Saving-Investment Association in Turkey

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ABSTRACT

The aim of this paper is to investigate the domestic saving-investment relation in Turkey. Feldstein-Horioka (1980) argued that domestic saving and investment have close association in closed economies but under free capital mobility this relation disappears. However many empirical studies found that most of open economies have high saving investment association. By using two different data set, yearly (1962-2007) and quarterly (1980Q1-2007Q3), we employ cointegration technique to analyze corresponding relation. We also investigate the structural break in this relation and found that over the period 1962-2007 and 1980Q1-2007Q3, there is no significant break. In yearly base we found that there is almost one for one relation between saving and investment. However in quarterly base, there is cointegration relation but long-run coefficient of saving is insignificant.

Keyword: Investment, saving, capital mobility, Feldstein-Horioka puzzle, cointegration

JEL classification: C22; E21, E22, F21

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1. Introduction

The relationship between saving and investment has long been interest of the analysts. While in closed economy the relationship between domestic saving an investment show strong positive association, the presence of international capital mobility make it more complex to analyze.

In their very effective paper Feldstein and Horioka (1980) (FH hereafter) states that presence of relationship between national saving and investment would not be expected under the perfect capital mobility. In the case of perfect capital mobility, savings follow wherever the highest return is and the relations between domestic saving and investment disappear. However FH analyzed the corresponding relationships across 16 OECD countries, for the 1960–74 periods, and contrary to prediction found that domestic investment and savings were highly correlated. They argued that this is an evidence of imperfect capital mobility across countries and this result is named as FH puzzle in the literature. The FH conclusion of low capital mobility posed an uncomfortable puzzle because in most of the open macroeconomic models conventionally assume the high capital mobility since 1970s (Coakley et al, 1998).

Following FH, numerous studies devoted to analyze the FH puzzle. Feldstein (1983) extended the time period to 1960-1979, and show that there is no any decline in the relationship. Felstein and Bachetta (1991) investigate the same relation across 23 OECD countries over the period 1960-1986, and found that saving investment association only marginally declined. Also Obsfeld (1986), Golup (1990), Tesar (1991), use the same 16 OECD countries with FH and Penati and Doley (1984), Leachman (1990), Sinn (1992), Coakley et al (1994), Abott and De Vita (2003) and Helliwell (2004) use different OECD countries in their analysis and all of them found fully or partially empirical evidence for previous findings. On the other hand Murphy (1984) argued that large countries can effect the world interest rate and hence behave like closed economy, however small countries not. Dividing OECD countries as small and large, he found that response coefficient of saving (saving retention coefficient) is very close to one in large economies but it is 0.59 in small economies.

FH puzzle investigated not only in OECD countries but also in LDCs and developing countries. Coakley et al (1999) examine the saving investment association for 23 OECD countries and 44 LDCs over the 1965-1990 period and found that short-run covariance of saving-investment response is lower in the OECD countries. Wong (1990), found that in
LCDs capital mobility is high and argued that this may because of the size of non-tradable sector. In addition to this Issakson (2001) found similar results with Wong (1990) and argued that this may because of the foreign aid. Dooley et al. (1987), investigate 62 countries which of 48 are developing and found that saving-investment correlation is weaker in developing countries than in OECD countries. Kasuga (2004) investigate the corresponding association for 79 developing and 23 OECD countries and concluded that countries that have developed financial markets has low capital mobility, and LDCs have the reverse. He argued that this may because of the way that asymmetric information effects investment. Also Ozmen (2005) analyze the 79 countries and found that investment saving association is higher in larger economies. Payne and Kumazawa (2006) use a sample of 47 developing economies and get some evidence of high capital mobility across developing countries.

Turkey as a member of OECD investigated in cross sectional FH puzzle analysis. On the other hand there are also time series analyses for Turkey. Coakley et al. (1994) individually investigate the OECD countries including Turkey over the 1960-1992 periods. The time series saving retention coefficient is found to be 0.717 for Turkey. Yıldırım (2001) examine the nature of saving retention coefficient in Turkey by taking into account the structural reform in 1980 and found lower saving retention coefficient in post 1980 which support the FH interpretation. Also Erden (2005a) using Johansen cointegration technique investigate the saving investment association over the period 1963-2002 by dividing sample period as pre1980 (1963-1980) and post1980 (1981-2002). Erden (2005a) used private saving and investment instead of aggregate ones and the results show that domestic private investment and saving are closely related over the pre1980 period and private investment are mainly determined by private saving. However the corresponding linkage disappears over post 1980 period. Erden (2005b) using same variables and sample period make similar analyses and by employing dummy variables the financial liberalization date (1982) and full capital liberalization date (1989) in Turkey. Erden (2005b) found that only the date of 1989 does lead to structural change in saving investment relationship and the saving retention coefficient is higher at post 1989 period than pre 1980 period. These results are conflicting with Erden (2005a), Yıldırım (2001) and FH. Lastly Yentürk et al (2007) conduct an empirical study to analyze the interaction among investment, saving and growth by using quarterly data

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1 The time series coefficients of saving are range from 0.025 (Luxemburg) to 1.18 (Switzerland) and for 17 of 24 OECD countries is found to be higher than 0.5.
including 1987Q1-2003Q1 period. Yentürk et al (2007) use private saving and investment in their analysis and found that in medium and long run, saving and investment are cointegrated but there is no short run relationship between them.

The studies Ender (2005a, 2005b) are open to the critics. First of all, employing Johansen cointegration technique for a small sample can lead to misleading results. Also dividing such a small sample (n<40) into two sub-sample makes results more dubious. Actually using same variable, same time period and similar techniques, Ender (2005a) and Ender (2005b) find conflicting results that strongly support the our critics.

This study aims to investigate the nature of saving investment association in Turkey. We use ARDL bound testing procedure. Also existence of structural breaks in corresponding association is analyzed by using Bai and Perron (2003) procedure. Main advantage of Bai and Perron (2003) is that we have opportunity to determine the structural break in relationship, if any, endogenously instead of exogenously as Yıldırım (2001), Ender (2005a, 2005b) did before. We use two different data sets; first one is yearly data cover the 1963-2007 periods and the second one is the quarterly which is only available for 1980Q1-2007Q3 period. We find that there is no any structural break in saving investment relation both in yearly and quarterly base. However in yearly data we find almost one to one long-run relation between saving and investment but in quarterly data the corresponding relation disappear. We think that this may because of the solvency constraint. The rest of this paper is organized as follows. Section 2 analyzes the time series properties of data. Section 3 analyzes the presence of structural break. Section 4 analyzes the cointegration relation and section 5 concludes.

2. Time Series Properties of Data

We have two data set, yearly and range from 1962 to 2007 and quarterly and range from 1980Q1 to 2007Q3. Yearly saving and investment data are from State Planning Organization and quarterly saving and investment data are calculated using consumption based GNP data set of TURKSTAT and seasonally adjusted by Tramo/Seats.

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2 The calculation of private saving is problematic in Yentürk et al (2007) mostly because of the lack of data. They calculate private saving by extracting central government consolidated budget balance not public saving from aggregate saving.
Table 1. Unit Root Test (1962-2007)

<table>
<thead>
<tr>
<th></th>
<th>ADFa</th>
<th>PPb</th>
<th>KPSSc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>intercept</td>
<td>trend and int.</td>
<td>Intercept</td>
</tr>
<tr>
<td>$S$</td>
<td>-3.08**</td>
<td>-2.82</td>
<td>-3.12**</td>
</tr>
<tr>
<td>$I$</td>
<td>-2.45</td>
<td>-2.25</td>
<td>-2.54</td>
</tr>
<tr>
<td>Ng-Peron(\alpha) (Mza)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>intercept</td>
<td>trend and int.</td>
<td>Intercept</td>
</tr>
<tr>
<td>$S$</td>
<td>-4.04</td>
<td>-6.85</td>
<td>-1.42</td>
</tr>
<tr>
<td>$I$</td>
<td>-3.72</td>
<td>-6.26</td>
<td>-1.32</td>
</tr>
</tbody>
</table>

Intermediate and intercept trend and int. (ADF, PP, KPSS, Ng-Peron, DF-GLS)

$S$: domestic saving/GNP
$i$: domestic investment/GNP

Outcomes of the following tests: Augmented Dickey-Fuller (ADF), Philipps-Perron (PP), KPSS, Ng-Perron and Dickey-Fuller GLS de-trended (DF-GLS)

a: Null hypothesis is ser is nonstationary, b: Null hypothesis is that seri is stationary

* (**) [***] indicate significance level at %1 (%5) [%10]. Maximum lags are 12 and the information criterion is the Modified Akaike Information Criterion defined by Ng and Perron (2001). In the DF-GLS test, Elliot-Rothenberg-Stock (1996) modified the ADF tests by detrending the data so that explanatory variables.

The $M\alpha$ and $M\tau$ statistics are modified forms of the Phillips-Perron (1988) $Z\alpha$ and $Z\tau$ statistics and advocated by Ng-Perron (2001).

Table 1 shows the five different unit root test results for the $s$ (domestic saving/GNP) and $i$ (domestic investment/GNP). For the only intercept case, the results of tests are mixed for savings but for the trend and intercept case four of the five test indicate that yearly savings is I(1). The results for investments show more common trend and we can conclude that yearly investment is I(1).

Table 2: Unit Root Test (1980Q1-2007Q3)

<table>
<thead>
<tr>
<th></th>
<th>ADFa</th>
<th>PPb</th>
<th>KPSSc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>intercept</td>
<td>trend and int.</td>
<td>Intercept</td>
</tr>
<tr>
<td>$S$</td>
<td>-2.06</td>
<td>-1.79</td>
<td>-2.23</td>
</tr>
<tr>
<td>$I$</td>
<td>-2.31</td>
<td>-2.28</td>
<td>-5.69*</td>
</tr>
<tr>
<td>Ng-Peron(\alpha) (Mza)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>intercept</td>
<td>trend and int.</td>
<td>Intercept</td>
</tr>
<tr>
<td>$S$</td>
<td>-1.01</td>
<td>-3.29</td>
<td>-0.59</td>
</tr>
<tr>
<td>$I$</td>
<td>-8.80**</td>
<td>-9.54</td>
<td>-2.09**</td>
</tr>
</tbody>
</table>

Intermediate and intercept trend and int. (ADF, PP, KPSS, Ng-Peron, DF-GLS)

$s$: domestic saving/GNP
$i$: domestic investment/GNP

Outcomes of the following tests: Augmented Dickey-Fuller (ADF), Philipps-Perron (PP), KPSS, Ng-Perron and Dickey-Fuller GLS de-trended (DF-GLS)

a: Null hypothesis is ser is nonstationary, b: Null hypothesis is that seri is stationary

* (**) [***] indicate significance level at %1 (%5) [%10]. Maximum lags are 12 and the information criterion is the Modified Akaike Information Criterion defined by Ng and Perron (2001). In the DF-GLS test, Elliot-Rothenberg-Stock (1996) modified the ADF tests by detrending the data so that explanatory variables.

The $M\alpha$ and $M\tau$ statistics are modified forms of the Phillips-Perron (1988) $Z\alpha$ and $Z\tau$ statistics and advocated by Ng-Perron (2001).
Table 2 shows the unit root test results for quarterly saving and investment date set. Unit root tests unambiguously indicate that the savings are I(1), on the other hand the tests results are mixed for investments. While ADF cannot reject the null hypothesis of unit root for both cases only intercept and trend and intercept, PP and DF-GLS reject the null hypothesis. Ng-Perron reject the null of unit root for the trend and intercept case and KPSS cannot reject the null hypothesis of there is no unit root for both cases.

3. Structural Break Test for Relationship Between Investment and Saving

In this section we analyze the presence of structural break. If FH hypothesis of the relation between saving and investment disappear under the free capital mobility, one should expect that at 1989 there must be a structural break.

Closer look at the Figure1, roughly indicate that there seem to be no structural break between two series, they move together during all covered period. To get more robust results we employ statistical test for structural break. To test the presence of a break in investment saving association we employ Bai and Perron (1998, 2003) procedure which consists of running regressions and testing for breaks simultaneously. We examine the following FH relation:

\[ i_t = \alpha + \beta_s s_t + \varepsilon_t \]
where $i$ is domestic investment/GNP and $s$ is domestic saving/GNP and $\varepsilon$, white noise error term.

Table 3: Structural Break Test (1962-2007)

<table>
<thead>
<tr>
<th>supF($t$)</th>
<th>supF($t+1/t$)</th>
<th>U Dmax and W Dmax</th>
</tr>
</thead>
<tbody>
<tr>
<td>The supF(1): 0.00</td>
<td>supF(2): 0.000</td>
<td>U Dmax: 1596641*</td>
</tr>
<tr>
<td>The supF(2): 1596641*</td>
<td>supF(3): 0.00</td>
<td>W Dmax: 2108132*</td>
</tr>
</tbody>
</table>

The number of breaks selected by procedure: 0

The number of observations is 46. By following Bai and Perron (2003) it is allowed serial correlation in errors of the regression. It is allow up to 3 break and a trimming $\varepsilon = 0.20$

The number of observation in our sample is 46, and we allow serial correlation in errors of the regression. We allow up to three break and trimming value 0.20. U Dmax and W Dmax significant at %1 level but supF(1), supF(2|1) and supF(3|2) are insignificant. These results indicate that we have at most one break (in here 1975). However the sequential procedure found no break and the confidence intervals (not reported) indicate meaningless interval which also indicate the difficulty to conclude that a break is presents. Consequently we can conclude that there is no o break in the association between saving and investment during the period 1962-2007.

Figure 2: Saving Investment (1980Q1-2007Q3)

Figure 2 shows the seasonally adjusted investment/GNP and savings/GNP. Compare to the yearly data, co-movement of two series less obvious. Table 2b shows the structural break test results of quarterly saving and investment relation.
Table 4: Structural Break Test (1980Q1-2007Q3)

<table>
<thead>
<tr>
<th>$i_t = \alpha + \beta s_t + \varepsilon$</th>
<th>$\sup_{F_t(k)}$</th>
<th>$\sup_{F_t(l+1/l)}$</th>
<th>$U_{Dmax}$ and $W_{Dmax}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sup_{F_1(1)}$: 0.19</td>
<td>$\sup_{F_2(1)}$: 0.00</td>
<td>$U_{Dmax}$: 8691212*</td>
<td></td>
</tr>
<tr>
<td>$\sup_{F_2(2)}$: 264*</td>
<td>$\sup_{F_3(2)}$: 0.00</td>
<td>$W_{Dmax}$: 14488591*</td>
<td></td>
</tr>
<tr>
<td>$\sup_{F_3(3)}$: 8691212</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of break selected by procedure

Sequential: 0

The number of observations is 111. By following Bai and Perron (2003) it is allowed serial correlation in errors of the regression. It is allow up to 3 breaks and a trimming $\varepsilon = 0.20$

The number of observation is 111 and we allow the serial correlation in errors of regression. Again we allowed up to three breaks and trimming value 0.20. The structural break test results for quarterly data are very similar with test results for yearly data. While the test found first possible break at 1989Q2, the significance of break is questionable. SupF(1) and sequential procedure indicate no break also confidence intervals (not reported) are meaningless. Thus we cannot conclude that there is significant presence of structural break in relation.

4. Testing the Relationship Between Investment and Saving in Turkey: ARDL Model Bound Testing Approach

In this section we analyze the cointegration relation between saving and investment. Cointegration techniques, developed by Engle and Granger (1987), Johansen (1991, 1995), employed previous studies require that all variables are integrated in same order. However autoregressive distributed lag model (ARDL) bound test approach to cointegration (Pesaran et al., 2001) does not require that all variables are integrated same order. As time series properties of our data show some inconclusive results, employing ARDL bound testing approach save us from being sure about that all series are significantly I(1).

ARDL is the major workhorse in dynamic single-equation regressions. The ARDL modeling approach is popularized by, Pesaran and Smith (1998), Pesaran and Shin (1999), and Pesaran et al. (2001). The main advantage of this approach lies in the fact that it can be applied irrespective of whether the variables are I(0) or I(1). Another advantage of this approach is that the model takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework. Moreover, a dynamic error correction model (ECM) can be derived from ARDL through a simple linear transformation. The ECM integrates the
short-run dynamics with the long-run equilibrium without losing long-run information. It is
also argued that using the ARDL approach avoids problems resulting from non-stationary
time series data (Shrestha, 2005).

ARDL \((p,q)\) model without trend for FH relationship is:

\[
\Delta i_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta i_{t-i} + \sum_{i=0}^{q} \delta_i \Delta s_{t-i} + \lambda_1 i_{t-1} + \lambda_2 s_{t-1} + \nu_t
\]  

(2)

Where \(\alpha\) is drift component and \(\nu_t\) are white noise errors. \(\Delta\) denotes first difference operator.
The first part of the equation with \(\beta\) and \(\delta\) represents the short run dynamics of model and
the second part of the equation with \(\lambda\)’s represents the long-run dynamics of the model. If the
all \(\lambda\)’s are zero it means that there is no long-run relationship between variables.

In the equation (2) the terms with summation signs represents the error correction dynamics
and the terms with the \(\lambda\) represents the long-run relationship. To test the non-existence of
level relationship between growth of industrial production index and term structure of interest
rate two separate bond test applied. In the first step it is used \(F\)-test for the null hypothesis
\(\lambda_1 = \lambda_2 = 0\) and \(t\)-test for the null hypothesis of \(\lambda_1 = 0\). Rejecting the null hypothesis will
lead to reach stable long-run level relationship between term structure of interest rate and
growth of industrial production.

Given statistics of structural break we employ ARDL bound testing procedure to the whole
period. Table 5 shows the information criterion and the F version of Lagrange Multiplier
(LM) statistics for testing the hypothesis of no residual serial correlation.

<table>
<thead>
<tr>
<th>(P)</th>
<th>AIC</th>
<th>SBC</th>
<th>(F) [prob]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(AIC,SBC)</td>
<td>3.7399&lt;</td>
<td>3.9004&lt;</td>
<td>0.73681 [0.4852]</td>
</tr>
<tr>
<td>2</td>
<td>3.7713</td>
<td>4.0146</td>
<td>0.090103 [0.9140]</td>
</tr>
<tr>
<td>3</td>
<td>3.8445</td>
<td>4.1722</td>
<td>0.31686 [0.7306]</td>
</tr>
</tbody>
</table>

\(F\) statistics for null of no serial correlation.
-\(AIC\): indicates the model selected by Akaike Information Criterion. The lag order selection by
\(AIC\) is carried out by using underlying ARDL model for the conditional ECM (2) as in Pesaran
et al. (2001).
-\(SBC\): indicates Schwarz Information Criterion
Both Akaike and Schwartz information criterion select lag 1. The F statistics show that we cannot reject the null hypothesis of no serial correlation.

Table 6: F and t statistics for testing the existence of cointegration relationship (1962-2007)

<table>
<thead>
<tr>
<th>P</th>
<th>$F_{tv}$</th>
<th>T</th>
<th>$F$ (prob)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.85**</td>
<td>-3.37**</td>
<td>0.13678 [0.8726]</td>
</tr>
<tr>
<td>2</td>
<td>3.92</td>
<td>-2.77***</td>
<td>0.31686 [0.7306]</td>
</tr>
<tr>
<td>3</td>
<td>3.02</td>
<td>-2.44</td>
<td>0.49753 [0.6130]</td>
</tr>
</tbody>
</table>

The $F_{tv}$ statistics is used to test for the null hypothesis $\lambda_1 = \lambda_2 = 0$ and t statistics for the null hypothesis of $\lambda_1 = 0$ in equation (2). Asymptotic critical values for $F_{tv}$ statistic are obtained from Table CI(iii) Case III: Unrestricted intercept and no trend, asymptotic critical values for t statistic are obtained from Table CII(iii) Case III: Unrestricted intercept no trend (Pesaran et al, 2001). Critical values for F statistics for the number of independent variable $k=1$, at %1 (%5) [%10] level: lower bound [I(0)] is 6.84 (4.94) [4.04] and upper bound I(1) is 7.84 (5.73) [4.78]. Critical values for t statistics for the number of independent variable $k=1$, at %1 (%5) [%10] level: lower bound is -3.43(-2.86)[-2.57] and upper bound is -3.82(-3.22)[-2.91] (Pesaran et al, 2001).

-** [***] denotes the null hypothesis of no cointegration is rejected at %1 (%5) [%10] level.

Table 6 shows the $F_{tv}$ and t statistics for the existence of cointegration. For the selected lag 1, the $F_{tv}$ and $t$ statistics reject the null hypothesis of there is no level relationship at %5 level. Also F statistics show that there is no serial correlation.

As we find that there is cointegration relationship we can get long-run coefficients from the following ARDL($p,q$) model:

$$
   i_t = \alpha + \sum_{i=1}^{p} \beta_i i_{t-i} + \sum_{i=0}^{q} \varphi_i s_{t-i} + \nu_t
$$

(3)

$$
   i_t = \alpha + \beta_1 i_{t-1} + \beta_2 i_{t-2} + \ldots + \beta_p i_{t-p} + \varphi_0 s_t + \varphi_1 s_{t-1} + \ldots + \varphi_q s_{t-q} + \nu_t
$$

(4)

Thus long run relationship is 

$$
   \tilde{i}_t = \frac{\alpha}{1 - (\beta_1 + \beta_2 + \ldots + \beta_p)} + \left(1 - \frac{\varphi_0 + \varphi_1 + \ldots + \varphi_q}{1 - (\beta_1 + \beta_2 + \ldots + \beta_p)}\right) s_t + \nu_t
$$

where

$$
   \left(1 - \frac{\varphi_0 + \varphi_1 + \ldots + \varphi_q}{1 - (\beta_1 + \beta_2 + \ldots + \beta_p)}\right)
$$

is long-run effect of $s_t$ on $i_t$.

To estimate long-run coefficients, firstly it is required to estimating equation (4) by OLS. Optimal number of lag is determined by AIC. The ARDL method estimates $(p+1)^k$ number of
regressions to obtain optimal lag length for each variable, where $p$ is the maximum number of lag to be used and $k$ is the number of variables in equation.

The estimated order of ARDL $(p,q)$ model were selected by searching across the $(3+1)^2=16$ ARDL models, spanned by $p=0,1,2,3$ and $q=0,1,2,3$ using the AIC information criterion. As a result we select the ARDL $(1,0)$.

Table 7: Long-run coefficients (1962-2007)

<table>
<thead>
<tr>
<th>Selected Model</th>
<th>Constant $(t$ statistics)</th>
<th>Slope $(t$ statistics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDL(1,0)</td>
<td>2.72 (0.40)</td>
<td>0.96* (2.89)</td>
</tr>
</tbody>
</table>

* indicate significance at %1.

Estimated order of an ARDL $(p,q)$ model in two variables $(i,s)$ were selected by searching across the $(3+1)^2=16$ ARDL model, spanned by $p=0,1,\ldots,3$ and $q=0,1,\ldots,3$, using AIC.

The estimated coefficients are represented on Table 7. The long-run coefficient of saving is found to be 0.96 which is very close to 1. This result indicates that the saving investment relationship during 1962-2007 is almost one to one.

The short run dynamics of the model is shown in Table 8 which tabulates the estimates of error correction model (ECM) associated to ARDL selected by AIC for estimating long-run relations in Table 7.

Table 8: ECM Results (1962-2007)

<table>
<thead>
<tr>
<th>Regressor</th>
<th>Coeff.</th>
<th>$t$ value $(t$ prob)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta s$</td>
<td>0.423</td>
<td>3.32 (0.002)</td>
</tr>
<tr>
<td>$EC_{t-1}$</td>
<td>-0.273</td>
<td>-3.08 (0.004)</td>
</tr>
</tbody>
</table>

$R^2=0.345$ $F_{SC}=0.938$ [0.40], $X^2_N=1.05[0.59]$ $F_{FF}=0.014$ [0.90]

Regression are estimated by OLS. EC is error correction terms that are defined as $EC = i-2.721 - 0.966*s$. $X^2_N$, $F_{SC}$ and $F_{FF}$ denotes Chi square statistics to test normality and F statistics for serial correlation and Ramsey Regression Equation Specification Error Test (RESET) test respectively. P values are given in [.].

The error correction term and short run coefficient of saving is significant. The value of EC is -0.273, indicate that 27 percent of disequilibria of the previous year come back to the long run equilibrium in the next year. The coefficient of $\Delta s$ measures what extend a temporary annual
shock to domestic saving pass thorough into domestic investment given long-run relation. It show that almost half of the temporary shock in saving pass thorough into domestic investment.

We employ same procedure for quarterly data. Table 9 tabulates the information criterion for lag selection and F statistics for serial correlation. We use maximum 12 lags to cover three year.

Table 9: Statistics for Selecting FH equations (1980Q1-2007Q3)

<table>
<thead>
<tr>
<th>P</th>
<th>AIC</th>
<th>SBC</th>
<th>F [prob]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.4067</td>
<td>-2.3085</td>
<td>44.334 [0.0000]</td>
</tr>
<tr>
<td>2</td>
<td>-2.6999</td>
<td>-2.5517</td>
<td>21.394 [0.0000]</td>
</tr>
<tr>
<td>3</td>
<td>-3.0605</td>
<td>-2.8619</td>
<td>13.800 [0.0000]</td>
</tr>
<tr>
<td>4</td>
<td>-3.4222</td>
<td>-3.1724</td>
<td>3.0320 [0.0141]</td>
</tr>
<tr>
<td>5</td>
<td>-3.4291</td>
<td>-3.1276</td>
<td>5.2351 [0.0003]</td>
</tr>
<tr>
<td>6(SBC)</td>
<td>-3.5418</td>
<td>-3.1880</td>
<td>2.3664 [0.0462]</td>
</tr>
<tr>
<td>7</td>
<td>-3.5213</td>
<td>-3.1144</td>
<td>4.6551 [0.0009]</td>
</tr>
<tr>
<td>8</td>
<td>-3.5174</td>
<td>-3.0570</td>
<td>2.6825 [0.0271]</td>
</tr>
<tr>
<td>9</td>
<td>-3.5844</td>
<td>-3.0697</td>
<td>2.2395 [0.0587]</td>
</tr>
<tr>
<td>10</td>
<td>-3.6041</td>
<td>-3.0345</td>
<td>1.0343 [0.4039]</td>
</tr>
<tr>
<td>11(AIC)</td>
<td>-3.6403</td>
<td>-3.0150</td>
<td>2.0074 [0.0880]</td>
</tr>
<tr>
<td>12</td>
<td>-3.6064</td>
<td>-2.9248</td>
<td>1.5041 [0.2001]</td>
</tr>
</tbody>
</table>

F statistics for null of no serial correlation.

-AIC: indicates the model selected by Akaike Information Criterion. The lag order selection by AIC is carried out by using underlying ARDL model for the conditional ECM (2) as in Pesaran et al. (2001).

-SBC: indicates Schwarz Information Criterion

SBC selects 6 lag but AIC select 11 lag. For 6 lag the null hypothesis of no serial correlation can be rejected at %5, and for 11 lag we can reject the null hypothesis at %10 level. However for the lag 10 and 12, the null of no serial correlation cannot be rejected. Taking all these results we search the level relationship across the model include 6 lags to 12 lags.
Table 10: F and t statistics for testing the existence of cointegration relationship 
(1980Q1-2007Q3)

<table>
<thead>
<tr>
<th>P</th>
<th>F_{iv}</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5.72***</td>
<td>-2.45</td>
</tr>
<tr>
<td>7</td>
<td>4.04</td>
<td>-2.06</td>
</tr>
<tr>
<td>8</td>
<td>5.91</td>
<td>-2.42</td>
</tr>
<tr>
<td>9</td>
<td>8.12*</td>
<td>-3.11***</td>
</tr>
<tr>
<td>10</td>
<td>4.94</td>
<td>-2.41</td>
</tr>
<tr>
<td>11</td>
<td>5.57</td>
<td>-2.68</td>
</tr>
<tr>
<td>12</td>
<td>6.33**</td>
<td>-1.68</td>
</tr>
</tbody>
</table>

The $F_{iv}$ statistics is used to test for the null hypothesis $\lambda_1 = \lambda_2 = 0$ and t statistics for the null hypothesis of $\lambda_1 = 0$ in equation (2). Asymptotic critical values for $F_{iv}$ statistic are obtained from Table CI(iii) Case III: Unrestricted intercept and no trend, asymptotic critical values for t statistic are obtained from Table CII(iii) Case III: Unrestricted intercept no trend (Pesaran et al, 2001). Critical values for $F$ statistics for the number of independent variable $k=1$, at %1 (%5) [%10] level: lower bound [l(0)] is 6.84 (4.94) [4.04] and upper bound l(1) is 7.84 (5.73) [4.78]. Critical values for t statistics for the number of independent variable $k=1$, at %1 (%5) [%10] level: lower bound is -3.43(-2.86)[-2.57] and upper bound is -3.82(-3.22)[-2.91] (Pesaran et al, 2001).

- * (**) [***] denotes the null hypothesis of no cointegration is rejected at %1 (%5) [%10] level.

$F_{iv}$ statistics indicate that for lag 6 at %10, for lag 9 at %1 and for lag 12 at %10 level the null of no level relationship rejected. Thus for appropriate lag order we can find cointegration relation.

Table 11: Long-run coefficients (1980Q1-2007Q3)

<table>
<thead>
<tr>
<th>Selected Model</th>
<th>Constant (t statistics)</th>
<th>Slope (t statistics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARDL(3,0)</td>
<td>0.277* (2.93)</td>
<td>-0.48 (-1.08)</td>
</tr>
</tbody>
</table>

* indicate significance at %1.

Estimated order of an ARDL (p,q) model in two variables (i,s) were selected by searching across the $(12+1)^2=169$ ARDL model, spanned by $p=0,1,...,12$ and $q=0,1,...,12$ using AIC.

By searching across $(12+1)^2=169$ ARDL model and using AIC we select ARDL(3,0) model. However the long run coefficient of saving is negative but insignificant.

Taking into account the results derived from yearly data and following the FH (1980) one can argue that there is no free capital mobility in Turkey. However, the results derived from quarterly data indicate that there is capital mobility in Turkey. Thus we have two contradicting results.
One of the explanations of this conflicting result may come from balance of payment dynamics. As current account is equal to saving minus investment public or private decision makers respond to balance of payment disequilibrium and this lead to close association between saving and investment. On the other hand governments can target the current account by using some policy instrument. Also Coakley et al (1996) argued that there is no theoretical reason to believe that the FH coefficients should be stable structural or reduced from parameters and including neoclassical growth theory and business cycles models many theories suggest that saving and investment has close association irrespective of whether there is free capital mobility or not. FH puzzle is not puzzle but just statistical artifact because solvency constraint. Solvency constraint on balance of payment leads to current account as a share of GNP a stationary process. Since current account is equal to saving minus investment, saving and investment rates should cointegrate with a unit coefficient. So it is solvency constraint that FH coefficient measures (Coakley et al. 1998). Clearly the possibility of observing the effect of balance of payments on corresponding relation on yearly base is higher than on quarterly base.

5. Conclusion

Felsthein and Horioka (1980) argued that the association between domestic saving and investment is perfect in closed economy but the presence of capital mobility breakdown this relation. However the empirical findings of close saving investment correlation in OECD countries, considered as a puzzle. In this regard, we analyze the saving investment relation in Turkey. To do this we use two different data set; yearly from 1962 to 2007 and quarterly from 1980Q1 to 2007Q3 and employ ARDL bound testing approach. The previous studies for Turkey take into account the effects of financial liberalization at 1982 and full capital account liberalization at 1989 exogenously in Turkey. We argued that if FH final statement is true, instead of taking the effects of corresponding dates in Turkey exogenously, one can find structural break endogenously in saving investment relation. However by employing Bai and Perron (1998, 2003) structural break test we find that there is no significant structural break. After that analyzing the S-I relation on whole periods we find different results for different data set. Using yearly data we find that saving and investment are cointegrated, and the long run coefficient of saving is 0.96. From FH point of view this almost one to one relation can be regarded as no capital mobility in Turkey. We also employ error correction model to
investigate the short dynamics and find that almost one third of the previous period shock corrected in next period and half of change in domestic saving pass thorough domestic investment. In analyzing same relation by using quarterly data we find that while saving and investment cointegrated, the long run coefficient of saving is not significant. So following FH statement, this finding indicates that there is free capital mobility in Turkey. This two conflicting results may because of the balance of payment dynamics. It is possible to argue that the responds to balance of payment or target of balance of payments leads to close association between saving and investment and effects of balance of payments more likely observed in yearly base.
6. References


