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Estimating Income and Price Elasticity of Turkish Exports with Heterogeneous Panel Time-Series Methods

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ABSTRACT

In this paper, we employ panel time-series methods Dynamic OLS, Mean Group and Common Correlated Effects Mean Group to estimate the long-run price and income elasticities of Turkish exports to country groups categorized by geographical regions (EU27, other European countries, Asia, Middle East and North Africa (MENA)) and development levels (developed and developing). In doing so, we use bilateral trade data of Turkey with 67 countries over the period 2005Q1-2013Q4. We find that price and income elasticities vary across country groups. Income elasticity estimates are statistically significant in every country group classification and range between 1.82 and 3.35. Exports to the EU27, other European and the developed countries have higher income responsiveness. On the other hand, price elasticity ranges between -1.56 and -0.27 and is found statistically significant only in exports to the EU27, the MENA and the developing countries. Empirical results imply that region-specific measures have to be taken in trade policy design. In addition, policies based on real exchange rate depreciation would have fewer roles in boosting exports, whereas sustainable growth in trading partners is a more crucial factor to achieve sustainable growth in Turkish exports.

Keywords: Panel Data, Time-Series, Elasticity, Cross-Dependence, Mean Group Estimation, Common Correlated Effects

JEL Classification: C23, F14

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I. INTRODUCTION

The estimation of price and income elasticities of exports has been paid much attention in the empirical trade literature due to its important implications on economic policy design for growth performance, international competitiveness, balance of payments equilibrium and industrial strategies. While price elasticity is an indicator for the relative strength of a country's production, income elasticity shows the non-price competitiveness of a country, influenced by many factors such as export composition, destination, marketing strategies (Baiardi et al., 2014). If elasticities are low (high), the growth or current account dynamics of a country is less (more) likely to be affected by changes in external conditions (Aziz and Li, 2008). Therefore, accurate estimation of elasticities is of great importance for appropriate economic policy design.

In this study, our aim is to estimate the long-run price and income elasticities of Turkish exports to different country groups categorized by geographical regions and development levels with panel time-series estimation methods. We use country-level panel data over the period 2005Q1-2013Q4. We take Turkish exports as our laboratory for several reasons. First, figuring out the impact of macroeconomic factors on trade dynamics of Turkey may provide valuable information for trade dynamics in peer countries. After suffering important setbacks during 1990s, starting with 1994 domestic crisis and continuing with Asian and Russian crisis of late 1990s, Turkey experienced a phase of growth similar to many emerging markets (EMs) in the last decade. Supportive external conditions, along with the improved policy frameworks, continued trade and financial liberalization and growth-enhancing reforms facilitated strong and robust growth. In addition, Turkey, as many EMs, also used the decade to implement structural reforms, strengthen policy frameworks, reduce vulnerabilities and build buffers. These efforts resulted in remarkable fiscal consolidation, improved macro-financial stability and flexible exchange rate regimes (Gros and Selçuki, 2013; Cubeddu et al., 2014).

These notable changes in the structure of the Turkish economy led to substantial structural changes in export dynamics (Aydın et al., 2007; Saygılı and Saygılı, 2011). Accordingly, the share of Turkish exports in the world trade increased substantially, from 0.36 percent in 1980s to around 1.0 percent in the 2000s. Along with the change in the commodity composition of Turkish trade, import content of production and exports increased (Yükseler and Türkan, 2006; Aydın et al., 2007; Saygılı and Saygılı, 2011; Gros and Selçuki, 2013). Due to the surge in import dependence of overall exports, export coefficients altered. While income elasticity coefficient increased, real exchange rate elasticity declined (Aydın et al., 2007; Saygılı and Saygılı, 2011). This transformation of the Turkish trade is similar to what other developing economies experienced in the same period (Kaminski and Ng, 2006; Bayoumi et al., 2011) (Appendix, Figure A1). Second, Turkey has been experiencing high current account deficits and its sustainability is always a big concern. Hence, maintaining sustainable growth in exports is critical for the rebalancing process. Finally, growth in exports is considered as one of the main sources of economic growth in Turkey. Accordingly, accurate identification of the power of external factors on export growth not only becomes important for pursuing balanced-growth policies but also help understanding to what extent external conditions can assist achieving such policy targets in Turkey.

Why do we analyze trade elasticities by disaggregating Turkish exports into different country groups? In the literature, early studies employ aggregate data to detect trade elasticity (see; Kreinin, 1967; Houthakker and Magee, 1969; Bahmani-Oskooee, 1986). However, aggregate data may suppress actual movements at disaggregated levels and cause biased estimates (Bahmani-Oskooee and Goswami, 2004; Marquez, 2005). Specifically, when aggregate data is used, significant trade elasticity with one trading partner can be more than offset by insignificant trade elasticity with another trading partner (Bahmani-Oskooee and Goswami, 2004). For trade elasticity estimations in Turkey, Halıcıoğlu (2007) and Kaplan and Kalyoncu (2011) identify aggregation bias. The main reason is that exports of Turkey contain heterogeneity in terms of both the destination and the composition of goods. The differences in elasticity coefficients with respect to the composition of exported goods have been investigated to some extent (Coşar, 2002; Binatlı and Sohrabji, 2009; Berument et al., 2014). However, the number of studies analyzing Turkish exports based on the trade destination is quite limited. Halıcıoğlu (2007), Uz (2010) and Berument et al. (2014) disaggregate Turkish exports on country basis, but they do not make any inference on the overall or regional exports. Besides, studies employing regional exports do not use bilateral trade data to account for heterogeneities within regions (Çulha and Kalafatcılar, 2014). Thus, our study fills these gaps in the Turkish literature. Furthermore, the international trade literature finds that distance to export markets has significant effects on bilateral trade. The elasticity of trade volumes with respect to distance is usually estimated to be negative (Leamer and Levinsohn, 1995; Overman et al., 2003; Disdier and Head, 2008). By estimating export elasticities across regional groups, we control the distance effect to some extent. Finally, with the help of accurate regional elasticity estimates, policymakers could determine proper trade policy across country groups and take region specific measures by following prospects for these regions' economic dynamics.

Our empirical methods utilize bilateral trade data of Turkey with 67 trading partners accounting for more than 80 percent of the total Turkish exports on average throughout the estimation period. We adopt the reduced form of imperfect substitute model proposed by Goldstein and Khan (1985). Our methodology is related to the literature, which focuses on the estimations of the related income and price elasticities in export and import demand equations (see Houthakker and Magee, 1969; Khan, 1974 for widely-cited studies). To gauge exchange rate elasticity, real exchange rate is used as in other studies (Bahmani-Oskooee and Economidou, 2005; Bahmani-Oskooee and Ratha, 2008; Kumar, 2008). We employ panel time-series estimation techniques to calculate price and income elasticity of exports to each region. Explicitly, Mean Group (MG) and Common Correlated Effects Mean Group

(CCEMG) are used as primary estimation methods. Both methods allow heterogeneous parameter estimation across countries. Furthermore, CCEMG takes into account dependence across countries. We use Dynamic OLS (DOLS), which impose homogeneity in parameters across countries, as the third estimation method to identify the extent of bias coming from homogeneity assumption and the role of cross-dependence in estimated coefficients. To our best knowledge, this will be the first study to employ these techniques in estimating price and income elasticities of exports in Turkey.

The results of our novel approach show that price and income elasticity estimates of Turkish exports vary across country groups. Accounting for heterogeneity and cross-dependence across countries has impact on the parameter estimates. Weighting scheme in calculating elasticity coefficients for country groups has significant implications, as well. Income elasticities fall and price elasticities increase in absolute terms when individual coefficients are weighted with countries' shares in total exports in comparison to standard equal-weighting scheme. According to the trade-weighted results, income elasticity estimates are statistically significant in every country group; however, they are higher for the EU27, the other European countries and the developed countries compared to other regions and the developing countries. On the other hand, price elasticity is statistically significant in only some of the country groups. Among them, exports to the EU27, the MENA and the developing countries are more responsive to price changes compared to other regions and the developed countries. Variations in the estimated coefficients across country groups may arise from the difference in export composition to each region, the degree of vertical integration with each group and factors like distance, cultural proximity, and tastes.

Our results suggest that sustainable growth in trading partners is a crucial factor for maintaining sustainable growth in Turkish exports. The exchange rate policies to support export growth may not be as effective as expected due to its weaker impact compared to foreign income on exports. The variation between the relative importance of price and income across export destinations shows that policymakers should design different policies across regions to boost exports. For example, policymakers may prefer the undervalued Turkish Lira against the currencies of the MENA countries whose exchange rate elasticity is higher compared to other regions. However, they may opt for product diversification in Asia whose exchange rate elasticity is statistically insignificant.

The rest of the paper is structured as follows. Section II introduces the data. Section III presents the model and the estimation methodologies. Section IV discusses empirical results, while the last section concludes.

II. DATA

We use a macro panel data set, which consists of 67 trading partners of Turkey over the period 2005Q1-2013Q4 (Appendix Table A1). Countries whose share in total Turkish exports exceeds 0.1 percent are included in the sample. However, some countries meeting this criterion have to be dropped out due to the unavailability of quarterly income data. Nevertheless, total share of the selected countries in Turkish exports is still above 80 percent on average during the sample period.

For the empirical analysis we compile data for real exports to each country (EXP), bilateral real exchange rate (RER) with each country and real gross domestic product of each country (GDP) in our sample. Bilateral EXP and RER data are our own calculations. Real export to each country is calculated according to the following formula:

$$EXP_i = \sum_m \frac{SITC_{m,i}}{P_m} \quad for\ all\ i = 1,2,\ldots 67\ and\ m = 0,1,\ldots 8$$

where "i" denotes the i^{th} country, m denotes the code of the 1-digit level SITC section, $SITC_{m,i}$ is the nominal export to country "i" in US Dollars classified under m^{th} 1-digit SITC section [1], P_m is the unit export price of the m^{th} 1-digit SITC section. On the other hand, bilateral real exchange rate with the i^{th} country is calculated according to the following formula:

$$RER_i = \frac{P^T}{e^i.P^i} \quad for\ all\ i = 1,2,\ldots 67$$

where P^i is the consumer price level of the i^{th} country, P^T is the consumer price level of Turkey, e is the nominal exchange rate with the i^{th} country. In our calculation, a rise (fall) in RER implies an appreciation (depreciation) of the domestic currency. Data source for nominal exports to each country ($SITC_{m,i}$) and consumer price level for Turkey (P^T) is Turkish Statistical Institute (TURKSTAT). We retrieve nominal exchange rate (e^i) and price level data for trading partners (P^i) from IMF-IFS database. Finally, GDP data of trading partners are compiled mostly from Eurostat and IMF-IFS databases. When necessary, we also benefit from national statistics offices' and central banks' databases. All data are indexed as 2005=100 and seasonally adjusted where relevant.[2]

III. EMPIRICAL METHODOLOGY

There are two main approaches in estimating elasticity coefficients. The first one is to employ supply-side models. This approach assumes that there is always demand for exported goods; however, production capacity in the countries limits the ability to meet the foreign demand (Goldstein and Khan, 1978). The second one is to employ demand-side models (Houthakker and Magee, 1969; Goldstein and Khan; 1985). Underlying assumption of these models is that domestic firms can always adjust their production capacities to meet any level that trading partners demand to buy. The latter is the most common approach in the literature. We follow the mainstream approach, since the limiting role of

[1] There are 9 SITC 1-digit section items: 0: "Food and live animals", 1: "Beverages and tobacco", 2: "Crude materials, inedible, except fuels", 3: "Mineral fuels, lubricants and related materials", 4: "Animal and vegetable oils, fats and waxes", 5: "Chemicals and related products, n.e.s.", 6: "Manufactured goods classified chiefly by material", 7: "Machinery and transport equipment", 8:"Miscellaneous manufactured articles". We exclude gold item from our calculations.

[2] We use officially published seasonally adjusted figures when available. Other seasonally adjusted figures are our own calculations using TRAMO/SEATS methodology.

supply-side factors on Turkish exports is doubtful and supply-side models are more suitable for smaller countries. In this study, we employ the reduced form of the imperfect substitutes model proposed by Goldstein and Khan (1985). In this model, real export is a function of real exchange rate and real foreign gross domestic product.

Several methods have been utilized to estimate demand-side models. The classical time-series estimation methods using aggregate trade data are probably the most used approach in the literature. However, these studies are claimed to suffer from the so-called aggregation bias problem, which is described as the systematic deviation of macro parameters from the average of the corresponding micro parameters (Theil, 1954). Consequently, studies using disaggregate trade data at country or sectoral level have been increasing in number. Increased degrees of freedom and thus reduced data multicollinearity are advantages of such panel data setting. Further, it eliminates, at least reduces, estimation bias and provides micro foundations for an aggregate data analysis (Hsiao, 2003, p.311). It also allows incorporating heterogeneous data structure into the analysis so that information at the country level is not lost, which in turn helps eliminate aggregation bias problem and yields more reliable estimation results. In the light of these advantages, we prefer panel data estimation methods.

Classical panel data estimation methods, which are applied on micro data sets, i.e. large cross-section and short time dimensions, are not suitable for estimating price and income elasticity of exports with macro panel data sets, which have moderate time and cross-section dimensions. When conventional methods are applied to such data sets, coefficient estimates become biased and inconsistent. In macro panel data sets, T is large enough to evaluate time-series properties of variables, such as stationarity. Further, it enables to run separate regressions for each panel unit to allow for parameter heterogeneity (Eberhardt and Teal, 2011). In addition, cross-sectional independence assumption in micro panel data sets may no longer hold in macro panel data sets. Therefore, panel time-series estimation methods, which take into account heterogeneity and dependence across units are more preferable for our study.

Panel Unit-Root Tests

Initially, we check the stationarity of the variables by panel unit-root tests. These tests are more powerful compared to their single time-series counterparts in smaller sample sizes as the cross-sectional dimension increases the number of observations. However, heterogeneity and dependence across cross-sections may influence unit-root test results. The so-called first generation panel unit-root tests such as Im, Pesaran and Shin (2003), Levin, Lin and Chu (2002), Breitung (2000), Hadri (2000) build on the assumption of cross-sectional independence across panel variables, while the second generation unit-root tests addresses cross-sectional dependence (Breitung and Pesaran, 2007). The cross-sectional independence hypothesis in testing unit-root in macro panels is claimed to be quite restrictive and unrealistic by some scholars (O’Connel, 1998; Phillips and Sul, 2003). This necessitates checking the existence of cross-sectional dependence across panel units as the first step and then the stationarity of variables accordingly. This is of great importance since if first generation tests are applied to cross-sectionally dependent data, it leads to size distortions and low power (Hurlin and Mignon, 2007).

We test the existence of cross-sectional dependence across panel units by Pesaran (2004) cross-sectional dependence (CD) test.[3] The test results reject the null hypothesis of cross sectional independence for each variable in the data set (Table 1). This is not surprising because most of the countries in our sample are highly integrated. Persistent and high commodity price hikes before the Lehman crisis and widespread recessions after the Lehman crisis period may explain the cross-sectional dependence in our data set.

Table 1. Average Correlation Coefficient & Pesaran (2004) Cross-Sectional Dependence Test

Variable	***CD-test***	***p-value***	***Corr***	***Abs(Corr)***
EXP	126.71	0.000	0.418	0.489
RER	117.03	0.000	0.399	0.512
GDP	225.15	0.000	0.750	0.785

Notes: H_o: Cross-Sectional Independence CD~N(0,1)
CD-test shows the test statistic, calculated as explained in section 2.1 of Pesaran (2004). Corr denotes the average correlation of the residuals, while Abs(Corr) denotes the average absolute correlation of the residuals.

We use the cross-sectionally augmented Im, Pesaran and Shin (CIPS) test developed by Pesaran (2007) to examine the stationarity of variables. This test allows for heterogeneity in the autoregressive coefficient of the Dickey-Fuller regression and assumes cross-sectional dependence in form of a single unobserved common factor with heterogeneous factor loadings. We run the test for each variable up to 4 lags with and without a trend. The results show that we cannot reject the null hypothesis that the series are non-stationary in most of the specifications (Table 2). Therefore, we may conclude that our variables are I(1).[4]

Table 2. Pesaran (2007) Unit-Root Test (CIPS)

	EXP				***RER***				***GDP***			
	specification without trend		***specification with trend***		***specification without trend***		***specification with trend***		***specification without trend***		***specification with trend***	
lags	***Z_t-bar***	***p-value***	***Z_t-bar***	***p-value***	***Z_t-bar***	***p-value***	***Z_t-bar***	***p-value***	***Z_t-bar***	***p-value***	***Z_t-bar***	***p-value***
0	-12.006	0.000	-9.961	0.000	2.037	0.979	2.262	0.988	-0.005	0.498	-2.239	0.013
1	-7.042	0.000	-2.996	0.001	-0.328	0.372	-4.187	0.000	-0.483	0.314	-0.815	0.208
2	-2.811	0.002	1.630	0.948	2.278	0.989	1.021	0.846	0.935	0.825	1.916	0.972
3	-3.195	0.001	1.088	0.862	3.831	1.000	0.634	0.737	0.997	0.841	2.170	0.985
4	-0.417	0.338	3.968	1.000	4.782	1.000	2.726	0.997	3.078	0.999	6.222	1.000

Notes: Ho: Series are I(1).
Z_t-bar is the test statistic for Pesaran (2007) CIPS test.

[3] Moscone and Tosetti (2009) introduce alternative tests but none of them outperforms the CD-test.
[4] To cross-check the results, we performed unit-root test for each variable for each country individually. The results do not change significantly. The detailed test results are available upon request.

Panel Cointegration Test

Given that variables are integrated of order one, we perform panel cointegration test developed by Westerlund (2007)[5] to rule out the possibility of a spurious relationship. This is an error-correction based test which tests the null hypothesis of no cointegration by checking the existence of error correction for each panel member as well as the whole panel.[6] To this end, it calculates 4 different statistics, which are G_a, G_t, P_a and P_t. According to the test results, we reject the null hypothesis of no cointegration for the panel as a whole (Table 3). Therefore, we conclude that there is a stable equilibrium long-run relationship between export demand, real exchange rate and foreign income.

Table 3. Westerlund (2007) Panel Cointegration Test

Results for H_o: no cointegration
Average AIC selected lag length: 2.52
Average AIC selected lead length: .42

Statistic	Value	Z-value	P-value	Robust P-Value
G_t	-2.72	-5.93	0.00	0.01
G_a	-11.03	-2.43	0.01	0.22
P_t	-20.14	-6.23	0.00	0.01
P_a	-11.81	-8.51	0.00	0.02

Notes: For G_a and G_t, the rejection of H_o is taken as evidence of cointegration of at least one of the cross-sectional units. For P_t and P_a, the rejection of H_o is taken as evidence of cointegration for the panel as a whole.

Methodology

We employ three different panel time-series estimation methods to quantify the long-run real exchange rate and foreign income elasticity coefficients for Turkish exports with respect to geographical and economic development country groups. These are Dynamic OLS (DOLS) proposed by Kao and Chiang (2000), Mean Group (MG) proposed by Pesaran and Smith (1995) and Common Correlated Effects Mean Group (CCEMG) proposed by Pesaran (2006).

DOLS is an estimator for cointegrated relationships and assumes homogeneous long-run covariance structure across cross-sectional units. The parameters are calculated by estimating Equation 2.1, where Y denotes the dependent variable, i.e. real exports (EXP) and X is the vector of independent variables, i.e. real exchange rate (RER) and foreign real income (GDP). In addition to the level of the explanatory variables, DOLS equation includes the lags (q_1) and leads (q_2) of the first difference of the explanatory variables to correct the endogeneity bias (Vogelsang and Wagner, 2014).[7]

$$Y_{i,t} = \alpha_i + X'_{i,t}\,\beta + \sum_{j=-q1}^{q2} c_{i,j}\,\Delta X_{i,t+j} + v_{i,t} \qquad \text{(Eq. 2.1)}$$

[5] For each series the optimal lead and lag lengths are chosen by Akaike Information Criterion (AIC). The Bartlett kernel window width is set according to the formula $4.(T/100)^{2/9}$, where T is the number of observations (Persyn and Westerlund, 2008).

[6] This test has advantages over those based on residual dynamics. First of all, the residual based tests are more prone to failing rejection of no cointegration between variables due to the common factor restriction they exert on long-run and short-run parameters (Persyn and Westerlund, 2008). Second, this test is able to account for cross-dependence between variables while testing for no cointegration.

[7] We use the default values for the number of lags (q_1) and leads (q_2), which are 2 and 1, respectively.

Parameter homogeneity assumption of DOLS is quite restrictive. When T is large enough, one may run separate regressions and yield different elasticity results for each cross-section. We utilize MG to introduce such heterogeneity into our analysis. Under this approach, the standard procedure is to estimate Equation 2.2 for each trading partner and then average β_i to calculate elasticity coefficients for each country group (Eberhardt, 2012). However, each country's share in Turkish exports is different. Therefore, it may be reasonable to weight β_i with the share of that country in Turkish exports so that developments in major trading partners influence the overall outlook more. We report both equal-weighted and trade-weighted results in order to show the impact of weighting schemes on the results.

$$Y_{i,t}=\alpha_i + X'_{i,t}\,\beta_i + u_{i,t} \qquad \text{(Eq. 2.2)}$$

Although MG estimator allows heterogeneous parameter estimation, it is not concerned with cross-sectional dependence, which can be broadly defined as contemporaneous correlation among individuals (e.g. households, firms, regions, countries etc.) left after conditioning on individual characteristics (Moscone and Tosetti, 2009). Global shocks like commodity price shocks or any type of effect that causes interdependence between units may be a source of cross-sectional dependence (Eberhardt and Teal, 2011). Here, we utilize CCEMG to take into account such effects in heterogeneous panel time-series estimation setting. The aim is to get unbiased estimates for β_i.

Empirical model representation of CCEMG can be presented as a simple system of equations from Equation 2.3 to Equation 2.5. As depicted, X_{it} and u_{it} contain an unobserved common factor f_t that captures cross-section dependence with heterogeneous factor loadings γ_i. $\varepsilon_{i,t}$ and ϵ_{it} are assumed to be white-noise. Under this approach, possible bias in β_i problem arising from common shocks to X_{it} and u_{it} is eliminated by including cross-section averages of the dependent and independent variables for the entire panel ($\bar{Y}_t$ *and* $\bar{X}_t$) as shown in Equation 2.5. It is important to note that the values of the coefficients of the panel averages (δ_i and μ_i) are not meaningful in empirical application (Eberhardt, 2012). Their only task is to eliminate the biasing impact of the unobservable common factor on β_i. In standard application, the coefficients β_i are also averaged arithmetically to get CCEMG estimator for country groups. However, as in MG, we calculate both equal-weighted and trade-weighted averages.

$$X_{i,t}=\theta_i + \gamma_i\, f_t + \varepsilon_{i,t} \qquad \text{(Eq. 2.3)}$$

$$u_{i,t}=\pi_i + \gamma_i\, f_t + \epsilon_{i,t} \qquad \text{(Eq. 2.4)}$$

$$Y_{i,t}=\alpha_i + X'_{i,t}\,\beta_i + \delta_i\,\bar{Y}_t + \mu_i\,\bar{X}_t + u_{i,t} \qquad \text{(Eq. 2.5)}$$

Our main focus will be on MG and CCEMG results. DOLS serves as a benchmark to identify the impact of heterogeneity and cross-dependence assumptions on our estimation results and to compare our results with those of other studies in the literature, which assume parameter homogeneity. In the estimations, all variables are in logarithmic terms. Thus β_i contains the price and income elasticity coefficients of Turkish exports. We expect price elasticity to be negative and income elasticity to be positive.

IV. Empirical Analysis and Results

In this section, we report and discuss the results for the long-run price and income elasticity of Turkish exports derived from DOLS, MG and CCEMG estimations. We begin with reporting equal-weighted estimation results of MG and CCEMG and compare them with DOLS for the overall sample, the developing and the developed countries. Then we present results for geographical regions. We do not report CCEMG estimation results for geographical regions. This is because CCEMG requires large N and large T for efficient estimates but geographical regions have either small or moderate N. At the end, we report trade-weighted results for MG and CCEMG in comparison with equal-weighted results.

Table 4 presents estimation results for the whole country sample by three different estimation methods.[8] It shows that income elasticity of exports varies between 2.46 and 2.86 while price elasticity takes values between -0.21 and -0.56, which are all statistically significant. Each method provides different results which validate two suspicions. First, DOLS, which assumes homogenous parameters across countries, comes up with the smallest income and price elasticity coefficients which may be signaling a likely heterogeneity bias. Second, the difference in parameter estimates of CCEMG and MG may be an evidence of cross-sectional dependence. CCEMG which accounts for both parameter heterogeneity and cross-sectional dependence reveals that foreign income is elastic (2.58), whereas real exchange rate is inelastic (-0.56). The literature finds a wide range of export elasticity estimates for Turkey. The income elasticity varies from 0.21 to 4.5 and price elasticity ranges from -1.68 to 0.4 (Appendix, Table A2). Our results are somewhere between these values.

Table 4. Estimation Results for the Overall Sample

	DOLS	MG	CCEMG
GDP	2.46***	2.86***	2.58***
	(0.168)	(0.228)	(0.460)
RER	-0.21**	-0.39***	-0.56***
	(0.096)	(0.118)	(0.199)
Constant		-7.21***	-2.49*
		(1.362)	(1.410)
Observations	2013	2351	2351
Number of countries	61	67	67

Notes: Real Exports is the dependent variable in all estimations. The estimation method for each regression is written at the top of each column. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Dummy variables for 2008 global financial crisis and 2011 Euro debt crisis are included in MG regressions. All dummy variables are significant at 5% significance level.

[8] DOLS does not permit unbalanced panel data estimation. Therefore, it excludes countries with missing observations. In the sample, 6 out of 67 countries have missing data. Hence, the number of observation in DOLS is different than that of MG and CCEMG which may lead to incorrect comparison. However, we rerun the MG and CCEMG models with balanced data, but the results are robust to sample change.

Table 5 shows the estimation results of price and income elasticities of exports to country groups according to the development levels. Three methods unanimously conclude that Turkish exports are more sensitive to economic activity in the advanced economies compared to the developing ones. Income elasticity estimates vary between 2.16 and 2.61 for the developing countries and between 3.03 and 3.37 for the developed countries. As for the price elasticities, the results are not that straightforward. Regarding the exports to the developing countries, DOLS, MG and CCEMG point out that price elasticities are -0.31, -0.31 and -1.0, respectively. Results of DOLS and CCEMG are found to be statistically significant but that of MG is insignificant. Regarding price elasticities of exports to the developed countries, they range between -0.02 and -0.42, but only the result of MG estimation is statistically significant. Since CCEMG is superior to other estimation techniques under the presence of cross-sectional dependence, its results are more reliable. CCEMG results suggest that price elasticity of exports to the developing countries is obviously higher than that of the developed ones in absolute terms. The price is unit elastic for the exports to the developing countries, but it is close to zero and statistically insignificant for the exports to the developed countries. In a nutshell, income elasticity is higher for exports to the developed countries whereas price elasticity is higher for exports to the developing countries in absolute terms.

Table 5. Estimation Results for the Developing and Developed Countries[9]

	Developing Countries			**Developed Countries**		
	DOLS	MG	CCEMG	DOLS	MG	CCEMG
GDP	2.16***	2.61***	2.31***	3.37***	3.09***	3.03***
	(0.228)	(0.303)	(0.552)	(0.260)	(0.347)	(0.773)
RER	-0.31*	-0.31	-1.00***	-0.11	-0.42***	-0.02
	(0.177)	(0.190)	(0.257)	(0.094)	(0.129)	(0.285)
Constant		-6.81***	-4.14***		-0.22***	-1.18
		(1.888)	(1.557)		(0.028)	(3.190)
Observations	1,023	1,271	1,271	990	1,080	1,080
Number of countries	31	37	37	30	30	30

Notes: Real Exports is the dependent variable in all estimations. The estimation method for each regression is written at the top of each column. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dummy variables for 2008 global financial crisis and 2011 Euro debt crisis are included in MG regressions. All dummy variables are significant at 5% significance level.

The international trade literature finds that the distance has a significant effect on bilateral trade. The elasticity of trade volumes with respect to distance is usually estimated to be negative (Leamer and Levinsohn, 1995; Overman et al., 2003; Disdier and Head, 2008). By estimating export elasticities across geographical regions, we control the distance effect on bilateral trade to some extent. We display elasticity estimates for these groups by DOLS and MG in Table 6. Income elasticities are statistically significant in all country groups according to both DOLS and MG. MG estimation provides that Turkish exports give the highest response to GDP growth in the EU27 countries and the

[9] See Appendix Table A1 for the list of countries.

smallest response to economic growth in the MENA countries.[10] As for the degree of responsiveness to price changes, results are ambiguous. MG estimation reveals that they are statistically significant in the MENA and the EU27 countries, but insignificant in Asia and other European countries. According to DOLS estimation, price elasticities are statistically significant in the MENA and other European countries, while insignificant in the EU27 and Asian countries. That is to say, while DOLS proposes Turkish exports to the EU27 countries are insensitive to relative price changes, MG suggests the opposite. The reverse is true for other European countries.

When we look at the country specific coefficient estimates of MG, they represent substantial variation between countries. Most of the price elasticities are statistically significant for the countries in the EU27. Forcing homogeneity assumption to elasticity coefficient in the DOLS estimation for the whole countries results in extremely different conclusion compared to MG which takes heterogeneity across country differences into account. This indicates the importance of taking into account heterogeneity within country groups.

Price and income elasticities display different characteristics across country groups. Furthermore, price and income estimates for each country group diverge from the estimates for the whole country sample, which are 2.58 and -0.56, respectively. For example, real exchange rate coefficient is found to be unitary elastic in the developing countries and zero in the developed countries. Furthermore, foreign income coefficient is 2.91 in the EU27 and 1.71 in the MENA. These results support the importance of disaggregate elasticity analysis with respect to regions and hint at potential aggregation bias problem in coefficient estimates if analyses are done at aggregate level.

Table 6. Regional Price and Income Elasticities of Turkish Exports

	EU27		Other Europe		Asia		MENA	
	DOLS	MG	DOLS	MG	DOLS	MG	DOLS	MG
GDP	2.64***	2.91***	2.74***	2.76***	1.47***	2.78***	1.91***	1.71***
	(0.228)	(0.316)	(0.344)	(0.731)	(0.247)	(0.462)	(0.420)	(0.434)
RER	0.16	-0.43**	-1.30***	-0.22	-0.12	-0.072	-0.49**	-0.58**
	(0.097)	(0.166)	(0.182)	(0.189)	(0.204)	(0.296)	(0.241)	(0.289)
Constant		-6.60***		-7.33*		-8.38***		0.098
		(1.782)		(4.042)		(2.906)		(3.380)
Observations	792	864	330	396	396	432	165	299
Number of countries	24	24	10	11	12	12	5	10

Notes: Real Exports is the dependent variable in all estimations. The estimation method for each regression is written at the top of each column. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dummy variables for 2008 global financial crisis and 2011 Euro debt crisis are included in MG regressions. All dummy variables are significant at 5% significance level.

Up to this point, we have reported standard (equal-weighted) MG and CCEMG estimation results. Taking equal-weighted instead of trade-weighted average to estimate elasticities for country groups may be misleading. Hence, we calculate the weighted average of the coefficients by using each

[10] For the MENA region, data are available for only 10 countries, 5 of which include missing observations. As DOLS does not allow for unbalanced data, number of countries falls to 5. Hence, we need to be careful when interpreting the results of DOLS for the MENA countries.

country's average share in Turkish exports throughout the sample period. Table 7 compares the MG and CCEMG estimation results for country groups according to two weighting schemes.

For the overall sample, income elasticities from both MG and CCEMG get smaller when individual (heterogeneous) coefficients are trade-weighted. This implies that on average countries with higher income elasticities have lower share in Turkish exports. On the contrary, price elasticities increase in absolute terms when they are trade-weighted. The direction of change in elasticity estimates for the developing and the developed countries is similar, except for the price elasticity estimate from MG for the developed countries, which remains almost the same. It is noteworthy that change in the weighting scheme does not affect the statistical significance of the estimates. As for the geographical regions, income elasticities decline in the EU27, Asia and the MENA countries, but increase in other European countries when trade-weighted. Price elasticities for Asia and other European countries remain statistically insignificant. In absolute terms trade-weighted MG points to higher price elasticity for the MENA and lower price elasticity for the EU27. In short, weighting individual elasticities with respect to export share generally induces statistically significant decline in income elasticities and statistically significant increase in price elasticities in absolute terms ignoring for a few exceptions.

Table 7. Equal and Trade-Weighted Results of MG and CCEMG for Country Groups

Income Elasticity Estimates						
	MG			**CCEMG**		
	Equal-weighted	Trade-Weighted	Difference	Equal-weighted	Trade-Weighted	Difference
ALL	2.86***	2.43***	-0.43***	2.58***	2.17***	-0.41***
Developing	2.61***	2.25***	-0.36***	2.31***	1.82***	-0.49***
Developed	3.09***	2.57***	-0.52***	3.03***	2.56**	-0.48**
EU27	2.91***	2.55***	-0.36***			
Other Europe	2.76***	3.35***	0.59***			
Asia	2.78***	2.14***	-0.64***			
MENA	1.71***	1.44**	-0.28***			
Price Elasticity Estimates						
	MG			**CCEMG**		
	Equal-weighted	Trade-Weighted	Difference	Equal-weighted	Trade-Weighted	Difference
ALL	-0.39***	-0.55**	-0.17***	-0.56***	-0.72***	-0.16***
Developing	-0.31	-0.82	-0.51***	-1.00***	-1.26***	-0.26***
Developed	-0.42***	-0.39**	0.03	-0.02	-0.29	-0.27***
EU27	-0.43**	-0.27**	0.16***			
Other Europe	-0.22	0.01	0.23***			
Asia	-0.072	-0.12	-0.05			
MENA	-0.58**	-1.56*	-0.98***			

Notes: Real export is the dependent variable in all estimations. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The results indicate that income elasticities are greater than the price elasticities across all country groups except for the MENA countries. That is to say, Turkish exports are highly sensitive to foreign income changes, but less sensitive to relative price changes. This outcome implies that foreign income has a significant role in export growth pattern. Furthermore, changes in the exchange rate have lower impact on rising export income. On the other hand, exports to the MENA countries are more sensitive to relative prices. These estimates may explain the recent trends in export market share. Turkey's main export destination is the EU27, which accounts approximately half of total exports. In the post-Lehman bankruptcy period, while the export share of the EU27 countries falls from 55% to 45%, the export share of the MENA countries increases from 20% to 30% (Appendix, Figure A2). The decline in the share of the EU27 countries, characterized by low income growth after global financial crisis, is almost compensated by increase in the share of the MENA countries with the help of high income growth together with depreciated bilateral exchange rate.

By means of estimated regional elasticities, policymakers could determine proper trade policy across country groups and take region specific measures by following prospects for these regions' economic dynamics. Our estimates imply that the policies based on exchange rate depreciation have fewer roles in boosting export. Therefore, sustainable growth in trading partners is the key to the sustainable export growth. However, policymakers do not have direct influence on foreign income. Hence, these results suggest that policymakers may increase exports via extensive margin. Aldan and Çulha (2013) and Türkcan (2014) assert that Turkey has room to increase its exports via extensive margin by new products and destinations.

What might be the explanation to different income and exchange rate elasticities across country groups? One of the reasons is probably the variation in the composition of exports across destinations as depicted by Table 8 and Figure A3 in the Appendix. While intermediate goods constitute almost two-third of the total exports to Asia, they constitute approximately one third of the total exports to the EU27 countries. The dissimilarity is also evident between the developed and the developing economies. Export share of intermediate goods is higher for the developing countries. Binatlı and Sohrabji (2009) find that the price and income elasticities of exports are different across consumption, capital and intermediate goods. This evidence can partially explain the variation in elasticities across country groups.

Table 8. Average Real Exports Shares with respect to BEC Classification during 2005-2013 (Percent)

	EU27	Other Europe	MENA	Asia	Developed	Developing
Intermediate Goods	38.4	49.9	58.8	65.1	39.5	57.7
Consumption Goods	48.7	39.7	32.9	22.1	48.4	31.6
Capital Goods	12.7	10.1	7.8	11.9	11.8	10.2

Notes: Authors' own calculation.

Although the export shares of the MENA and the developing countries with respect to BEC classification are very similar, their elasticity estimates are quite different. This finding implies that there might be other reasons responsible for variation in the elasticity estimates. Vertical integration may explain the disparities to some extent. Saygılı and Saygılı (2011) assert that vertical integration leads to the production of unconventional goods which gives rise to increase in income elasticity and decline in price elasticity of exports. There is a high degree of vertical integration between Turkey and Asian countries through automobile industry, which has the highest share in Turkish exports. This might be the cause of insignificant real exchange rate coefficient of exports to Asia. Other than vertical integration, cultural proximity, distance and tastes may have impact on coefficient estimates.

Finally, we may compare our results with Çulha and Kalafatcılar (2014) as they also investigate regional trade elasticities of Turkish exports for almost the same time spell. Qualitatively, our results are in general similar to each other. Both studies find higher income elasticity for exports to the developed countries, while higher and statistically significant price elasticity for exports to the developing countries. However, quantitatively our results are diverse. Specifically, our income elasticity estimates are considerably smaller and price elasticity estimates are higher in absolute terms. Further, we find statistically significant, albeit low, price elasticity for exports to European countries, while they do not. They carry out a VAR analysis using aggregate data for each country group. Since they do not account for heterogeneity within country groups, aggregation bias is probably the main source of the difference in our results.

V. CONCLUSION

This study aims to quantify the price and income elasticity of Turkish exports to country groups categorized by geographical regions and economic development levels. To this end, unlike most of the studies in the literature for Turkey, we use disaggregate data at country level instead of aggregated data at regional level. In this way, we are able to incorporate the heterogeneities across trade partners within the same groups into our analysis. This is important because as put forth by studies like Halıcıoğlu (2007) and Kaplan and Kalyoncu (2011), aggregation bias in the estimated coefficients is a potential problem for the Turkish case.

In this study, panel time-series estimation methods Mean Group and Common Correlated Effects Mean Group are used for the first time in estimating trade elasticities for Turkish exports. These methods take into account the presence of heterogeneity and cross-sectional dependence. Along with them, Dynamic OLS method, which does not allow for heterogeneity and cross-dependence in the analysis, is used as a benchmark to evaluate the impact of heterogeneity assumption on the estimated elasticities. We report our estimation results under different country classifications with respect to geography and development level as the EU27, Other European countries, Asia, MENA, developed and developing.

Our results show that price and income elasticity estimates vary across country groups regardless of the estimation methodology. Income elasticity estimates are statistically significant in all country groups; however they are higher for the EU27, other European countries and developed countries compared to other regions and developing countries, respectively. On the other hand, price elasticity is statistically significant in only some of the country groups. Among them, exports to the MENA, EU27 and the developing countries are more responsive to price changes compared to other regions and the developed countries. Differences in the estimated coefficients may reflect the difference in export composition to each region, the degree of vertical integration with each group and factors like cultural proximity, distance and tastes. Therefore, empirical results point out that policy makers should design region-specific measures in trade policy design. Moreover, while policies based on real exchange rate depreciation have fewer roles in boosting total exports, sustainable growth in trading partners is a more crucial factor to achieve sustainable growth in Turkish exports.

Comparison of our DOLS, MG and CCEMG estimation results provide evidence on the dependence across cross-sections and existence of heterogeneity in the data. Thus, the results support findings of previous studies on aggregation bias problem in estimated coefficients. Therefore, it is important to take into account these factors while analyzing elasticities in order to get more reliable estimation results. Further research may apply the same analysis on disaggregate data at sectoral level to get unbiased price and income elasticities for different sectors. On the other hand, price and income elasticities for Turkish import demand may also be estimated by heterogeneous panel time-series estimation techniques. This way, together with the results of export demand elasticities Marshall-Lerner condition may be tested more accurately.

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APPENDIX

Table A1. The List of Trading Partners in the Data Sample by Country Groups*

EU 27	***Other Europe***	***MENA***	***Asia***	***Developing***	***Developed***
Germany	Albania	Bahrain	Azerbaijan	Argentina	USA
Austria	Belarus	Egypt	China	Albania	Australia
Belgium	Bosnia	Iran	Georgia	Azerbaijan	Austria
Bulgaria	Croatia	Iraq	Hong Kong	Bahrain	Belgium
Czech Republic	Iceland	Israel	India	Belarus	Canada
Denmark	Macedonia	Jordan	Indonesia	Bosnia	Czech Republic
Estonia	Norway	Morocco	Japan	Brazil	Denmark
Finland	Russia	Qatar	Kazakhstan	Bulgaria	Finland
France	Serbia	Saudi Arabia	Kyrgyzstan	Chile	France
Greece	Switzerland	Tunisia	Malaysia	China	Germany
Hungary	Ukraine		Singapore	Croatia	Greece
Ireland			South Korea	Egypt	Hong Kong
Italy			Thailand	Estonia	Iceland
Lithuania				Georgia	Ireland
Malta				Hungary	Israel
Netherlands				India	Italy
Poland				Indonesia	Japan
Portugal				Iran	Malta
Romania				Iraq	Netherlands
Slovakia				Jordan	New Zealand
Slovenia				Kazakhstan	Norway
Spain				Kyrgyzstan	Portugal
Sweden				Lithuania	Singapore
United Kingdom				Macedonia	Slovakia
				Malaysia	Slovenia
				Mexico	South Korea
				Morocco	Spain
				Peru	Sweden
				Poland	Switzerland
				Qatar	United Kingdom
				Romania	
				Russia	
				Saudi Arabia	
				Serbia	
				Thailand	
				Tunisia	
				Ukraine	

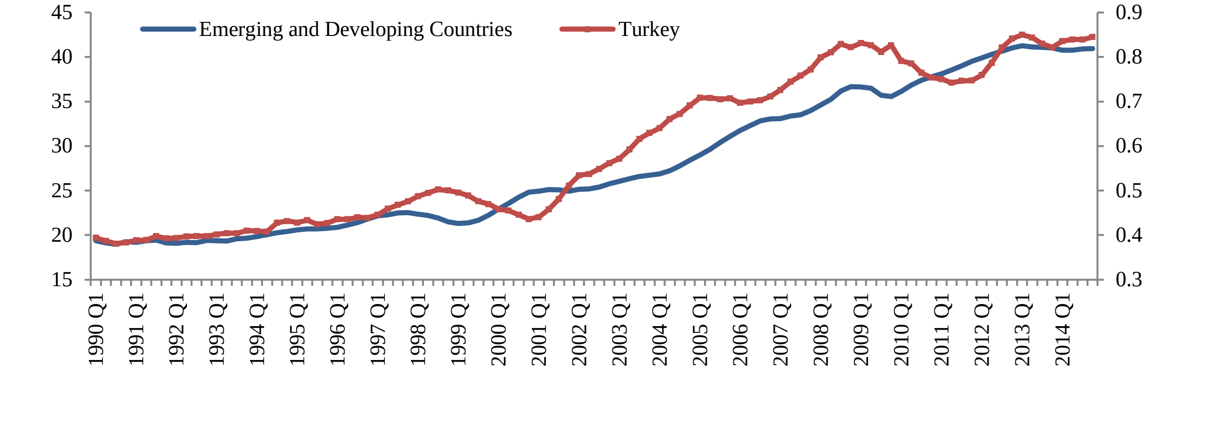
* Countries with no quarterly GDP data and whose share in total Turkish exports is below 0.1 percent are excluded from the data sample. Categorization with respect to development level as developed and developing is done in reference to IMF World Economic Outlook, October 2014 Report

Table A2. Estimation Results of Empirical Studies on the Long-Run Turkish Export Elasticities*

Authors	Data Type	Methodology	Period	Income Elasticity	Price Elasticity**
Coşar (2002)	Aggregate Disaggregate	Panel Cointegration -SUR	1989-2000 Quarterly data	4.5	0.4
Kadılar and Şimşek (2005)	Aggregate	Cointegration	1970-2002 Annual data	0.21	-1.68
Aydın et al. (2007)	Aggregate	Kalman Filter	1987-2006 Quarterly Data	0.29 - 0.50	(-0.24) – (-0.06)
Halıcıoğlu (2007)	Disaggregate	ARDL-based Cointegration	1985-2005 Quarterly Data		
Togan and Berument (2007)	Aggregate	Cointegration	1970-2005 Annual Data	3.41	-0.34
Binatlı and Sohrabji (2009)	Aggregate Disaggregate	Cointegration	1999-2008 Quarterly Data	1.42	-1.64
Kaplan and Kalyoncu (2011)	Aggregate Disaggregate	Aggregation Bias Test	1987-2005 Quarterly Data	1.11	-0.23
Saygılı and Saygılı (2011)	Aggregate	Kalman Filter	1987-2008 Quarterly Data		
Berument et al. (2014)	Disaggregate	SUR	1996-2009 Monthly data		
Çulha and Kalafatcılar (2014)	Disaggregate	VAR	2003-2013 Quarterly Data		

* The coefficients of income and real exchange rate elasticities in the table provide only the findings of the analyses based on aggregate data.
** The coefficients of real exchange rate obtained from the studies are adjusted according to our definition for the sake of easier comparison.

Figure A1: The Share of Emerging and Developing Economies' Exports and Turkish Exports in World Exports



Notes: Categorization as Emerging and Developing Countries is done in reference to IMF classification.

Figure A2. Market Share of Geographical Regions in Turkish Exports

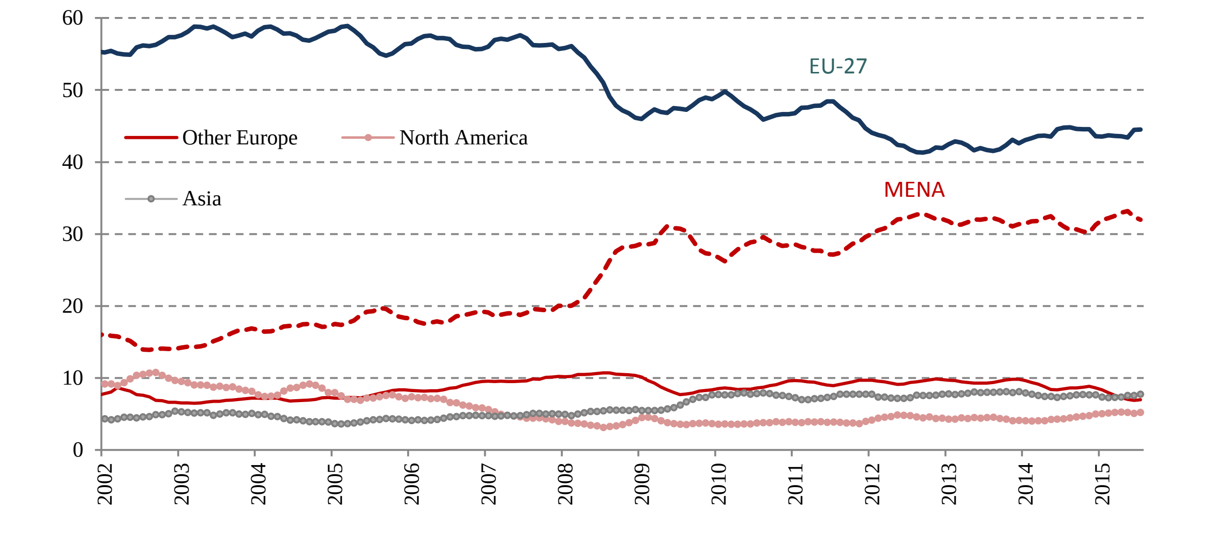
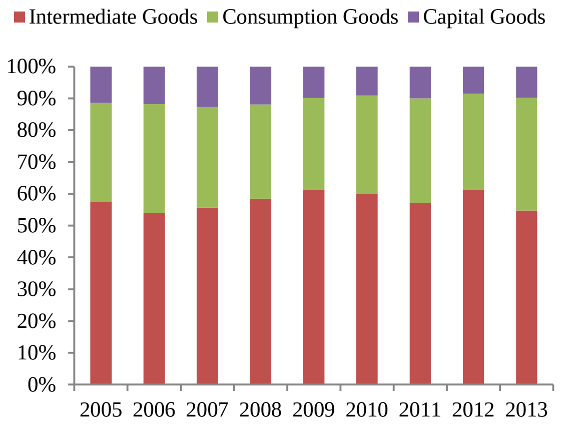
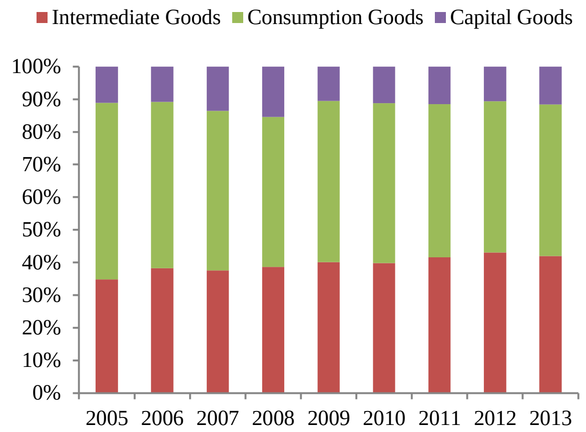


Figure A3. The Composition of Turkish Real Exports with respect to the BEC Classification

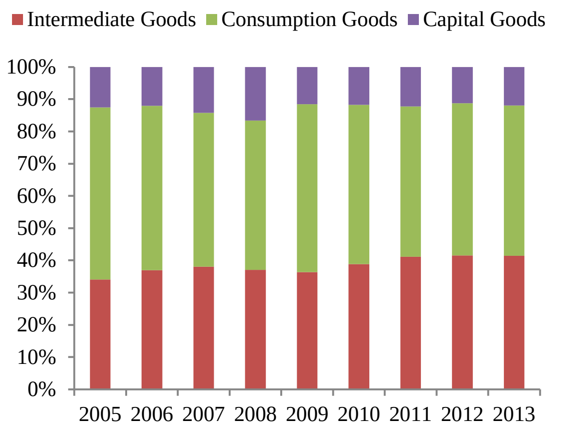
Developing Countries



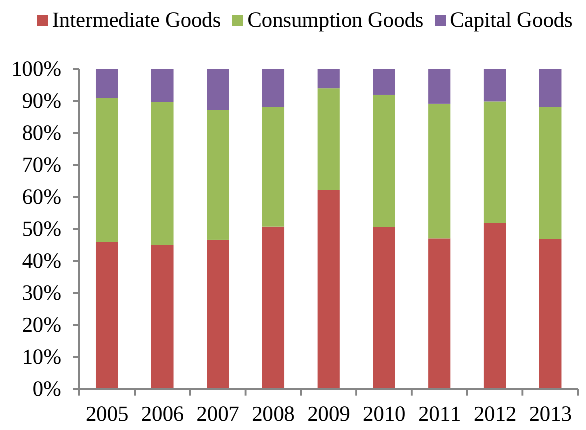
Developed Countries



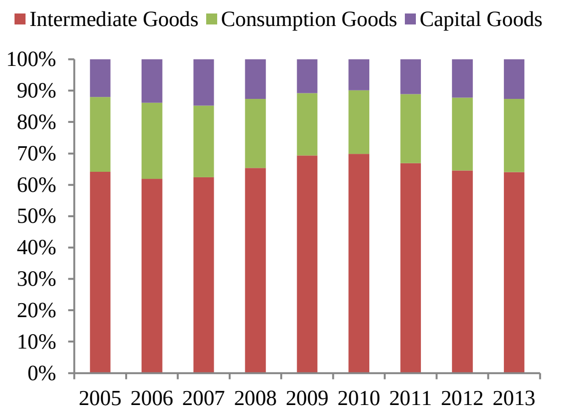
EU27



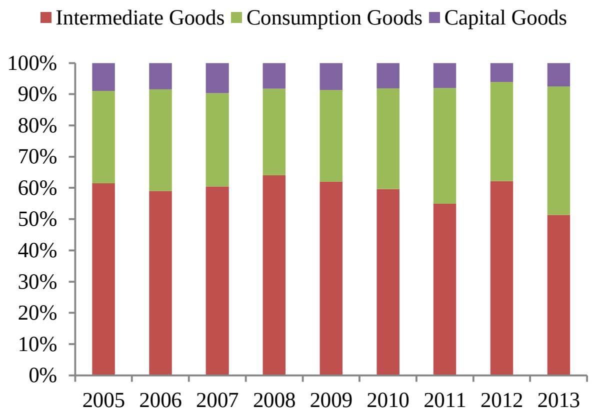
Other European Countries



Asia



MENA



Notes: Other goods item is excluded from the graphs since its share is less than 1 percent.

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