Elasticities of Turkish Exports and Imports

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Abstract

The Turkish current account has been exploding in the last few years leading to concerns of a crisis. One of the primary factors identified in the rising deficits is the appreciating lira. In addition, income elasticity of exports and imports can also shed light on continuing trade deficits. In this paper we analyze exchange rate and income elasticity of Turkish imports and exports. We find a significant gap between domestic and foreign income elasticities (for exports and imports respectively) which points to a threat of growing trade deficits. In addition we also find that the exchange rate elasticity is negative for both Turkish exports and imports. This indicates that depreciation of the Turkish lira will have a negative effect on both imports and exports.

I. Introduction

Turkey faced two major crises, (1994 and 2001) in the last decade and a half. Large current account deficits played a role in both crises. (Ogus Binatli and Sohrabji, 2008) Since the mid-2000s, Turkey is once again facing a much worsened current account position leading to concerns of a crisis. It is therefore important to understand the factors that impact the current account deficit.

The trade deficit is the major driving force of the current account deficit. Trade balances are affected by changes in the exchange rate. An appreciating exchange rate by making imports cheaper and exports more expensive can exacerbate the trade deficit. Trade balances are also impacted by income changes. A rise in income of a country's trading partners will cause exports to increase and improve the trade position. An increase in domestic income leads to higher imports which worsens the trade position of a country. In this paper we analyze the responsiveness of Turkish trade to the exchange rate and income.

Income and exchange rate elasticties for exports and imports have been estimated for several countries such as China by Thorbecke (2006), Japan by Bahmani-Oskooee and Goswani (2004), the U.S. by Houthakker and Magee (1969), Mann and Plück (2005) and Chinn (2005), G-7 countries by Hooper, Johnson and Marquez (1998) and for several developed and developing countries by Marquez (1990). We contribute to this literature by examining these elasticties for Turkey which to the best of our knowledge have not been analyzed in the literature. Through this we provide a more comprehensive understanding of the Turkish trade position.

When estimating trade elasticities for the U.S. Houthakker and Magee (1969) found an asymmetry between income elasticity of imports and exports with the former being significantly higher than the latter. Later literature has reinforced this Houthakker-Magee puzzle. We also find a significant gap between domestic and foreign income elasticities for exports and imports. One way of reducing the bias is to disaggregate trade elasticities. We follow the literature and study exchange rate and income elasticties for three categories of goods namely, consumption, intermediate and capital goods for Turkey. We find a significant gap between income elasticities of imports and exports which points to a threat of growing trade deficits. In addition we also find that the exchange rate elasticity is negative

for both Turkish exports and imports. This indicates that depreciation of the Turkish lira will have a negative effect on both imports and exports.

II. Background

As noted earlier, Turkey has experienced large current account deficits which have led to crises. The current account deficit to GDP ratio was 2.83% and 4.64% in the years immediately preceding the 1994 and 2001 crisis respectively. This represented a major deterioration when compared with the three-year average preceding the two crises as noted by Oğuş Binatlı and Sohrabji (2008). The Turkish current account position has deteriorated significantly since 2004. Figure 1 shows that for most of the quarters beginning in 2004 the current account deficit to GDP ratio breached the 5% sustainability threshold exceeding 8% in some periods. The driving force of the current account deficit is the trade deficit which has consistently deteriorated in this period (figure 1).

Figures 2 and 3 map the components of the trade balance from 1998 to 2008. There is a surplus in trade of services and a deficit in merchandise trade for the sample period. However, since services make up a small component of trade Turkey faces an overall trade deficit for the sample period.

Both exports and imports (as a percentage of GDP) have increased over the sample period as seen in figures 2 and 3. Expectedly, merchandise is a major component of both exports and imports. On average, the share of services is approximately 28% of total exports and 12% of total imports. While trade of services have increased in Turkey over the sample period, its share in exports and imports has been declining since 2001 (figures 2 and 3). This shows the growing importance of merchandise trade in Turkey.

Due to the importance of merchandise trade in Turkey's external position, it is important to study the commodity composition of exports and imports. Figure 4 graphs the relative weights of consumption goods, intermediate goods and capital goods in Turkish exports. Capital goods are a minor component of exports for the entire sample period averaging 1.5% of GDP for the period. Consumption goods and intermediate goods are mostly equivalent averaging 7% and 6.5% of GDP respectively. Until the first quarter of 2006 consumption goods are a bigger component of total exports. However, the relative importance of the two types of exports is reversed in the second quarter

of 2006 with intermediate goods being a more important component. By 2008 exports of intermediate goods outweigh consumption goods by about 3 percentage points.

Figure 5 maps out the commodity composition of Turkish imports. Turkey imports a relatively minor percentage of consumption goods. Capital goods are relatively more important ranging from 2-5% of GDP and an average of 4%. However, the biggest category of Turkish imports is intermediate goods. While this category of imports is high throughout the sample period, it has been increasing since the mid-2000s.

Changes in imports and exports are affected by exchange rates and incomes (domestic and foreign respectively). In the following section we analyze the impact of exchange rate and income elasticity on imports and exports.

III. Exchange rate and income elasticities of Turkish exports and imports

We use quarterly data from 1999 first quarter to 2008 third quarter. Our sample is restricted by the fact that GDP figures for Turkey computed by the current method are only available going back to 1998 first quarter. We use the GDP of the Euro zone as a proxy for foreign income in the export demand function which restricts our sample another year. We estimate export and import demand functions according to equations (1) and (2) for total exports, total imports, consumer goods exports and imports, capital goods exports and imports and intermediate goods export and imports. All data are in logs hence all estimated parameters are elasticities. The data on total exports and imports as well as exports and imports of consumer, capital and intermediate goods is from the electronic database of the Central Bank of Turkey. All other data are from the International Financial Statistics database. The trade data is in millions of current US dollars which are multiplied by the real exchange rate to calculate real exports and imports in Turkish liras. The real exchange rate is computed by multiplying the nominal exchange rate (Turkish lira to foreign currency unit) with prices for Turkey and the foreign country. We use the indicator buying rate for the nominal exchange rate and consumer price index (CPI) for price levels of both countries as $E\dfrac{P^f}{P^{Tur}}$.

E is the nominal exchange rate for Turkish lira to one unit of foreign currency, P^f is the foreign country's CPI and P^{Tur} is the CPI for Turkey both indices with 2003 as the base year. We use real GDP of Turkey as a proxy for real income in the import demand function and real GDP of the Euro zone as a proxy of real foreign income in the export demand function. It would be more appropriate to use a trade weighted GDP for foreign income and a trade weighted exchange rate in the export demand functions but we opt to refrain from computing a GDP and exchange rate which are not readily observable. We compute elasticities with respect to the US dollar, Euro and the real effective exchange rate. The European Union has been a major destination for Turkish exports for the entire sample period, accounting for 60 percent of exports at the end of the nineties and about fifty percent of exports currently and thus is the right choice for foreign income.

We follow the literature in setting up the import and export functions as,

$$\ln M_t = \alpha_0 + \alpha_1 \ln rer_t + \alpha_2 \ln GDP_t + \varepsilon_{1t} \tag{1}$$

$$\ln X_t = \beta_0 + \beta_1 \ln rer_t + \beta_2 \ln GDP_t^* + \varepsilon_{2t} \tag{2}$$

where M denotes real imports, X denotes real exports, rer is the real exchange rate, GDP and GDP^* are domestic and foreign real income respectively. If the variables are integrated of order one we can test for cointegration and compute exchange rate and income elasticities using the error correction framework. Estimation steps are as follows. First the order of integration of variables used are determined by unit root tests. Then lag length is chosen by considering several information criteria in an unrestricted VAR where maximum lag length is set at five given the size of the sample. In addition to Likelihood Ratio Tests and Final Prediction Error, Akaike, Schwartz, and Hannan Quinn information criteria are considered. Lag length is chosen based on the outcome of majority of the tests. Diagnostic tests are performed to ensure the model cointegration tests are performed on a correctly specified model. The Johansen (1991) VAR-based cointegration tests are implemented to test for the existence of a cointegrating relationship and to identify the cointegrating equation. Finally, vector error correction models based on the identified cointegrating equation are estimated.

Unit root tests on variables indicate that all variables are integrated of order 1. Unit root test results are presented in Appendix A , Tables A1 and A2. We report the ADF, Phillips-Perron and KPSS unit root test statistics on each variable. Johansen cointegration estimation results of exchange rate and income elasticities of imports and exports show that a significant gap between income elasticities exists which points to a threat of growing trade deficits as noted by Houthakker and Magee (1969). In addition, exchange rate elasticities of both exports and imports are negative. indicating that a depreciation of the Turkish lira will have a negative effect on both imports and exports.

Since EU is Turkey's biggest trading partner we use EU real GDP for foreign income. We use three measures of real exchange rate in the estimation, the real effective exchange rate, the real exchange rate computed from the euro to lira nominal exchange rate and Turkish and EU price indices, and the real exchange rate computed from the US dollar to lira nominal exchange rate and Turkish and US price indices. We use total exports and imports as well as exports and imports of goods and services separately. We further disaggregate exports and imports of goods by type of goods namely consumption goods, intermediate goods and capital goods. All variables are in log form and thus the coefficients can be interpreted as elasticities. Data for EU GDP and EU CPI is available from the International Financial Statistics database and the rest of the data is from the Central Bank of Turkey. The total and disaggregated elasticities for Turkish imports and exports are presented in tables 1,2 and 3.

We find evidence of the Houthakker-Magee puzzle for Turkey. Focusing on total goods and services we find that elasticity of imports with respect to domestic income is significantly higher than the elasticity of exports with respect to foreign income. From table 1 we see that if Turkish and EU real income rose by 1% each, imports of goods and services would increase by 0.83% and exports of goods and services would increase by 0.61%. The gap is more pronounced when using the real effective exchange rate in the estimation with the elasticities being 1.16% and 0.6% respectively (table 3). The results show that if domestic and foreign real income were to grow at the same pace, the trade deficit in Turkey would widen considerably. Disaggregating trade elasticities does not completely eliminate the income elasticity gap for Turkey. Overall, the income elasticity gap for all goods show a threat for the Turkish trade balance.

Turning now to exchange rate elasticity results we find that a 1% depreciation of the lira would lead to a 0.60% decline in imports.

The point estimate for the income elasticity for imports and exports are 1.106 and 0.886 respectively. A one-sided test where the null hypothesis is income elasticity for imports is equal to that of exports is rejected at 1 percent level of significance (critical value is 3.7).

We estimate elasticities for components of trade as well. All income elasticities are positive and significant. The income elasticity of imports and exports of intermediate goods are 1.17 and 0.52 respectively. The equality of income elasticities is rejected against the alternative hypothesis of greater income elasticity of intermediate imports at 1 percent level of significance (critical value is 3.41). For consumer goods and capital goods, the difference between income elasticity of imports and exports is not statistically significant.

All statistically significant exchange rate elasticities are negative indicating that an appreciating lira will increase exports as well as imports. Exchange rate elasticities for imports and exports of consumer goods deserve attention. The income elasticity of consumer goods imports is -0.711 compared to an income elasticity of consumer goods exports of -1.44. The difference between the two exchange rate elasticities is statistically significant. A depreciating Turkish lira would lead to a greater decrease in consumer goods exports than consumer goods imports. We argue that this result is largely due to the particularity of the sample used in this study. A long span of growth for the Turkish economy coincided with a period of global liquidity and growth and this has certainly affected our results. The exchange rate elasticity for exports of capital and intermediate goods are positive but lack statistical significance. To make sense of these findings, the structure of Turkish exports and imports needs to be scrutinized and this task will be undertaken in the next section.

IV. Conclusion

We estimated exchange rate and income elasticities for Turkish imports and exports and investigate the effect of an appreciating lira on Turkish foreign trade. We estimated elasticities for total exports and imports as well as capital goods, intermediate goods and consumer goods exports and imports. We found that a significant gap between income elasticities of imports and exports exists. The income elasticity for imports is significantly greater that exports which warns against increasing

trade deficits over time. We also found exchange rate elasticities of both exports and imports to be negative indicating that a depreciation of the Turkish lira will have a negative effect on both imports and exports.

We argued that the grater income elasticity of imports was due to the large income elasticity of intermediate imports. Turkey's growth is dependent on intermediate imports. In addition, we argued that Turkey's exports are sufficiently diversified such that both an appreciating and a depreciating Turkish lira create their own winners.

References:

Alper, C.E & I. Saglam (1999). The equilibrium real exchange rate: Evidence from Turkey. MPRA Working Paper No. 1924.

Atasoy, D. & S. C. Saxena (2006). 'Misaligned? Overvalued? The Untold Story of the Turkish Lira'. Emerging Markets Finance and Trade 42(3): 29-45.

Bahmani-Oskooee M, Goswami GG (2004) Exchange rate sensitivity of Japan's bilateral trade flows. Japan and the World Economy 16(1): 1-15.

Bahmani-Oskooee, M. & F. Niroomand (1998). 'Long-run price elasticities and the Marshall–Lerner condition revisited.' Economics Letters 61:101–109

Chinn M (2005) Doomed to deficits? Aggregate U.S. trade flows re-visited. Review of World Economics 141:460-485.

Cushman, D.O. (1987). 'US bilateral trade balances and the dollar.' Economics Letters 24:363–367.

Cushman, D.O. (1990). 'US bilateral trade equations: forecasts and structural stability.' Applied Economics 22:1093–1102.

Haynes, S.E., M. M. Hutchison & R. F. Mikesell (1996). 'US–Japanese bilateral trade and the yen–dollar exchange rate: an empirical analysis.' Southern Economic Journal 52:923–932.

Hooper, P., K. Johnson & J. Marquez (1998). 'Trade Elasticities for G-7 Countries.' International Finance Discussion Papers No. 609 (Washington, DC, Federal Reserve Board, April).

Houthakker, H.. & S. Magee (1969). 'Income and Price Elasticities in World Trade.' Review of Economics and Statistics 51:111-25.

Johansen, S. (1991). 'Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models.' Econometrica, 59:1551-1580.

Mann C, Plück (2005) The U.S. trade deficit: A disaggregated perspective. *Institute for International Economics Working Paper Series, WP 05-11*.

Marquez, J., (1990). 'Bilateral Trade Elasticities.' The Review of Economics and Statistics 72(1):70–77.

Oğuş Binatlı A, Sohrabji N (2008) Analyzing the present sustainability of Turkey's current account position. Journal of International Trade and Diplomacy 2(2):171-209.

Thorbecke, W (2006) How would an appreciation of the renminbi affect the U.S. trade deficit with China? Topics in Macroeconomics, Berkeley Electronic Press 6(3): 1454-1468.

Table 1: Long Run Coefficient Estimates for Turkish Imports and exports (TL/€ real exchange rate)

	Imports		Exports	
	Exchange rate elasticity	**Income elasticity**	**Exchange rate elasticity**	**Income elasticity**
Total goods and services	-1.12*	0.83*	-2.01*	0.61*
	(0.44)	(0.02)	(0.25)	(0.01)
Total goods	-1.55*	0.79*	-2.64*	0.59*
	(0.14)	(0.01)	(0.57)	(0.02)
Total services	-0.09	0.66*	1.01	0.55*
	(0.19)	(0.01)	(0.69)	(0.03)
Consumption goods	-1.92*	0.57*	-0.86	0.59*
	(0.20)	(0.01)	(0.85)	(0.03)
Intermediate goods	-1.86*	0.76*	-4.83*	0.46*
	(0.24)	(0.01)	(0.64)	(0.02)
Capital goods	-1.31*	0.64*	-3.00*	0.47*
	(0.11)	(0.01)	(2.07)	(0.08)

Notes: * indicates statistical significance at 1% level of significance.

Table 2: Long Run Coefficient Estimates for Turkish Imports and exports (TL/$ real exchange rate)

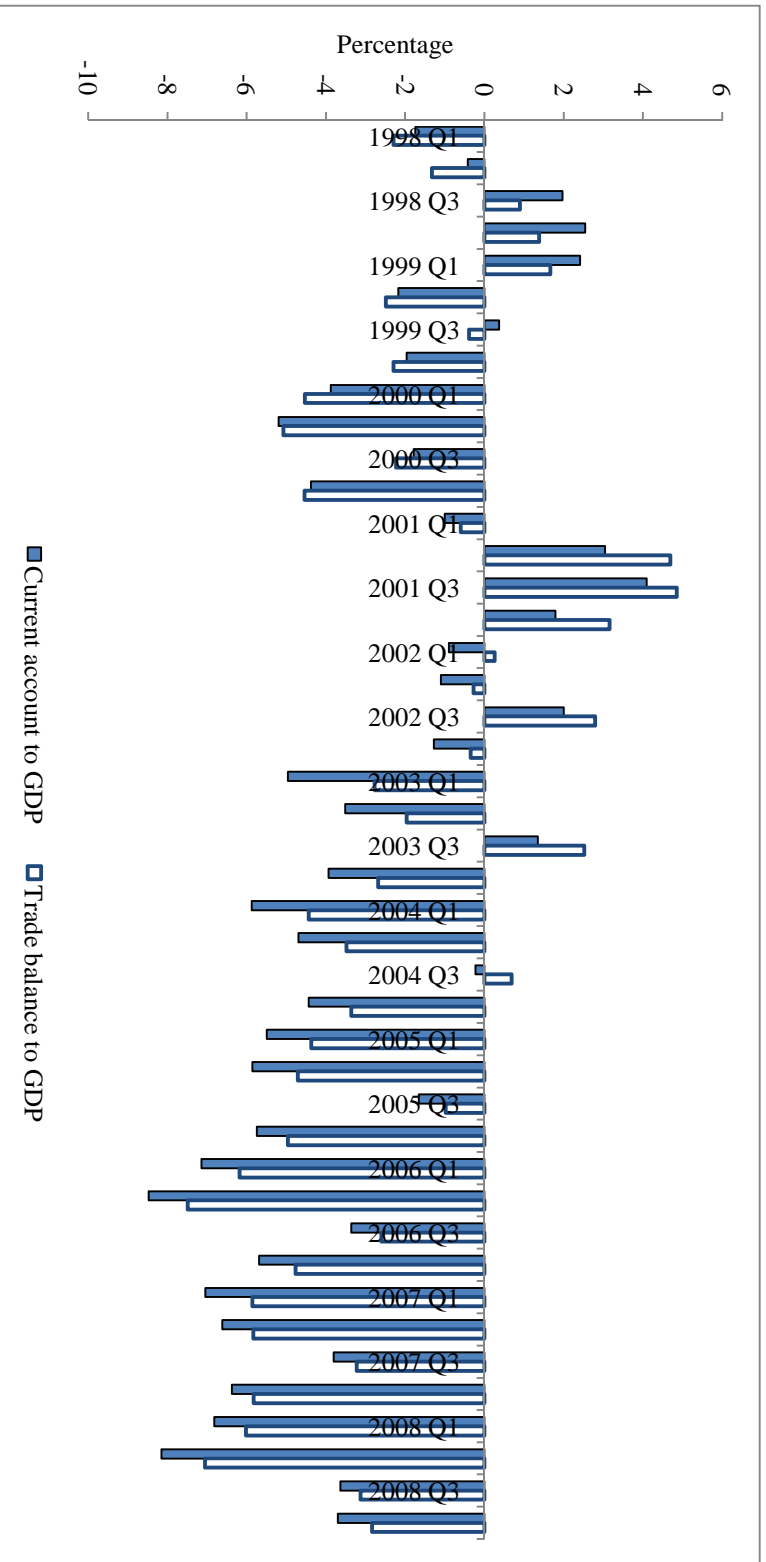|	Imports		Exports	
	Exchange rate elasticity	**Income elasticity**	**Exchange rate elasticity**	**Income elasticity**
Total goods and services	-0.60[*]	1.11[*]	-0.75[*]	0.89[*]
	(0.12)	(0.04)	(0.05)	(0.02)
Total goods	-0.61*	1.10*	-1.14	1*
	(0.04)	(0.10)	(0.13)	(0.04)
Total services	0.22	2.91*	-0.12	0.60*
	(0.16)	(0.36)	(0.07)	(0.02)
Consumption goods	-0.71[*]	0.93[*]	-1.44*	0.95[*]
	(0.07)	(0.03)	(0.29)	(0.08)
Intermediate goods	-0.80[*]	1.17[*]	0.02	0.52*
	(0.30)	(0.11)	(0.54)	(0.16)
Capital goods	0.45[*]	0.87[*]	0.13	0.98[*]
	(0.07)	(0.03)	(0.25)	(0.36)

Notes: [*] indicates statistical significance at 1% level of significance.

Table 3: Long Run Coefficient Estimates for Turkish Imports and exports (real effective exchange rate)

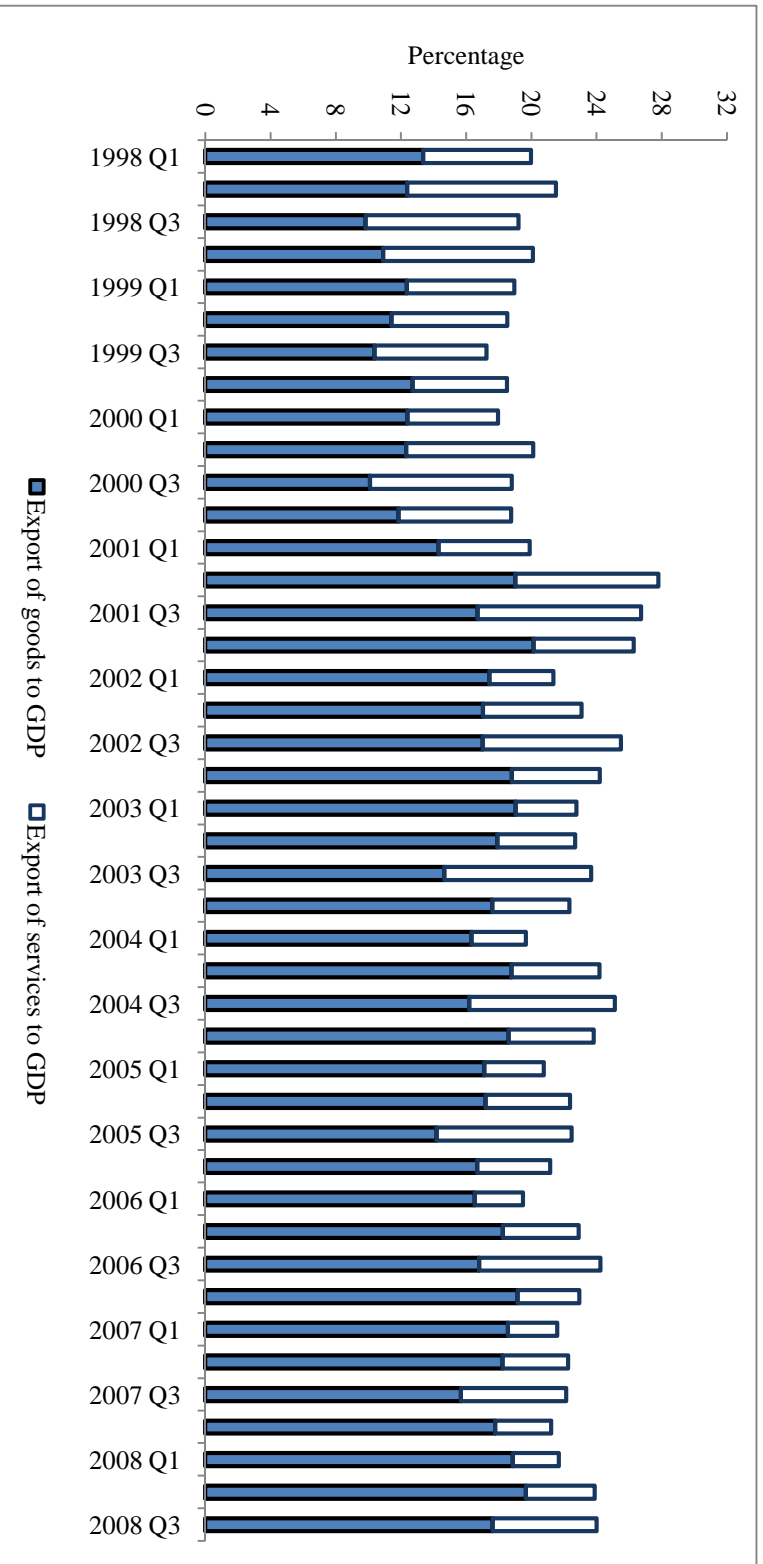|	Imports		Exports	
	Exchange rate elasticity	**Income elasticity**	**Exchange rate elasticity**	**Income elasticity**
Total goods and services	0.94**	1.16*	1.32*	0.60*
	(0.52)	(0.55)	(0.09)	(0.18)
Total goods	2.67*	0.37	1.64*	1.42*
	(0.50)	(0.23)	(0.11)	(0.23)
Total services	0.56**	0.41*	0.18	0.15
	(0.33)	(0.15)	(0.14)	(0.34)
Consumption goods	-0.73	2.95*	-0.08	3.66*
	(0.65)	(0.73)	(0.28)	(0.50)
Intermediate goods	-5.35*	8.60*	2.99*	0.20
	(0.82)	(1.09)	(0.37)	(0.57)
Capital goods	-0.02	1.93*	2.89*	2.22*
	(0.19)	(0.21)	(0.09)	(0.21)

Notes: * and ** indicates statistical significance at 1% and 5% level of significance respectively.
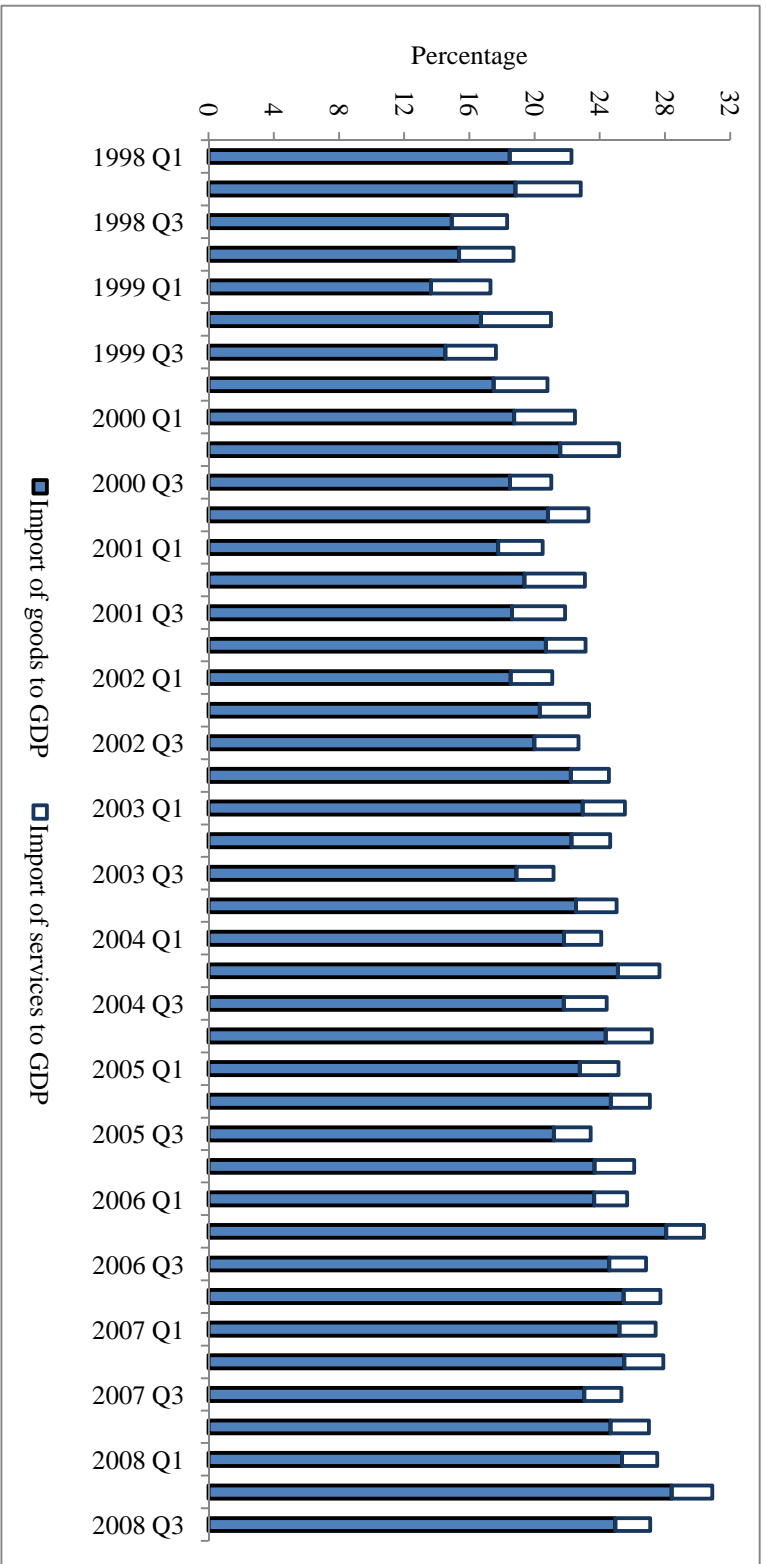
Figure 1: Current account and trade balance to GDP

Figure 2: Exports of goods and services to GDP

Source: Central Bank of Turkey
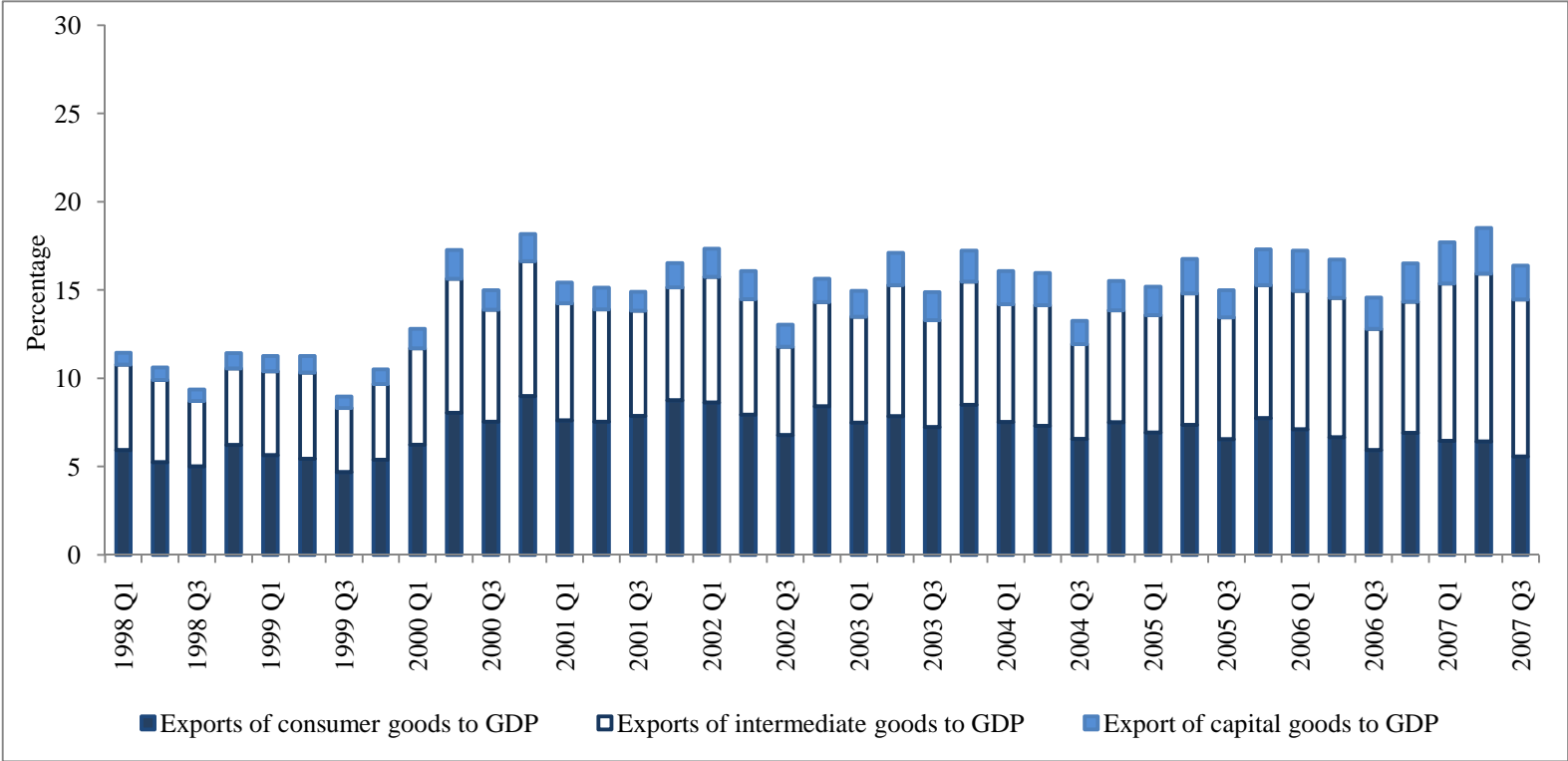
Figure 3: Imports of goods and services to GDP

Legend: ■ Import of goods to GDP   □ Import of services to GDP

Percentage (x-axis): 0, 4, 8, 12, 16, 20, 24, 28, 32

Categories (y-axis): 1998 Q1, 1998 Q3, 1999 Q1, 1999 Q3, 2000 Q1, 2000 Q3, 2001 Q1, 2001 Q3, 2002 Q1, 2002 Q3, 2003 Q1, 2003 Q3, 2004 Q1, 2004 Q3, 2005 Q1, 2005 Q3, 2006 Q1, 2006 Q3, 2007 Q1, 2007 Q3, 2008 Q1, 2008 Q3

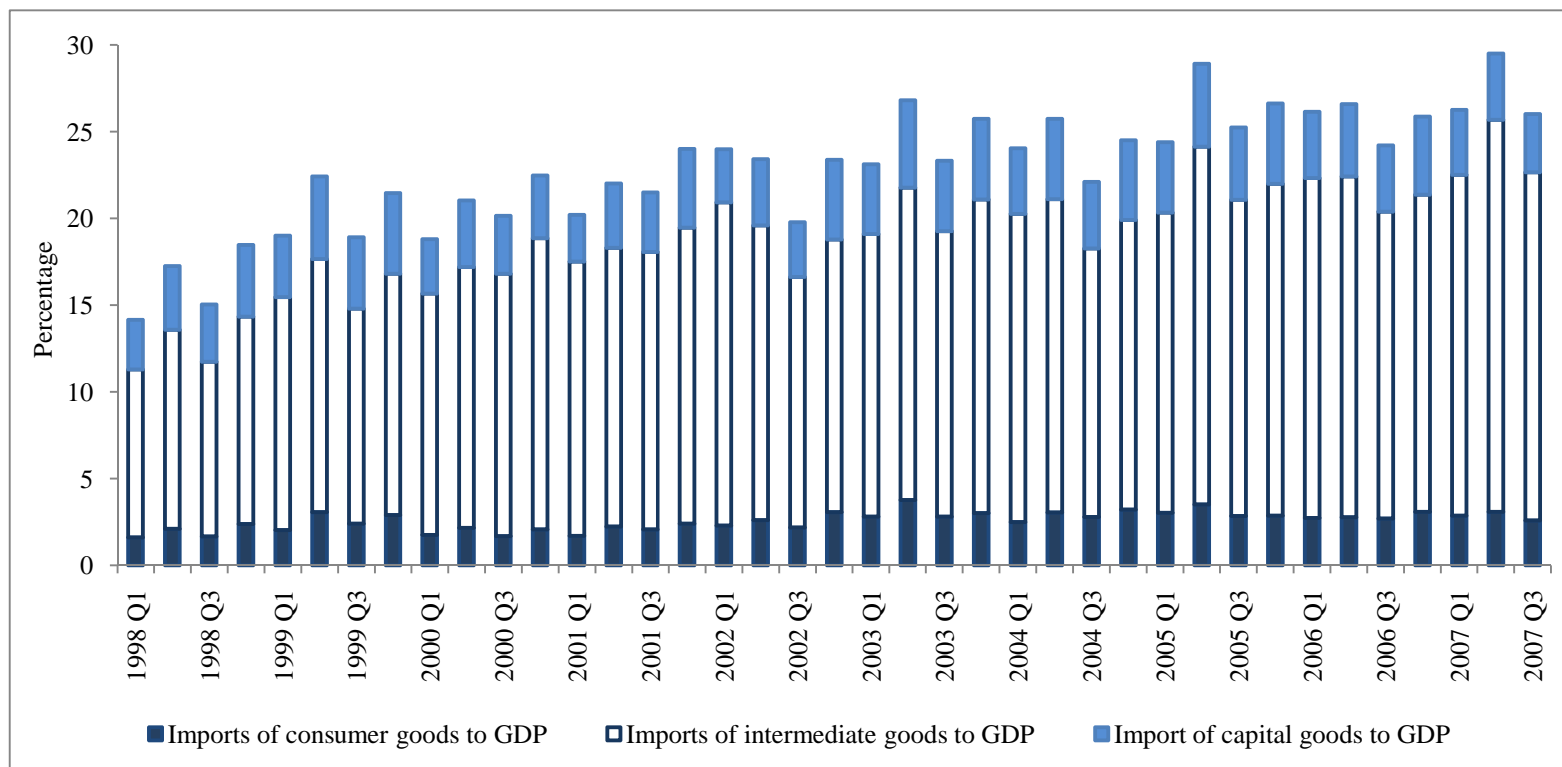**Figure 4: Exports of consumption, intermediate and capital goods to GDP**

Source: Central Bank of Turkey

Figure 5: Imports of consumption, intermediate and capital goods to GDP

Source: Central Bank of Turkey

Appendix A
Table A1 *Unit Root Tests*

	ADF[a]			Phillips-Perron[b]			KPSS[c]	
	No Intercept No Trend	Intercept	Intercept and Trend	No Intercept No Trend	Intercept	Intercept and Trend	Intercept	Intercept and Trend
rer	-1.250576 [0]	-0.138606 [0]	-2.534070 [1]	-1.286375 [8]	-0.086197 [7]	-2.107312 [8]	0.644173** [5]	0.138354 [4]
	-4.770937*** [0]	-4.928896*** [1]	-5.106475*** [1]	-4.688832*** [9]	-4.975081*** [15]	-6.340216*** [26]	0.217660 [8]	
Imports	2.247597 [0]	-1.069351 [0]	-3.007178 [1]	4.005302 [11]	-0.990048 [7]	-3.214768* [2]	0.758228*** [5]	0.117890 [3]
	-5.946292*** [0]	-6.500168*** [0]	-6.409781*** [0]	-5.974310*** [4]	-11.00183*** [23]	-12.29491*** [25]	0.129285 [11]	
Exports	2.952258 [4]	-0.879472 [0]	-4.718831*** [1]	4.573989 [22]	-0.235557 [34]	-3.289400* [14]	0.745848*** [5]	0.074843 [5]
	-5.498303*** [0]	-5.055914*** [3]		-5.550855*** [26]	-9.529556*** [19]	-8.881118*** [18]	0.347751* [21]	
GDP	1.442658 [0]	-0.445149 [0]	-1.903577 [0]	1.564834 [6]	-0.421655 [5]	-1.880402 [4]	0.655409** [5]	0.156597** [5]
	-5.057996*** [0]	-5.181417*** [0]	-5.151138 [0]	-5.031971*** [5]	-5.065602*** [7]	-4.980982*** [10]	0.153203 [6]	0.119139 [8]
GDP-EU	0.228391 [0]	-3.305969** [1]	-3.735758** [1]	0.872185 [34]	-2.384338 [7]	-2.680920 [6]	0.577901** [1]	0.147961** [1]
	-5.102102*** [3]			-7.934242*** [35]	-9.223081*** [36]	-9.705315*** [36]	0.050496 [3]	0.045003 [3]

a Lag length is presented in square brackets. Lag length is selected based on Schwartz information criteria when maximum lag length is 9.
b Bandwidth is in square brackets and was chosen by Newey-West algorithm using Bartlett kernel.
c Bandwidth is in square brackets .

Table A2 *Unit root test continued*

	ADF[a]			Phillips-Perron[b]			KPSS[c]	
	No Intercept No Trend	Intercept	Intercept and Trend	No Intercept No Trend	Intercept	Intercept and Trend	Intercept	Intercept and Trend
Imports-consumer	1.289912 [0]	-1.415594 [0]	-2.437668 [0]	1.735226 [7]	-1.374685 [5]	-2.637225 [2]	0.701591** [5]	0.078394 [4]
	-6.704987*** [0]	-6.923408*** [0]	-6.832713*** [0]	-6.669330*** [3]	-7.025124*** [5]	-6.919034*** [5]	0.112350 [8]	
Imports-intermediate	2.858894 [0]	-1.412809 [0]	-4.057412** [1]	5.765937 [23]	-1.548929 [19]	-4.920542*** [23]	0.775872*** [5]	0.067427 [3]
	-5.547225*** [0]	-5.130575*** [2]		-5.548726*** [5]	-13.86831*** [34]		0.374371 [25]	
Imports-capital	1.063699 [0]	-1.560169 [0]	-2.087587 [0]	1.657903 [13]	-1.558549 [8]	-2.236394 [5]	0.66105** [5]	0.095090 [4]
	-5.066761*** [0]	-5.093567*** [0]	-5.035490*** [0]	-5.028590*** [26]	-7.124086*** [36]	-7.044668*** [36]	0.201641 [13]	
Exports-consumer	1.165570 [0	-2.298341 [4	-2.028532 [0	2.509852 [37	-1.682674 [37	-1.871313 [9]	0.6877760** [5]	0.189520** [4]
	-5.207152*** [0]	-4.802201*** [3]	-5.539314*** [3]	-5.203816*** [14]	-5.917677*** [36]	-9.712804*** [24]	0.500000** [37]	0.500000*** [37]
Exports – intermediate	3.409193 [4]	0.349627 [4]	-2.672320 [0]	5.033126 [24]	1.325055 [23]	-2.485089 [6]	0.746559*** [5]	0.113230 [1]
	-5.023614*** [0]	-5.155609*** [3]	-5.140403*** [3]	-4.961377*** [5]	-7.859289*** [27]	-9.186122*** [30]	0.361727 [22]	
Exports-capital	4.526183 [4]	-0.995623 [4]	-5.324508*** [2]	6.774601 [37]	-1.478821 [37]	-3.461946 [18]	0.763185*** [5]	0.103583 [6]
	-5.469658*** [0]	-6.842788*** [3]		-5.470111*** [3]	-10.71163*** [36]	-13.61710*** [36]	0.500000** [37]	

a, b, c See notes in above table.