, therefore, RTA is expected to have a significant positive sign. Religion and language are used as cultural variables to capture information costs and the coefficients are expected to be positive. Trade – GDP ratio is used to proxy openness of an economy to trade and hence is also expected to be positive in this case. Data on exports are taken from the United Nations Commodity Trade Statistics

Database (UN COMTRADE). Data on the rest of the variables are taken from World Bank Development Indicators (WDI) 2011.Distance is taken from CEPII with data in kilometers from capital of Pakistan to capitals of the trading partners. Data on regional trade agreements is taken from the World Trade Organization (WTO). Equation (4) is estimated using the Poisson Maximum Likelihood Estimator as it has been proved to give unbiased results as compared to OLS.

Estimation Results

The estimated results of equation (4) are presented in Table 1. All the variables of the gravity model possess their respective predicted signs apart from the border variable. The result shows numerically that a 1 % increase in the GDP of the importer and exporter country results in an increase of 2.44 % [exp (0.89)] and 3.21 % [exp (1.17)] in exports of Pakistan, respectively. The variable Distance has appeared with the expected sign which is negative and significant. The distance variable suggests that as the distance between the countries increases by 1 %, the export of Pakistan decrease 0.31 %. Interestingly, the variable "Border" variable is inversely related with Pakistan's exports. Pakistan shares a common border with China, India, Iran and Afghanistan. Afghanistan has not been included in the analysis because its data is not available. Except for China, trade Iran and India is at a low level, and it is generally considered that this trade is unrecorded and underground. Hence the results suggested a negative sign for the border variable as there is limited trade amongst the neighboring countries of Pakistan. The rest of the variables are all in line with the gravity model theory and represent positive relationship with the exports of Pakistan.

The coefficients estimated from the gravity model are used to calculate the predicted exports of Pakistan, and then these predicted exports are compared to the actual exports to see whether or not export potential for Pakistan exist. Equation (5) provides the methodology used to calculate these potentials.

$$Export\ Potential = \left\{\frac{\left[\left(\frac{Actual\ Exports}{Predicted\ Exports}\right)-1\right]}{\left[\left(\frac{Actual\ Exports}{Predicted\ Exports}\right)+1\right]}\right\} \quad (5)$$

The plus one (+ 1) and minus one (- 1) in equation (5) are used to standardize the export potential. Thus the reported potentials will be between minus one (- 1) and plus one (+ 1) where a positive index value (0 , 1) shows a higher bilateral trade than what is predicted by the model and that the exports have reached or exceeded the potential level whereas a negative index value (-1 , 0) reveals the opposite scenario.

Table 2 provides the export potential of Pakistan with the sample countries. The favorable results suggest that Pakistan still has the potential of increasing exports with 86 countries. The highest potential lies with countries of Iceland, Brunei Darussalam and Barbados whereas actual trade has exceeded with countries like Kenya, Bangladesh, Madagascar and United States. In fact these results show that Pakistan is currently focusing on trade with countries of exhausted potentials. United States, United Kingdom, United Arab Emirates and Germany are a few of the countries with which foreign trade of Pakistan is the highest, amounting to almost 33 percent Pakistan's total exports in the year 2011, yet the results reveal that export potential with these countries have exhausted. Hence, although the exports of Pakistan are flowing towards developed countries, the real trade potential of Pakistan lies with developing countries which is highly unrealized.

Conclusion

The export market scenario of Pakistan reveals a grim picture. During the past years, exports of Pakistan are not increasing as much as the imports and this has led to the building of a large trade deficit for Pakistan and is hurting the economy of Pakistan severely. Trade data of Pakistan reveals that no step has been taken to diversify the exports commodities and markets which can be held responsible for the increase in trade deficit. As such, exports are gradually declining and losing markets, whereas at the same time, exports of the neighboring countries of India, China, Bangladesh etc. are increasing and capturing the potential markets of Pakistan.

The main objective of this research is to highlight the countries with which export potential for Pakistan exist and highlight the important factors affecting the trade environment of Pakistan by using a gravity model. The coefficients of all the variables used in the model are in line with the theory of the gravity model, with the exception of the border variable, which is attributed to low levels of trade with the close proximity neighbors. The export potentials of Pakistan are bright as Pakistan still has potentials for improving its trade with the highlighted countries. The outcome of this study implies that Pakistan can bolster its exports by directing foreign trade to countries having potentials of export and as a result can control or possibly reduce the trade deficit that is damaging its economy.

Table 1: Estimation Results

Dependent Variable: Export / Method: PMLE		
Variable	Coefficient	Std. Error
Constant	-30.206*	1.797
GDP_i	0.892*	0.020
GDP_j	1.168*	0.086
Distance	-1.172*	0.068
Common Border	-0.855*	0.202
RTA	0.626**	0.253
Common Religion	0.672*	0.086
Common Language	1.070*	0.069
$TRADE\text{-}GDP_i$	0.846*	0.051
$TRADE\text{-}GDP_j$	0.662**	0.305
R-squared	0.709	
Adj. R-squared	0.707	

Notes: All variables except dummies are expressed in natural logarithms. *, **, ***, denotes significance at 1%, 5% and 10% respectively.

Table 2: Export Potentials of Pakistan

Country	Potential	Country	Potential
Iceland	-0.97	New Zealand	-0.20
Brunei Darussalam	-0.97	Panama	-0.19
Barbados	-0.97	Mexico	-0.17
Gabon	-0.96	Russian Federation	-0.15
Suriname	-0.95	Ukraine	-0.10
Belize	-0.95	El Salvador	-0.09
Papua New Guinea	-0.94	Mauritania	-0.08
Albania	-0.94	Belgium	-0.07
Armenia	-0.93	Zambia	-0.05
Slovak Republic	-0.92	Nepal	-0.04
Burkina Faso	-0.92	Zimbabwe	-0.03
Guyana	-0.90	Honduras	-0.03
Bolivia	-0.88	Burundi	-0.02
Trinidad and Tobago	-0.88	Netherlands	-0.02
Bhutan	-0.88	Canada	-0.02
Libya	-0.87	Thailand	0.03
Malta	-0.87	Greece	0.06
Seychelles	-0.86	Senegal	0.06
Slovenia	-0.86	Japan	0.08
Turkmenistan	-0.85	Brazil	0.09

Mali	-0.85	Australia	0.10
Iran, Islamic Rep.	-0.83	Hong Kong SAR, China	0.11
Chad	-0.83	Colombia	0.12
Kazakhstan	-0.82	Argentina	0.13
Latvia	-0.79	Saudi Arabia	0.13
Czech Republic	-0.79	France	0.14
Switzerland	-0.79	Uganda	0.15
Austria	-0.78	Malawi	0.16
Jamaica	-0.75	Korea, Rep.	0.18
Croatia	-0.74	Ethiopia	0.18
Azerbaijan	-0.74	Nigeria	0.19
Singapore	-0.74	Congo, Dem. Rep.	0.20
Ireland	-0.72	Guatemala	0.21
Hungary	-0.71	Chile	0.21
Costa Rica	-0.70	Portugal	0.23
Tajikistan	-0.68	Cote d'Ivoire	0.24
Maldives	-0.67	Cameroon	0.25
Kyrgyz Republic	-0.66	Ghana	0.25
Georgia	-0.66	Mauritius	0.28
Bulgaria	-0.66	Indonesia	0.29
Fiji	-0.65	United Arab Emirates	0.29
Norway	-0.63	Liberia	0.31
Qatar	-0.62	Germany	0.32
Finland	-0.62	Cambodia	0.34
Algeria	-0.62	Italy	0.36
Estonia	-0.59	Sudan	0.36
Tunisia	-0.58	Spain	0.38
Kuwait	-0.57	Turkey	0.39
Lebanon	-0.57	Philippines	0.40
Romania	-0.56	Egypt, Arab Rep.	0.41
Ecuador	-0.55	Vietnam	0.42
Malaysia	-0.53	Guinea-Bissau	0.44
Cyprus	-0.48	Niger	0.51
Denmark	-0.48	Gambia, The	0.52
China	-0.47	United Kingdom	0.57
Bahrain	-0.46	Guinea	0.58
Lithuania	-0.46	Yemen, Rep.	0.58
Uruguay	-0.43	Togo	0.58
Poland	-0.43	Sierra Leone	0.63
India	-0.42	South Africa	0.65
Morocco	-0.42	Comoros	0.68
Sweden	-0.40	Djibouti	0.70
Syrian Arab Republic	-0.36	Benin	0.70
Venezuela, RB	-0.36	Afghanistan	0.72
Jordan	-0.30	Mozambique	0.75
Uzbekistan	-0.30	Sri Lanka	0.82
Paraguay	-0.27	Tanzania	0.82
Oman	-0.27	United States	0.84
Iraq	-0.26	Madagascar	0.86
Dominican Republic	-0.21	Bangladesh	0.89
Peru	-0.21	Kenya	0.90

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УДК 33

Экспортный потенциал Пакистана: данные гравитационной модели торговли

[1] Ясир Тарик Мохманд
[2] Аниль Салман
[3] Кхурум С. Мухгаль
[4] Мухаммад Имран
[5] Недим Макаревик

[1] COMSATS Institute of Information Technology, Исламбад, Пакистан
E-mail: yasir.t.mohmand@gmail.com
[2] COMSATS Institute of Information Technology, Исламбад, Пакистан
E-mail: aneelsalman@gmail.com
[3] COMSATS Institute of Information Technology, Исламбад, Пакистан
E-mail: khurrum.mughal@gmail.com
[4] IQRA University, Исламбад, Пакистан
E-mail: imraneco@yahoo.com
[5] Посольство Боснии и Герцеговины в Пакистане, Исламбад, Пакистан
E-mail: nmakarevic.science@gmail.com

Аннотация. В этом исследовании гравитационная модель используется для анализа экспортной среды Пакистана. Как свидетельствуют данные о торговле, доля Пакистана в мировом экспорте является незначительной, а импорт доминирует в торговом балансе страны. Неспособность диверсификации рынка сбыта рассматривается в качестве основной причины дефицита торговли. Это исследование подчеркивает основные факторы, влияющие на экспортную среду Пакистана. Результаты гравитационного уравнения используются для расчета экспортного потенциала Пакистана со странами-партнерами. Полученные результаты свидетельствуют, что Пакистан по-прежнему имеет достаточный экспортный потенциал с большинством стран-партнеров и, как таковой, возможно, может уменьшить или контролировать торговый дефицит, ориентируясь на эти страны.

Ключевые слова: международная торговля, Пакистан, гравитационная модель.