EFFECTS OF RAIL TRANSPORTATION COSTS AND INFRASTRUCTURES ON IRAN-MIDDLE ASIA COMMERCIAL POTENTIALS: A GRAVITY MODEL APPROACH

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Abstract

This paper analyzes impact of various factors related to the transportation sector as well as costs associated based on gravity model. The results of the estimated gravity model using panel data from 1992 to 2006 indicates that transportation costs, crystallized in the variable of distance among countries, have negative impact on trade between Iran and middle Asia countries. Also the effect of factors related to rail transport like long lines of rail network and the amount of load moved is relatively strong. With expanding transportation system and specially investment in rail transportation infrastructure as a clean, affordable, reliable and efficient tool, Iran is in a very specific geographic location to enjoy comparative advantage of the benefits of transit for middle Asia and increase export revenues and improve their strategic position in the region

Key words: commercial potential, gravity model, rail transportation, Middle Asia Countries

JEL Classification: F10, F11, F14, O53

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Introduction

Iran is in a specific geographic location and can play key role in the transport of goods by land transport (rail and road) as well as air and sea ones. Iran can serve bridge between Asia – Europe and North – south, establishing rail network link between Europe and continents like India. Moreover, Iran due to geographical conditions accessibility to sea, can be considered as loop of goods and passengers route of middle Asia countries with the other world countries and the major load centers of world, especially in the southern Persian Gulf markets.

This study investigate the role of rail transport network in Iran trade potential with Central Asian countries that are one of the most effective areas for trade with Iran, based on gravity model. For this purpose, at first the business conditions, economic characteristic and current situation of transport infrastructure should be studied in these countries.

2. Business and economic conditions and rail transport infrastructure in middle Asia countries and Iran

2.1. Trade and regional economic conditions and trade relation with Iran

Central Asian countries have in total about 58 million people including Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan and Kazakhstan, the most populous country is Uzbekistan with 27 million people and least populous country is Turkmenistan with 4/8 million people.

In terms of geographical location and energy resources Central Asia after the Persian Gulf region is a critical area of international future development in the word. This region with possesses immense resource of oil, gas, coal, uranium, iron, and non- ferrous metals and agricultural talents has high potential for growth and market development, However , the lack of financial resources to exploit of these resources is considered as a major problem in this area.

Central Asian countries in the region after independence in 1991, placed on agenda tradition on the state economy to open economy, like most other independent countries of the former Soviet Union. So that these countries during 1995 to 2000, with economic reforms, particularly in the area of trade and price liberalization, reduction of government intervention, transparency in the business environment and attract the investment policy before taking its natural resources in the area could improve their economic growth and should control their high inflations with different songs.

Global statics about foreign trade of central Asia series indicate that in 2008 the value of commodity imports totaled 5/57 billion dollars shows the share of 79/0 per cent of global imports for these countries. Also in the field of exporting these have sent totaled 96/5 billion dollars of goods for the export purposes showing that these countries have responded 46 percent of global demand for goods, statics comparison of product s import and export of these countries represent 39 billion dollars surplus in 2008. Therefore we can say this region has currency earnings needed to meet their import. On the other hand the labor costs per unit of production were on the rise in these countries. And caused the production costs and commodity prices rise in this country ,statics also show that the real private consumption expenditure has increased because of relatively high economic growth showing that increased imports from these countries is in the coming years.

Latest available statics on foreign trade of Iran with central Asia suggest the performance of Iran in using of these markets are not so good, and in recent years trade and Iran trade balance with these countries has been negative. This issue as well as many other Iranian economic failures is resulting from heavy reliance on oil revenue, and lack of necessary attention to developing non-oil exports.

Table 1- Commodity trade with Central Asian states of Iran in 2008

(Billion Dollars)	Kazakhstan	Kirgizstan	Turkmenistan	Tajikistan	Uzbekistan	Total
Exports to Iran	61	44	1800	170	66	2141
Imports from Iran	295	18	450	45	237	1044
Commercial balance of Iran	234	-24	-1350	-125	170	1097-

Source: Islamic Republic of Iran Customs

Therefore the potential trade between Iran and Central Asian countries is high and if development come to provide, export promotion is possible and there are the strengthen infrastructure including international transport infrastructure as a regional rail network.

2.2. current status of infrastructure and rail transport industry in Iran: Opportunities and Challenges

Based on derived statics from existing resources, Iranian railway has been able to venture, carry 33 tons and 44/5 million passengers using the main road network of about 8500 km, 21633 devices wagon freight and 1666 devices passenger wagon in its rail network. Also based on the

whole traffic unit moved passenger and load carried in listed year respectively were 20/5 billion tons-kilometer and 13/9 billion people – km that these figures compared with international average are not in a desirable level.

due to its strategic position and having the axis of corridors in the north – south and east – west, Iran can get high income from transit and promote the economic position in regional and global levels but yet could not get its own special place in this context that the failure to bring rail transport network is considered on one reason to this issue.

economic theory view, subdivision- railway transport has increasing efficiency in wide range of factors used in their production, it means increased utilization increased the production factors because of this situation the share of investment is high, it means average cost of production unit decreased by increasing production. Also the demand elasticity rail transport service is about one. Given these condition, by expanding rail network, increasing the possibility of lower prices and increased demand and profitability will be fully prepared. So if the space of activities be open, private sector management practices in the rail transport system in a competitive environment, opportunities in this sector will be created to increase consumer welfare and improving the national economy.

2-3- Current status of rail transportation infrastructure in middle Asia countries and a brief comparison with a wider geographical North- South communication corridor.

Cost of transporting transit goods through North – South corridor is cheaper by 30 percent than other more traditional routes and it is calculated 40 percent of time saving (between 17 and 22 days). On this basis can be expected cost of goods passing through this route has decreased. This has a lot of merchants and trader attention to this corridor.

3. Theoretical and empirical literature

3.1. Gravity model

One application of gravity model is using it to explain bilateral trade flows between countries. Actually this model is a modified version of Newton s law of gravity, according to this law, attraction between two objects is a function of mass and distance between them. Data flexible control and the appropriate number of variables are some of the benefits related to the gravity model.

In the fundamental form, the gravity model explains the exports level from the country i to country j by exporting countries GDP and importing countries GDP and the distance between them through the following formula:

$$X_{ij} = G \frac{M_1^{\beta_1} M_2^{\beta_2}}{D_{ij}^{\beta_3}}$$

Where X_{ij} is an object or in fact is the bilateral trade flows, G is proportionality coefficient, M1 is country i GDP, M_2 is country j GDP, and D_{ij} is the geographical distance between two countries.

The best variables that can shows the economic size of countries is GDP variable, increasing country's GDP increased to attract produced goods and import demand and export demand and export supply and thus country's flow of foreign trade increased.

Differences between two countries represent the transportation cost and distance between two countries, and amount of trade between countries is related inversely. However, whatever geographical distance is more between two countries the cost transportation increases.

Also, in order to avoid too simply modeling and avoiding observed skewed error and therefore much closer to reality analysis, other influential variables such as population, which t implicitly reflect extent and size of each country's market also be added to the model, so that gravity model result to be generalized. However, in this research in addition to this parameter, other explanatory variable are terms such as rail and road lines, total shipment of road and rail, and also the amount of displaced travelers by air and rail fleet which somehow reflects the strength of transport infrastructure in those countries that are studied. Next, some studies that using gravity models are referred.

3-2- Overview of some studies using gravity models

Further studies before 2000, as mentioned with sectional data approach, are estimated gravity model to the OLS method. In order to the estimated number of variables virtually are ignored, many of the effects of heterogeneity are not considered among studied countries. So, studies after 2000 have emphasized to this feature and they are used panel data method. Since in this paper, the listed method is used, in this section has tried to mention to the studies with the same approach.

John McCallum (1995) is used gravity model for economic integration review of Canada and United State. In this study, also population variables have entered to the model for two i and j

regions and have shown that these variables present a lot of effects. he states that the review in 10 countries in 50 states of Canada and the United States reach the conclusion that integrity of Canada- America s free trade zone has a large impact on Canada trade and not only didn't decrease trade between Canadian provinces but also this business shall more than 20 times.

Sologa and Winters (1999) are paying to study new preferred agreements using gravity model that began in early 1990.the model takes the 17 regression equation annually for the period 1980 to 1996.the results show that there is no significant witness claims that regionalism is increased the trade between countries within the group.

Adeli and Elahi (2006), smart study, is One of the few studies has been done in Iran using the gravity models associated with infrastructure and transportation costs. This study was sought to make the quantity impact of rail and road transport infrastructure and ECO region on a regional trade of Iran with other ECO member trough gravity model. This paper has been shown that the increase in transportation costs reduced the trade volume and also the effect of having transportation infrastructure has been increased trade flows.

Gholami (2006) has paid to analyze the effects of trade liberalization in Iran with the Islamic countries using the gravity model. In this study we have tried to examine benefits of implementing trade liberalization policies in the form of treaties and regional trade. results of this study suggest that, regionalism could be the most effective way for gradual opening of national economies in these kind of countries and their integration into global economy for developing countries that aren't readiness sudden arrival of free trade. Also trade liberalization has significant positive impact on Iran s foreign trade with 16 trading partner.

In Kobra Shakibae and Bta study (2009), gravity models modeling and estimation of trade effects has been used with the aim of identifying the success or failure of Iran s potential for regional block in Southeast Asia. Results of this study represent 61 percent commercial potential of Iran and economic integration of regional block countries and state that bilateral trade flows between them increases. Also without presence of Iran, estimated the model was more convergent and regional block would increase 71 percent trade between the block members.

4. Model and Empirical Results

4.1- Model

According to classical gravity model (stem), volume of trade exchange between two countries is a function of their income (GDP), population, and distance of two countries together.

But also in the generalized gravity models are used another explanatory variable depending on the purpose of investigating. Also in this study in order to assess the relationship between transport infrastructure on Iran trade flows and selected countries, in addition to classic variable of geographic distance which is a representation to show transportation costs in trade between countries, gradually in modeling state are added other variable to the model to explain trade flows such as volume of rail and road lines of countries and trade of load and the passenger transported by rail and air fleet. Considering the above points can display the prototype as following:

$$X_{ij} = \beta_0 GDP_i^{\beta_1} GDP_j^{\beta_2} POP_i^{\beta_3} POP_j^{\beta_4} D_{ij}^{\beta_5} e_{ij}^t \qquad \text{Eq(1)}$$

Where X_{ij} is exports to each of the countries studied, GDP and GDP, respectively are GDP of Iran and each of other countries based on 2000 constant prices, POP is population and D_{ij} represent the distance between countries i and j s capital. In this equation and subsequent equation index I indicate Iran and index J REPRESENT 5 COUNTRIES TRADING PARTNER OF Iran in Central Asia including Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

In order to make the above linear model can take logarithm of both sides of the equation.

$$LnX_{ij} = \beta_0 + \beta_1 LnGDP_i + \beta_2 LnGDP_j + \beta_3 LnPOP_i + \beta_4 LnPOP_j + \beta_5 LnD_{ij} + \varepsilon_t \qquad \text{Eq (2)}$$

To estimate the impact of rail transport infrastructures, also we are added to the model rate rail lines variable based on km and also, the amount of load carried by the Iranian rail network, and five other countries in terms of million ton kilometers and also the number of passengers moved by the fleet in terms of million kilometers.

$$LnX_{ij} = \beta_0 + \beta_1 LnGDP_i + \beta_2 LnGDP_j + \beta_3 LnPOP_i + \beta_4 LnPOP_j + \beta_5 LnD_{ij} +$$
$$\beta_6 LnRail_i + \beta_7 LnRail_j + \beta_8 LnRGT_i + \beta_9 LnRGT_j + \beta_{10} LnRPC_i + \beta_{11} LnRPC_j + \varepsilon_t \qquad \text{Eq(3)}$$

Where the rail, RGT and RPC, respectively, are: Countries of rail lines by km, Amount of load carried by rail network and the number of passengers moved by rail.

But in order to further develop of the model and also considering other modes of transport on trade flows, at next step, we are added to model variable such as rate and passenger transport by air fleet (per million tons of kilometers) that respectively show them with ATF and APC symbols and also the amount of road lines in terms of kilometers (road)

$$LnX_{ij} = \beta_0 + \beta_1 LnGDP_i + \beta_2 LnGDP_j + \beta_3 LnPOP_i + \beta_4 LnPOP_j + \beta_5 LnD_{ij} +$$
$$\beta_6 LnRail_i + \beta_7 LnRail_j + \beta_8 LnRGT_i + \beta_9 LnRGT_j + \beta_{10} LnRPC_i + \beta_{11} LnRPC_j +$$
$$\beta_{12} LnATF_i + \beta_{13} LnATF_j + \beta_{14} LnAPC_i + \beta_{15} LnAPC_j + \beta_{16} LnRoad_i + \beta_{17} LnRoad_j + \varepsilon_t$$

Eq(4)

It can be used the product of variables as a single variable because in this type of modeling information related to the country I (Iran) remain fixed. Thus equation 2, 3 and 4 can be rewritten in the form of equation 5 , 6 and 7 as follows:

$$LnX_{ij} = \beta_0 + \beta_1 Ln(GDP_i \times GDP_j) + \beta_2 Ln(POP_i \times POP_j) + \beta_3 LnD_{ij} + \varepsilon_t$$

Eq(5)

$$LnX_{ij} = \beta_0 + \beta_1 Ln(GDP_i \times GDP_j) + \beta_2 Ln(POP_i \times POP_j) + \beta_3 LnD_{ij} +$$
$$\beta_4 Ln(Rail_i \times Rail_j) + \beta_5 Ln(RGT_i \times RGT_j) + \beta_6 Ln(RPC_i \times RPC_j) + \varepsilon_t$$

Eq(6)

$$LnX_{ij} = \beta_0 + \beta_1 Ln(GDP_i \times GDP_j) + \beta_2 Ln(POP_i \times POP_j) + \beta_3 LnD_{ij} +$$
$$\beta_4 Ln(Rail_i \times Rail_j) + \beta_5 Ln(RGT_i \times RGT_j) + \beta_6 Ln(RPC_i \times RPC_j) +$$
$$\beta_7 Ln(ATF_i \times ATF_j) + \beta_8 Ln(APC_i \times APC_j) + \beta_9 Ln(Road_i \times Road_j) + \varepsilon_t$$

Eq(7)

4.2. Data

In this study, five Central Asian countries are chosen that were geographically enclosed and also is potentially providing rail exchanges possibility between them and Iran .as it was said that these countries are: Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Data used in the model is annually information about countries GDP (in constant 2000 prices) Population, level of rail lines and roads, load and passenger rates transported by rail and road fleets, has been extracted of World Development Indicators. Statics relating to the distance between Tehran and the capital of other countries is adapted of www.distancefromto.net, Web site and also information about Iran s exports to five countries studied, according to America dollars is adapted of Islamic Republic of Iran customs trade yearbook.

In this study models (5), (6) and (7) is estimated by using panel data and data from five countries mentioned on period 1992 to 2006. Views of this estimate are equal to 75 observations.

4.4. Model Estimation

The result of table 1 shows that based on F statics obtained for each equation, ability to estimate the model assumption will be accepted in the target countries. also according to the results of Husmen test, fixed effects model for the equation (5) and (6) and random effect models the equation (7) are selected as the top models. Model results indicate that geographic distance

variable (transportation costs) is confirmed with 95 percent significance level on all models and have expected sign.

Table 4- estimation results of Gravity model (dependent variable: logarithm of exports to country j)

Coefficient	Eq(5) Joint Effect	Eq(5) Fixed Effect	Eq(5) Random Effect	Eq(6) Joint Effect	Eq(6) Fixed Effect	Eq(6) Random Effect	Eq(7) Joint Effect	Eq(7) Fixed Effect	Eq(7) Random Effect
Intercept		10.78^{**} (5.34)	14.39 (1.56)		18.59^{**} (4.76)	17.24^{**} (2.92)		29.59^{**} (2.69)	9.50^{**} (10.79)
$Ln(GDP_i \times GDP_j)$	0.02 (0.40)	0.0075 (0.12)	0.018 (0.22)	0.14^{**} (1.99)	0.25^{**} (2.45)	0.19^{**} (2.89)	0.014^{**} (2.10)	0.35^{**} (2.54)	0.14^{**} (2.56)
$Ln(POP_i \times POP_j)$	0.36^{**} (3.33)	0.46^{**} (3.80)	0.26^{*} (1.66)	0.37^{**} (2.31)	0.36^{**} (2.12)	0.31 (1.26)	0.14^{**} (2.83)	0.31^{**} (2.39)	0.20^{**} (2.65)
$Ln(D_{ij})$	-0.66^{**} (-4.43)	-1.33^{**} (-12.67)	-0.64^{**} (-4.03)	-0.89^{**} (-4.34)	-0.90^{**} (-3.96)	-0.89^{**} (-3.07)	-1.21^{**} (-6.50)	-0.98^{**} (-3.18)	-1.07^{**} (-2.69)
$Ln(Rail_i \times Rail_j)$				0.58^{**} (3.42)	1.008^{**} (2.67)	0.87^{**} (2.82)	0.88^{**} (4.96)	1.37^{**} (2.90)	0.87^{**} (2.75)
$Ln(RGT_i \times RGT_j)$				0.40^{**} (3.20)	0.78^{**} (2.93)	0.69^{**} (2.81)	0.55^{**} (5.19)	1.09^{**} (2.98)	0.61^{**} (2.32)
$Ln(RPC_i \times RPC_j)$				-0.06^{*} (-1.67)	0.02 (0.89)	-0.02 (-0.68)	0.07^{*} (1.91)	0.04 (1.01)	0.04 (0.93)
$Ln(Road_i \times Road_j)$							0.75^{**} (3.95)	0.08 (0.18)	0.45^{**} (0.83)
$Ln(ATF_i \times ATF_j)$							0.17^{**} (4.07)	0.13 (1.12)	0.08^{**} (0.73)
$Ln(APC_i \times APC_j)$							0.11 (1.29)	0.06 (0.52)	0.05 (0.33)
$LnX_{ij}(-1)$	0.49^{**} (13.44)		0.45^{**} (8.21)	0.44^{**} (14.43)	0.45^{**} (4.96)	0.44^{**} (9.60)	0.48^{**} (17.69)	0.42^{**} (4.42)	0.47^{**} (8.11)
R^2	0.80	0.84	0.72	0,88	0.91	0.78	0.90	0.91	0.79
D.W	1.98	1.018	2.06	1.90	2.12	2.31	2.28	2.09	2.39

F		18.28	43.27		25.97	31.69		22.19	22.83

Note: The values in parentheses represent t statistics are at 95%

Note: ** for significant at the 95% confidence level & * for Significant at 90% confidence level

Examining the results of estimating models (5), (6) and (7) can be concluded as following:

Ratio of gross domestic variable and also the country's population (β_1 and β_2) mostly are significant and their sign is expected in all cases. thus the result of estimate is confirmed the first gravity model hypothesis that whatever the size of the two countries economy is more and more people are in its place, trade volume will increase between them.

Sign of the distance variable in the estimated (β_3) is negative and also have been reported significant in all cases. It means whatever the distance of any country is more with Iran, volume of its trade relation with Iran reduced. Reasons, including increased transportation costs.

Among the variable related to rail transport infrastructure that have been particularly presented in the equation (6), amount of load carried by rail variables as well as railroads, after estimating, meet the theoretical expectation and they are also meaningful. But amount of moved passengers variables by the fleet wasn't significant in the equation and only in a fixed effect approach provides sign agrees with previous expectation, perhaps it can be expressed in order to justify this phenomenon, search doesn't seem very logical for establishing a logical relationship between these variables with the depended variables which is Iran s commodity export to the five other countries, since the passenger transport are considered among the business services. However as can be seen the coefficient obtained for the explanatory variables (RPC) in the equation (7) and coefficients related to the amount of moved passenger variable by air fleet were not significant on 95 percent confidence level that possibly justify the recent evidence will be the case.

Also Coefficients related to the long lines of the road are significant with a very strong and significant coefficient of rail long lines in the equation (7), these results suggest the high volume of trade of Iran and the studied countries via ground transportation.

5. Conclusion

In this paper we were looking for reviewing the effects of infrastructures and rail transport costs of Iran and central Asia collection on trade flows of these countries with Iran based on gravity model. In dimension of impact costs of transportation we took advantage from

geographical distance variable (that is one of the classic gravity model variables) as a representative to reflect the cost of transportation. The results suggest a negative effect on this parameter on the current volume of Iran s exports to these countries. According to research results in discussion about the infrastructure rail transport, which suggests a positive and significant correlation of rail lines volume with our exports to selected countries,

more investment in construction of rail way lines and also special effort and attention to build quickly strategic lines has significant role in taking strength of this critical path such as Chabahar –Zahedan –Mashhad and Bandar Abbas-Bafq-Mashhad as an important part of Northern and Southern parts of the interface loop of North- South corridor, and on the other hand it leads communication and access of studying countries in this research to the open water of the Persian Gulf and Oman sea.

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