Misaligned? Overvalued? The Untold Story of the Turkish Lira

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Abstract: There is a consensus among scholars that overvalued exchange rates result in currency crises. This paper estimates the equilibrium real exchange rate for Turkey using the correct methodology and finds that the lira was indeed overvalued before the crises in 1994 and 2001. However, the actual real exchange rate is at present close to the equilibrium level, exposing the myth propagated by the Turkish exporters that lira's overvaluation is responsible for Turkey's uncompetitive exports. The paper also highlights the role for fiscal adjustment in macroeconomic stability.

Keywords: Turkish lira, overvaluation, equilibrium real exchange rate, misalignment

JEL classification: F1, F3, F4

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1. Introduction

Even though long-run equilibrium real exchange rates are a function of real variables only, actual real exchange rates respond to both real and monetary variables (Edwards 1989). The departure of actual real exchange rate from the equilibrium level in the short and medium run due to short run frictions and adjustment costs is common. However, certain deviations from the equilibrium level could become persistent through time leading to *misalignments*. The literature has found exchange rate misalignment (namely, overvalued exchange rate) as an important predictor of currency crises (see Kaminsky, Lizondo and Reinhart, 1998 and the literature cited within). The huge costs that these misalignments impose in the form of currency crises make it impossible for policymakers to overlook the problem. Turkey's crises in the last decade bear a testimony to the devastation caused by such crises.

An overvalued exchange rate causes domestic exports to become uncompetitive in the world markets and puts pressure on governments for protectionism. Turkish exporters have recently raised their concerns alleging that the overvalued lira is making the Turkish exports uncompetitive. Similarly, the U.S. exporters are holding China's undervalued currency responsible for their huge current account deficits and for prolonging of the recession in the United States. In the wake of the Asian currency crisis in 1997, some emerging countries expressed concern about losing competitiveness to the Asian countries since the Asian currencies experienced huge devaluations. Hence, ascertaining the equilibrium exchange rate, and hence the extent of misalignment, is important in determining the competitiveness of the economy. This is especially relevant in the case of

Turkey, given its customs union with the European Union. An overvalued exchange rate could indeed push Turkey into a severe balance of payments crisis.

In the event of misaligned exchange rates, policymakers often find themselves entrapped in a dilemma – external competitiveness or internal stability (fiscal and price stability). In the case of Turkey, policymakers have to weigh the need for devaluation to boost exports (if exchange rate is indeed overvalued) versus keeping inflation low because the share of imported raw materials and capital goods in total imports is high (Guncavdi and Orbay, 2001). Kalkan (2002) finds that increasing rates of depreciation cause real depreciations, which he interprets as a dilemma for the government. If the government wants to control inflation by controlling the rate of depreciation, it has to accept the appreciation of real exchange rate and therefore deterioration of trade balance. While an appreciated exchange rate keeps the level of foreign debt low, devaluation leads to high interest rates (through uncovered interest parity) thus increasing the debt level.

In order to solve the policy dilemma, we feel the need to estimate the equilibrium real exchange rate for Turkey to assess if the recent crises in 1994 and 2001 were caused by overvalued exchange rate and to test the claim of the Turkish exporters that the overvalued exchange rate is making the Turkish economy uncompetitive. The rest of the paper is organized as follows. Section 2 gives a brief account of Turkey's economic history. Section 3 reviews the literature on Turkish exchange rate. Section 4 describes the theoretical underpinnings for our empirical model. Section 5 presents the estimation and the results from the error correction models. Section 6 estimates the equilibrium real exchange rate for Turkey. Section 7 concludes with policy implications.

2. Turkey's economic history

Prior to the stabilization program in 1980, Turkey followed a highly protective and inward-looking policy, plagued with inflationary pressures. Under this strategy, domestic producers enjoyed protection while multiple exchange rate practices were in place to favor imports of inputs for domestic industry. The economy performed well until the late 1970s, when worsening of inflation and current account was aggravated by the increasing public deficits and the two oil crises, thereby creating pressure on the exchange rate. Foreign borrowing was used extensively to finance current account deficits. High inflation along with a fixed exchange rate led to losses in competitiveness and a balance of payments crisis in 1977-78. However, the post-1980 period witnessed a policy of abolition of most price controls, continual real depreciation (at least until the end of 1989) to boost exports and liberalization of exchange and payments system (see Asikoglu and Uctum, 1992, and Erol and van Wijnbergen, 1997 for description of the exchange rate policy). By late 1980s, both current account and capital account were liberalized.

In the early years of the program, impressive growth rates, burgeoning exports and falling inflation rate together with improved fiscal position created a buoyant economic environment. However, after 1987, Turkey experienced the boom-bust cycles, resembling the Southern Cone experience – using exchange rate for stabilizing inflation, without correcting the underlying budget deficits – which would result in speculative attacks (see Calvo and Vegh, 1999, for a survey). Trade liberalization led to unwanted consequences on the trade balance because it was not supported by appropriate fiscal corrections (Kale, 2001). High public deficits kept interest rates high, which led to

appreciation of the lira and burgeoning current account deficits, which culminated in the financial collapse in 1994.

The 1994 financial collapse led to the adoption of a stabilization and structural adjustment program, consisting of fiscal retrenchment to reduce inflation and to improve the external balance (Kale, 2001). However, political uncertainties, combined with loose fiscal and monetary policies, undermined the credibility of the disinflation program.

In 1999, the newly established government embarked on a new disinflation program. The program in essence was an exchange rate based stabilization program (with a fixed exit date). The program also aimed at fiscal discipline and structural reforms. Exchange rate was predetermined in line with the targeted inflation rate. Liquidity creation by the central bank was tied to the foreign exchange purchases. [2]

The initial effects of the program were typical in that inflation slowed down, interest rates declined, consumption boomed and current account deficit surmounted. The program relied on the sustainability of capital inflows. Like the 1994 crisis, banks borrowed recklessly from abroad with short maturities. After capital began to flow out, the fragile banking sector was pushed into a banking crisis in November of 2000. The loss of confidence precipitated the currency crisis of February 2001. As a result, Turkish authorities decided to let the lira float. From then on, the program has been implemented under a floating exchange rate regime.[3]

After one and half decade of economic instability in the Turkish economy, the recent stable performance has raised hopes. Inflation is declining and is expected to be at below the target rate of 20% at the end of 2003 – mainly caused by the appreciation of

[2] Refer to Keyder (2001) for details on the disinflation program and the crisis of 2000.
[3] For details on the failure of the exchange-rate-based program in Turkey, refer to Gokkent, Moslares and Amiel-Saenz (2003).

the lira. However, increasing current account deficits and short term capital inflows are causing concerns. In addition, "overvalued lira" has become the center stage of discussions in the economic circle. Our aim in this paper is to estimate the equilibrium real exchange rate to test if overvalued lira was responsible for the crises in 1994 and 2001 and also to test the claim about present overvaluation of the lira.

3. Literature Review

We admit that ours is not the first study examining the equilibrium real exchange rate in Turkey, but it is the only paper that estimates the equilibrium using the correct methodology. We now review some of the empirical studies on Turkish real exchange rate and point to their shortcomings. Alper and Saglam (2000) estimate the equilibrium using cointegration method – the study is flawed in terms of omitting the main determinant of equilibrium real exchange rate for Turkey, namely, government spending. They use a bilateral exchange rate (vis-à-vis the U.S. dollar), instead of the effective exchange rate, when Turkey's main trading partner is Germany. In addition, they use the actual values of the fundamentals to construct the equilibrium exchange rate. While Dordoodian, Jung and Yucel (2002) use a theoretical model similar to ours, they use a dated econometric technique, moving-average method as used by Edwards (1989) to estimate the long run equilibrium. Using PPP in a non-linear model, Sarno (2000) finds that the real Turkish lira adjusts non-linearly towards its equilibrium level for the period 1980-97. Using a time varying parameter model, Ozlale and Yeldan (2002) find that lira remained structurally undervalued for most of 2000. Their estimation suffers from misspecification of the model, which ignores the impact of terms of trade and

productivity increases on the real exchange rate. In addition, they estimate the equilibrium real exchange rate by multiplying the coefficient vector with the actual values of the regressors. This includes both the temporary and the permanent components in the regressors, which by definition, is not the equilibrium. Using a structural VAR model, Erlat and Erlat (1998) find that real shocks explain the fluctuations in the real exchange rate, and once displaced from the equilibrium, it takes about 3 – 4 years for the real and nominal exchange rates to return to the equilibrium value. However, this model does not explicitly estimate the equilibrium real exchange rate. Due to the shortcomings in the previous studies, our paper attempts to improve on the existing literature by accounting for all the long run and the short run variables that affect real exchange rates and by estimating the equilibrium real exchange rate, where only the permanent components of the long run fundamentals are included.

4. Theoretical Underpinnings

We use the models developed by Montiel (1997), Edwards (1989, 1994) and Elbadawi (1994) to determine the real fundamentals affecting the long-run real exchange rate. The equilibrium real exchange rate is one that is consistent with simultaneous internal and external balance. The predictions from these models are summarized below:[4]

- Changes in the ***composition of government spending*** affect the long-run equilibrium REER in different ways, depending on whether the spending is directed toward traded or non-traded goods. If government spending is directed mainly toward traded goods and services, the trade balance deteriorates. To bring the external balance in

[4] Following the convention used by the IMF, an increase in the real effective exchange rate (REER) is an appreciation. The REER is defined as the relative price of non-tradables to tradables. Some of these predictions have been reproduced from Cerra and Saxena (2002).

equilibrium, the REER must depreciate (expected sign is negative). Conversely, spending directed mainly toward non-traded goods and services generates excess demand in the non-traded sector. To restore the sectoral balance, there must be an appreciation of the REER (expected sign is positive).

- Changes in the ***terms of trade*** also affect the long-run equilibrium REER in different ways, depending on whether the income effect or the substitution effect dominates. If terms of trade deterioration shifts the demand away from importables and into the nontradables, this would put an upward pressure on the real exchange rate, hence we would expect a negative sign. On the other hand, if the income effect from the terms of trade deterioration dominates the substitution effect, we would expect a depreciation of the real exchange rate and hence a positive sign.
- As ***exchange and trade controls*** in the economy decrease, the demand for imports leads to external and internal imbalances, which require real depreciation to correct them. Using the ratio of import tariff revenue to imports as the proxy for exchange and trade controls, as trade barriers are reduced (a reduction in the value of this proxy), the total amount of trade will increase. Accordingly, a reduction in controls should be associated with real depreciation, and the expected sign is positive. If, however, the share of exports plus imports in the GDP is used as a proxy for openness, then a reduction in trade barriers will be associated with higher trade, requiring a real depreciation (negative sign).[5]
- The long-run effect of a reduction in ***capital controls*** is ambiguous.[6] The reduction in capital controls is equivalent to a decrease in the tax on foreign borrowing that

[5] We use both these definitions to check the robustness of our results.
[6] In the short-run, both the substitution and the income effect of capital inflows lead to an appreciation.

generates a positive wealth effect, which increases consumption in all periods. Hence, an appreciation is required (positive sign) for equilibrium to hold. On the other hand, by the intertemporal substitution effect, future consumption is lower than present consumption, which exerts a downward pressure on the future (long-run) price of non-tradables, and hence a depreciation of the REER is required (negative sign). The overall sign of the equilibrium depends on which effect dominates.

- ***Technological progress (Balassa-Samuelson)***: Higher differential productivity growth in the traded goods sector leads to increased demand and higher real wages for labor in that sector. The traded goods sector expands, causing an incipient trade surplus. To restore both internal and external balance, the relative price of non-traded goods must rise (REER appreciation).
- ***Investment*** in the economy: According to Edwards, when investment is included in the theoretical model, the intertemporal analysis includes supply-side effects that depend on the relative ordering of factor intensities across sectors. Therefore, the sign on the exchange rate in response to increased investment is ambiguous.

In addition to the long-run relationship, we consider some of the macroeconomic policies that result in overvaluation of the domestic currency, that is, short-run misalignments. We use Edwards' proxies for "inconsistent" macroeconomic policies – expansionary policies lead to appreciation of the exchange rate -- reflecting a mounting disequilibrium or real exchange rate overvaluation. These variables are included in the short-run part of the specification as all the crises in Turkey have been caused mainly by

expansionary policies and severe balance of payments problems. We test this model empirically in the next section.[7]

5. Empirical Model: Estimation and Results

The model discussed above is estimated using an error correction model (ECM).[8] As Cerra and Saxena (2002) note, before the advent of cointegration technique, researchers used partial adjustment or auto-regressive models, which did not account for the tendency of many economic variables to be integrated and therefore also did not account for the possibility that the economic variables share a common stochastic trend. If these economic variables in fact share a common stochastic trend, then these variables are linked in the long run and their dynamic paths should also depend on their current deviations from their equilibrium paths. The ECM has the advantage of capturing the common stochastic trend among the non-stationary series and the deviations of each variable from its equilibrium.

The variables used in the analysis are described in the appendix. The dependent variable for our models is the log of the real effective exchange rate, which is a trade-weighted index calculated by the IMF. Based on the theoretical models, the independent variables represent the set of fundamental determinants of the real effective exchange rate and a set of exogenous variables that are thought to contribute to the short-run misalignment. Table 1 presents the descriptive statistics of all the variables used in the models.

[7] Cerra and Saxena (2002) include the Edwards-style short run factors for India, but find them insignificant.
[8] For testable implications of the intertemporal model, refer to Saxena (2000).

In order to estimate the error correction models, all of the fundamentals are examined for unit roots. The lag length is determined using the Schwartz Criterion and Akaike Criterion. Unit test results are reported in Table 2. Standard unit root tests reveal that the null hypothesis of a unit root cannot be rejected for the real exchange rate nor for any of its long-run fundamentals and the index of political confidence, but that it can be rejected for the current account, excess credit, the fiscal balance to high powered money and the first difference of the index of political confidence. Only the Phillips-Perron test rejects the null hypothesis of a unit root for technological progress, exchange controls and Balassa-Samuelson variable. As Saxena (2000) notes, the unit root tests suffer from lack of power. That is, when a series is stationary, but highly correlated, rejection of the unit root test hypothesis requires a longer time series than is typically available. Spurious relationships may be found if the variables are assumed to be stationary when in fact they are not. Hence, it is more conservative to assume that the variables are nonstationary even if they are not. We proceed with our analysis on the assumption that all the long-run fundamentals are indeed non-stationary.

To estimate the error correction model, the series are first tested for cointegration. The results from cointegration test using the method of Johansen (1991) are reported in Table 3. The lag length for the error correction model is determined by backward selection, beginning at a lag length of four to economize on degrees of freedom. The likelihood ratio test indicates that an error correction model with two lags is the most appropriate specification. The cointegration results indicate one cointegrating vector.

We estimate five error correction models in order to test the robustness of our results. Models 1 and 3 are estimated with only the long run fundamentals and we add the

short run fundamentals in Models 2 and 4. Hence, Models 1 and 2 include tariff revenues as a measure of exchange controls, while Models 3 and 4 incorporate the variable openness. All these models show very consistent results. An increase in government consumption leads to a real appreciation, as conventional wisdom suggests since a higher proportion of government spending is directed towards non-traded goods. A decrease in exchange and trade controls lead to a real depreciation. An increase in investment is associated with a real appreciation (except in Model 1 where it is insignificant). A decrease in capital controls leads to an increase in capital inflows, which causes a real depreciation in the long run, suggesting that the intertemporal substitution effect dominates the income effect. A deterioration in the terms of trade shifts the demand away from importables to non-tradables leading to a real appreciation – implying that the substitution effect dominates the income effect.[9] This is consistent with the finding in Kipici (1996) that the substitution effect dominates the income effect for Turkey, which implies that the consumption-tilting motive dominates the consumption-smoothing motive.

The more puzzling result is regarding the technological progress. According to all the four models, technological progress leads to a depreciated real exchange rate. We suspect that the proxy for technological progress (the rate of growth of industrial production index) is a bad one. It is a well-known fact that Balassa-Samuelson variable is a relative-relative price, i.e., it captures the relative price of traded goods to non-traded goods, relative to the relative prices in the trading partners' economies. Hence, if productivity in Turkey's tradable sector (proxied by manufacturing sector growth) grows

[9] This is inconsistent with the empirical regularity that a deterioration in the terms of trade is associated with a real depreciation.

faster than the non-tradable sector and this outpaces the relative productivity growth in its trading partners' economies, the price of non-tradables rises in Turkey causing the Turkish lira to appreciate in real terms. However, Ghosh (2002) notes that the faster growth in manufacturing productivity affects the equilibrium real exchange rate through another channel. If countries' exports are assumed to be imperfect substitutes, then standard trade models imply that an increase in supply will require a lower relative price. In this case, a faster growth in Turkey's manufacturing productivity will lower its relative price, implying a depreciation in the equilibrium real exchange rate. Hence, we include a measure of Balassa-Samuelson effect and Turkey's relative manufacturing productivity instead of technological progress in Model 5.[10] The results indicate that an increase in Balassa-Samuelson variable appreciates the equilibrium real exchange rate (although insignificantly), while an increase in Turkey's manufacturing productivity (relative to its trading partners) depreciates the equilibrium exchange rate. Most of the other results remain the same, except that the signs on the terms of trade and exchange control reverse, but become insignificant. Hence, the variable technological progress seems to be capturing the growth in Turkey's manufacturing sector relative to its trading partners, which leads to a depreciation of the equilibrium real exchange rate.

We include the short-run fundamentals in Models 2 and 4. We started with four lags of all the short-run variables and arrived at the final specification by deleting the insignificant lags. Here again the results are consistent across the models. Like Edwards (1989), expansionary fiscal policy (i.e., an increase in budget deficits) leads to an appreciated real exchange rate, which signifies an exchange rate misalignment. This is consistent with the Mundell-Fleming model with capital mobility – where expansionary

[10] The construction of these variables follows Ghosh (2002).

fiscal policy leads to a balance of payments surplus and hence an appreciation of the exchange rate.[11] Unlike Edwards (1989), expansionary monetary policy (domestic credit creation) leads to a depreciated exchange rate. In Edwards' model, an increase in domestic credit led to an increase in domestic prices, which along with a fixed exchange rate, led to a real appreciation. However, in Turkey, the effects of expansionary monetary policies have been offset by the continuous depreciation of the nominal effective exchange rate. As the current account balance improves, the real exchange rate appreciates. An improvement in the confidence in the economy depreciates the real exchange rate. At first the result may seem counter-intuitive. We believe that this connection is operating through the capital inflows. An increase in the confidence in the economy encourages short term capital inflows. But shortly thereafter, this short term debt may appear unsustainable which causes the real exchange rate to depreciate.

We take Model 2 as the baseline model to construct the equilibrium real exchange rate. This model is preferred over Model 4 because of its higher explanatory power and significant long run fundamentals.

6. Estimating the Equilibrium Real Exchange Rate

The main aim of this paper is to estimate the Turkish equilibrium exchange rate to gauge the extent of overvaluation of the real exchange rate at the time of the crises in 1994 and 2001. In addition, we want to assess any misalignment that may still exist. We now turn to estimating the equilibrium real exchange rate. As noted by Cerra and Saxena (2002), earlier studies estimated the equilibrium real exchange rate using the *actual*

[11] Agenor, McDermott and Ucer (1997) also find that a positive shock to government spending leads to an appreciation of the temporary component of the real exchange rate.

values of the fundamentals, which contains the temporary components of these fundamentals. Other researchers have used decomposition techniques (Beveridge-Nelson decomposition, Hodrick-Prescott filters, etc) to decompose the fundamentals separately and then use only their permanent component to construct the equilibrium exchange rate (for example, Edwards 1989). But this methodology ignores the relationship that is estimated through an error correction model. Hence, we use the methodology proposed by Gonzalo and Granger (1995) that uses the joint information in the error correction system to construct the permanent components of the endogenous variables. To conserve space, we refer the readers to Gonzalo and Granger (1995) and Saxena (2000) for the description of the methodology. This methodology has been used in Alberola, et al (1999), Cerra and Saxena (2002) and Saxena (2002) to estimate equilibrium real exchange rates.

Chart 1 depicts the actual and the equilibrium real exchange rate for Turkey from 1982Q1 to 2003Q1. We observe an overvaluation of more than 10% in 1993Q4 and 25% in 2000Q4. The depreciation in the aftermath of the 1994 crisis led to an overshooting of the real exchange rate, but the depreciation after 2000 has led to a movement in the actual real exchange rate towards the equilibrium, eliminating the misalignment in 2002Q3. The actual real exchange rate is close to the equilibrium now, hence exposing the myth propagated by the Turkish exporters that the lira is overvalued.[12]

7. Conclusions and policy implications

[12] In order to conserve space, we have eliminated the charts for the forecasts of the real exchange rate, which perform very well, as in Cerra and Saxena (2002). Those results are available upon request from the authors.

Our main aim in the paper is to estimate the equilibrium real exchange rate for Turkey. The literature review demonstrates that while papers have been written about the equilibrium real exchange rate in Turkey, they suffer from a serious shortcoming – they all use actual values of the fundamentals, which contain their own temporary components. In this paper, we estimate the equilibrium real exchange rate for Turkey using the correct methodology and find that the Turkish lira was overvalued before the crises in 1994 and 2001. However, this overvaluation has been eliminated and the actual real exchange rate is close to its equilibrium value now.

Our results have obvious policy implications. Our results show that budget deficits appreciate the exchange rate, leading to overvaluation. This result confirms the role of fiscal adjustment in restoring macroeconomic stability – a result consistent with Agenor, McDermott and Ucer (1997) and Kale (2001). In the past, Turkish policymakers have used discrete nominal devaluations to maintain the competitiveness of the Turkish exports. But this quick-fix policy has ignored the role for fiscal discipline in macroeconomic stability. Continued budget deficits have led to misaligned exchange rate, which has led to the collapse of the lira twice in the past 10 years. While Turkish lira has been floating since the last crisis in 2001, yet claims that the lira is overvalued call for policy interventions. In fact, our results show that the actual real exchange rate is very close to its equilibrium level now implying that policies will better serve to improve the competitiveness of Turkish exports when focused on fundamentals such as productivity increases rather than temporary solutions of nominal devaluations.

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APPENDIX: Data Sources and Construction

Data Sources

Variable	Description of the Variable	Source
REER	Real Effective Exchange Rate	IMF calculation
NER_L$	Period average nominal exchange rate	IFS line rf
TOT	Terms of Trade	State Institute of Statistics, Turkey
GDP	Gross Domestic Product	State Institute of Statistics, Turkey
RGDP	Real Gross Domestic Product	State Institute of Statistics, Turkey
GCON	Government consumption expenditures	State Institute of Statistics, Turkey
X	Exports	IFS line 70
M	Imports	IFS line 71
CAPINFLOW	Capital Inflows	IFS line 78bjd + 78cad
IPI	Industrial Production Index	Central Bank of Turkey
INV	Gross fixed capital formation	State Institute of Statistics, Turkey
CURRENTACCBAL	Current account balance	IFS line 78aldzf
CUSTREV	Custom revenue	Fiscal and Financial Statistics, SIS, Public accounts bulletin and General Directorate of Revenues
GBAL	Consolidated budget balance	Central Bank of Turkey
HPM	High-powered money	IFS line 14
DOMCREDIT	Domestic credit	IFS line 32
CONF_COMP	Index of composite confidence	Ratings complied by PRS group in the *International Country Risk Guide*
VAMFG	Value Added in manufacturing	Annual Survey of Mfg Industries, SIS
EMPMFG	Total employment in manufacturing	Annual Survey of Mfg Industries, SIS
EMPTOTAL	Total employment	Treasury Statistics
MFGHR_partner	Manufacturing output per hour index for Turkey's main trading partners	Bureau of labor statistics website
RGDP_partner	Real gross domestic product of Turkey's main trading partners	Bureau of economic analysis website
EMPTOTAL_partner	Total employment in Turkey's main trading partner economies	Bureau of labor statistics website
Trade_partner	Turkey's trade with its main trading partners	Central Bank of Turkey

Data Construction:

1. *LREER = Ln(REER)*
2. *LGCONGDP = Ln(GCON/GDP)*
3. *LTOT = Ln(TOT)*
4. *LOPEN = Ln(X + M / GDP)*
5. *LINVGDP = Ln(INV/GDP)*

6. $TECHPRO = Ln(IPI/IPI_{-4})$

7. $LEXCHCONTROL = Ln(CUSTREV/M)$

8. $CAPCONTROL = (CAPINFLOW/GDP)_{-1}$

9. $GBALHPM = GBAL/HPMONEY_{-1}$

10. $EXCREDIT = \Delta Ln(DOMCREDIT) - \Delta Ln(GDP)_{-1}$

11. $DCONF\_COMP = CONF\_COMP - CONF\_COMP_{-1}$

12. $tradeweight = \dfrac{X_i + M_i}{\sum_i X_i + M_i}$, *where i = Turkey's main six trading partners, i.e., Germany, United States, United Kingdom, France, Italy and Japan.*

13. $RELMFGPROD = \ln(VAMFG / EMPMFG) - \sum tradeweight * \ln MFGHR\_partner$

14. $BALSAM = \ln(VAMFG / EMPMFG) - \ln(RGDP / EMPTOTAL) - \sum tradeweight * (\ln MFGHR\_partner - \ln(RGDP / EMPTOTAL\_partner))$

Table 1. Descriptive Statistics of the Variables

Variable	Sample Period	Mean	Standard deviation
LREER	1980Q1 - 2003Q2	4.60	0.13
LTOT	1982Q1 - 2003Q2	4.57	0.08
LGCONGDP	1980Q1 - 2003Q2	-2.28	0.25
LOPEN	1980Q1 - 2003Q1	-1.23	0.29
TECHPRO	1981Q1 - 2003Q2	0.05	0.07
LINVGDP	1980Q1 - 2003Q2	-1.57	0.20
CAPCONTROL	1980Q2 - 2003Q1	0.01	0.05
LEXCHCONTROL	1980Q1 - 2003Q1	-3.08	0.87
RELMFGPROD	1982Q1 - 1999Q1	-0.09	0.09
BALSAM	1982Q1 - 1999Q1	-0.02	0.06
GBALHPM	1980Q2 - 2003Q1	-1105.70	1229.30
EXCREDIT	1980Q3 - 2002Q4	0.003	0.09
CURRENTACCBAL	1980Q1 - 2002Q4	-345.89	951.43
CONF_COMP	1984Q1 - 2003Q1	55.51	6.10
DCONF_COMP	1984Q2 - 2003Q1	0.01	2.74

Table 2. Unit Root Tests

Variable	ADF Statistic	PP Statistic
LREER	-2.98 *	-2.51 *
LTOT	-2.71 *	-2.67 *
LGCONGDP	-0.92 *	-2.05 *
LOPEN	-0.81 *	-2.50 *
TECHPRO	-3.09 *	-4.69
LINVGDP	-1.93 *	-2.75 *
CAPCONTROL	-2.18 *	-5.70
LEXCHCONTROL	-0.11 *	-0.65 *
RELMFGPROD	-2.09 *	-1.89 *
BALSAM	-2.54 *	-4.56
GBALHPM	-4.43	-5.49
EXCREDIT	-11.61	-11.56
CURRENTACCBAL	-6.36	-5.83
CONF_COMP	-1.97 *	-2.14 *
DCONF_COMP	-7.69	-7.66

Note: Variables are defined in Appendix 1. The sample period for each variable is given in Table 1. Asterisks * denote non-rejection of null hypothesis of a unit root at 1% significance level. Critical values are from MacKinnon (1991). These are the results from Unit Root testing in levels. However, all the series were stationary in first differences.

Table 3. Johansen Cointegration Tests

			Trace Test			Max-eigenvalue Test		
	Hypothesized		Trace	Critical Value		Max-Eigen	Critical Value	
Model	No. of CE(s)	Eigenvalue	Statistic	5 percent	1 percent	Statistic	5 percent	1 percent
Model 1	None **	0.57	150.07	124.24	133.57	68.97	45.28	51.57
	At most 1	0.31	81.10	94.15	103.18	30.86	39.37	45.10
Model 2	None **	0.66	159.84	124.24	133.57	79.05	45.28	51.57
	At most 1	0.36	80.79	94.15	103.18	32.57	39.37	45.10
Model 3	None **	0.55	157.15	124.24	133.57	65.38	45.28	51.57
	At most 1	0.35	91.76	94.15	103.18	34.76	39.37	45.10
Model 4	None **	0.61	151.19	124.24	133.57	70.45	45.28	51.57
	At most 1	0.33	80.74	94.15	103.18	29.81	39.37	45.10
Model 5	None **	0.59	170.40	156.00	168.36	0.59	51.49	51.42
	At most 1	0.54	118.91	124.24	133.57	0.54	44.92	45.28

*(**) denotes rejection of the hypothesis at the 5%(1%) level

Trace test and Max-eigenvalue test indicate 1 cointegrating equation(s) at both 5% and 1% levels for all models, except for Model 5, where Max-eigenvalue test indicates 1 cointegration equation at 5% level only.

Table 4. Results from Error Correction Models

	Model 1	Model 2	Model 3	Model 4	Model 5
LGCONGDP	0.551 **	1.635 ***	0.438 **	0.654 ***	2.074 ***
	0.226	0.581	0.202	0.238	0.590
LTOT	-1.920 **	-12.163 ***	-2.682 ***	-6.767 ***	3.312
	0.786	2.114	0.934	1.123	2.545
LEXCHCONTROL	0.123 **	0.805 ***			-0.357
	0.059	0.204			0.269
CAPCONTROL	-0.296	-12.099 ***	-1.276	-6.218 ***	-9.025 ***
	1.119	3.081	1.275	1.565	3.305
LINVGDP	-0.060	4.463 ***	0.208	2.288 ***	0.973
	0.273	0.894	0.319	0.480	0.860
TECHPRO	-3.685 ***	-4.854 ***	-3.539 ***	-0.851	
	0.676	1.764	0.753	0.896	
BALSAM					0.525
					2.364
RELMFGPROD					-8.353 ***
					2.583
LOPEN			-0.422 **	-1.178 ***	
			0.195	0.267	
CONSTANT	15.103	73.715	17.856	39.217	-5.935
CointEq	-0.092 ***	-0.027 **	-0.071 **	-0.058 **	-0.075 ***
	0.031	0.011	0.030	0.026	0.018
GBALHPM(-1)		-0.00002 **		-0.00002 **	
		0.000		0.000	
EXCREDIT(-1)		-0.162 *			
		0.085			
DCONF_COMP(-2)		-0.006 **		-0.008 ***	-0.007 ***
		0.003		0.003	0.003
CURRENTACCBAL(-4)		0.00002 ***		0.00002 ***	0.00004 ***
		0.000		0.000	0.000
Adjusted R2	0.178	0.376	0.104	0.290	0.459
Sample period	1982:4 - 2003:1	1984:4 - 2003:1	1982:4 - 2003:1	1984:4 - 2003:1	1984:4 - 1999:1
# of observations	82	74	82	74	58

Note: Asterisks ***, ** and * denote the significance of the variables at 1, 5 and 10 percent level of significance, respectively.

Chart 1: Turkey: Actual and Equilibrium Real Effective Exchange Rate