TURKEY'S EXPORT DYNAMICS: A SIMULTANEOUS-EQUATION MODEL ANALYSIS

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ABSTRACT

Turkey is one of the countries where a major portion of exports is critically dependent on foreign manufacturing on its land which in turn is dependent on imports of intermediate goods. Intermediate goods imports make 70% of Turkey's total imports. This critical feature of the economy, which causes endogeneity in regression models, led us to use simultaneous-equations model in analyzing its exports and imports. We covered the period from 2003 to the end of 2013 which is economically more stable. While imported intermediate goods play a critical role in exports, we find that exports are more sensitive to real exchange rates than imports.

Keywords: international trade, exports, imports, simultaneous-equation models, intermediate goods

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1 Introduction

There are many different models used to analyze export/import dynamics with each focusing on a different aspect of the problem. Understandably, these dynamics may differ across regions, countries or the conditions which justify using different models. The primary three factors are income level at the domestic and the foreign country, relative prices and movements in exchange rates. The secondary factors are trade policies, monetary and fiscal policies and producer level features (Yücel 2006).

Starting in the late seventies, the higher cost of labor in the developed countries forced producers to look for opportunities in countries with relatively cheaper cost of labor. The major beneficiaries of such a movement of capital were the Southeast Asian countries. These countries became known for their high levels of exports with current account surpluses. Foreign direct investment (FDI) played a major role in these results. In fact, according to Singh and Jun, export orientation is the strongest variable for explaining why a country attracts FDI (Singh and Jun 1995).

Another factor in determining exports is the level of intermediate goods imports. Together with FDI, imports of intermediate goods have a determining role in the level of exports in low-cost-labor countries. Therefore, they cannot be thought independently. The cost of labor in Turkey, which is the subject of this paper, is lower than many of the developed countries, even if not as low as the Southeast Asian countries. Turkey's average ratio of its intermediate goods imports to total imports is more than 71% over 11 years (Figure 1, Turkey's ratio of its intermediate goods imports to total imports). Since intermediate goods play an important role in export goods production, we cannot think them independent of exports. In this paper, we analyzed intermediate goods imports and exports of Turkey in a simultaneous equations model with the thinking that these two variables are endogenous.

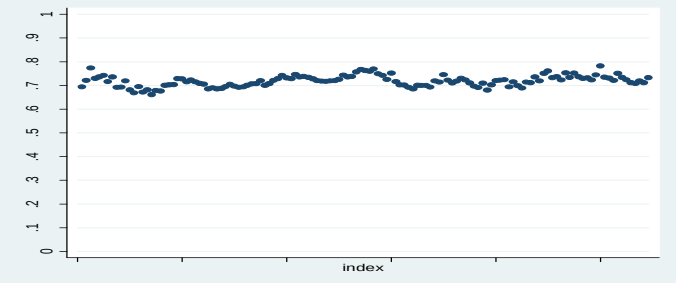

Fig. 1: Turkey's ratio of its intermediate goods imports to total imports

2 Literature Review

The causal relationship between exports and intermediate goods imports of Turkey is tested in a paper by Yildirim et al. (2012). They use a leveraged bootstrap-corrected MWALD test to find this relationship. They found no causal relationship between real exchange rates and imports/exports though.

Giles et al. (2000) surveys more than a hundred and fifty papers looking for causal relationships between export and import levels. Although they suggest extreme care in interpreting much of the applied research, they conclude that there is a relationship between exports and growth (export-led growth). But the direction of the causality, export-led growth or growth-led export is ambiguous in the existing literature (up to the date of their publication). The results also vary according to the method, time period and country. For Turkey, Temiz et al. (2010) show that the direction of the causality is from economic growth, measured as real GDP, to real export.

Gerni et al. (2008) first determine imports as a determinant of exports in their paper. Then they build an econometric model to analyze the relationships. In their model, imports is taken as an independent variable where there is a bidirectional causal relationship. This requires a more careful analysis where one should either use a simultaneous equation model, like we did in this paper, or instrumental variables.

In a study using Turkish data, Tuncer (2013) uses Granger causality tests to confirm the causal relationship from imports to exports. Aktaş (2009, "a"), covering the period 1996-2006, tests the time series data for cointegration and uses an error correction model to show bidirectional causality in between exports and imports. Aktaş (2010, "b") uses vector autoregression (VAR) technique to study the relationship between real exchange rates RER and exports/imports. He finds no relationship between RER and exports/imports which is the same result found by many other papers in the literature.

Using Toda-Yamamoto causality test, Soyyiğit (2010) shows that industrial product exports depend on intermediate goods imports and capital goods imports in Turkey. This is an expected result for not only Turkey, but many other countries that depend on production stemming from foreign direct investment. Öztürk (2012) suggests investing in research and development instead of using the exchange rates to improve the current account deficit for Turkey. Current account deficit is a chronic problem of the Turkish economy after the liberalization of its economy in

early eighties. It only got worse recently. Use of real exchange rates is considered as a policy instrument but as shown by many papers, its effectiveness as an instrument to manipulate trade balance is ambiguous. Finally, Demez and Ustaoğlu (2012) show that Turkish exports are not sensitive to structural breaks and currency rate changes, another paper in the same line of research.

3 The Model

As discussed in the literature review above, exports and imports are dependent on each other. This is especially true for countries like Turkey where cheaper labor, both at blue collar and white collar levels, is giving it a comparative advantage in production of certain goods. Therefore, we used a simultaneous equations model, where the need is verified by Hausman specification test, to analyze the exports and imports of the Turkish economy using data from 2003 to 2013. Turkey experienced a major crisis in 2008, together with the rest of the world. We added a dummy variable for the significance of that period. Our model follows:

$$EX = \beta_0 + \beta_1 IIM + \beta_2 CIM + \beta_3 RER + \beta_4 OIP + \beta_5 DUM + u_{1t} \quad (1)$$

$$IIM = \alpha_0 + \alpha_1 EX + \alpha_2 RER + \alpha_3 IP + \alpha_3 DUM + u_{2t} \quad (2)$$

3.1 Data

EX is for total exports, IIM: imports of intermediate goods, CIM: imports of capital goods, RER: real exchange rate, IP: domestic industrial production and OIP: OECD countries industrial production index. Since Turkish economy trades mostly with OECD countries, OIP is taken as a proxy for the real economy of Turkish trade partners.

OECD industrial production index, OIP, and Turkish industrial production, IP, data are taken from OECD's website. It was already seasonally adjusted. EX, IIM, RER values are downloaded from the Central Bank of Turkish Republic website, (EVDS). We seasonally adjusted data series using the X-12 ARIMA method. We used the natural logarithm of all variables in all tests and regressions. The data is monthly data from 01.2003 to 11.2013, one month less than 11 years.

3.1.1 Use of Dummy a Variable

The world experienced a crisis in 2008. Looking at the data for Turkey, we see that there are big shifts during this period and we used a dummy variable to account for the shifts of the period.

3.2 Stationarity Tests

Since we use time series data there is a stationarity problem in the data, as expected, except for the real exchange rate, RER. We used augmented Dickey-Fuller test to verify the stationarity (Dickey and Fuller 1979). The results are given in Table 1, Augmented Dickey-Fuller Test Results. Looking at the results, we see that all but the real exchange rate are nonstationary in first degree. The null hypothesis is that there is a unit root in augmented Dickey-Fuller test. Since the test value is greater than the critical values, we do not reject the null and except the existence of a unit root.

Table 1: Augmented Dickey-Fuller Test Results

Variables	Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value
EX	-1.682	-3.5	-2.888	-2.578	0.4402
IIM	-1.49	-3.5	-2.888	-2.578	0.5386
CIM	-2.114	-3.5	-2.888	-2.578	0.2390
RER	-3.629	-3.5	-2.888	-2.578	0.0052
OIP	-1.195	-3.5	-2.888	-2.578	0.6756
IP	-2.592	-3.5	-2.888	-2.578	0.0947

Taking the first difference removes the nonstationarity of all variables. In Table 2 we show results for the first differences.

Table 2: Augmented Dickey-Fuller Test Results for first differences

Variables	Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon approximate p-value
ΔEX	-19.205	-3.5	-2.888	-2.578	0.0000
ΔIIM	-13.535	-3.5	-2.888	-2.578	0.0000
ΔCIM	-17.313	-3.5	-2.888	-2.578	0.0000
ΔOIP	-5.64	-3.5	-2.888	-2.578	0.0000
ΔIP	-23.731	-3.5	-2.888	-2.578	0.0000

3.3 Simultaneity

In this simultaneous equation model, the number of endogenous variables is 2 which are exports, EX, and intermediate imports, IIM. The predetermined variables are CIM, RER, IP and OIP. The first equation (1) excludes one variable, IP, and the second equation (2) excludes two variables, CIM and OIP. Therefore equation (1) is just identified and equation (2) is over identified. Therefore, there is no identification problem in using the simultaneous equation model (Gujarati 2003). We need to use Hausman specification test to test for simultaneity though.

3.4 Hausman Specification Test

We regressed the intermediate goods imports on all predetermined variables and computed the residuals from this regression. Then, we regressed the exports on its independent variables given in equation (2) with adding the residuals computed from the first regression as an independent variable. Since we cannot reject the null hypothesis that the coefficient of the residual in the last regression is zero, at 5% and 10% levels, we conclude that there is a simultaneity problem (Hausman 1978). Therefore, we use the method of simultaneous equations.

To avoid endogeneity, we took the lagged values of capital intermediate goods and OECD industrial production index. The same lagged values are used in the Hausman specification test and the two-stage least square regression.

Table 3: Hausman Specification Test Results

Source	SS	df	MS	Number of obs = 129
Model	.539842647	5	.107968529	F(5, 123) = 20.21
Residual	.657106487	123	.005342329	Prob > F = 0.0000
				R-squared = 0.4510
Total	1.19694913	128	.009351165	Adj R-squared = 0.4287
				Root MSE = .07309

D.EXln	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IIMln D1.	1.588722	.3236963	4.91	0.000	.9479855	2.229459
CIMln LD.	.150619	.0852693	1.77	0.080	-.0181663	.3194043
RERln D1.	-.2841618	.2485802	-1.14	0.255	-.7762111	.2078875
OIPln LD.	-2.244175	1.059442	-2.12	0.036	-4.341276	-.1470742
IIMln_res	-.7644905	.3380481	-2.26	0.025	-1.433636	-.095345
_cons	-.0058306	.0073024	-0.80	0.426	-.0202852	.0086241

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. test IIMln_res

 ( 1)  IIMln_res = 0

       F(  1,   123) =    5.11
            Prob > F =    0.0255
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3.5 Simultaneous-Equation Model

We used the two-stage least squares method to estimate the model. All variables, but the real exchange rate and the OECD industrial production index are meaningful. The results are shown in Table 4, Two-stage least-squares regression.

Table 4: Two-stage least-squares regression

Two-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	F-Stat	P
D_EXln	129	5	.1111553	-0.2697	6.54	0.0000
D_IIMln	129	4	.0608096	0.3284	15.16	0.0000

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
D_EXln						
IIMln						
D1.	2.18562	.423059	5.17	0.000	1.352357	3.018884
CIMln						
LD.	.2346785	.1181797	1.99	0.048	.00191	.467447
RERln						
D1.	-.0863668	.3616075	-0.24	0.811	-.7985943	.6258607
OIPln						
LD.	2.029331	2.007339	1.01	0.313	-1.924353	5.983015
dum	.2608578	.0990171	2.63	0.009	.0658322	.4558833
_cons	-.031055	.0147148	-2.11	0.036	-.0600374	-.0020726
D_IIMln						
EXln						
LD.	-.2133389	.0645279	-3.31	0.001	-.340434	-.0862437
RERln						
D1.	.0890424	.1961293	0.45	0.650	-.2972567	.4753415
IPln						
LD.	-.2515383	.1087074	-2.31	0.021	-.46565	-.0374266
dum	-.1432971	.0245458	-5.84	0.000	-.1916429	-.0949513
_cons	.0207828	.0055805	3.72	0.000	.0097913	.0317743

Endogenous variables: D.EXln D.IIMln
Exogenous variables: LD.CIMln D.RERln LD.OIPln dum LD.EXln LD.IPln

4 Conclusion

For countries like Turkey where exports are critically dependent on imports of capital and intermediate goods, there are bidirectional causalities which bring the issue of endogeneity. Covering the period from 2003 to 2013, we studied the dynamics Turkey's exports/imports in a simultaneous-equation model. In our analysis we found similar results to what was already in the literature. While imports of intermediate goods are vital in determining exports, capital goods imports are not as important as intermediate goods. Again in line with the literature, real exchange rates do not help us to explain the dynamics of exports and imports. The coefficients for the real exchange rate variable both in the exports and the imports equation are meaningless.

Future area of research includes using panel data on bilateral trade in between countries. Such a study can give more accurate results since each country will have its own industrial production data instead of one index for the rest of the world.

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