

**EXPLAINING TURKEY'S INTERMEDIATE GOODS IMPORTS
DEMAND AND ESTIMATING ELASTICITIES: INDUSTRIAL
COUNTRIES' PRICE DEFLATED REAL MODELS**

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Assuming theoretical causalities, this study attempts to explain the demand for industrial countries price deflated real investment, intermediate and total production goods imports by various variables and estimates income, relative import price, real and nominal foreign exchange rates, terms of trades, relative import price adjusted and foreign terms of trade adjusted real foreign exchange, and export elasticities of these goods for the period of 1982-2004. As a result of estimations, the computed variables are able to explain import demand for these good around 99 %. The income, relative import price and foreign exchange rate elasticities of investment good import are found less elastic than the related elasticities of intermediate good import. It is found that export increases create inducement effect on income elasticity and lead to higher production good imports.

1. Introduction

Export expansion and increasing product variety of Turkey have brought about additional new imported investment and intermediate goods import since 1980. This study aims to estimates statistical significances of various variables in explaining production goods imports and estimates price and income related elasticities of investment, intermediate and the total of production good imports demands in aggregates. We consider that theoretically the relative import price, foreign exchange rate, terms of trade, income and export are important variables in explaining the imports of these goods.

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The followed export oriented industrialization strategy has forced firms to minimize their unit costs via using cheap and technology obtained imported inputs to compete at international markets. Firms have better access to imported inputs and new technology to increase their productivity under the export-oriented industrialization with liberalized trade. Seyidođlu (2001, p.600) emphasizes the impossibility of development of developing countries without facing international trade. Tuncer (2003, pp.1-3) outlined the evidence that the imported investment goods increase labor productivity and so domestic value added in Turkey. He emphasized increasing importance of technology or information transferring to developing countries from developed countries for growth. It is the evidence that information spreads out by investment and intermediate goods trading. The variety of intermediate goods brings about the most appropriate input choice for final goods production for the firms at lower cost compared to the availability of fewer intermediate goods.

According to Tuncer (2003, p.5) Turkey's technology transferring exists through investment and intermediate goods trading and the substitubility of investment good is lower than intermediate good. This yields lower price elasticity of imported investment goods compared to intermediate goods. In addition, higher share of intermediate goods than investment goods in import bring about higher intermediate good income elasticity than investment good income elasticity.

During the export oriented industrialization period, the nominal value of Turkish Lira was devaluated but overvalued in real terms on the average and domestic TOT increased about 13.5 points. These developments result in increases in import spending on investment and intermediate goods in addition to increases in production good imports arising from the lack of R&D (research and development), lack of technological and new input innovations in the country during the period. Today production goods amounts to 90 % of the total import of which 71 % is intermediate good and imported inputs provide more than 60 % of Turkish exports, and the export contributes to Turkey's economic growth. Therefore, in these circumstances, one has to consider how the foreign exchange rate, relative import price, terms of trade, income and export be effective on import demand for production goods of Turkey.

Section 2 presents a literature review on the importance of topic and the import related variables. Section 3 presents the methodology, data sources and definitions and functional relationships of variables, and section 4 shows the results. Finally section 5 presents the main conclusions.

2. Literature Review

Borga and Zeile (2004, p.1) points out an increasing share of intermediate good trading in production under global trade in the world since 1970s. Material and components trading among countries add value through fabrication, assembly, or other processing before a final product production. Countries' specialization in different stages of the production process enlarges material and components trading among countries and adds value during these stages before a final product is supplied at markets

The increasing technological and human capital gap between developed and less developed countries has brought about higher investment and created new intermediate goods imports by less developed countries from developed ones under global trade. Akçay and Demirhan (2005) found the openness leading to economic growth for the Turkish economy for the period of 1950-2000. Based on their acceptance of "the openness-led economic growth" hypothesis we shall expect export is closely related to investment and intermediate goods imports. International trade brings about technology diffusion and less developed countries benefit from this trade. Guisan (2005) found that imports have a significant and positive effect on industry and a positive indirect effect on non-industrial growth in a comparative analysis between Turkey and Mexico. On the other hand, Alam (2003, pp. 101-102) found very significant effect of imported capital goods in the aggregate production function and an increase in manufactured exports had played an important role for the capital goods import demand in Mexico and Brazil to conclude that technology diffusion comes from capital goods imports in favor of accepting Rodrik's et al. (1995) "investment led-export growth hypothesis" as in capital goods lack countries like Korea and Taiwan rather than the export-led growth hypothesis in aggregate in 1960-1970s. Rodrick analysis outlines the evidence that the export orientation was the result of an increase in demand for imported capital

goods as a consequence of investment increases in capital good lack but skillful labor abundant Korea and Taiwan.

Yamak and Korkmaz (2005, p.18) set up Turkish general import as a function of import price relative to domestic price and income in their monthly study for the period of 1995:1 - 2004:4. They found (p.34) the output elasticity of real intermediate import goods (0.29) higher than real investment import goods' output elasticity (0.16). They found the real effective foreign exchange rate elasticity of real intermediate import goods (0.14) less elastic than real investment goods' real effective foreign exchange rate elasticity (0.56), the imports of both goods increase as foreign exchange rate increases in the models considering 2001 crises. They also found a causality from real effective exchange rate towards both real imported investment and intermediate import goods trade balance, and so indirect causality towards real imported investment and intermediate import goods from real effective exchange rate.

Stern (1991, p. 129-131) states that different governmental policies and competition stimulate growth. Grossman and Helpman (1990, p.517) consider the spillover effects of scientific and technological knowledge on foreign trade and economic growth. The authors also mentioned the importance of trade in technological advance for developed countries. Hatemi-J and Irandoust (2001), pp.149-152) point out that productivity leads to greater exports by pointing out technological differences as being an important motivating factor for trade in developed countries. This implies higher investment and intermediate goods imports from developed countries by developing countries including Turkey under insufficient technological advances in connection to Tuncer's statement. Aklan (1997) points out the importance of technology transferring to increase qualities of products and to reduce production cost in competing at domestic and outside markets and its impossibility without importing high level technology under the lowest level of R&D expenditures of Turkey among OECD countries after 1980.

Feenstra and Markusen (1994, pp.429-433) reached increasing marginal productivity and accumulation of capital at a greater range of inputs. Funke and Ruhwedel (2001, p.240) found a significantly positive relationship between the index of relative product variety for import and export across countries and relative per capita income levels in a study

for the United States and the eighteen OECD countries. Both cases imply that increasing variety of inputs increases firms' productivity and economic growth, which is possible via freer trade unless a less developed country does not develop new inputs satisfactorily obtaining new technology.

Theoretically, the openness to international trade promotes rapid technological absorption from developed countries. Weinhold and Rauch (1997, p.15) found the evidence of openness that accelerates industrial output growth. Edwards (1993, p.1389) surveyed literature of economic growth and concludes that freer trade leads to higher equilibrium economic growth through increasing variety of inputs, lowering input costs and relaxing obstructions compared to the autarky. Guisan and Exposito (2004, p.7) found that the increase of imports of many complementary goods and services increases domestic production, implying the importance of import-led impact on the supply side on the productions in developing countries. According to Gürak (2006), most of the developing countries import technology and human capital-intensive goods from developed countries under global competition. Demir et al. (2005, p.185) states that Turkish export development basis on investment and intermediate goods imports and so economic growth depends on the availability of imported production goods. The authors found Granger causation from income towards trade volume in the short run. Tarı and Kumcu (2005) argue that overvalued domestic currency causes higher imports and lower exports.

3. Model Construction, Variables and Pearson Correlation Coefficients

There is no specific model. There will be various models which will be showing the effects of various variables either separately or together on industrial countries' wholesale price deflated real production goods imports demands of Turkey. In other words, real values of imported investment, intermediate, production goods and real income and export are deflated by industrial countries' wholesale price indexes based on 1987 principle year.

The functional forms are established basing upon the theoretical causal statements to specify models. Industrial countries' wholesale price deflated real import demands; imported investment goods (LIRKM),

imported intermediate goods (LIRING), imported total production goods (LIRKMINT) based on The World Trade Organization (WTO)'s BEC (Broad Economic Classification) definition, are related to (i) industrial countries' wholesale price deflated real gross national product (LIRGNP), (ii) import price relative to domestic wholesale price; relative import price ($LPMTWPI = \ln(PM/TWPI)$), (iii) real foreign exchange rate (LREXC), (iv) relative import price adjusted real foreign exchange rate ($LREXCPMTWPI = \ln(REXC/(PM/TWPI))$), (v) domestic terms of trade (LTOT), (vi) foreign term of trade adjusted real exchange rate ($LREXCTOT = \ln(REXC/(PM/PX))$), (vii) foreign term of trade adjusted nominal exchange rate ($LNEXCTOT = \ln(NEXC/(PM/PX))$), (viii) industrial countries' wholesale price deflated real export (LIREXP), (ix) export excluded income ($LIRGNPEXP = \ln(RGNP-REXP)$) to estimate export and domestically created net income effects on the investment and intermediate goods imports. Moreover, the lagged income is considered in model estimations². The foreign terms of trade adjusted exchange rate is computed to show iterative effect of domestic TOT and exchange rate on the imports. A lower foreign terms of trade makes foreign goods cheaper relative to export goods. Therefore, a negative relationship is expected between foreign TOT and import, or a positive relationship between TOT and import. All the variables in the parentheses are in the forms of natural logarithmic values.

One can show functional relations and theoretically expected sign effects for import models as follows:

$$LIRKM, LIRING, LIRKMINT = f\{LPMTWPI^+, LIRGNP^-, LREXC^+, LREXCPMTWPI^+, LTOT^-, LEXCTOT^+, LIRGNPEXP^+, LIREXP^+\},$$

additionally two dummy variables are applied to measure the effect of Turkish economic crises in 1994 (D1994) and in 2001 (D2001).

² Because the last year's GNP may affect current year's import demand for production goods.

Table 1 shows us the degrees of linear correlation between variables which are used in linear regression models. The simple correlation ratios especially between imported investment, intermediate and production good and their explanatory variables indicates significant linear relationship in logarithmical forms. The high correlation between imported investment and intermediate goods implies us complementary use of these goods in domestic production. The linear correlation between production goods import and foreign TOT adjusted real exchange rate variable is found more reasonable compared with the relation of imports regarding with real exchange rate and TOT.

Table 1: Pearson correlation coefficients

VARIABLE	LIRKM	LIING	LIRKMINT	LIRGNP	LIRGNP _{t-1}	LPMTWPI	LREXC	LREXCPM TWPI	LTOT	LREX CTOT	LNEXC TOT	LIRGNPEX	LIRGNPEX _{t-1}
LIRKM	1												
LIING	.99669	1											
LIRKMINT	.99787	.99987	1										
LIRGNP	.99844	.99864	.99911	1									
LIRGNP _{t-1}	.99535	.99381	.99464	.99629	1								
LPMTWPI	.99584	.99891	.99891	.99824	.99633	1							
LREXC	-.57363	-.5789	-.5781	-.58184	-.53603	-.55338	1						
LREXCPMTWPI	-.99611	-.99936	-.99923	-.99885	-.99474	-.99915	.58715	1					
LTOT	-.12697	.17891	-.16897	-.14615	-.15153	-.19737	-.16488	.18368	1				
LREXCTOT	-.61564	.64178	-.63699	-.63146	-.58856	-.62413	.91735	.65183	.24138	1			
LNEXCTOT	-.99594	.99928	-.99913	-.99888	-.99486	-.99940	.57794	.99979	.18811	.64456	1		
LIRGNPEX	.99853	.99817	.99875	.99995	.99628	.99779	-.58372	-.99850	-.14042	-.63099	-.99852	1	
LIRGNPEX _{t-1}	.99493	.99300	.99392	.99575	.99996	.99567	-.53490	-.99404	-.14778	.58593	-.99412	.9958	1
LIREXP	.99611	.99939	.99925	.99795	.99442	.99899	-.56188	-.99859	-.18398	-.62709	-.99873	.9973	.9936

Import data are obtained from *Foreign Trade Statistics, Undersecretariat of The Prime Ministry for Foreign Trade (2005)*. Foreign exchange rate, gross national product, trade price indices and GDP deflator are obtained from *Statistical Indicators 1923-2004, Turkish Statistical Institution (2005)*.

In the following estimated models '*' represents 5-10 %, '**' represents 1-5 %, and '***' represents 0-1 % significance levels.

4. Results of the Industrial Countries' Price Deflated Real Models

In this section, estimated models and elasticities are presented through Tables 2-4. The same variables are computed for each type import demand whether they satisfy econometric criteria or not to keep on association in model construction.

4.1 Relative Import Price, Industrial Countries' Price Deflated Real Income, Real Foreign Exchange Rate, and Relative Import Price Adjusted Real Foreign Exchange Elasticities.

Table 2 shows us the industrial countries' wholesale price deflated real income, relative import price, real exchange rate and relative import price adjusted real exchange rate elasticities and estimated models of the industrial countries whole sale price deflated real investment, intermediate and the total of production goods import demands.

Table 2: Estimates of models and relative import price, industrial countries' price deflated real income, real foreign exchange rate, and relative import price adjusted real foreign exchange elasticities

VARIABLE	LIRKM 1	LIING 2	LIRKMINT 3	LIRKM 4	LIING 5	LIRKMINT 6	LIRKM 7	LIING 8	LIRKMINT 9
CONSTANT	0.23 1.19	2.16 .9**	1.16 .8	3 2.46	5.35 3.35	4.98 3.03	3.41 1.94*	7.86 1.92***	5.05 1.8***
LIRGNP _t		0.36 .14***	0.54 .12***					0.18 .15	0.41 .14***
LIRGNP _{t-1}	0.4 .17**			0.86 .02***	0.89 .02***	0.88 .02***	0.38 .15**		
LPMTWPI _t	0.44 .15***	0.53 .12**	0.36 .11***						
LREXC _t				-0.91 .36**	-1.08 .49**	-0.98 .44**			
LREXCPMTWPI _t							-0.46 .13***	-0.67 .13***	-0.46 .13***
D2001	-0.61 .22***				-0.03 .34	-0.12 .31			
D1994		-0.20 .11*							
R ²	.9951	.9987	.9988	.9930	.9907	.9922	.9941	.9988	.9989
Adj R ²	.9944	.9985	.9987	.9923	.9892	.9910	.9936	.9987	.9988
F Ratio***	1298	4784	8560	1414	671	807	1699	8288	9254
DW	1.965	1.23	1.35	1.548	0.71	0.847	1.486	1.367	1.287
Lower, Upper	(2.34, 2.922)**	(.858, 1.407)***	(.938, 1.291)***	(.938, 1.291)***	(.858, 1.407)***	(.858, 1.407)***	(.938, 1.291)***	(.938, 1.291)***	(.938, 1.291)***
Decision	No -	inconclu	No +	No +	+auto	+auto	No +	No +	+auto
Multicollinearity	yes	yes	yes	no	no	no	yes	yes	yes

These statistics indicate that real devaluation of domestic currency reduces both types of production goods imports as theoretically expected in sign. The intermediate good import demand is found more sensitive to the real foreign exchange rate than investment good import demand as seen in the estimated Models through 4 and 6 in Table 2. However, Models 5, 6 and 9 indicated autocorrelation problem³. On the other hand, excluding Models 4, 5, 6 all other models indicated multicollinearity problem. This problem arises from the deflating nominal income by domestic prices then industrial countries' prices deflation and the use of relative import price and relative import price adjusted real exchange rate with income in model. Only Model 4 does not indicate neither autocorrelation nor multicollinearity problem among estimated models to consider a valid model in view of autocorrelation and multicollinearity problem⁴.

However, all the coefficients are found statistically significant except for income elasticity in Model 8 even though multicollinearity problem. As an approximation, the intermediate good import demand is found more sensitive to the relative import price, to the relative import price adjusted real foreign exchange rate and to the income than investment good import demand in all estimated models in Table 2. Production goods import increases as relative import prices increase; investment good import increases by 0.32, intermediate good import increases by 0.41 percentage, and production good import increases by 0.29 percentage as a result of a one percentage increase in relative import price on the averages. All means that a one percentage increase in real income, relative import price, and a one percentage decrease in real exchange rate or in relative import price adjusted real exchange rate increases the imports of these goods less than a percentage.

Dummy variable D2001 is found significant only in Model 1 and Dummy variable D1994 is found significant only in Model 2. It is found that the 2001 Turkish economic crisis reduced investment good import, 1994 crisis reduced intermediate good import significantly, and in these years domestic currency is devaluated about 100% nominally. On the

³ Autocorrelation problem does not cause biased estimates but yields inefficient test statistics.

⁴ Econometric theory states that multicollinearity yields biased coefficients and insignificant or small "t" ratios not to consider estimated coefficients for evaluations.

other hand, estimated positive relative import price elasticities for these imported goods contradict theoretical expectations.

4.2. Industrial Countries' Price Deflated Real Income, Industrial Countries' Price Deflated Real Export Excluded Real Income and Export, TOT, Foreign TOT Adjusted Real and Nominal Exchange Rates, Relative Import Price Adjusted Real Exchange Rate Elasticities

Table 3 shows the elasticities of industrial countries' price deflated real income, domestic TOT, real foreign exchange rate, foreign TOT adjusted real and nominal foreign exchange rates of the import demand for industrial countries' price deflated investment, intermediate and production goods. Models 10-15 do not indicate neither autocorrelation nor multicollinearity problem. Income is not highly correlated with domestic TOT, real exchange rate and with foreign TOT adjusted real exchange rate, but highly correlated with foreign TOT adjusted nominal foreign exchange rate as seen in models through 16 to 18.

A one percentage improvement in domestic TOT increases investment good import by 0.41 percentage and decreases intermediate good import by 1.38. However, adverse relationship exists between investment and domestic TOT as seen in Model 19. Both foreign TOT adjusted real and nominal foreign exchange rate affect import demand for production goods adversely as theoretically expected. Both the domestic TOT and foreign TOT adjusted real exchange rate elasticities of intermediate good import are found higher than the elasticities of investment good import.

Table 3: Estimates of models and industrial countries' price deflated real income, industrial countries' price deflated real export excluded real income and export, TOT, foreign TOT adjusted real and nominal exchange rate, relative import price adjusted real exchange rate elasticities

VARIABLE	LIRKM 10	LIING 11	LIRKMINT 12	LIRKM 13	LIING 14	LIRKMINT 15	LIRKM 16	LIING 17	LIRKMINT 18	LIRKM 19
CONSTANT	-5.01 3.63	4.61 1.7***	2.92 1.48**	-1.62 .87*	1.18 .88	1.1 .83	0.75 1.26	4.66 1.4	2.64 1.32**	-6.38 2.13***
LIRGNP _t		0.93 .01***	0.92 .01***					0.2 .16	0.45 .15***	0.89 .01***
LIRGNP _{t-1}	0.87 .02			0.86 .02***	0.87 .02***	0.87 .02***	0.44 .18***			
LTOT _t	0.41 .79	-1.38 .37***	-0.96 .33***							-0.76 .47***
LREXCTOT _t				-0.72 .39*	-1.44 .39***	-1.3 .37***				
LNEXCTOT _t							-0.41 .14***	-0.68 .15***	-0.45 .14***	
D2001	-0.61 .27**						-0.5 .21**			
R ²	.9932	.9984	.9988	.9921	.9926	.9934	.9954	.9987	.9988	.9973
Adj R ²	.9921	.9982	.9986	.9913	.9919	.9927	.9947	.9985	.9987	.997
F Ratio	920	6235	8020	1253	1342	1503	1373	7494	8269	3636
DW	1.915	1.184	1.218	1.697	.952	1.144	1.791	1.447	1.254	.77
Lower, Upper	(2.34, 2.922)**	(.938, 1.291)***	(.938, 1.291)***	(.938, 1.291)***	(.938, 1.291)***	(.938, 1.291)***	(.858, 1.407)***	(.938, 1.291)** *	(.938, 1.291)***	(.938, 1.291)***
Decision	No -	Inconclus	Inconclus	No+	Inconclus	Inconclusiv	No +	No +	Inconclusi	+ auto
Mulicollinearity	no	no	no	No	no	no	yes	yes	yes	no

4.3. Estimates of Models and Industrial Countries' Price Deflated Real Income, Industrial Countries' Price Deflated Real Export Excluded Real Income and Export, Relative Import Price Adjusted Real and Nominal Exchange Rate Elasticities

Table 4 considers export excluded industrial countries' prices deflated real income effect in addition to real and relative import price adjusted real foreign exchange rates effects on the import demand for production goods imports. However, all estimated models indicated multicollinearity problem, and

Models 28 indicated both autocorrelation and multicollinearity problems. Except for the sign of relative import price adjusted real exchange rate for investment good import none of them alternated in sign, and all of them indicated statistically significant coefficients. If one would evaluate the tendencies of estimated elasticities in sign and magnitude even they exhibits multicollinearity problem, export elasticity of imported investment good is found less than export elasticity of imported intermediate good as seen in estimated Models 20 through 27 in Table 4. A one percentage increase in export increases investment good import by 0.49, intermediate good import by 0.82, and production good import by 0.65 percentages on the averages as seen in Models 20-22. A one percentage increase in the real value of USD in terms of TL decreases investment good import demand by 0.59, intermediate good import demand by 0.32 and production good import demand by 0.20 percentages on the averages as seen in models 20-22, *Ceteris Paribus*.

5. Conclusion

In the models above, the imported input goods are assumed to be endogenous variables and other variables are assumed to be exogenous basing upon the economic theory. The domestic and industrial countries' prices deflated import demand for investment, intermediate and the total of production goods can be explained by income, relative import price, real foreign exchange rate, terms of trade, relative import price and foreign terms of trade adjusted real foreign exchange rate and export around 99 %. All estimated models show quite high determination ratios and mostly significant elasticity coefficient even though many of them indicated either multicollinearity or autocorrelation or both of them. In fact, it is difficult to have a perfect model without facing autocorrelation and multicollinearity problem to evaluate the estimated coefficients properly based on econometric criterions.

On the average relative import price, real exchange rate, relative import price and foreign TOT adjusted real exchange rate elasticities of the intermediate goods import demand are found higher than the related elasticities of investment goods import demand. This implies lower substitubility of the imported investment good compared to imported intermediate good.

The income elasticity of imported investment and intermediate good are found close to each other, but export excluded income and export separated elasticities differed. The export elasticity of intermediate good import is found higher than export elasticity of investment good import but export excluded income elasticity of investment good import is found higher than intermediate good import.

The price and income elasticities are mostly found less elastic. This means that a percentage change in exogenous variables will cause changes in imported investment and intermediate good import less than a unit percentage on the average.

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