SHORT-TERM CAPITAL MOVEMENTS AND INTEREST RATE DIFFERENTIALS

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Introduction

In this paper, the relationship between short-term capital movements and interest rate will be investigated for Turkey. An economic analysis will be followed by an econometric analysis. And finally, the results will be introduced in the conclusion part.

Economic Analylsis

In order to make an arbitrage, capital movements occur between countries. The source of this arbitrage is the interest rate differences between countries. The progress in communication technology has simplified these movements. In line with this progress, a debate emerged about the advantages and disadvantages of these movements.

How can we explain international capital movements? The Portfolio Balance Theory has a key role in explaining these movements. According to this theory, individuals set investment portflios according to the value of their wealth. They take the risk and the expected payoff of the assets (stocks and bonds) into account in order to decide which one is the best.

The expected payoff of an asset is not only the interest that it will pay but also the change in the market value of that asset. While analysing international markets, we have to take the exchange rate into account. The assets with highest expected payoff at a specific risk are the most preferable ones.

The main purpose of the invester is to maximize the expected value of her portfolio. In order to do so, she must diversify her portfolio. According to the Portfolio Theory, in order to minimize risk, portfolio diversification is needed.

A typical investor may set up a portfolio consisting of both domestic and foreign assets. In the current time, the trade of foreign assets are much easier than before. Holding foreign assets with domestic assets has the advantage that the portfolio is not affected so much by the crises in the domestic country. That is to say, holding foreign assets decrease the risk of the overall portfolio. Investor sets up her portfolio according to her tastes and finds an optimal equilibrium for herself.

Holding payoff and risk rate constant, a change in the wealth of the investor does not affect the diversification of the portfolio. This fact explains the continuing-flow component of the international capital movements. That is to say, continuing-flow component of the capital movements are caused by the increase in the real income of the investors.

The other source of the capital movements is due to the stock arrangements. The effect of this kind is higher than the income effects. For instance if the foreign interest rate increases, the investor arranges the diversification of her portfolio by an increase in the ratio of her foreign assets. Therefore she will decrease the ratio of domestic assets in her portfolio. That is to say, such arrangements have a huge effect on the value of capital movements. The effect of stock arrangements are bigger than the effect of the increase in the real income.

Portfolio balance theory helps us to understand the structure of capital movements. In the absence of this theory, we would expect a continuing-flow after an increase in the foreign interest rates. But by the help of this theory, we realize that the effect of such an increase is temporarily.

Econometric Analysis

Quarterly Turkish data covering period 1990:1 to 2001:2 (46 observations in all) is used to estimate the parameters of the OLS model. The aim is to find the relation between the Short-term Capital Movement (SCM) and the Interest Rate Differential (ID)[1].

Before formal tests for stationarity, we may have a look at the plot of data for SCM and ID in Figure 1 and Figure 2 respectively. Both figures give us the idea that the series are stationary, because they valotile around a constant mean.

Analogously, the correlograms of the series are shown in Figure 3 and Figure 4 for SCM and ID respectively. Both figures show that the autocorrelation disappears very quicly. This also gives us the idea that there is no autocorrelation in both series, so the series are stationary.

In line with standart (formal) procedures, we will check for the stationary, using the Augmented Dickey-Fuller (ADF) test. We will start with SCM series.

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[1] The details of the data is given in the APPENDIX of this paper.

The unit root test results for variable SCM (for the level, using the Dickey-Fuller regressions include an intercept but not a trend) is shown in the following table:

Table 1 – Augmented Dickey-Fuller Unit Root Tests for SCM 1991Q2-2001Q2

	Test Statistic	AIC[2]	SBC[3]	HQC[4]
DF	-3.0682	-137.5157	-139.2293	-138.1397
ADF(1)	-3.4602	-136.9307	-139.5011	-137.8667
ADF(2)	-2.6394	-137.9002	-141.3274	-139.1482
ADF(3)	-2.5582	-138.5394	-142.8233	-140.0993
ADF(4)	-2.7071	-138.9536	-144.0943	-140.8255
95% CV	-2.9339			

This table shows that the test statistics for DF and ADF(1) are insignificant while the test statistics for ADF(2), ADF(3) and ADF(4) are significant, in levels. That is to say, the series are stationary under DF and ADF(1), but non stationary under ADF(2), ADF(3) and ADF(4) in levels.

[2] Akaike Information Criterion
[3] Schwarz Bayesian Criterion
[4] Hannan-Quinn Criterion

All the criterions (AIC, SBC and HQC) suggest that ADF(1) must be used[5]. In order to check this result, we must run a regression of an ADF(1) form and search for a serial correlation, and in turn stationary. Such a regression is as follows:

$$\Delta SCM_t = \beta_1 + \beta_2 t + \delta\ SCM_{t-1} + \alpha_1\ \Delta SCM_{t-1} + u_t \qquad (1)$$

Then we obtain:

$$\widehat{\Delta SCM_t} = \underset{(0.85114)}{0,94076} + \underset{(-3.4602)}{-0.76126}\ SCM_{t-1} + \underset{(1.7477)}{0.34347}\ \Delta SCM_{t-1} \qquad (2)$$

where *t-ratios* are in parenthesis. The *p-value* for the LM test for autocorrelation between u_t's is (0.225). Under the null hypothesis that there is no autocorrelation, this *p-value* is insignificant; that is to say there is no autocorrelation.

So, we can respect in these criterions and realize that SCM series is stationary by comparing the ADF(1) test statistic, (-3.4602), with the 95% critical value for the augmented Dickey-Fuller statistic, (-2.9339).

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[5] We look for the greatest value (the smallest value in absolute terms) in these criterions.

But to get a certain result, we can check whether or not there is a trend in SCM series. The unit root test results for variable SCM (for the level, using the Dickey-Fuller regressions include an intercept and a linear trend) is shown in the following table:

Table 2 – Augmented Dickey-Fuller Unit Root Tests for SCM 1991Q2-2001Q2

	Test Statistic	AIC	SBC	HQC
DF	-3.0750	-137.7094	-140.2797	-138.6454
ADF(1)	-3.2522	-137.4990	-140.9261	-138.7469
ADF(2)	-2.2599	-138.4989	-142.7828	-140.0589
ADF(3)	-2.0481	-139.3144	-144.4551	-141.1863
ADF(4)	-2.1742	-139.8652	-145.8627	-142.0492
95% CV	-3.5217			

This table shows that all of the test statistics are statistically significant. That is to say, SCM series is non stationary under the Dickey-Fuller form with an intercept and a linear trend. So, if there is a trend, SCM series is non-stationary. We can check whether or not there is a trend via a regression as follows:

$$\Delta SCM_t = \beta_1 + \beta_2 t + \delta SCM_{t-1} + u_t \qquad (3)$$

We will try to find whether or not there is a serial correlation in u_t. In order to do so, we run the regression in equation (3) and obtain the following regression results:

$$\begin{aligned} \Delta\widehat{SCM_t} &= 3.1997 - 0.10947t - 0.48679SCM_{t-1} \\ t_{ratio} &= (1.2593)\ (-1.2347)\ (-3.0750) \end{aligned} \qquad (4)$$

The *t-ratio* of the trend is (-1.2347). That shows that a linear trend is not significant under the null hypothesis that $\beta_2 = 0$, even at a significance level of 20%.

So far, we have showed that SCM series is stationary. But what about the other series, ID? We will use the same method in order to check the stationarity of this series.

The unit root test results for variable ID (for the level, using the Dickey-Fuller regressions include an intercept but not a trend) is shown in the following table:

Table 3 – Augmented Dickey-Fuller Unit Root Tests for ID 1991Q2-2001Q2

	Test Statistic	AIC	SBC	HQC
DF	-5.1434	-157.2648	-158.9784	-157.8888
ADF(1)	-4.5802	-157.8216	-160.3920	-158.7576
ADF(2)	-3.3744	-158.8092	-162.2363	-160.0572
ADF(3)	-3.4002	-159.2577	-163.5416	-160.8177
ADF(4)	-3.1428	-160.0250	-165.1657	-161.8969
95% CV	-2.9339			

Table 3 shows that all the test statistics are insignificant. That is to say, under the null hypothesis that the series is stationary, ID series is stationary at 5% significance level.

So far, we have showed that ID series is stationary. We had shown that SCM series are also stationary. Now, we can construct a regression in order to analyse the relation between SCM and ID.

Before that we have to find the causality between these two variables. That is to say which one causes the other? In order to make such an analyses, we will use the Granger causality test. The test statistics for this tests (with 4 lags) are represented in the following table:

Table 4 – Granger Causality Tests for ID and SCM

Null Hypothesis	Number of Observations	F-Statistic	Probability
ID does not Granger Cause SCM	42	2.09834	0.10332
SCM does not Granger Cause ID	42	1.07614	0.38406

This table shows that, under the normality assumption which will be analysed later, there is no causality between these variables at 10% significance level. But if we enlarge our significance level to 20%, we realize that ID causes SCM. We will respect this result.

If we run a regression with an intercept as follows:

$$SCM = \beta_1 + \beta_2 ID + u_t \qquad (5)$$

we obtain the following results:

$$\widehat{SCM} = 1.6262 + 0.22293\ ID \qquad (6)$$
$$(1.5529) \quad (2.3382)$$
$$[0.128] \quad [0.024]$$

where *t-ratios* are in parenthesis and *p-values* for *t-ratios* are in brackets. According to the *p-values*, we realize that the intercept is not significant at 5% and 10% significance levels. *We realize that there is a weak relationship between SCM and ID.* The value of $\overline{R}^2$ (0.108959) justifies this conclusion.

The diagnostic tests for this regression (with an intercept) is shown in the following table:

Table 5 – Diagnostic Test Statistics for the Regression With Intercept

Test Statistics	LM statistics
Serial Correlation	7.4046 [0.116]
Functional Form	3.7550 [0.053]
Normality	34.4538 [0.000000]
Heteroscedaticity	0.10342 [0.748]

In this table, p-values are given in parenthesis. Lagrange Multiplier (LM) p-value for serial correlation is (0.116). So we can conclude that there is no serial correlation at 5% significance level. Similarly there is no heteroscedasticity in the regression and there is no problem in the functional form. But we have problems in value for normality. We will insert dummy variables for the financial crises periods in order to remedy this statistics later in this paper.

Since the intercept is insignificant at 5% significance level, we may run another regression between SCM and ID excluding intercept. That is to say we may get rid of the intercept in equation (6), which results in a regression as follows:

$$SCM = \beta \, ID + u_t \tag{7}$$

Then we obtain the following results:

$$\begin{aligned} \widehat{SCM} &= 0.18593 \, ID \\ &\quad (1.9831) \\ &\quad [0.053] \end{aligned} \tag{8}$$

where *t-ratio* is in parenthesis and the *p-value* for *t-ratio* is in brackets. *We again realize that there is a weak relationship between SCM and ID.* The value of $\overline{R}^2$ (0.061768) justifies this conclusion.

The diagnostic test results for this regression (without an intercept) is shown in the following table:

Table 6 – Diagnostic Test Statistics for the Regression Without Intercept

Test Statistics	LM statistics
Serial Correlation	7.6596 [0.105]
Functional Form	4.7887 [0.029]
Normality	20.7528 [0.000]
Heteroscedaticity	.0068786 [0.934]

We have no problem in serial correlation and heteroscedasticity but we have problems with functional form and normality. So we can conclude that we may include intercept to the model, after comparing the functional form results between Table 5 and Table 6.

With or without intercept, we have problems with normality. In order to remedy this problem, we will insert a dummy to the regression. We will do this in order to capture the probable effects of financial crises. There are two effective financial crises in Turkey in the analysed interval. One of them is the 1994 crises and the other one is the 2001 crises.

We will insert dummies in our model as follows. The ID variables of 1993-4 and 1994-1 seem to be like an outlier of 1994 crises. Similarly 2000-4 variable of ID is another outlier of 2001 crises. We will use two different dummies for these financial crises. We will use 1 for these outliers and 0 for other periods.

Before the analysis we must check the causality between ID and SCM, with a regression including dummies. First, we will take the case of dependent SCM. Working with restricted VAR[6] we reach the statistics of the following table:

Table 7 – Restricted Model with Dependent SCM

Statistics	Test Statistics	p-values
LM test	9.4612	0.051
LR test	10.7199	0.030
F-Statistics	2.2534	0.086

And if we take ID as dependent, we reach the following statistics, by using restricted VAR[7] again:

[6] Here we will restrict the four lagged values of ID and check the statistics.
[7] Here we will restrict the four lagged values of SCM and check the statistics.

Table 8 – Restricted Model with Dependent ID

Statistics	Test Statistics	p-values
LM test	9.0191	0.061
LR test	10.1531	0.038
F-Statistics	2.1193	0.102

If we compare Table 7 and Table 8, we realize that ID causes SCM, even the p-value of the LM test in Table 7 is nearly equal to 5% significance level. Respecting this result, now we can run the regression with dummies as follows:

$$SCM = \beta_1 + \beta_2 ID + \beta_3 D_1 + \beta_4 D_2 + u_t \quad (9)$$

and we obtain the following results:

$$\begin{aligned} \widehat{SCM} = &\ 1.5129 + 0.39695\ ID + 8.9037 D_1 + 9.3813 D_2 \\ &\ (1.4313) \quad (2.4313) \quad (1.1745) \quad (0.95746) \quad (10) \\ &\ [0.160] \quad [0.25] \quad [0.247] \quad [0.344] \end{aligned}$$

where *t-ratio* is in parenthesis and the *p-value* for *t-ratio* is in brackets.

The diagnostic test results for this regression (with dummies) is shown in the following table:

Table 9 – Diagnostic Test Statistics for the Regression With Dummies

Test Statistics	LM statistics
Serial Correlation	7.3313 [0.119]
Functional Form	0.85215 [0.356]
Normality	22.5122 [0.000058]
Heteroscedaticity	0.071806 [0.789]

In this table, p-values are given in parenthesis. Table 9 shows us that we have no problem with serial correlation, functional form and heteroscedasticity. But we have still problems with normality. That is to say, to include dummies for the values of ID variable in financial crises is not an appropriate way for us.

According to the regression with dummies, we again realized that there is a weak relationship between SCM and ID. The value of $\bar{R}^2$ (0.14170) justifies this conclusion.

By including dummies, we raised the value of $\overline{R}^2$ from (0.108959) to (0.14170). But we still have the problem of normality. With and without dummies, we found that there is a weak relationship between ID and SCM.

Conclusion

We investigated the relationship between short term capital movements and interest rate differentials for Turkey. By using quarterly data for Turkey, covering period 1990:1 to 2001:2, we found that there is weak relationship between short term capital movements and insterest rate differentials for Turkey.

FIGURE 1

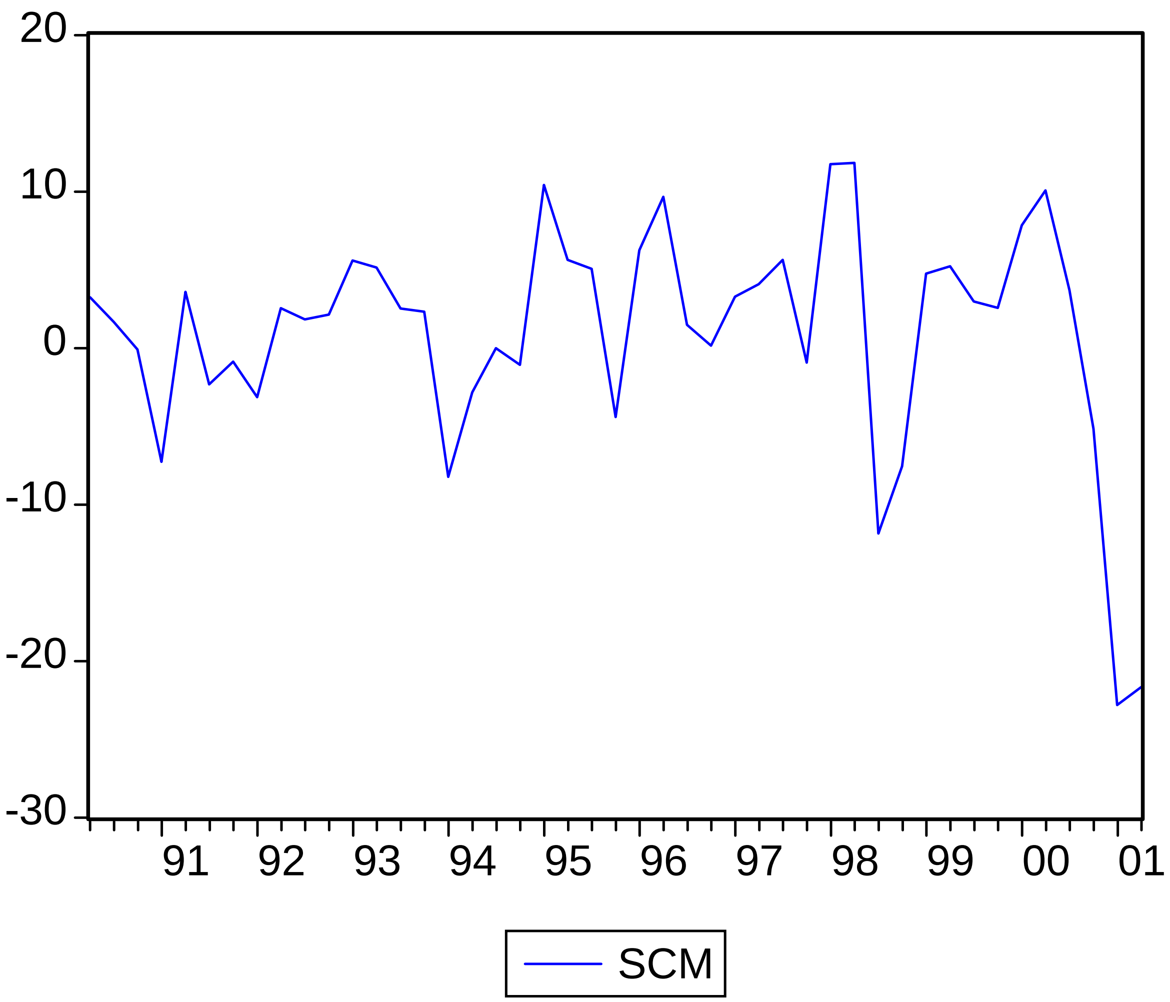


FIGURE 2

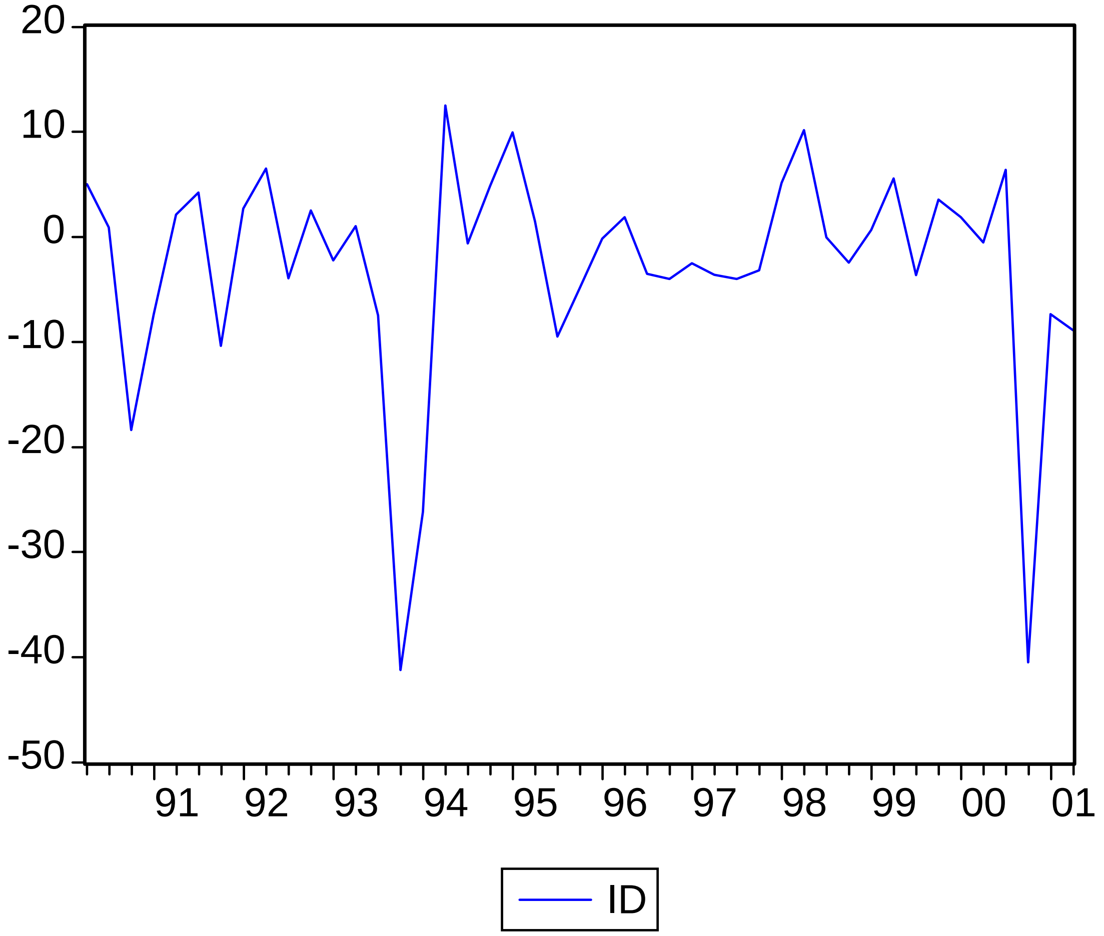


FIGURE 3

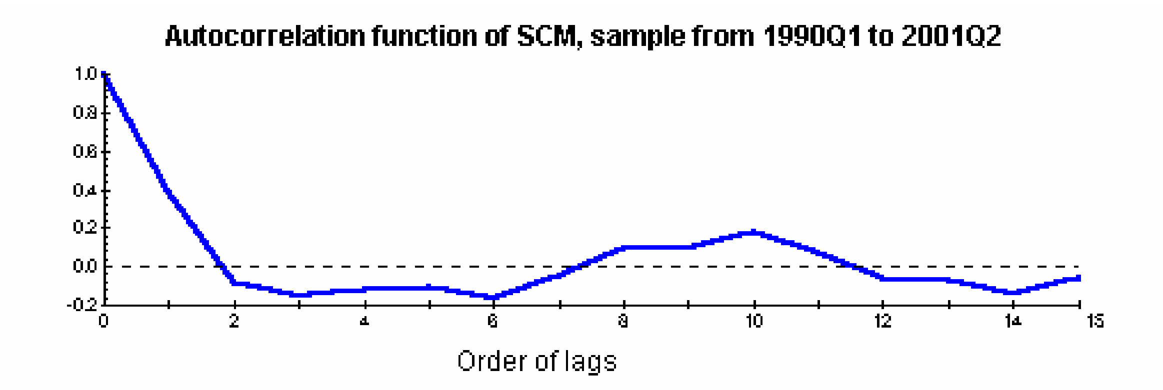
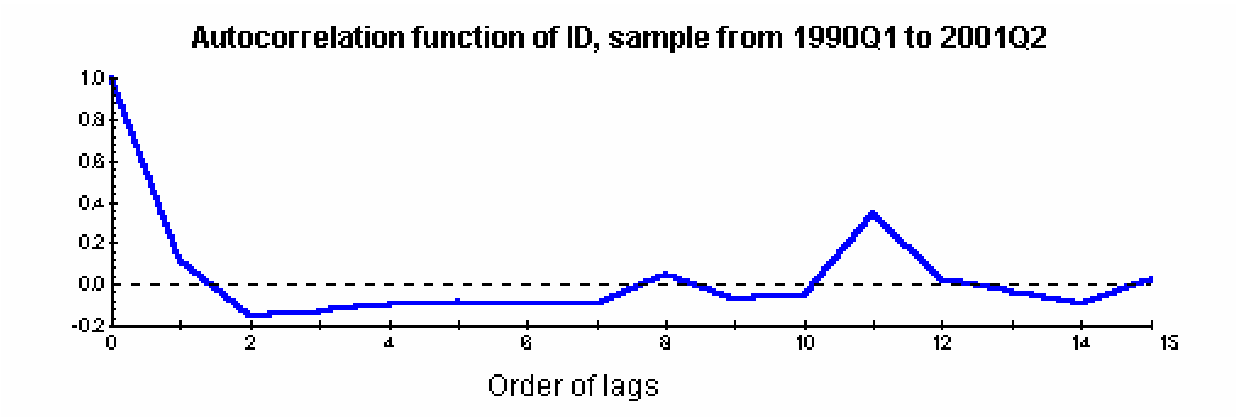


FIGURE 4



APPENDIX

This APPENDIX describes the construction fo the date presented in the text. All series were obtained from IMF's *International Financial Statistics* (IFS), expect for the gross national product (GNP) which was obtained form Central Bank of The Republic of Turkey (CBRT). Series Code references in parenthesis are to the *International Financial Statistics* cd-rom.

Short-Term Capital Movements

The source of short-term capital movements is the IFS. This variable is the sum of Portfolio Investment Assets (18678BFDZF...), Portfolio Investment Liabilities N.I.E. (18678BGDZF...), Other Investment Assets (18678BHDZF...), Other Investment Liabilities N.I.E. (18678BIDZF...) and Net Errors and Omissions (18678CADZF...)[8].

In the analysis the ratio of the short-term capital movements to GNP in $ was used. GNP in TL was obtained from (CBRT). It was devided by Market Rate (11260D..ZF...) exchange rate of one US dollar to Turkish liras in order to obtain GNP in $.

[8] This definition was taken from Sachs, Tornell and Velasco (1995).

Interest Rate Differential

The soruce of interest rate differential is the IFS. Turkish interest rate on 3 Months' Time Deposit (18660L..ZF...) are accepted as the domestic interest rate and 3 Month's Euro Dollar Rate in London (11260D..ZF...) is accepted as the foreign interest rate. The interest rate differential between the domestic rate of return on Turkish 3 Months' Time Deposits and Euro Dollar London is given by:

$$\rho_t = (1+i_t/100)^{1/4} - (1+i_t^*/100)^{1/4}(s_{t+1}/s_t)$$

where i_t is the interest rate on 3 months' time deposits, i_t^* is the 3 months' eurodollar rate in London, and s_t is the Market Rate (11260D..ZF...) exchange rate of one US dollar at time t to s_t Turkish liras[9].

[9] This definition was taken from Agénor, McDermott and Ucer (1997).