

# DOES REAL EXCHANGE RATE MATTER FOR EMERGING MARKETS' INTERNATIONAL TRADE? A GRAVITY MODEL APPROACH FOR TURKEY

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## Abstract

From its perspective, we apply the gravity panel data model (log of OLS and REM models) to Turkey's bilateral trade flows over 1990-2005, using annual data. In our augmented gravity model, we test the model for the effects of real exchange rate (RER), and a set of dummy variables (Custom Union (COSTUM), The crisis of 1994 (D\_94) and 2001 (D\_01), either facilitating or restricting trade between pairs of countries, on trade performance of Turkey, as well as the core variables; distance (DIST), incomes (GDPs or PPP) and populations (POPs) of the trading countries, as quoted in standart models.

**Keywords:** Real Exchange Rate, Trade, Gravity Model

**JEL Classification :**F13, F15, F31

## Introduction

Trade is an entegral part of the total development growth and national growth of an economy. This is, in fact, a crucial instrument for industrialisation while access to foreign exchange is essential for sustained economic development.

In the 1860s, H.Carey first applied Newtonian physics to the study of human behaviour, and the so-called "gravity equation" has since been widely used in the social sciences. In economics, gravity model studies have achieved empirical success in explaining various types of inter-regional and international flows (including labor migration, commuting, customers, hospital patients, and international trade). Gravity model of international trade was developed independently by Tinbergen [1] and Pöyhönen [2]. Gravity type models have often been used to analyse trade flows between countries and trading blocs. Previously however, these models were only applied to either cross-section data, or to single country time-series data, which imposed severe explicit (or implicit ) restrictions on the sepecification of the model. Recently gravity models have been generalised and adapted to a panel data setting, where several time-series of cross-section data sets were pooled. This approach not only increases the the degree of freedom, it also enables the proper specification of source and target country effects and time (or business cycle) effects.

Although Gravity models have been criticised for their lack of theoretical underpinnings, empirically ( especially in forecasting ) they seem to perform particularly well, and are therefore well suited for policy analysis [3]. Among them, Tinbergen [1], Linnemann [4], Aitken [5], Thursby and Thursby [6], Anderson [7], Bergstrand [8], Oguledo and MacPhee [9], Brad [10], Frankel et al [11, ]Matyas [12,13] and Cheng and Wall [14] are of importance.

Turkey is one of the rapidly emerging markets in the world. Beginning in 1980, Turkey changed its economic development policy from “import substitution for industrialization” to an “export-oriented growth” strategy. And this strategy has led Turkey’s foreign trade to develop enormously in terms of quantity and quality since the 1980s.

The gravity model of international trade has become one of the standard tools for analyzing trade patterns and trade. In its usual modern articulation, the gravity model hypothesizes that the larger, the richer, the closer together two countries are, the more they trade.

The relationship between the real exchange rate and the level of output is an important and controversial issue and determinant of the real exchange rate; and secondly, the effects of changes in the real exchange rate on the level of output of the economy also is related to the exchange regime of a country. This issue is discussed in section II.

In section III, gravity model is analysed in the light of the Newtonian physics notion which has been adapted to international trade theories. Furthermore, in its theoretical justification, we focus on both standard equilibrium models and augmented forms of gravity equations of trade (following Linneman, Anderson, Bergstrand, Helpman & Krugman, Eaton and Kortum, Deardoff, Jakab et.al and others )

Section IV deals with application of the gravity model in analysing Turkey’s trade. After giving a brief picture of her trade, sample size and data issues are taken into consideration. Countries are chosen on the basis of importance of trading partnership with Turkey and availability of required data. The data collected for the period 1990-2005 (26 years ). All observations are annual. From its perspective, we apply the gravity panel data model (log of OLS and REM models) to Turkey’s bilateral trade flows over 1990-2005, using annual data. In our augmented gravity model, we test the model for the effects of real exchange rate (RER), and a set of dummy variables (Custom Union (COSTUM), The crisis of 1994 (D\_94) and 2001 (D\_01), either facilitating or restricting trade between pairs of countries, on trade performance of Turkey, as well as the core variables; distance (DIST), Incomes (GDPs or PPP) and populations (POPs) of the trading countries, as quoted in standard models.

This paper explores the determinants of bilateral trade flows between Turkey, as a rapidly emerging market, and 37 counterparts, developing and developed, belonging to the European Union, OECD and other organizations. A gravity model of international trade is empirically tested to investigate the relationship volume and direction of international trade. In doing so, especially it is emphasised the role of exchange rates between trading countries as for Turkey. This study also is an attempt to find out the major determining factors of Turkey’s trade flow using panel data estimation technique.

Therefore, we have applied generalised gravity model for our analysis. The model is “augmented” in that, several conditioning variables that account for other factors that may affect trade have been included over and above the income and distance.

### **1. Does Real Exchange Rate Matter For Trading Counterparts?**

There has been controversy among economists on whether the high level of exchange rate volatility characterizing the world economy since the breakdown of the fixed exchange rate system has had a negative effect on international trade. Empirical observations show that daily or monthly nominal exchange rate movements have become much more volatile since 1973 [15]. The most common assertion has been that the risk associated with this exchange rate volatility has reduced the level of exports, for example, Hooper and Kohlhagen [16].

It is of considerable importance to have information about the causes of exchange rate changes since some changes require corrective intervention by the monetary authorities, whereas some others do not. The reason is that movements in the real exchange rate (RER), defined in the economic literature as the price ratio of tradable goods to non-tradable goods, may or may not signal a loss in the competitive stance for economy. An appreciation of the real exchange rate, for instance, may be accompanied by an appreciation of the equilibrium real exchange rate (ERER). To the extent that the movements in RER are accompanied with movements in ERER, there is no need for policy intervention, however, when the real exchange rate movement is a significant departure from its equilibrium value.

The choice of an exchange rate regime has been and will continue to be a major, but controversial, area of research in economics. Following Poole (1970) there is some consensus among economists that the optimal exchange rate regime depends on the nature of shocks facing an economy. In particular, it depends on whether shocks are real, nominal, domestic, or foreign [17].

The relationship between the real exchange rate and the level of output is an important and controversial issue and determinants of the real exchange rate; and secondly, the effects of changes in the real exchange rate on the level of output of the economy. Halpern and Wyplosz [18] investigated the determinants of the real exchange rate for transition economies. They found that, following liberalisation, the real exchange rate usually first depreciates sharply and then appreciates, with the most important determinant of real exchange rate appreciation being increases in labour productivity.

Ricchiuti [19] in his paper, analysed the determinants of the trade flows between Developed and Developing Countries using an augmented version of the Gravity Equation. In doing so, he added two extra variables: the technological distance and the bilateral real exchange rate (RER). To study the movement in the relative prices and their impact on trade pattern, he found a positive effect on export of a devaluation of the bilateral exchange rate.

Choudhri and Khan [20] present new evidence on whether Balassa-Samuelson effects can explain the long-run behaviour of real exchange rates in developing countries based on a panel data sample of 16 developing countries. The paper finds that the traded-nontraded goods, and the relative price in turn exerts a significant effect on the real exchange rate. The term of trade also influence the real exchange rate. These results provide strong verification of Balassa-Samuleson effects for developing countries.

Cho et al [15] studied the effect of medium-to long-run exchange rate uncertainty on agricultural trade and compared the impact on agricultural trade relative to other sectors. In their paper, clearly, interest lied in whether exchange rate uncertainty had effected the growth in agricultural trade using gravity model.

Herrero and [21] empirically showed that China's trade balance was sensitive to fluctuations in the renminbi<sup>1</sup> real effective exchange rate. And the limited reduction in the trade surplus has led Chinese exports to fall with a renminbi's real appreciation.

In their paper, Ramos et al [22] they have attempted to explain why the results of previous authors who have made analysed the relationship between exchange rate stability and trade flows have been so different. In this sense, they proved that time structural instability and proper dynamic specification seems to be the most important factor explaining these differences.

Hooper and Kohlhagen [16] and Cushman [23]analyse the impact of nominal and real exchange rate variability, respectively, on bilateral trade flows from 1965 to 1977 for Canada, France, Germany, Japan, the United Kingdom and the Unites States. They found that the impact of the exchange rate variability on trade has, generally, been significant. But another paper by Savvides [24] uses a wider set of countries than previous studies for the period 1973-1986 and finds no evidence of this relationship for developing countries as well as for the full sample of countries but the oppisite for industrialised ones.

A few studies on contractionary devaluation and real exchange rate based on regression analysis include those of Edwards [32], Agenor [26] and Morley [27]. In a pool-time-series/cross-country sample, Edwards [25] regressed the real GDP on measures of the nominal and real exchange rates, government spending, the terms of trade, and measures of money growth. He observed that devaluation tended to reduce the output in the short term even where other factors remained constant. His results for the long term effect of a real devaluaiton were more mixed: but as a whole it was suggested that the initial contractionary effects was not observed subsequently. In the same way, Agenor [26] using a sample of twenty-three deveolping countries, resgressed output growth on contemporaneous and lagged levels ones in the real exchange rate and on deviatons of actual changes from epected ones in the real exchange rate, goverment spending, the money supply, and foreign income. The results showed that surprises in real exchange rate depreciation actually boosted output growth, but that depreciations of the level of the real exchange rate exerted a contractionary effect.

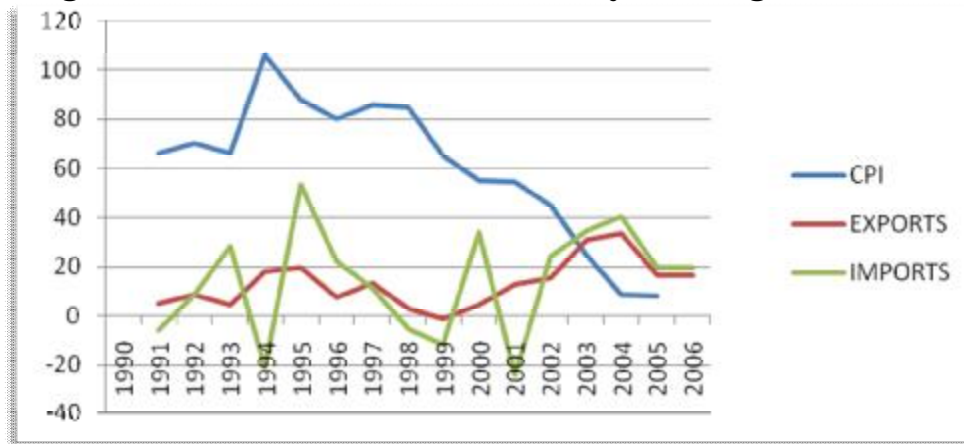
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<sup>1</sup> Renminbi means "people's currency" and issued by the People's Bank of China, the monetary authority of the PRC.

Vergil's paper on Turkey [28], empirically investigates the impact of real exchange rate volatility on the export flows of Turkey to the United States and its three major trading partners in the European Union for the period 1990:1-2000:12. The standard deviation of the percentage change in the real exchange rate is employed to measure the exchange rate. The results obtained in his paper, on the whole, provide evidence that the real exchange rate volatility has a significant negative effect on real exports.

Greater openness may cause economies to be vulnerable to volatility due to trade shocks, but more openness generally enables specialization and scale economics [29]. The term export ratio is commonly used in trade theory to reflect relative the share of export ( an accompanying import ratio) in overall economic activity. The term is expressed in terms of export share in gross domestic product (GDP).

**Figure 1. Trade Flows and CPI of Turkey, % change (1990-2006)**



*Source: International Monetary Fund, International Financial Statistics( IFS )*

The 1978-80 debt crisis marked the end of the inward orientation of the Turkish economy and hence the important substitution motive in the trade regime. The 1980-83 period under military rule was characterized by economic stabilization and trade liberalization at the same time. Real exchange rate depreciation and export promoting strategies led to strong export growth. Restrictive wage policies enhanced saving mainly in the public sector, curbed domestic absorption and hence promoted export expansion. The real depreciation of the Turkish Lira (TL) and the depression of real wages continued during the 1984-87 period of civilian administration and supported the trade reforms of the period. Imports were liberalized gradually after 1983, and in 1989 tariffs were lowered to a large extent as part of a program aiming to fight inflation and in 1990 nearly all quantity and price restrictions were removed [30].

Turkey experienced large and growing fiscal and external imbalances following the capital account liberalization in 1989, until the first quarter of 1994, and during that period the real exchange rate appreciation was no less than 20%. As seen in Figure 1,

with “export-led growth policy”, Turkey received huge capital inflows. Liberalization in trade led exports and imports to rapidly growth in period of 1990-94. Import and export growth also was the main source of ever-risen consumer price index (CPI) in that period. But when came to 1994, when a big crises rose, annual percentage change in CPI was 106%, 17,96% in exports, -20,93% in import, respectively.

In the aftermath of the crisis in 1994, the Turkish economy contracted by 6%, the highest level of annual output loss in the history of the Turkish Republic. As month on month annual inflation rates hit 150% in 1994, and as real wages fell sharply, private consumption and investment declined. As these effects curbed aggregate demand, other effects were at work to decrease output through supply channels. The import boom in 1993 was replaced with a very sharp contraction in 1994 ( -20.93%) after the TL devaluation. After an output loss of 6.1% in 1994, output recovery was rapid due to devaluation policy. The economy grew about 7.5 and 8% in 1995 and 1996.

An interesting case in figure 1 is that, after devaluation program export growth rate was less than import growth rate ( 19.50% in exports, 53.45% in imports, respectively). Because of the 94 crises, CPI growth remained slow and never would reach at that high level of 94 (106%) with an ever-decreasing trend, in period of 1994-2006.

Turkey’s export increased substantially in the years between 1996 and 2006. In 1996, the total value of exports was 23 billion dollars, whereas in 2006 it reached 85 billion dollars. After 1996 there were certain global and domestic factors, which affected the trade performance of Turkey. The crises in Asia and Russia in 1997 and 1998, the two severe earthquakes that occurred in the Marmara region in 1999, and the crises in Turkey in November 2000 and February 2001 adversely affected economic conditions. As a result of these developments, the country witnessed substantial declines in import demand during 1999 and 2001.

During the period 1996-2006, Turkey’s total exports grew at an average annual rate of 13 per cent. It only one year (1999) did the increase in exports halt and decline 1.4 percent. In the remaining years between 1996 and 2006, Turkey’s exports increased substantially. Turkey’s export in 2006 were 85 billion US dollars whereas they were 23 billion in 1996.

## **2. The Basic and Augmented Gravity Model and Data**

### **2.1. The Basic Model**

The gravity equation is a simple empirical model for analyzing bilateral trade flows between geographical entities. In the last two decades, partly due to enhancements in statistical analysis, both empirical and theoretical articles have improved the gravity theory. The model is analogous to the Newtonian physics function that describes the force of gravity and explains the flow of trade between a pair of countries as being proportional to their economic “mass” (national income) and inversely proportional to the distance between them. The model has a lineage that goes back to Tinbergen [1] and Pöyhönen [2], who specified the gravity model equation as follows:

$$Trade_{ij,t} = \frac{\alpha \cdot GDP_{it} \cdot GDP_{jt}}{Distance_{ij,t}} \quad (1)$$

Where  $Trade_{ij}$  is the value of bilateral trade between country  $i$  and  $j$  at time  $t$ ,  $GDP_{it}$  and  $GDP_{jt}$  are country  $i$  and  $j$ 's respective national income at time  $t$ .  $Distance_{ij}$  is a measure of the bilateral distance between the two countries and  $\alpha$  is a constant of proportionality.

Taking logarithms of the gravity model equation as in (1) we get the linear form of the model and the corresponding estimable equation as:

$$\text{Log}(Trade)_{ij,t} = \alpha + \beta_1 \log(GDP_{it} \cdot GDP_{jt}) + \beta_2 \log(distance_{ij}) + u_{ij,t} \quad (2)$$

where  $\alpha$ ,  $\beta_1$  and  $\beta_2$  are coefficients to be estimated. The error term  $u$  captures any other shocks and chance events that may effect bilateral trade between the two countries. Equation (3) is the core gravity model equation where bilateral trade is predicted to be a positive function of income and negative function of distance.

Trade theorists have found the model to be consistent with theories of trade based upon models of imperfect competition and with the Heckscher-Ohlin model. Frankel [1] credits Helpman and Krugman [35] for the standard gravity model. The derivation of a proportionate relationship between trade flows and country size as given by Helpman do not include a role for distance.

There are several reasons, though, for the inclusion of distance as an explanatory variable. Some of these explanations are as follows [31]:

- Distance is a proxy for transport costs
- Distance is an indicator of the time elapsed during shipment. For perishable goods the probability of surviving intact is a decreasing function of time in transit
- Distance may be correlated with the cost of searching for trading opportunities and the establishment of trust between potential trading partners
- Cultural distance: It is possible that greater geographical distance is correlated with larger cultural differences. Cultural differences can impede trade in many ways such as inhibiting communication, clashes in negotiating styles etc.

The size of the exporting and the importing countries are basic determinants in explaining exports. Generally countries are expected to trade more as they increase in size. The size of the economy can either be measured by the two variables to reflect the capacity to supply exporting goods. Likewise, the GDP of the country importing from Turkey ( $Y_{j,t}$ ) is believed to represent its demand for exports, that is country's j demand is believed to increase as ( $Y_{j,t}$ ) increases.

Recipient and Export country population is often inserted in gravity model equations as an additional determinant of trade. Generally coefficient for recipient country population is expected to be positive, since bigger market in the recipient country is expected to demand more goods. And population in the export country is expected to be able to supply more as the population grows in size. Therefore inserting population growth in the model we obtain

$$\begin{aligned} \text{Log(Trade)}_{ij,t} = & \alpha + \beta_1 \log(\text{GDP}_{it} \cdot \text{GDP}_{jt}) + \beta_2 \log(\text{POP}_{it} \cdot \text{POP}_{jt}) \\ & + \beta_3 \log(\text{distance}_{ij}) + u_{ij,t} \end{aligned} \quad (3)$$

where  $\text{POP}_{it}$  stands for population of exporting country i at time t and  $\text{POP}_{jt}$  for importing country j, at time t, in addition to equation (2).

In addition to the basic gravity model equation we estimate an augmented gravity model equation to first analyze international trade flows and then estimate the trade potential for Turkey with its trading partners. The model is “augmented” in that, several conditioning variables that account for other factors that may affect trade have been included over and above ( the natural logarithms of) income, population and distance.

## 2.2. The Augmented Model

As suggested by Matyas [12] the bilateral real exchange rate can effect trade flows. In this paper, this effect is expected between Turkey and her counterparts. Also the volatility of both exchange rate and prices in countries in consideration is likely to be the major cause of a reduction in the trade flows.

The real exchange rate (RER) can be defined as the ratio of the price level of the typical basket of goods and services in country-i to country-j. Following Edwards [32]:

$$\text{RER}_{ij} = \frac{E_{ij} P_j^*}{P_i} \quad (4)$$



Where, E is the bilateral nominal exchange rate, P\* a price index of the foreign country and P is a domestic price index (i is the exporter and j the importer). USD has been used to achieve the bilateral nominal exchange rate<sup>2</sup>:

$$E_{i,j} = \frac{\text{Currency}_i}{\text{USD}} \times \frac{\text{USD}}{\text{Currency}_j} \quad (5)$$

The Producer price Index (PPI) of the importer has been used a proxy for traded goods prices and the Consumer Price Index of the exporter for the domestic price index.

Hence, our variable is:

$$RER_{ij} = \frac{E_{ij}(PPI_j)}{CPI_i} \quad (6)$$

We expect a positive sign for RER: a depreciation of the home currency relative to the foreign currency (an increase in RER ) should lead to more export and less import for the home country. The effect of real exchange rate on exports will be positive (negative) if the export component of total trade is significantly larger than the import component.

Often times, dummies are also included in the model, like a dummy for “common border” determining whether countries have common borders, a dummy for identical languages to state the cultural similarity, and a dummy for custom or economic union determining whether countries are in the same custom or economic union which is thought to stimulate the trade between trading countries. Here, we include “custom” dummy to capture this facilitating effect.

When choosing a gravity model specification for Turkey, equation (3) is used as a base case. The model specification in equation (7) is an extension of equation (3), where population has been inserted as an additional factor in the model:

$$EXP_{ij,t} = e^{\beta_0} (GDP_{i,t})^{\beta_1} (GDP_{j,t})^{\beta_2} (POP_{i,t})^{\beta_3} (POP_{j,t})^{\beta_4} (Dist_{ij,t})^{\beta_5} (RER_{ij,t})^{\beta_6} (Custom_{ij,t})^{\beta_7} e^{u_{ij,t}} \quad (7)$$

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<sup>2</sup> G. Ricchiuti ( 2004), because of lack of data, used SDR (the unit of account of the International Monetary Fund) to obtain the bilateral nominal exchange rate, “Empirical Evidence on the North-South Trade Flows:an Augmented Gravity Model”, <http://mpa.ub.uni-muenchen.de/1326/>

Writing equation (7) in linear form we get the final equation to be estimated:

$$\begin{aligned}
 \ln(EXP)_{ij,t} = & \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) \\
 & + \beta_3 \ln(POP_{it}) + \beta_4 \ln(POP_{jt}) + \beta_5 \log(Dist_{ij}) \\
 (8) \quad & + \beta_6 \log(RER_{ij,t}) + \beta_7 \ln(Custom_{ij,t}) + u_{ij,t}
 \end{aligned}$$

In equation (8) export from country (i) to country (j) at time (t) is denoted by  $EXP_{ij,t}$ . Exports are a function of export country  $GDP_{j,t}$ , recipient country  $GDP_{j,t}$ , export country population  $POP_{i,t}$ , recipients country population  $POP_{j,t}$ , the distance  $Dist_{i,j}$  between the exporting and importing country. Additionally, real exchange rate  $RER_{ij,t}$  between i and j, and the custom union dummy variable  $Custom_{ij,t}$  takes the value 1 if trade counterparts are in the same union, 0 otherwise. Finally  $u_{ij,t}$  denotes error term.

### 3.3. The Data Set

Bilateral exports is defined as logarithms of real export ( $EXP_{ij,t}^R$ ) measured in millions of US dollars deflating current USD export figures by export price indice. GDP of foreign and home country are defined as logarithms of real GDP at constant dollar of country (i) and (j).

Population of home and foreign countries are defined as logarithms of  $POP_{it}$  and  $POP_{jt}$ , where  $POP_{it}$  and  $POP_{jt}$  are the population of country i and j measured in million of inhabitants.

Real exchange rates in constant dollars at 1995 are defined as  $RER_{ij}$ , where bilateral nominal exchange rate denotes the rate between currencies i and j in terms of dollars. Lastly distance between countries is measured as the great circle distance between national capitals in kilometres [36].

The annual data set considered in the estimations are for the period 1990-2003. Bilateral nominal export data are obtained from The Undersecretariat of The Prime Ministry for foreign Trade, GDP and Population data from the World Bank World Development Indicators the CD-ROM version, and the rest of data from the CD-ROM version of the International Financial Statistics

Additional variables, except Custom, that were not included in the discussions of the model were also considered. The Turkish domestic financial crisis of 1994 and 2001 is captured by the dummy variable TR\_94, and TR\_01, respectively, which of these take the value of unity at in 1994 and 2001, zero otherwise.

#### 4. Estimation Results and Conclusion

Standard gravity models often use cross-section data to estimate trade patterns in a given year, or on averaged data. However, panel-data might provide additional insights, capturing the relevant relationships over time and avoiding the risk of choosing an unrepresentative year. Moreover, panels allow to monitor unobservable individual effects (b)  $i$  between trading partners: such feature is relevant because a proper econometric specification of the gravity equation should control for heterogeneous trading relationships. For this reason, we run panel regressions. The random-effects model (REM) would be more appropriate when estimating trade flows between a randomly drawn sample of trading partners from a larger population. On the other hand, the fixed-effects model (FEM) would be a better choice than the REM when one is interested in estimating trade flows between a predetermined selection of countries [33].

The standart and augmented gravity equations fit well Turkish export data over 1990-2005 as suggested by Table 1 and Table 2. In Table 1, we use single index model, in that the coefficient of each variables, are independently, estimated. But in Table 2, using OLS and REM methods, we run double index model, in that the coefficient of the sum of GDPs ( $GDP_i+GDP_j$ ) and of the sum of POPs ( $POP_i+POP_j$ ) are estimated.

As far as GDP size and population are concerned, except  $GDP_i$ , the coefficients are statistically significant ( at the 1% significance level). In particular the sum of GDPs of exporter and importer countries is found to have a positive coefficient (in Table 2), implying that Turkey tends to trade more with large economies. While Turkey's exports increase slightly more than 0.66% in basic model and 0.03 in augmented model as  $GDP_i+GDP_j$  increases by 1%. Even though, in the single index model the impact of exporter country is much higher than importing country reflecting that an increase in GDP of Turkey also increases the openness of Turkey to the world trade (the export/ GDP ratio), this impact is insignificant in the augmented model (in both OLS and REM).

The estimated coefficient on distance has the anticipated negative sign and is slightly over 1, indicating that trade between a pair of countries falls by a little over 1 per cent for every 1 percent incerase in the distance between them, in the both of basic models. This case differs in the augmented models and the coefficients on distance is lower than 1 indicating low tranportation cost.

The sign of dummy variable for the crisis of 1994, as predicted is positive. This states that in that year a devaluation of real exchange rate has restricted import tendency, but contrary, stimulated the export volume of Turkey, approximately 7%.

To remove the serail correlation problem which is proxied by Durbin Watson test statistcis, we include one lagged value of the dependent variable, exports, on the right hand side of the model because of significant relationships between past and duture export performance. This tendency also reflects a long-run relationship.

Costum and D\_01 dummies, stating to be in the same costum union and the crisis of 2001, respectively, are excluded from the models because of their insignificant coefficients. Also both of these create serial correlation problems.

We expect a positive sign for RER. Because a depreciation of the home currency relative to the foreign currency (an increase in RER ) should lead to more export and less import for the home country. The effect of real exchange rate on exports will be positive (negative) if the export component of total trade is significantly larger than the import component. This case is experienced in the financial crisis of 1994 and february 2001 in Turkey. The coefficient of RER in the augmented single and double index models is statisticillay significant and positive as expected. But overally this impact is not much influenced on the export behavior of Turkey. But on the other hand, the effect of RER on export is much positively influenced when bilaterally exports to Azerbaijan, Canada, China, Denmark, France, Germany, Greece, Netherlands, United Kingdom, USA, Italy, Sweden, Spain and Russia are taken into consideration.

**Table 1. Panel Data Estimation Results, 1990-2005 (Single Index Model)**

Variable	Basic Model		Augmented Model	
	OLS	REM	OLS	REM
C	-34.01** (-7.81)	-36** (-9.56)	-9.64** (-3.25)	-9.64** (-3.40)
Ln(GDPi)	0.80* (1.98)	0.46 (1.39)	-0.27 (-1.04)	-0.27 (-1.09)
Ln(GDPj)	0.62** (36.35)	0.60** (39.50)	0.04** (3.05)	0.04** (3.20)
Ln(POPi)	4.05** (5.128)	4.63** (6.84)	1.45** (2.70)	1.45** (2.82)
Ln(POPj)	0.13** (6.74)	0.06** (2.68)	0.02 (1.64)	0.02* (1.71)
dist	-1.09** (-63.13)	-1.09** (-35.53)	-0.11** (-4.41)	-0.11** (-4.61)
Ln(RER)			0.01** (2.80)	0.01** (2.93)
D_94			0.07** (3.20)	0.07** (3.35)
Ln(X <sub>t-1</sub> )			0.90** (53.34)	0.90** (55.80)
Adj. R <sup>2</sup>	0.83	0.64	0.94	0.94
F-Stat.	596	212	1225	1225
Obs.	592	592	550	550

*Notes:* Here the dependent variable is logarithm of real export. OLS stands for the panel OLS estimator, REM random effects respectively. Figures in (.) indicate the standart error. (\*) denotes coefficient significant at the 5% level of significance, (\*\*) denotes the 1% level of significance.

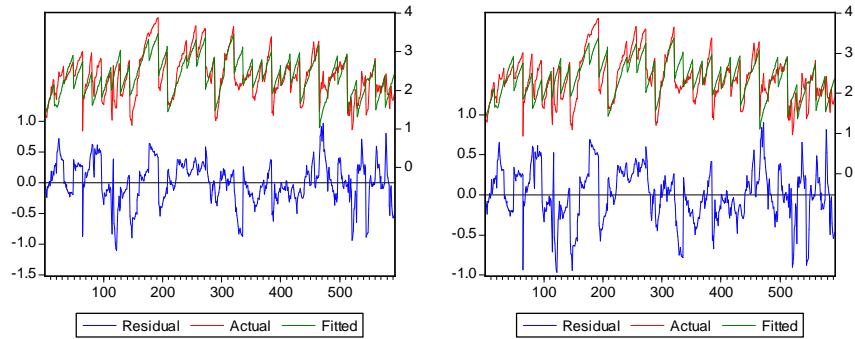
**Table 2. Panel Data Estimation Results, 1990-2005 (Double Index Model)**

Variable	Basic Model		Augmented Model	
	OLS	REM	OLS	REM
C	-1.44** (-3.51)	-1.45** (-3.79)	--0.10 (-0.64)	-0.10 (-0.66)
Ln(GDPi+GDPj)	0.66** (21.67)	0.66** (23.40)	0.03** (2.53)	0.03** (2.60)
Ln(POPi+POPj)	0.05* (1.60)	0.05* (1.72)	0.02 (1.27)	0.01 (1.30)
dist	-1.15** (-21.94)	-1.15** (-23.68)	-0.09** (-3.68)	-0.09** (-3.77)
Ln(RER)			0.02** (2.42)	0.01** (2.47)
D_94			0.06** (2.80)	0.06** (2.86)
Ln(X <sub>i,t-1</sub> )			0.92** (58.03)	0.92** (59.43)
Adj. R <sup>2</sup>	0.57	0.57	0.94	0.94
F-Stat.	269	269	348	1580
Obs.	592	592	550	550

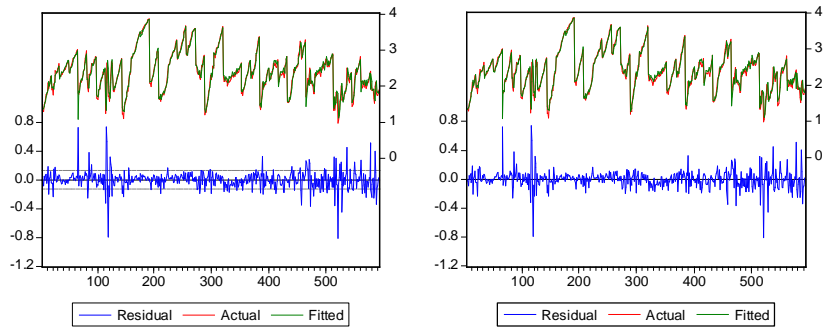
*Notes:* Here the dependent variable is logarithm of real export. OLS stands for the panel OLS estimator, REM random effects respectively. Figures in (.) indicate the standart error. (\*) denotes coefficient significant at the 5% level of significance, (\*\*) denotes the 1% level of significance.

**Figure 2. Actual and Fitted Residuals**

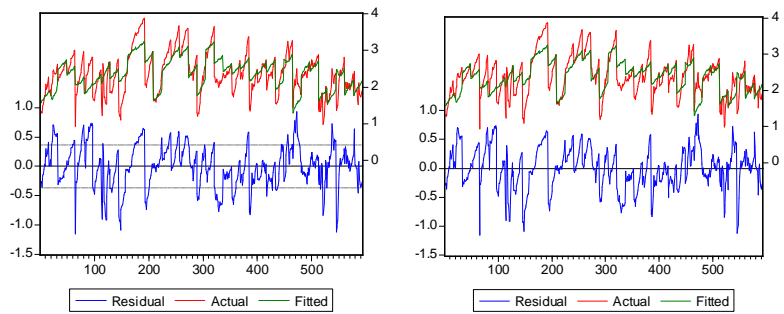
**i) Single Models (Basic)**



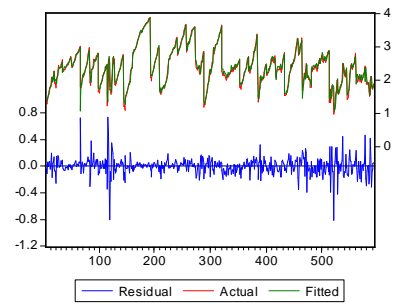
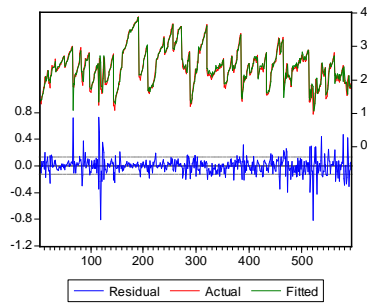
**ii) Single Models (Augmented)**



**iii) Double Models (Basic)**



**iv) Double Models (Augmented)**





**Table 3. Turkey's Exports to Countries in Consideration**

(1990-2005, ANNUAL, IN MILLIONS \$)

EXPORTS					EXPORTS				
COUNTRY	1990	1995	2000	2005		1990	1995	2000	2005
USA	968	1,514	3,135	4,911	ENGLAND	745	1,136	2,037	5,917
GERMANY	3,064	5,036	5,180	9,455	SPAIN	199	354	713	3,011
ALBANIA	6	57	61	191	SWEEDEN	80	106	200	662
AUSTRALIA	23	44	122	228	SWITZERLAND	293	238	239	553
AUSTRIA	178	275	293	659	ITALY	1,106	1,457	1,789	5,617
AZERBAIJAN	0	161	230	528	JAPAN	239	180	149	234
BELGIUM	312	452	647	1,292	CANADA	64	96	173	365
BULGARIA	10	183	253	1,179	HUNGARY	31	160	110	379
ALGERIA	201	269	383	807	EGYPT	160	246	376	687
CHINA	37	67	96	550	NORWAY	40	54	80	245
DENMARK	87	133	219	733	POLLAND	103	272	175	830
FINLAND	25	42	76	297	PORTUGAL	44	60	185	396
FRANCE	737	1,033	1,657	3,806	RUSRIA	0	1,238	644	2,377
S. AFRICA.	51	67	71	316	SYRIA	194	272	184	552
S. KOREA	109	100	130	100	S. ARABIA	338	470	387	962
HOLLAND	435	737	874	2,470	TAIWAN	110	108	69	78
IRAN	495	268	236	913	UKRAINA	0	199	258	821
IRLAND	25	48	203	405	JORDAN	81	170	100	289
					GREECE	139	210	438	1,127
<b>TOTAL</b>	<b>6,246</b>	<b>10,175</b>	<b>13,454</b>	<b>27,611</b>	<b>TOTAL</b>	<b>3,748</b>	<b>6,646</b>	<b>7,768</b>	<b>23,686</b>

Source: The Undersecretariat of The Prime Ministry for foreign Trade, 2008 [37].

## References

- Tinbergen, Jan. (1962) "Shaping the World Economy: Suggestions for an International Economic Policy", *New York: The Twentieth Century Fund*
- Pöyhönen, P. (1963), "A Tentative Model for the Volume of Trade Between Countries", *Weltwirtschaftliches Archiv*, 90(1), pp. 93-100
- Harris, M. N. And Laszlo Matyas (1998), "The Econometrics of Gravity Models", *Melbourne Institute Working Paper*, No. 5/98
- Linnemann, H. (1966), "An Econometric Study in International Trade Flows", North Holland, Amsterdam.
- Aitken, N.D. (1973), "The Effect of the EEC and EFTA on European Trade: A Temporal Cross-Section Analysis", *American Economic Review*, Vol. 63, pp. 881-892.
- Thursby, J.G. and M.C. Thursby (1987), "Bilateral Trade Flows, the Linder Hypothesis and Exchange Risk", *Review of Economics and Statistics*, Vol.69, pp. 488-495
- Anderson, James E. (1979), "A Theoretical Foundation for the Gravity Equation", *American Economic Review* 69(1): 106-116.
- Bergstrand, J.H. (1985), "The Gravity Equation in International Trade: Some Micro-Economic Foundations and Empirical Evidence", *Review of Economics and Statistics*, Vol.67, pp. 474-481
- Oguledo, V.I. and C.R. MacPhee (1994), "Gravity Models: A Reformulation and an Application to Discriminatory Trade Arrangements", *Applied Economics*, Vol.26, pp.107-120
- Brad, C. (1994), "World Trade in Apparel: An Analysis of Trade Flows using the Gravity Model", *International Regional Science Review*, Vol. 17, pp. 151-166.
- Frankel, Jeffrey A. (1993), "Regional Trading Blocs", Institute for International Economics
- Matyas, L. (1997), "Proper Econometrics Specification of the Gravity Model", *The World Economy*, Vol.20, pp. 363-368.
- Matyas, L. (1998), "the Gravity Model: Some Econometric Considerations", *The World Economy*, Vol. 21, issue 3, pp.397-401

Cheng I-Hui and Howard J. Wall (2005). "Controlling for Heterogeneity in Gravity Models of Trade and Integration", *Federal Reserve Bank of St. Louis Review*, jan/Feb 2005, 87(1), pp.49-63

Cho, G.; Ian M. Sheldon, and S. Mccorrison (2002), "Exchange Rate Uncertainty and Agricultural Trade", *Amer. J. Agr. Econ.* 84(4):931-942

Hooper, P., and S.W. Kohlhagen. (1978), "The Effects of Exchange Rate Uncertainty on the Prices and Volume of International Trade", *Jour. Of Int. Econ.* 8:483-511  
<http://www.ecom.unimelb.edu.au/iaesrwww/home.html>

Agbeyebge, Terence D. And P.N. Osakwe (2004), "Real Exchange Rate Volatility and the Choice of Regimes in Emerging Markets"  
<http://arrow.hunter.cuny.edu/research/papers/HunterEconWP404.pdf>

Halpern, L. And C. Wyplosz (1997), "Equilibrium Exchange Rates in Transition Economies", IMF Staff Pap. 44 (1997), pp.430-461  
<http://www.jstor.org/view/00208027/ap070150/07a00040/0>

Ricchiuti, Giorgia (2004), "Empirical Evidence on the North-South Trade Flows: an Augmented Gravity Model", *Munich Personal RePEc Archive*, paper no:1326  
<http://mpra.ub.uni-muenchen.de/1326/>

Choudhri, E. U. And M. Khan (2004), "Real Exchange Rates in Developing Countries: Are Balassa-Samuleson Effects Present?", IMF Working Paper, WP/04/188  
<http://ideas.repec.org/p/imf/imfwpa/04-188.html> - 25k

Herrero, A. G and T. Koivu. (2007), "Impact of China's Exchange Rate Policy on Trade in Asia", [apeaweb.org/confer/hk07/papers/garcia-herrero-koivu.pdf](http://apeaweb.org/confer/hk07/papers/garcia-herrero-koivu.pdf)

Ramos, R.,M. Clar and J. Surinach (2000), "Trade and Exchange Rate Variability: New Evidence From EU Countries", *40th Congress of The European Regional Science Association, Barcelona*  
[www.ersa.org/ersaconfs/ersa00/pdf-ersa/pdf/103.pdf](http://www.ersa.org/ersaconfs/ersa00/pdf-ersa/pdf/103.pdf)

Cushman, D. (1983), "The Effects of Real Exchange Rate Risk on International Trade", *Journal of International Economics*, 15, 45-63

Savvides, A. (1992), "Unanticipated Exchange Rate Variability and the Growth of International Trade", *Weltwirtschaftliches Archive*, 128, 446-463

Edwards, S. (1989), "Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries", Cambridge, Mass., MIT Press

Agenor, Pierre-Richard. (1991), "Output, Devaluation and the Real Exchange Rate in Developing Countries", *Weltwirtschaftliches Archiv*, 127, no:1, 18-41

Morley, S. A., (1992), "On the Effect of Devaluation During Stabilization Programs in LDCs", *review of Economics and Statistics*, 74, no.1: 21-27

Vergil, Hasan (2001), "Exchange Rate Volatility in Turkey and Its Effect on Trade Flows", *Journal of Economic and Social Research*, 4(1), 83-89

Kristjansdottir, Helga (2005), "A Gravity Model Exports from Iceland", Centre for Applied Microeconomics, <http://www.econ.ku.dk/CAM/>

Celasun, Oya (1998), "1994 Currency Crisis in Turkey", World Bank Policy Research Working Paper no.1913, [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=615008](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=615008)

Batra, Amita (2004), "India's Global Trade Potential: The Gravity Model Approach", The ICRIER Working Paper Series, no.151

Edwards, S. (2000), "Capital Flows and The Emerging Economies", The University of Chicago Press.

Egger, P., (2000), "A Note on the Proper Economic Integration on FDI and Exports: a Gravity Approach", CEPS *Working Document* 156, Brussels, Centre for European Policy Studies

Poole, W., (1970), "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model", *Quarterly Journal of Economics*, 84, 197-216

Helpman, E. and P. Krugman, (1985), "Market Structure and Foreign Trade. Increasing Returns, Imperfect Competition, and the International Economy", *Cambridge MA/ London: MIT Press*

<http://www.mapcrow.info/cgi-bin/distance.cgi?city1=Turkey>

The Undersecretariat of The Prime Ministry for foreign Trade, 2008

<http://www.dtm.gov.tr/dtmweb/index.cfm?action=detayrk&dil=TR&yayinid=1115&icerikid=1224&from=home>