

Analysis of Afghanistan's Trade Factors Using Gravity Model

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ABSTRACT:- In the present study, the explanatory factors and variables of Afghanistan trade process with Iran, Pakistan, India, China and Turkey after the change of the system from planned economy to market economy in Afghanistan from 2011 to 2021 using the model of gravity on cross-sectional data. Relevant time, it was tested experimentally that the findings of the present study show the positive and increasing effects of GDP, population, religion and language on the process of trade interactions of mentioned countries with Afghanistan and vice versa, but the variables of exchange rates and common culture between countries. At the level of 0.05, they do not have a significant impact on the cycle of trade interactions. In addition, by measuring convergence velocity, we found that there was potential space for increased Afghan trade with Turkey, India, China, and Iran, respectively, but the divergence of trade interaction with Pakistan was cited by quantitative analysis of the present study.

Keywords: - Gravity Model, Export, Import, Currency Rate, Convergence, Divergence

I. INTRODUCTION

Afghanistan introduced and implemented a market economy in 2002, after years of witnessing the implementation of a planned economy. One of its key objectives was to provide, support and encourage the private sector in economic activities and to facilitate the process of trade activities (import and export) of the countries in question with the technical and technological cooperation of the international community. In fact, this provided the reasons for the rapid growth of GDP, employment and foreign investment in the country. There is no doubt that Afghanistan is a good market for importing goods and services with the loss of most of its production and service facilities. However, the subject of this study to explain it is a meaningful explanation of the basic factors that indicate the comparative advantage of countries interacting with Afghanistan and vice versa. Case studies similar to the present study on the explanation of these factors by Dan et al. (2011), Butter Chary and Benarge (2006), Monantri (2005), Grogman and Absfield (2005), Balm Quist (2004), Deirdorf (1998) and Birgstrand (1985) and each according to the theoretical foundations, the appropriate model for analyzing such issues is the model of gravity. According to the diligence and low knowledge of the researcher, there has been no research in Afghanistan to clarify this issue and therefore, in addition to the current research, more studies are needed in this regard. The rest of the topics of the present study are arranged as follows: in the second part, the data and experimental model of the present research are specified, in the third part, the data and findings of the research are analyzed, and in the fourth section, we will summarize the present research.

Data and research model

Data

The data used in the present study is cross-sectional and covers six countries such as Afghanistan, Iran, Pakistan, China, Turkey and India from 2011 to 2021. The Value of trade Interactions (import and exports) as a dependent variable from the website of the International Trade Center, independent variables includes GDP as the size of the economy, exchange rates and population as the size of the market from the World Bank and the distance between the mentioned countries from the Website of Research and Expertise on World Economy have been obtained. Three Dummy variables such as language, religion and culture have been added, where the number 1 indicates a common language and culture and the number 0 indicates a dissimilarity of language, religion and culture.

II. MODEL

In the present study, the gravity model introduced by Tinbergen (1962) is used. However, in the main model, only two independent variables such as GDP and the distance between two or more countries are considered that in this study, some other variables such as exchange rates, language, culture and religion have been added and the model used as its logarithm specified below:

$\text{Log}(T_{ijt}) = \beta_0 + \beta_1 \log(Y_{it} Y_{jt}) + \beta_2 \log(N_{it} N_{jt}) + \beta_3 (EX_{ijt}) + \beta_4 (D_{ij}) + \beta_5 (CUL_{ij}) + \beta_6 (Etb_{ij}) + \beta_7 (Lang_{ij}) + e_{ijt}$
Where, $\text{Log } T_{ijt}$ is the log value of trade of the mentioned countries during the years in question, Y_{it} is the value of GDP of Afghanistan, Y_{jt} is the value of GDP of the relevant countries, EX_{ijt} is the exchange rate of the countries included in the model during the years, N_{it} is Population of Afghanistan, N_{jt} Population of related countries, D_{ij} distance in kilometers between countries, CUL_{ij} culture of countries, Etb_{ij} religion of countries, $Lang_{ij}$ language of countries, e_{ijt} is Random Disruption Variable and β are the angle coefficients in the model. In addition, in order to test temporal cross-sectional data and scientific inference, the following two models have been used, one of which will be selected later based on Hausmann (1978) test and the findings of the present study will be discussed:

III. MODEL WITH FIXED EFFECTS

In the model with fixed effects, which is specific to the temporal cross-sectional data test, each component has its own fixed value, and because a dummy variable is considered to work with each of these fixed values, The estimator of fixed effects is also called the estimator of dummy variables of least squares, and this model can be written as follows (Marno, 2004).

$$Y = D\alpha + \beta X + u$$

Where D is the matrix of dummy variables with dimensions NT (N) and X is the matrix of independent variables with dimensions NT (K) and β is the matrix of coefficients with dimensions K (1). Considering some variables of this research such as language, religion and culture that do not change over time, the model with fixed effects can show these components, but it should be noted that for each of these variables also the angle coefficients should be added In the model, that with this description, the problem of alignment of variances of the model can be solved by reducing the mean time value of each variable, and by doing so, we reach a model that will have no width from the origin and we can use the ordinary least squares method. To run it as specified:

$$\bar{u}_i = \frac{1}{T} \sum_{t=1}^T u_{it} \quad \text{While } \bar{X}_i = \frac{1}{T} \sum_{t=1}^T X_{it} \quad \text{and } Y_{it} - \bar{Y}_i = (X_{it} - \bar{X}_i)\beta + (u_{it} - \bar{u}_i),$$

$$\beta^{FE} = \left[\sum_{i,t} x'_{it} x_{it} \right]^{-1} \sum_{i,t} x'_{it} y_{it} \quad \text{And the same } y_{it} = Y_{it} - \bar{Y}_i \quad \text{while } x_{it} = (X_{it} - \bar{X}_i) \quad (\text{Gujurati, 2004}).$$

IV. MODEL WITH RANDOM EFFECTS

In spite of the fixed effects model, it is a random effects model in which the angle coefficients for each of the independent variables are randomly selected and, accordingly, the value $\alpha_{it} = \mu_i + v_{it}$ where v_{it} is assumed to be a function of the white noise distribution with is $(0, \sigma^2)$. The model formula is written with random effects as follows:

$$Y_{it} = \mu + \beta' X_{it} + v_i + u_i$$

Where v_i is assumed to be separate from the random disturbance variable. To study the findings of the present study based on a suitable model, whether with fixed or random effects, we use the Hausmann (1978) test, the formula of which is presented below:

$$H = (\beta_1 - \beta_0)' (Var(\beta_1))^{-1} (\beta_1 - \beta_0)$$

In which, in order to test the zero hypothesis of the suitability of the model with random effects, we will use the distribution of square chi to the level of 5% error.

V. ANALYSIS OF RESEARCH DATA AND FINDINGS

Although the pooled regression model is one of the most common and traditional methods for cross-sectional time data, one of its disadvantages is that it no considers the individual characteristics of countries (Do, 2006). Nevertheless, the easiest way to establish data analysis with fixed-effect and random-effect models is joint regression (see Table 1).

Dependentvariable: Commercial value	Angle coefficient	Square error	Statistics of T	Probability value
$Y_{it} Y_{jt}$	0.003679	0.0004809	7.59	0.000
$N_{it} N_{jt}$	0.002261	0.0016259	1.39	0.043
Exr_{ij}	0.002255	0.002852	0.89	0.378
$Lang_{ij}$	-1.39114	0.37822	-3.89	0.001
Cul_{ij}	-0.61772	0.311590	-1.98	0.005
Etb_{ij}	0.002567	0.029871	0.85	0.001
Width of origin	16.6517	0.37843	44.00	0.000

Table 1: Regression analysis results

The variables of GDP as the volume of economy, population, culture and religion were significant at the level of 0.05, but it is not possible to reach a suitable conclusion from the result of this regression, because the individual characteristics of countries are somehow non considered and fixed or Random effect models must be considered forobtain a more logical inference

Model	Fixed effect		Random effect	
Dependentvariable: Commercial value	Angle coefficient	Probable value	Angle coefficient	Probable value
$Y_{it} Y_{jt}$	0.005787	0.204	0.003647	0.000
$N_{it} N_{jt}$	0.027731	0.431	0.002261	0.000
Exr_{ij}	0.002164	0.457	0.002552	0.164
$Lang_{ij}$	-	-	0.002341	0.000
Cul_{ij}	-0.57157	0.065	-0.61772	0.057
Etb_{ij}	0.006541	0.247	0.003414	0.000
Width of origin	8.03520	0.000	16.6519	0.000

Table 2: Results of fixed effect and random effect models

Gross domestic product or $Y_{it} Y_{jt}$ has a significant probability value at the level of 0.05 has a positive effect on the country's trade trend with other countries included in the present study. 1 percent increase in the level of GDP causes an increase of 0.003647 percent increase in the level of imports and exports. The exchange rate (used dollar currency) in both models with a non-significant probability value at the level of 0.05 shows a very weak effect that not remarkable. Population is one of the variables that with a significant probability at the level of 0.05 has a positive effect on the process of Afghanistan's trade with the mentioned countries. In other words, a 1 percent increase in the population level provides a reason for an increase of 0.002261 percent in the commercial level. Language variable was one of the dummy variables that we entered in this study and from the table above it can be inferred that this is a significant variable at the level of 0.05 with an angle coefficient of 0.002341 but the variable of culture with an non-significant probability value at the level 0.05 cannot be considered according to both models. The common religion variable between Afghanistan, Iran, Pakistan, Turkey and.... countries included in the present study has a significant positive effect at the level of 0.05 and it is inferred that if the religion is common among the mentioned countries, it has 0.003414% increasing impact on the trade process and the opposite has a negative effect.

Hypothesiszero	Chi square	Probability value
The random effects model is suitable for testing this research	5.48	0.2414

Table 3: Hausmann test result

The table above shows the result of Hausmann test for selecting the appropriate model from the fixed effect and random effect models in which the statistical value of chi square is 5.48 with a probability value of 0.2414. The probability value presented is greater than the alpha level of 0.05, and with this description, the zero hypothesis cannot be rejected (see: Milliment, 2009). Therefore, the results obtained from the stochastic effect model are the basis for discussing the findings of the present study.

VI. POTENTIAL TRADE INTERACTIONS

Obviously, using the gravity model, a solution must be found to compare the amount of potential trade interactions with the actual interactions during the study period in order to be able to guide the direction of

policies in the case of trade interactions. Therefore, according to the model of gravity and using the convergence velocity method recommended by Jakab et al (2001), we measure and analyze the amount of potential trade interactions. The convergence velocity formula is as follows:

$$\text{Speed of Convergence} = \frac{\Delta T_p}{\Delta T_A} 100 - 100$$

Where ΔT_p is the average potential trade growth and ΔT_A is the average actual trade growth over the time under study. If the speed of convergence between Afghanistan and other countries is negative, then the amount of trade is higher than the desired level, we call it the speed of divergence, but if the speed of convergence is positive, there is space for more activities of trade (Egger, 2002).

Country	Current trade interactions log	Potential trade interactions log	Convergence	Divergence	Degree based on desirability
India	20.070	52.631	32.561		2
Iran	20.684	23.469	2.785		4
Pakistan	19.723	12.379		-7.344	
Turkey	16.851	121.739	104.888		1
China	250.269	260.934	10.665		3

Table 4: Convergence and divergence velocity analysis

The speed of convergence of trade interactions (imports in bulk more than exports) with countries such as India, Iran, Turkey and China is graded according to the space for developing trade interactions, in which interactions with Turkey are in the first category, India in the Second, China is in third category and Iran is in fourth category. Since Afghanistan is close Pakistan and domestic transportation routes are more accessible, it has led to divergence in trade relations with Pakistan.

IV. CONCLUSION

In the present study, using gravity model and cross-sectional empirical data for six countries such as Afghanistan, India, Pakistan, Iran and China during the years 2011 to 2022 by determining explanatory variables such as economic volume (GDP), market size (Population rate), geographical distance, exchange rates and three dummy variables such as language, culture and religion between countries interacting with Afghanistan were tested experimentally.

The findings of the present study indicate the Positive and increasing effects of GDP, population, religion and language on the process of trade interactions of mentioned Countries with Afghanistan and vice versa however, the variables of exchange rates and common culture between countries at the level of 0.05 do not have a significant effect on the process of trade interactions.

In addition, by measuring and analyzing the speed of convergence, we found that there was a potential space for increasing Afghanistan's trade with Turkey, India, China and Iran, respectively, but the divergence of trade interaction with Pakistan was cited by quantitative analysis of the present study.

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