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Export Dynamics in Turkey*

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Abstract

This paper presents a structural vector autoregression model to explore the export dynamics in Turkey. Given the notable export performance after 2002, albeit high-rated real appreciation of Turkish lira, we investigate the role of unit wages in explaining the high export growth. We observe that, through historical decomposition of exports, real unit wage, not the real exchange rate, has been the main determinant of Turkish exports after 1999. Moreover, the impulse response analysis suggests that the short-term impact of a real unit wage shock on exports is larger compared to that of the real exchange rate. The same conclusion applies even for the long-run effects, provided that the confidence in the economy is maintained. We also demonstrate the importance of real unit wages by estimating an error-correction model, which provides consistent results with the impulse response analysis. The analysis points out that the real exchange rate is not the sole determinant of the export behavior in Turkey. The main point of the study is that, export growth can be sustained, even when the real exchange rate is appreciating, if the improvement in labor productivity can be sustained.

JEL Classification Codes: C32, C51, and F17.
Key Words: Structural Vector Autoregression, Export Dynamics, Historical Decomposition.

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1. Introduction

There has always been an ongoing debate and critics about the level of the real exchange rate and its potential effects on foreign trade in Turkey. Exporter firms generally complain about overvaluation of domestic currency, as if it is the only variable that determines the degree of competitiveness in the international goods markets. This turns out to be a misbelief considering the enhanced export performance especially prevailed in the recent years, during which export developments cannot be explained by the movements of the real exchange rate: In 2003, the real exports had grown by 28.9 percent while the real exchange rate appreciation had been 21.4 percent compared to the year 2001.

The real exchange rate is the most widely used indicator since it is an index that can easily be constructed and allows one to measure competitiveness bilaterally or against a group of countries. While comparability is a major advantage, the use of aggregated price indices due to incomparable data for sub-sector prices might make it unrealistic in some cases. Unit labor cost in a certain industry emerges as an alternative indicator of competitiveness as it reflects the comparative advantage in production. Although this indicator's role in the determination of a country's competitiveness is generally disregarded and underestimated by the exporter firms, we argue that it can be significant in explaining the movements in exports.

On the other hand, recent literature mostly focuses on the role of relative prices in the determination of trade flows. Most of the empirical works on the determinants of trade flows are based on the imperfect substitutes model, which was described by Goldstein and Khan (1985). The studies trying to estimate trade elasticities, make use of relative export price and real world income as explanatory variables in an export equation. Khan (1974) estimates such an export demand function by OLS for a set of developing countries and concludes that relative price is a major determinant of exports. Bahmani-Oskooee and Niroomand (1998) and Senhadji and Montenegro (1999) also employ similar export demand specifications.[1]

There are other studies extending the variable set by including an exchange rate variable in the export demand function. Bahmani-Oskooee (1998) adds a nominal effective exchange rate in the export equation. Warner and Kreinin (1983) employ

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[1] Senhadji and Montenegro (1999) include a lagged export volume in addition to relative price and world income variables.

OLS technique to explain exports by a measure of world income, export price, effective exchange rate, a proxy for the expected exchange rate, and a weighted average export price of foreign countries. They found important role for the exchange rate and competitors' export price in explaining export dynamics for selected developed economies.

Sahinbeyoglu and Ulasan (1999) estimate error-correction models for export supply and demand functions for Turkey and uses the two-step Engle-Granger methodology. The variables involved are the real exchange rate and some measures of real income.[2] On the other hand, recognizing the simultaneity problem in estimating single equation models, Behar and Edwards (2004) use a vector-error-correction model to estimate the export supply and demand equations for South Africa. The variable set, which is constructed for both home and competitor countries, consists of a measure of aggregated prices, export prices, and income.

Relative price (or real exchange rate) is found to be a significant determinant of Turkish exports in a number of studies for Turkey.[3] However, the notable export performance in recent years, albeit high rated real appreciation of Turkish lira, creates room for investigating the role of unit wage in explaining the export behavior in Turkey.[4] It is, therefore, important to assess the sensitivity of exports to changes in above-mentioned indicators of competitiveness in order to evaluate whether real exchange rates are the sole driving force of exports. The main purpose of this paper is to examine the export dynamics in Turkey through analyzing the effects of the real exchange rate, the real unit wage, and the real income. In this respect, effects of these variables on real exports are questioned through estimating the corresponding elasticities and analyzing the response of real exports to various shocks. In doing so, we make use of econometric evidence in the context of structural vector autoregression (SVAR) and error-correction mechanism (ECM) models.

Section 2 consists of identification of a structural VAR, historical decomposition of real exports and examination of the impulse responses of real exports to demand, real exchange rate and real unit wage shocks. Section 3 introduces an ECM model through which short-run and long-run elasticities of exports with respect to corresponding variables are obtained. Section 4 concludes.

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[2] Export supply and demand equations include domestic income and foreign income respectively.
[3] See Saygili *et al.* (1998), Sahinbeyoglu and Ulasan (1999), Aydin *et al.* (2004).
[4] Aydin *et al.* (2004) also considers the unit wage in an export supply equation.

2. A Structural VAR Analysis of Export Dynamics

There has been a considerable interest in using VAR models to analyze the dynamic interaction of variables. Given the fact that single equation models are inadequate in the presence of feedback relations, VAR models come into the scene to handle the issue of exogeneity. In this context, Sims' (1980) suggestion of treating all variables as endogenous and estimating large-scale macro models as unrestricted reduced forms, provides the basis for VAR models.

However, Sims' VAR approach has been criticized, as it does not resort to economic theory. Even though one can avoid imposing "incredible restrictions" by treating all variables symmetrically, the procedure has been subject to criticisms as being mechanical. On the other hand, SVARs add an economic content as taking the contemporaneous relations between the variables into account. It also allows for the identification of the parameters based on an economic model and structural shocks. In this study, the interaction between real exports, real income, real exchange rate, and real unit wage are analyzed in a SVAR setting. Therefore, once the decision on whether the SVAR will be in level or difference form is made, the model will be introduced.

Sims (1980) recommends against differencing, in the purpose of keeping the relationships among the variables without loss of information. In the light of the existing literature, the question of whether the variables in a VAR need to be stationary is considered in the context of cointegration. The fact that non-stationary variables can lead to spurious regressions in the presence of long-run comovements requires a formal test for cointegration. Therefore, once the order of integration of the variables in our multivariate system is determined, Johansen (1988) technique will be carried out to test for cointegration. This procedure requires the selection of an appropriate lag-length of the VAR model, identification of the deterministic components (a constant and trend) and the determination of the cointegration rank.

Data

The models are estimated with quarterly data covering the period 1989:1-2003:3. The export and gross domestic product (GDP) figures are from the national accounts published by the State Institute of Statistics (SIS). The real exchange rate is the CPI based trade-weighted index calculated by the Central Bank of the Republic of Turkey (CBRT). The real unit wage in the manufacturing sector is calculated as

$$\frac{w.L}{Q} = \frac{w}{Q/L} \qquad (1)$$

where w is the real wage per working hour index in the manufacturing sector, L is the working hours index in the manufacturing sector, and Q is the manufacturing industry production, all of which are announced by the SIS. All data is obtained from the electronic data delivery system (EDDS) of the CBRT.[5]

Unit Root Tests

The stationarity of the variables is tested using the Augmented Dickey-Fuller (ADF) procedure. The test results suggest that the null hypothesis of a unit root cannot be rejected at 5 percent significance level for the series in levels (Table 1). On the contrary, the null of non-stationarity is strongly rejected for the first differenced series (Table 2). Therefore, all variables appear to be integrated of order 1.

Table 1
Augmented Dickey-Fuller Test Results for Levels

Variables in Logarithms	*Deterministic Component*	*Lag Length*	*ADF statistic*	*95% Critical Value*	*Order of Integration*
gdp	C, T	4	-3.02	-3.49	I(1)
exp	C, T	4	-2.28	-3.49	I(1)
rer	C	2	-2.15	-2.91	I(1)
ruw	C, T	4	-2.71	-3.49	I(1)

* The 5 percent critical values for the ADF tests are computed using the response surface estimates given in MacKinnon (1991, Table 1).

Table 2
Augmented Dickey-Fuller Test Results for First Differences

Variables in Logarithms	*Deterministic Component*	*Lag Length*	*ADF statistic*	*95% Critical Value*	*Order of Integration*
Δgdp	C	5	-4.22	-2.92	I(0)
Δexp	C	3	-4.37	-2.92	I(0)
Δrer	None	1	-6.60	-1.95	I(0)
Δruw	C	1	-5.73	-2.91	I(0)

* The 5 percent critical values for the ADF tests are computed using the response surface estimates given in MacKinnon (1991, Table 1).

[5] The data is available at http://tcmbf40.tcmb.gov.tr/fame/webfactory/evdpw/yeni/cbt-uk.html.

Determination of Cointegration Rank

Defining z_t as the vector of n endogenous variables, an unrestricted vector autoregression involving k-lags of z_t can be written as

$$z_t = A_1 z_{t-1} + \ldots + A_k z_{t-k} + u_t \qquad (2)$$

where z_t is $(n \times 1)$ and A_i is the $(n \times n)$ matrix of parameters. When reformulated, the unrestricted VAR model takes a vector error-correction (VECM) form.

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \ldots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi z_{t-k} + u_t \qquad (3)$$

where $\Gamma_i = -(I - A_1 - \ldots - A_i)$, $(i = 1, \ldots, k-1)$, and $\Pi = -(I - A_1 - \ldots - A_k)$. In this context, Johansen (1988) approach to testing for cointegration is equivalent to finding r, the number of linearly independent columns, namely the rank of Π, which contains information on long-run relationships among the variables constructing z_t.

The starting point to test for cointegration in a multivariate system requires an appropriate lag length selection for the unrestricted VAR. The optimal lag is taken as 3 according to the results suggested by the likelihood ratio test and Akaike and Schwarz information criteria, which are presented in the Appendix (Table 6).

The two widely used tests for the determination of cointegration rank are the maximal-eigenvalue and trace tests. The test results, which allow us to decide upon the configuration of the deterministic components at the same time, are presented in the Appendix (Table 7). Both test statistics suggest that there is one cointegrating relationship among the variables in an 'unrestricted intercepts and no trends' model, in which there is one intercept in the short-run part of the model. Hence, we construct a VAR model with the level series in the light of Sims' argument that differencing throws away information concerning the comovements in the data in the presence of cointegration.

The Model

Letting lower-case letters denote logarithmic values, the basic VAR specification can be written as

$$z_t = \sum_{s=1}^{L} \Phi_s z_{t-s} + u_t \qquad (4)$$

where z_t is a vector of real GDP, real exports, real exchange rate and real unit wage. Quarterly data is used for the sample period 1989:1-2003:3. Our VAR specification contains a constant and a centered seasonal dummy for the third quarter to capture the effect of higher economic activity in that period.

$u_t \equiv [y_t, x_t, q_t, w_t]'$ is the corresponding innovations vector from the reduced-form VAR. These residuals are serially uncorrelated but in general contemporaneously correlated, i.e. their variance-covariance matrix is not diagonal. In this respect, we will carry out a structural decomposition considering economically meaningful contemporaneous relationships among the variables, to identify uncorrelated shocks. A SVAR(3) is estimated using quarterly data for the sample period 1989:1-2003:3. The system is formulated as

$$y_t = a_{12} x_t + b_{14} v_t^{\theta} + v_t^{d} \tag{5}$$

$$x_t = a_{21} y_t + v_t^{x} \tag{6}$$

$$q_t = v_t^{q} \tag{7}$$

$$w_t = a_{41} y_t + a_{43} q_t + v_t^{\theta} \tag{8}$$

where $v_t \equiv [v_t^d, v_t^x, v_t^q, v_t^{\theta}]'$ is the vector of uncorrelated structural shocks to real demand, real exports, real exchange rate, and real unit wage respectively.

Equation (5) states that beyond the effects of lagged variables, there is a direct impact of real exports on real output since total production within a quarter includes exported goods as well. The movements of real output can also be as a response to structural shocks to real unit wage and shocks to demand. Equation (6) reflects the fact that some portion of the total production within a period is directed towards international markets, so there is a contemporaneous effect of real output on real exports. Equation (7) implies that real exchange rate appears as the most exogenously determined variable as there is no direct feedback from the other variables in the system. The fact that real output enters directly to the calculation of real unit wage variable is reflected as the contemporaneous effect of real output in Equation (8). Whenever there is a change in the overall activity, by definition there will be an automatic change in real unit wage.

In order to identify the system we imposed two restrictions on the real GDP equation. Firstly, the simultaneity problem in (5) and (6) is solved by calibrating a_{12}. The real export elasticity of real output, a_{12}, is restricted to be 0.2. In setting this elasticity, the coefficient from the linear regression of the percentage annual change of real GDP to that of real exports as well as the historical average share of real exports in real output is taken into account. Secondly, assuming that output is demand driven in the short-run, b_{14} is restricted to be zero.

Historical Decomposition

The historical decomposition of a time series is based on the following partition of the moving average representation of the structural model.

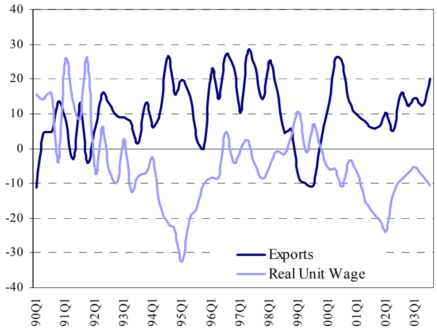
$$z_{t+j} = \sum_{s=0}^{j-1} C_s v_{t+j-s} + \sum_{s=j}^{\infty} C_s v_{t+j-s} \tag{9}$$

The sum component at the far right is the base forecast of z_{t+j} based on the information available at time t. However, the base projection of z_{t+j} cannot be equal to its realized value at time $t+j$, provided that new structural innovations from $t+1$ to $t+j$ take place. The first sum component represents the forecast error of z_{t+j}, which allows us to identify the sources of the unexpected movements in z_{t+j}. In this way, we can figure out whether the fluctuations in Turkish exports were the result of shocks to other variables in the system.

Historical decomposition of real exports for the period 1996:1-2003:3 shows that the export shocks have the most explanatory power for the gap between actual exports and the base forecast until 1999. After 1999, almost the entire difference between actual exports and the base forecast can be attributed to real unit wage shocks. On the other hand, real exchange rate, which is the most widely used competitiveness indicator, does not explain the deviation of ex-post exports from the base forecasts in this period (Figure 7). Therefore, real unit wages rather than real exchange rate developments has been playing a major role in causing movements in the export performance since 1999.

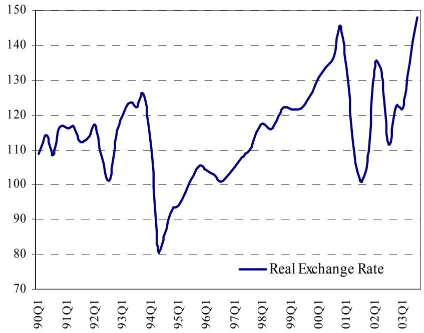
In a labor-intensive small economy, labor and imported intermediate and capital goods emerges as the principal inputs for production. An appreciated domestic currency creates incentive for firms to substitute labor for capital and thus contributes to the improvement of labor productivity. Hence, low real unit wages and appreciated domestic currency would cause production costs to fall significantly making exporter firms more competitive in international markets. In the Turkish economy through 1999 to 2003, the real unit wages declined by almost 40% resulting from depressed real wages and improved productivity. Historical decomposition results suggest that this has been the major driving force in the enhanced export performance especially after 1999, which is also verified by the figures below.

Fig. 1. Exports and Real Unit Wage (Annual % Change)



Source: SIS

Fig. 2. Real Exchange Rate (1995=100)



Source: CBRT

Impulse Response Analysis

The impulse responses are used to investigate the dynamic effects of structural shocks on real exports. In this context, the elasticity of exports with respect to income, price and cost variables can also be analyzed. The responses of real exports to the shocks are consistent with the economic theory. In that sense, a demand shock results in an expansion in the production of exported goods, while shocks to real exchange rate and real unit wage have adverse effects on real exports through higher input prices and thus production costs.

A 10% rise in demand induces a 0.6% increase in real exports contemporaneously, while the effect rises to 6% in the following period as the production plans are modified. After full adjustment has taken place the real exports expands approximately by 11% after twenty quarters. Therefore, most of the adjustment in response to new demand conditions takes one quarter (Table 8, Figure 7).

A shock to the real exchange rate starts to show its effects on exports with a lag of one quarter. A 10% appreciation in Turkish lira at time t gives rise to a 1.7% reduction in real exports at time $t+1$. The effect of the shock strengthens rapidly at each year so that the cumulative effect is a 6% fall in real exports after twenty quarters (Table 8, Figure 7).

The effect of a 10% real unit wage shock is a 2.5% expansion in real exports with a one- quarter lag after the shock takes place. The full adjustment occurs in ten quarters and the effects of the shock die out thereafter. The impact of the shock increases gradually bringing out a 3.8% drop in real exports after twenty quarters (Table 8, Figure 7).

The impulse responses to real exchange rate and real unit wage shocks, being major determinants of the movements in exports, have important implications beyond their magnitudes. Firstly, above figures indicate that a large portion of the cumulative response to a real unit wage shock is realized one period after the shock takes place. On the other hand, the initial responses of exports to a change in the real exchange rate are smaller. These differentiated effects are consistent with economic theory. A shock to real unit wage shows its effects on real exports quickly in such a case that it works as a direct shock to a real variable, output, which becomes available for sale in domestic or foreign markets at the same period. On the other hand, it takes a longer time for the total effect of a real exchange rate shock to be revealed. The goods market adjustment in response to a change in the real exchange rate takes time until the producers perceive that change and adjust their production plans accordingly.

Secondly, the rate of increase of exports in response to real exchange rate depreciation is greater compared to the case of a decline in the real unit wage. This makes the cumulative effect of the former one on real exports larger as opposed to relative initial effects. A similar explanation may be that the gains from enhanced productivity, thus reduced real unit wage, are consumed more quickly so that a stable level of real exports is observed after ten quarters. On the other hand, the slow adjustment in the goods market in terms of the producers' perception about the change in their competitiveness and adoption of new production plans makes the effects of the real exchange rate shock spread over a longer time period.

An Alternative Model

Following the financial liberalization in 1989, the Turkish economy has exhibited a boom-bust cycle characteristic, which in turn made the capital flows a significant determinant of economic growth. The fact that in the periods of macroeconomic stability, foreign capital has been attracted, which gave rise to a strengthening of domestic currency. The dependence of the economy on short-term capital flows created an environment, in which a real appreciation of Turkish lira coincided with high economic growth periods whereas a high real depreciation was consistent with crisis periods. Therefore, apart from its direct effect on relative price of home goods against their foreign counterparts, the real exchange has also an indirect effect on growth dynamics through a confidence channel depending on the quality of macroeconomic fundamentals in Turkey. This argument leads to a modification in the output equation while the other equations of the system remain the same.

$$y_t = a_{12}x_t + b_{13}v_t^q + v_t^d \tag{10}$$

where v_t^q is assumed to be the confidence shock, which captures the indirect effect of the real exchange rate on output. Therefore, a positive confidence shock is expected to generate higher output and thus exports.

Impulse response analysis confirms this anticipation. A 10 % real appreciation leads to a 2.8% in output and 0.2% in exports contemporaneously. In spite of this initial positive impact, the cumulative effects on output and exports are negative as expected. However, the negative effect of a real exchange rate appreciation on output and exports is more limited with the new specification. In the previous case, the cumulative effect of the real exchange rate on real exports was found to be larger than that of the real unit wage as opposed to their relative initial effects. When confidence shock is included, real unit wage more than compensates for the negative effect of real exchange rate, even in the long run (Table 9, Figure 8).

In general, impulse response and historical decomposition results are robust to this alternative model specification. After 1999, real unit wage shocks, rather than the real exchange rate, seem to be responsible for the deviations of base forecast from actual exports (Figure 8).

3. Estimating an ECM Model for Real Exports

The procedures followed up to now were based on the fact that all variables are integrated of order 1. However, non-stationarity of the real exchange rate may leave a doubt in ones mind, given the well-known purchasing power parity (PPP) hypothesis, which asserts that the deviations from PPP is transitory, or equivalently real exchange rate does not contain a unit root.

An alternative approach to test for cointegration is the autoregressive distributed lag (ARDL) procedure advanced in Pesaran and Shin (1995) and Pesaran *et al.* (1996). The main advantage of this technique is that it can be applied irrespective of whether the regressors are I(0) or I(1). By this way, one can avoid pretesting problems associated with standard cointegration analysis. Therefore, this procedure would not only provide a crosscheck for the cointegration results suggested by maximal eigenvalue and trace statistics, but also allow us to test and extract a cointegrating relationship in the form of an export function. Moreover, while the estimation of an error correction equation for the real exports would provide insights about the short-run dynamics, obtaining the long-run elasticities with respect to real exchange rate and real unit wage would allow us to make comparisons with the results of the previous analysis.

The estimation results indicate that an increase in domestic economic activity affects the real exports positively, whereas both a real appreciation of the Turkish lira and an increase in real unit wages has adverse effects on real exports. However, it should be noted that it is the growth rates of real export and real exchange rate that is negatively related, not the levels. In other words, as the appreciation rate increases, the rate of increase in real exports falls. The growth rate of the real exchange rate has a lagged effect while the unit wage growth has a contemporaneous effect on the rate of increase of real exports. The ECM coefficient in the model implies that, at each period, fifty percent of a deviation from the long-run equilibrium is corrected (Table 3).

Table 3
Error Correction Representation for ARDL(2,3,0,2)$^{\pm}$

Δexp	Δexp(-1)	Δrer	Δrer(-1)	Δrer(-2)	Δruw	Δgdp	Δgdp(-1)	ecm(-1)
-1.000	-0.273	0.012	-0.422	-0.266	-0.403	0.607	0.655	-0.518
	(-2.334)	*(0.087)*	*(-2.895)*	*(-1.983)*	*(-3.767)*	*(2.418)*	*(2.430)*	*(-3.962)*
R^2	0.88							
Adj. R^2	0.84							

$^{\pm}$ T-ratios in the parenthesis. The model also contains the first differences of a constant and three centered seasonal dummies, which are not presented in the table for visual ease.

The short-run elasticities of real exports with respect to real exchange rate and real unit wage are estimated to be 0.7 and 0.4 in absolute values, respectively. The short-run income elasticity of real exports is estimated as 1.3 (Table 3). As mentioned above, these elasticities should be interpreted as the response of the "growth rate" of real exports to the changes in the growth rates of the corresponding variables.

Table 4
Long-Run Coefficients from the ARDL Model±

ln(exp)	ln(rer)	ln(ruw)	ln(gdp)	constant	sc1	sc2	sc3
-1.000	0.556	-0.778	1.449	-4.816	0.857	0.866	0.255
	(2.694)	*(-6.944)*	*(5.163)*	*(-1.676)*	*(2.261)*	*(2.466)*	*(0.831)*

± T-ratios in the parenthesis. Sc1, sc2, and sc3 are the centered seasonal dummies for the first, second, and third quarters respectively.

The long-run elasticities of real exports with respect to real exchange rate and real unit wage are estimated to be 0.6 and 0.8 in absolute values, respectively. The long-run income elasticity of real exports is estimated as 1.4 (Table 4). Here, the positive coefficient of the real exchange rate emerges as an unexpected result that requires attention. Firstly, the economic crises experienced by Turkey in the last ten years gave rise to an unstable economy with high inflation and real interest rates and no sustained growth. The mechanism peculiar to the Turkish economy works in such a way that economic growth has been financed through capital inflows. The dependence of the economy on capital flows created an environment, in which the periods of real appreciation of home currency coincided with high economic growth periods whereas high real depreciation periods were associated with crisis periods. Moreover, export performance strongly depends on domestic activity and thus, general economic conditions. Given this fact, the negative relationship between real exports and the real exchange rate may be due to country-specific conditions. However, keeping this explanation in mind, the theory-inconsistent result is still surprising since the real GDP variable was expected to act as a controlling variable for the facts mentioned above.

Secondly, the estimated model can be interpreted as an export supply function rather than an export demand function. Due to the strong dependence of production on imported intermediate goods, constituting 75% of total imports, a real appreciation of domestic currency creates an incentive to expand production by reducing the input costs. In this respect, the positive coefficient of the real exchange rate may be seen as reflecting the stimulated output, and thus exports, as a result of a decline in production costs, in spite of a loss in competitiveness.

In a previous study by Sahinbeyoğlu and Ulasan (1999), Engle-Granger two-step procedure is followed and an error-correction model is estimated. They estimated the short-run elasticities of real exports with respect to real GDP and real exchange rate as -0.2 and 0.6 respectively. The corresponding long-run elasticities are estimated to be -0.3 and 0.06. These estimated coefficients significantly differ from our results. The estimated income elasticities are negative and low in absolute values, whereas we estimated them to be positive and greater than 1 for both short and long terms. The short-run price elasticities are inconsistent with our results in terms of signs or magnitudes.

In a panel data study, Neyapti *et al.* (2003) questions the effect of Turkey's participation in the European Customs Union. They estimated a positive income elasticity above 2 and negative real exchange rate elasticity as -0.7 without a short-run and long-run differentiation. The estimated real exchange rate elasticity is very close to ours for short-run in terms of sign and magnitude. The income elasticity is greater than our estimate but consistent with our finding that real exports are elastic with respect to income.

Table 5
The Effect of a 10 % Change on Real Exports (%)

Variables	*IR Analysis (no confidence shock)*	*IR Analysis (with confidence shock)*	*ECM*
gdp	8.40	8.40	12.62
rer	-4.84	-2.53	-6.76
ruw	-3.73	-3.73	-4.03

* Impulse responses cover a period of 12-quarters.

As a final evaluation, the short-run estimates of income, price and cost elasticities of real exports from the ECM analysis and the 12-quarter cumulative responses of real exports to shocks of these variables from the previous impulse response analysis, are consistent with each other to a wide extent (Table 5).

4. Conclusion

This paper uses structural VAR and error-correction models to investigate the role of real GDP, real exchange rate and real unit wage in explaining the export dynamics in Turkey. The SVAR analysis suggests that the response of real exports to a demand shock is large and almost fifty percent of the adjustment is completed in the next quarter. The response to a real exchange rate shock is lower than that to a real unit wage shock in the short-run, but cumulative effects show that the effect of the real exchange rate is greater than that of unit wage in a longer time period. This might be reflecting the fact that the former is an indirect shock to a production process and takes a longer time for the production plans to be adjusted once the producers perceive the gain in competitiveness. On the other hand, the latter is a direct shock to a real variable, which improves the production possibilities with the same quantity of inputs. Besides, when a confidence shock term is included in the output equation, real unit wage more than compensates for the negative effect of the real exchange rate, even in a longer term.

Moreover, historical decomposition of real exports for the period indicates that, after 1999, almost the entire difference between actual exports and the base forecast can be attributed to real unit wage shocks. This implies that the real exchange rate is not the only and the most important indicator of competitiveness, and thus is not the sole determinant of the export performance in Turkey. Instead, real exchange rate appreciation contributes to the high export performance by reducing the relative price of capital goods, thus inducing firms to substitute labor for capital. Increased capital-labor ratio in the production process promotes labor productivity and thereby causes unit wages to decline. In this respect, last two years' experience in Turkey signifies the dominance of the cost channel over the conventional demand channel in transmitting the effects of the real exchange rate. Therefore, export growth can be sustained, even when the real exchange rate is appreciating, if the decline in the real unit wage— through either a fall in real wages and/or an improvement in labor productivity— can be achieved.

Given the significant impact of real unit wage on exports, an ECM is estimated. The short-run elasticity of real exports with respect to income, price and cost variables computed using ECM analysis exhibit a strong resemblance with those obtained from the 12-quarter impulse responses. The income elasticity of real exports is greater compared to the elasticities with respect to real exchange rate and real unit wage. Moreover, the sensitivity of real exports to real exchange rate is greater than that to real unit wage. On the other hand, the long-run relationship shows that the income elasticity of real exports is close to the one for the short-run whereas the long-run elasticity of real exports with respect to real unit wage is almost doubled compared to its short-run elasticity. An interesting result is that an appreciation of Turkish lira is associated with higher export performance in the long run, which might be a consequence of the dependence of exports on imported intermediate inputs.

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Appendix

Table 6
Lag Choice Criteria

Lag	AIC	SBC	LR Test	p-value
8	-1200.72	-937.99	-	-
7	-1169.29	-937.47	21.14	0.17
6	-1169.18	-968.27	13.22	0.66
5	-1151.98	-981.98	24.11	0.09
4	-1154.31	-1015.22	16.87	0.39
3	-1161.08	-1052.90	16.32	0.43
2	-1113.49	-1036.22	57.74	0.00
1	-1064.26	-1017.90	65.31	0.00

Table 7
Johansen Cointegration Test Results

Maximal Eigenvalue Test

Null	Alternative	Model 1	Model 2	Model 3	Model 4	Model 5
r = 0	r = 1	27.08	28.42	27.96	33.41	31.40
r<= 1	r = 2	20.84	22.84	**10.60**	16.98	16.71
r<= 2	r = 3	5.27	8.99	5.54	10.39	7.47
r<= 3	r = 4	2.51	3.34	0.24	4.93	1.25

90% Critical Values for the Maximal Eigenvalue Test

Null	Alternative	Model 1	Model 2	Model 3	Model 4	Model 5
r = 0	r = 1	21.58	25.80	24.99	29.13	28.32
r<= 1	r = 2	15.57	19.86	19.02	23.10	22.26
r<= 2	r = 3	9.28	13.81	12.98	17.18	16.28
r<= 3	r = 4	3.04	7.53	6.50	10.55	9.75

Trace Test

Null	Alternative	Model 1	Model 2	Model 3	Model 4	Model 5
r = 0	r>= 1	73.29	63.60	44.35	65.70	56.85
r<= 1	r>= 2	21.29	35.15	**16.37**	32.29	25.45
r<= 2	r>= 3	4.07	12.33	5.78	15.31	8.74
r<= 3	r = 4	0.58	3.35	0.24	4.93	1.25

90% Critical Values for the Trace Test

Null	Alternative	Model 1	Model 2	Model 3	Model 4	Model 5
r = 0	r = 1	36.58	49.92	43.84	58.96	50.67
r<= 1	r = 2	21.58	31.88	26.70	39.08	31.57
r<= 2	r = 3	10.35	17.79	13.31	22.95	15.94
r<= 3	r = 4	2.98	7.50	2.71	10.56	2.71

Table 8
Impulse Response of Real Exports to 10% Shocks

Response of Real Exports to 10% Shocks (%)			
Period	Demand Shock	RER Shock	ULC Shock
1	0.554	0.000	0.000
2	6.074	-1.669	2.542
3	2.259	-1.358	2.419
4	4.565	-1.118	2.990
5	6.536	-2.187	2.628
6	5.371	-2.414	2.884
7	5.485	-2.826	3.452
8	6.803	-3.676	3.291
9	7.207	-4.074	3.429
10	7.215	-4.220	3.772
11	7.825	-4.533	3.780
12	8.400	-4.844	3.725
13	8.548	-5.025	3.821
14	8.798	-5.228	3.873
15	9.228	-5.477	3.833
16	9.506	-5.662	3.832
17	9.698	-5.800	3.856
18	9.974	-5.951	3.831
19	10.234	-6.091	3.790
20	10.412	-6.199	3.769

Table 9
Impulse Response of Real Exports to 10% Shocks
(Alternative Specification)

Response of Real Exports to 10% Shocks (%)			
Period	Demand Shock	RER Shock	ULC Shock
1	0.554	0.152	0.000
2	6.074	0.001	2.542
3	2.259	-0.737	2.419
4	4.565	0.137	2.990
5	6.536	-0.389	2.628
6	5.371	-0.937	2.884
7	5.485	-1.317	3.452
8	6.803	-1.805	3.291
9	7.207	-2.092	3.429
10	7.215	-2.236	3.772
11	7.825	-2.381	3.780
12	8.400	-2.534	3.725
13	8.548	-2.674	3.821
14	8.798	-2.808	3.873
15	9.228	-2.939	3.833
16	9.506	-3.048	3.832
17	9.698	-3.133	3.856
18	9.974	-3.208	3.831
19	10.234	-3.277	3.790
20	10.412	-3.335	3.769

Fig. 3. Historical Decomposition of Real Exports

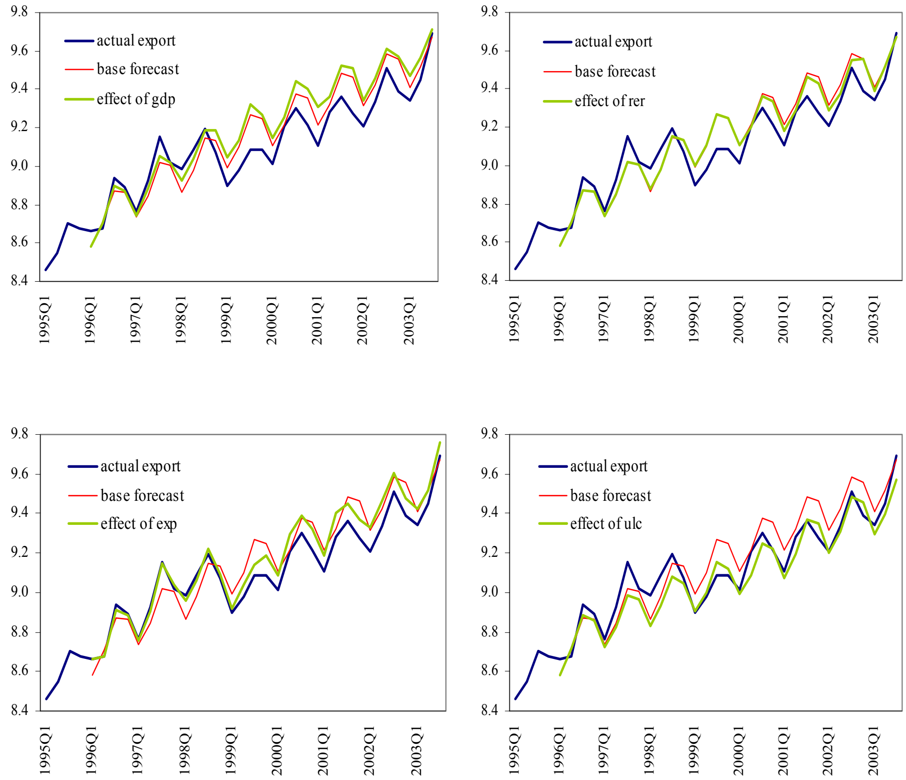

Fig. 4. Historical Decomposition of Real Exports (Alternative Specification)

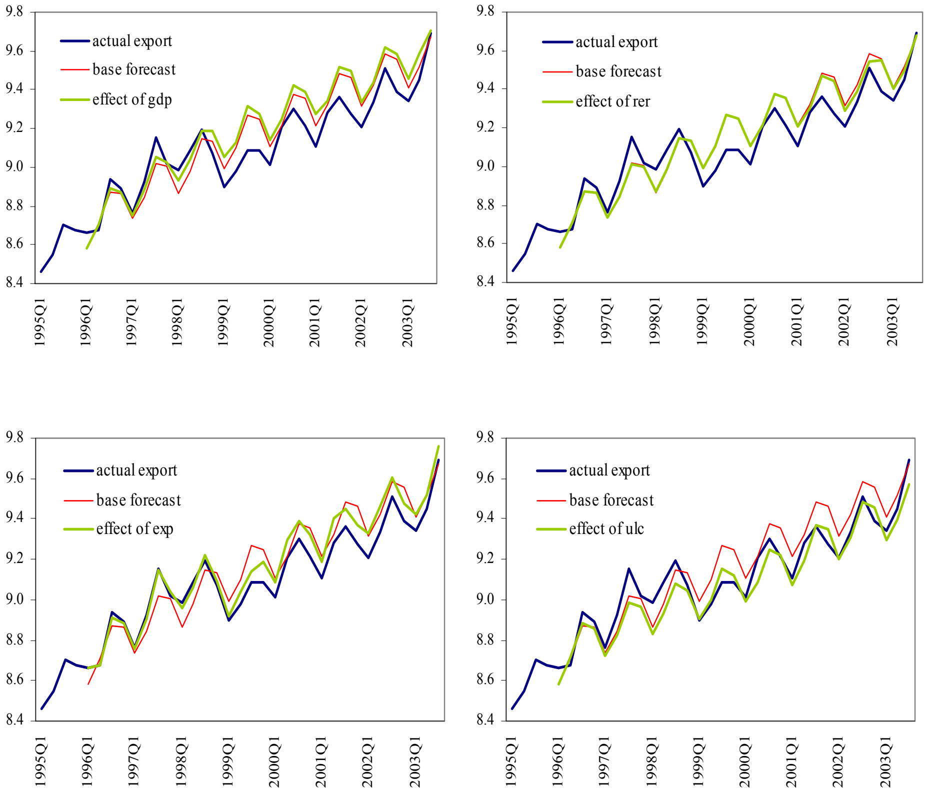

Fig. 5. Response of Real Exports to 10% Shocks

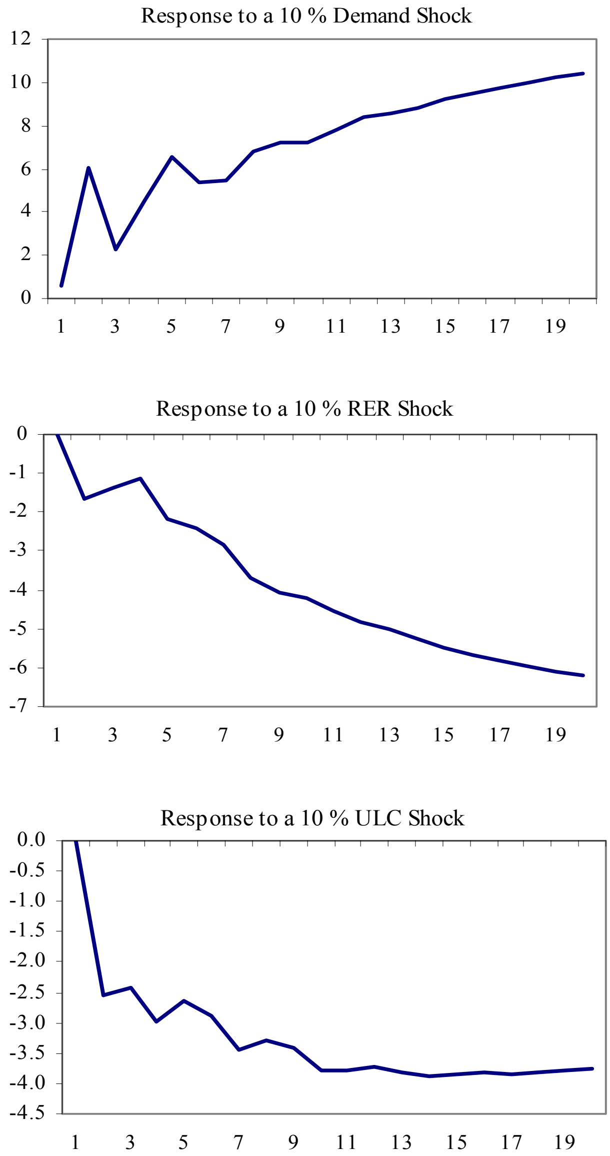

Fig. 6. Response of Real Exports to 10% Shocks (Alternative Specification)

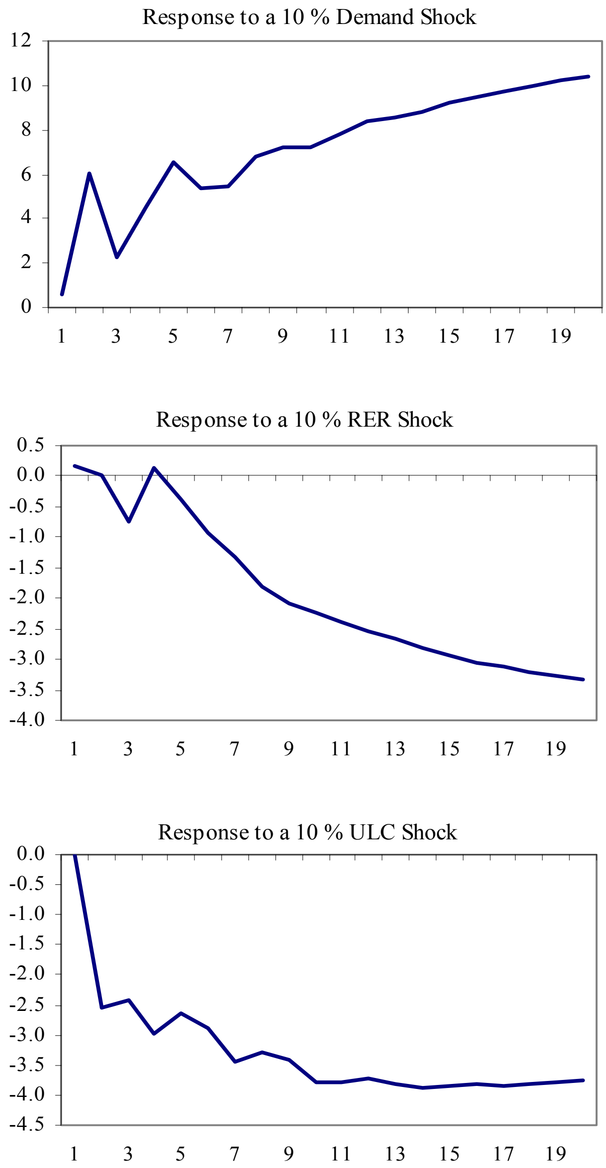

Fig. 7. Responses to One Standard Deviation Shocks

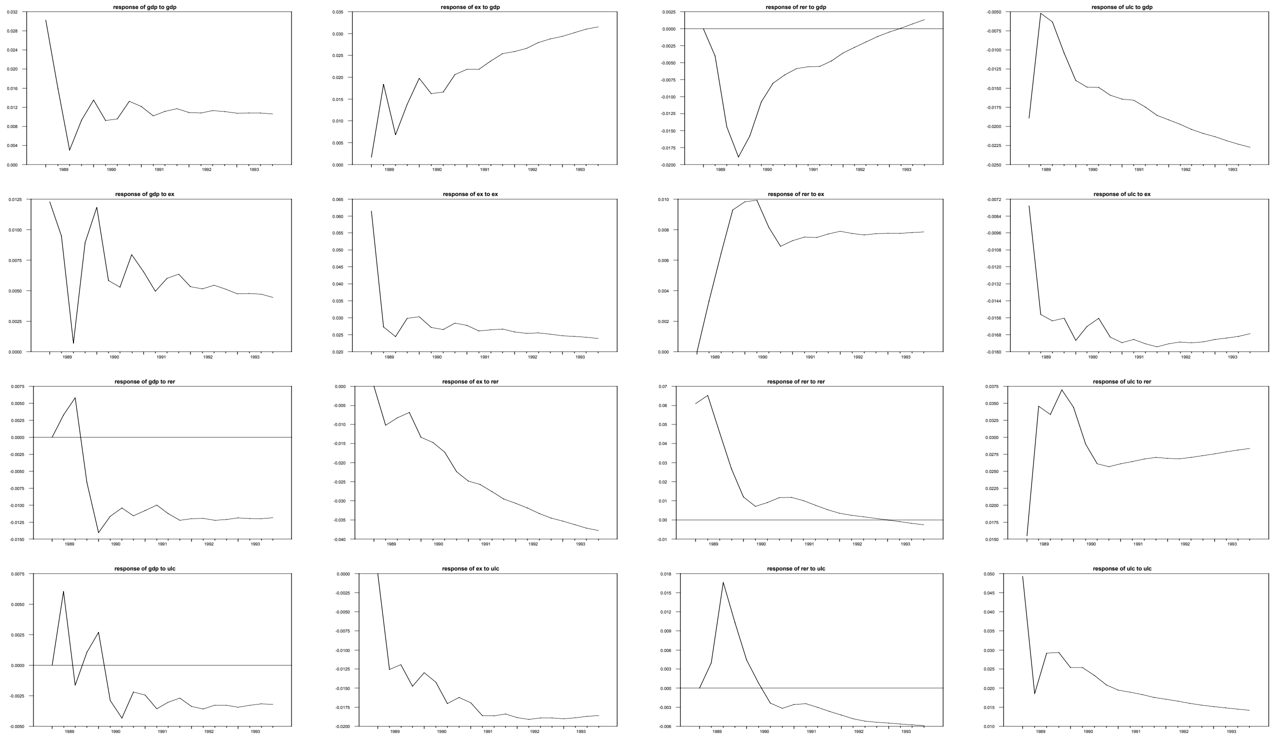

Fig. 8. Responses to One Standard Deviation Shocks (Alternative Specification)