International Journal of Economics and Financial Issues
Vol. 2, No. 1, 2012, pp.1-11
ISSN: 2146-4138
www.econjournals.com

Capital Mobility: An Application of Savings-Investment Link for Tunisia

Solarin Sakiru Adebola
College of Business
Universiti Utara Malaysia, Malaysia.
E-mail: sakiru1424@yahoo.co.uk

Jauhari Dahalan
College of Business
Universiti Utara Malaysia, Malaysia.
E-mail: djauhari@uum.edu.my

ABSTRACT: The paper examines the degree of capital mobility in Tunisia for 1970 to 2009 period, using Feldstein and Horioka (1980) method of savings and investment comovement. We apply ARDL bound test to assess comovement between savings and investment; and to compute the savings retention ratio with FMOLS and DOLS as complements. The results reveal low capital mobility, in contrary to Maminingi (1997) who note perfect capital immobility in Tunisia. Hence, efforts should be made by the concerned authorities to evolve policies that will mobilize international capital into the country.

Keywords: Tunisia; Savings–Investment; ARDL; Causality
JEL Classification: C22; E21; F21

1. Introduction

Capital mobility as perceived by Feldstein and Horioka (1980) or F-H has generated considerable interests in investigating savings and investment relationship. The vigour created in the subject-matter is partly due to the fact that F-H challenged the then established exchange rate and open-economy macroeconomic models and theories of the 1970s, which claimed that capital mobility was high. Instead, F-H argues that capital was relatively immobile because savings and investment were highly correlated. Using the average cross-sectional data across 16 OECD countries for the period covering 1960 to 1974, F-H empirically shows that some 90% of domestic savings remains within a country to finance domestic investment. In other words, capital is not internationally mobile, which negates the belief of the open-economy macroeconomic models that have argued for easing of barriers to capital movement.

Beyond the debate, it is pertinent to realize that F-H inadvertently introduced a new way of assessing the degree of international capital mobility. According to F-H, the degree of capital mobility is detected, by examining the relationship between savings and investment. In the absence of capital mobility, domestic savings and investment are highly correlated because domestic investment is financed by domestic savings. On the other hand, in a world of unhindered capital flows, countries with high level of investment need not rely on an equally high saving. By extension, F-H contends that the gap between domestic investment and savings must equal the difference between imports and exports and financed by external capital or foreign savings. Building on less developed countries (LDCs) suggest a much weaker association between savings and investment (Bangake and Eggoh, 2011).

In Africa, there are two strands of literatures on savings and investment. The first strand of literatures, which constitutes the bulk of literature, utilizes cross-sectional techniques to investigate the F-H hypothesis in African countries. These studies include Isaksson (2001), Adedeji and Thornton (2006), Bangake and Eggoh (2011). In practice, there are several limitations of cross-sectional studies. As the savings and investment correlation depends on the nature of the disturbances and the structure

of the economy, there is no reason to expect the savings and investment relation to be the same for every country in the sample, as cross-section regressions imply (Narayan, 2005a; Caporale et al., 2001). Cross-section analysis is susceptible to sample selection bias and its results are hard to interpret, since capital mobility estimates are derived at a particular point in time. Besides, the savings retention coefficient from a cross-section might be significantly affected by outliers (an observation that is conspicuously different from the observations in the sample), and the use of long-term averages of the savings and investment ratios leads to an upward bias in capital mobility (Caporale et al., 2001).

The second strand of literatures, which are fewer in number, attempt to avoid the problem associated with cross sectional approach, by employing time series methods. These include Agbetsiafa (2002) and Maminingi (1997) that employ time series in their studies on African countries. Of the two works, it is only Maminingi (1997) that consider Tunisia in its sample. The recent developments in Tunisia including efforts to limit barriers placed on capital mobility in the face of huge external financing requirements of Tunisia raises question on the continued validity of Maminingi (1997) findings on Tunisia. For example, Tunisia's financing requirements amount to about USD 3.2 billion in 2005 and USD 3.5 billion in 2006. It was projected that external resource requirements will be covered mainly by medium and long-term public and private loan disbursements in the amount of 1,904 million US dollars, foreign direct investments amounting to USD 1.5 billion and grants for the balance of 0.2 billion US dollars (AFDB, 2005). The gap in financing requirement persists in the presence of no restrictions on foreign direct investment in Tunisia (Ghazi, 2005) and policy over the years have focus on how to meet the requirement of local investment. In 2005, the Tunisian authorities began to liberalize their capital accounts in order to attract external savings, diversify the financing of the balance of payments and the composition of portfolios, and enhance the efficacy of the domestic financial markets (AFDB, 2005). Foreign investors are to hold up to 100% of project equity without prior authorization in most sectors in Tunisia. Besides, foreigners investing in agriculture can hold up to 66% of companies' capital. Shares of operating Tunisian companies can be freely purchased up to 50% of capital without authorization. In addition, foreign investors were allowed to repatriate profits and proceeds from the business transaction without any restriction. Tunisia continued to diversify its economy by signing a free-trade association agreement with the European Union in 1995 (FIPA, 2011a, b).

Against these backdrops, we investigate the degree of capital mobility in Tunisia by utilizing F-H hypothesis of the comovement of savings and investment in the country. A country with low capital mobility and, thus, high comovement between domestic saving and investment, would have a slope coefficient near unity. This study employs the bounds testing procedure to analyze the level relationship between saving and investment within an autoregressive distributed lag (ARDL) framework covering the period of 1970-2009. For robustness sake, we include two other estimators, which are the Fully Modified Ordinary Least Square (FMOLS) as advanced by Hansen and Phillips (1990), and Dynamic Ordinary Least Square lead/lag method (DOLS) as proposed by Stock and Watson (1993) to supplement the ARDL method. This is after applying Zivot and Andrews (1992) and Lee and Strazicich (2003) method to endogenously determine structural breaks in the unit root tests. Essentially, the study may guide policy makers in Tunisia on determining the extent of capital mobility in the country and to what extent external finance may fill the financing requirement of the country. The rest of the paper is organized as follows. In Section 2, the study provides a brief review of literature; Section 3 introduces the model, and Section 4 is on methodology and data of the study. In the penultimate section, we present the empirical results while in the final section we conclude.

2. Literature Review

The saving and investment relationship remains a puzzle today as it was in its initial years in the early 1980s. It continues to generate responses and counter responses from theoretical and empirical point of views. On the empirical front, most authors approach the nexus through cross sectional or time series approach. The works that utilize cross sectional framework are numerous with no uniformity in their findings. For example, Narayan and Narayan (2010) could not establish any evidence of panel cointegration between savings and investment in G7 countries. The authors interpret this result to mean high capital mobility since no long-term relationship exists between savings and investment. On the other hand, Coakley et al., (2004) observe high capital mobility on 12 OECD economies for the period covering 1980 to 2000. Cross sectional studies have also noted that high

capital mobility among developed countries is a recent phenomenon that started only in the 1990s. These include Rao, Tamazian and Kumar (2010) that estimate the savings retention ratio of 13 OECD countries for 1960 to 2007 period, using system GMM approach. Other related studies in this respect include Pelgrin and Schich (2008), Krol (1996) and Jansen (2000) who apply fixed effect model on 21 OECD countries and show that capital mobility increased in the 1990s.

The time series approach has been basically through cointegration approach. Seminally, Miller (1988) applies cointegration technique to study the savings-investment interaction on U.S. data for the 1946 to 87 period. Subsequent works include De Vita and Abott (2002) on US quarterly data covering 1946Q1 to 2001Q2; Payne (2005) on Mexico data for the period covering 1960-2002; Singh (2008) on Indian annual data for the period 1950-51 to 2001-02; Narayan (2005a) on Japan data for 1960–1999 period; Ang (2007) on Malaysia for the 1965-2003 period; and Pelagidis and Mastroyiannis (2003) on Greece data for the period covering 1960-1997. All these studies establish cointegration relationship between savings and investment, a result which basically indicate that capital mobility is low. However, few studies with time series approach failed to establish the existence of cointegration between savings and investment. Studies showing non-existence of cointegration between savings and investment include Sarno and Taylor (1998) on UK data spanning the period 1955:1 to 1994:4; and Schmidt (2003) on Australia.

Beyond the foregoing works, few investigations on sample inclusive of African countries have sprung up, recently. For example, in a large sample of 90 developing countries, using OLS techniques, Isaksson (2001) estimates the relationship between savings and investment covering the period 1975-1995. The total sample is divided into four geographical entities which include Asia, Latin America, Middle East (of which Tunisia is included in a cross sectional framework) and Sub-Saharan Africa. The study concludes that except for the Middle East, overall capital mobility is low.

Studies specifically on Africa include Adedeji and Thornton (2006) who tested the F-H hypothesis by applying FMOLS and DOLS panel cointegration techniques for the period 1970 to 2000 on six African countries. With the savings retention coefficients ranging from 0.73 to 0.39, the author argues that capital was relatively mobile in the selected African countries. However, the study does not consider the individual characteristics of each country. Therefore, policy based on these results may be misleading as different economies are characterised with different economic situations, which econometrics methods cannot adequately consider. Hence, Bangake and Eggoh (2011) approach the problem of individual country characteristics by dividing the sample of 37 African countries into various groupings such as CFA franc zone and non-CFA franc zone countries; oil-producing and non-oil producing countries; civil law and common law countries for 1970 to 2006 period. Furthermore, Bangake and Eggoh (2011) add an estimator-pooled mean group panel (PMG). The estimates of retention coefficients from FMOLS, DOLS, and PMG are 0.38, 0.58, and 0.36, respectively, for the sample as a whole. With these estimates, Bangake and Eggoh (2011) suggest that capital was relatively mobile in African countries compared to OECD countries.

Economic groupings cannot fully account for individual country characteristics, since the saving-investment nexus is largely determined by the nature and operation of the financial institutions and economic policies pursued in each country, it is more appropriate to carry out country-specific studies by examining the evolution of the variables of interest over time and relate the findings to policy designs (Ang 2007).

The issue of individual country characteristics on African countries is further addressed by Agbetsiafa (2002) who examine the F-H hypothesis on six emerging economies in Africa within time series framework. Agbetsiafa (2002) employ Johansen and Juselius cointegration techniques and causality tests based on an error correction model. Countries in the sample include Ghana, Ivory Coast, Kenya, Nigeria, and Zambia and South Africa. The study findings suggest unidirectional causality from saving to investment in Ghana, Ivory Coast, Kenya, Nigeria, and Zambia, and bidirectional causality for South Africa and savings and investment are cointegrated, thus share a long-run equilibrium association in the six countries. Thus, Agbetsiafa (2002) concludes that long-term capital is not internationally mobile. Conspicuously, Tunisia is absent from the sample of Agbetsiafa (2002).

In an earlier study, however, Maminingi (1997) estimates savings and investment correlations for 58 developing countries for the period covering including Tunisia 1970 to 1990 within time series framework. The author uses OLS and FMOLS. Utilizing the OLS method, Maminingi (1997) observes

perfect capital immobility for Tunisia as the coefficient of saving-retention is found to be very close to unity (at 0.92). The FMOLS shows that the coefficient of saving-retention for Tunisia is also close to unity (at 1.06). With the availability of longer time series data, small sample compatible time series approach (such as ARDL); the result of Maminingi (1997) on Tunisia can no longer hold much ground. Moreover, in the post 1970-1990, there have been several economic and institutional developments in easing capital restriction in Tunisia to address huge external financing requirement, which have been discussed earlier. Therefore, we investigate the savings and investment nexus taken into account all the issues raised above, by starting with the methodology of the study in the next section.

3. Model

In exploring the interaction between savings and investment nexus for Tunisia, the study employs the following simple regression equation:

$$I_t = \alpha_t + \beta S_t + \varepsilon_t \quad (1)$$

Where, I is gross national investment as a proportion of gross domestic product (GDP); S is the gross national saving as a proportion of GDP; β is savings retention ratio, α is constant; and ε is disturbance term.

4. Data and Methodology

4.1 Data

This study uses annual time series data on savings and investment for the 1970 to 2009 period. Gross fixed capital formation is utilized as a measure of investment because as Bayuomi (1990) argues that gross fixed capital formation is less procyclical than net fixed capital formation (because of the presence of inventories, which is highly procyclical, in computing net fixed capital formation). The data are obtained from World Development Indicators (WDI, 2010). Though data is available from 1960 on savings and investment, we actually start from 1970 because the 1961 to 1969 interval corresponds to the period of socialism in Tunisia (Bechri and Naccache, 2003). The variables are in their natural logarithm.

4.2 Stationarity test

In response to Perron (1989) seminal paper on the impact structural change on the power of the conventional unit roots tests, several unit-root tests that consider the presence of structural changes were developed. These works include Perron (1989) who propose unit root test with exogenous structural break. However, the arbitrarily selection of structural break date is a pitfall in the work of Perron (1989), and led Zivot and Andrews (1992) to advance a sequential Dickey-Fuller unit root test that most importantly considers break dates as endogenous. In the process, Zivot and Andrews (1992) idealized three species of tests, which include unit root test of trend stationarity process in the presence of a shift in mean (Model A) and a shift both in slope and intercept (Model C).

$$\Delta Y_t = \mu_1^A + \beta_1^A t + \mu_2^A DU_t + \alpha^A Y_{t-1} + \sum_{j=1}^{k} c_j^A + \Delta Y_{t-1} + \varepsilon_t \quad (2)$$

$$\Delta Y_t = \mu_1^C + \beta_1^C t + \mu_2^C DU_t + \mu_3^C DT_t + \alpha^C Y_{t-1} + \sum_{j=1}^{k} c_j^C + \Delta Y_{t-1} + \varepsilon_t \quad (3)$$

where, Δ represents first difference operator T_B is the break date, DU_t and DT are dummy variables for the break in mean (level) and trend, respectively. $DU_t = 1$ if $t > T_B$, alternatively 0; and $DT_t = t - T_B$ if $t > T_B$, alternatively 0. T_B is determined by the minimum *t*-statistic on the coefficient of the Autoregressive variable.

Due to the possibility of more than one structural break, Lumsdaine and Papel (1997) procedures provide for two breaks within same framework of Dickey-Fuller unit root tests. However, if a break exists under the null of unit root, Lumsdaine and Papel (1997) will exhibit size distortions such that the null of unit root hypothesis is rejected too often (Altinay, 2005), as Lumsdaine and Papel (1997) assume no breaks under the null. Hence, Lee and Strazicich (2003) advance a two-break

minimum LM unit root test that are not affected by structural breaks under the null. The Lee and Strazicich (2003) unit root tests with two structural breaks are modified versions of Schmidt and Phillips (1992) unit root tests, based on the Lagrange Multiplier (LM) principle and provides for structural break(s) in mean (Model A); both in mean and in trend (Model C). These are exemplified below:

$$y_t = \partial' Z_t + X_t, X_t = \beta X_{t-1} + \varepsilon_t \tag{4}$$

Z_t represents vector of exogenous variables and $\varepsilon_t \square iid\ N(0, s^2)$. The representation of Model A in Lee and Strazicich (2003), which allows for double breaks in mean (level) is exemplified as follows: $Z_t = [1, t, D_{1t}, D_{2t}]'$ where $\mathrm{D}_{\mathrm{jt}} = 1$ if $\mathrm{t} \geq T_B + 1, j = 1, 2$. On the other hand, the representation of Model C in Lee and Strazicich (2003) which allow for double breaks in both mean (level) and trends is shown by: $Z_t = [1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}]'$, where $DT_{jt} = t - T_{Bj}$ if $\mathrm{t} \geq T_B + 1, j = 1, 2$.

4.3 Cointegration

Following the stationarity test, the study examines the possibility of long run relationship between investment and saving for Tunisia through the cointegration test proposed by Pesaran and Shin (1999) and extended by Pesaran, Shin and Smith (2001), which is known as bound tests. The test offers numerous advantages. ARDL employs a single reduced form equation, as against the conventional Johanssen cointegration method, which requires laborious system of equation to estimate long run relationship. Bound test is applicable regardless of whether the underlying variables are I(0), I(1), or fractionally integrated. Moreover, the long and short-run parameters of the model are estimated simultaneously. As a result, the inability to test hypotheses on the estimated coefficients in the long run associated with the Engle-Granger method is avoided. Besides, it removes problems associated with omitted variables and autocorrelations; provides unbiased and efficient estimates (Narayan 2004). Furthermore, it is accommodating to small sample series, as obtainable in the current study. Procedurally, the bounds testing procedure involves two stages. The first stage is to establish the existence of a long run relationship using the following Unrestricted Error Correction Models (UECMs):

$$\Delta \ln I_t = \alpha_{10} + \sum_{i=1}^{p} \alpha_{11} \Delta \ln I_{t-1} + \sum_{i=1}^{p} \alpha_{12} \Delta \ln S_{t-1} + \delta_{11} \ln I_{t-1} + \delta_{12} \ln S_{t-1} + \varepsilon_{1t} \tag{5}$$

$$\Delta \ln S_t = \alpha_{20} + \sum_{i=1}^{p} \alpha_{21} \Delta \ln S_{t-1} + \sum_{i=1}^{p} \alpha_{22} \Delta \ln I_{t-1} + \delta_{21} \ln S_{t-1} + \delta_{22} \ln I_{t-1} + \varepsilon_{2t} \tag{6}$$

Δ represents first difference operator. The variables have been defined earlier. To establish long run relationship, joint significance test of cointegration $(\mathrm{H}_0 : \partial_{11} = \partial_{12} = 0, \partial_{21} = \partial_{22} = 0)$, is conducted on eq. (5) and (6). The F-test, which has a non-standard distribution, is considered on the lagged levels of the variables in determining whether a long-run relationship exists among the variables. In this regards, two bounds of critical values are generated. The lower bounds critical values serve as benchmark for I(0) variables, while the upper bound critical values serve as benchmark for I(1) variables. According to the bound test, cointegration exists if the computed F-statistic exceeds the upper critical value. If the F-statistic falls within the two bounds of critical values, the test becomes inconclusive. Finally, if the F-statistic is below the lower critical value, it implies no cointegration.

The second stage simply entails the estimation of long-run and short-run coefficients of the cointegrated equation, once long run relationship is established through the bound test. In this study, we adopt the small sample size critical values computed by Narayan (2005b) for the bound test as against Pesaran and Pesaran (1997) produced critical values, which are computed for a large sample size of 500 and 1000 observations.

4.4 Granger causality test

Granger (1988) demonstrates that causal relations among variables can be examined within the framework of ECM, with cointegrated variables. While the short run dynamics are captured by the individual coefficients of the lagged terms, the error correction term (ECT) contains the information of long run causality. Significance of lagged explanatory variable depicts short run causality. On the other hand, a negative and statistical significant ECT is assumed to signify long run causality. The equations are stated below:

$$\Delta \ln I_t = \alpha_{30} + \sum_{i=1}^{q} \alpha_{31} \Delta \ln I_{t-1} + \sum_{i=1}^{q} \alpha_{32} \Delta \ln S_{t-1} + \omega_1 ECT_{t-1} + \varepsilon_{3t} \quad (7)$$

$$\Delta \ln S_t = \alpha_{40} + \sum_{i=1}^{q} \alpha_{41} \Delta \ln S_{t-1} + \sum_{i=1}^{q} \alpha_{42} \Delta \ln I_{t-1} + \omega_2 ECT_{t-1} + \varepsilon_{4t} \quad (8)$$

Where ECT is derived from the long run cointegration relationship and must be significant for long run causality to exist. In each equation, ω should exhibit a negative and significant sign for causality to exist in the long run.

5. Empirical Results

In the ARDL framework, bound test for cointegration does not require *a prior* knowledge of the stationarity status. However, in ascertaining the true region of acceptance or rejection, bound test requires knowing the variables order of integration. Moreover, additional estimators employ in this study depends on integration property of the variables. Thus, we start the determination of the order of integration with Elliott, Rothenberg and Stock (DF-GLS), which is an improvement on Augmented Dickey Fuller test (ADF) and which de-trend the data prior to unit root tests.

The DF-GLS test suggests that both savings and investment attain stationarity at first difference. Due to space, these results are not reported here (and will be provided upon request). A major pitfall of DF-GLS is that it does not consider the possibility of structural breaks in the series. Hence, in Table 1, the study presents methods – Zivot and Andrews (1992) and Lee and Strazicich (2003) –that consider structural break(s) in testing for unit roots. The results of Zivot and Andrews (1992), which is reported in Panel A of Table 1, accepts the null hypothesis of non-stationarity of both series at level, thereby confirming the results of DF-GLS. The findings of Zivot and Andrews (1992) may not be satisfactory because of the possibility of two or more structural breaks on one hand and the presence of breaks under the null, on the other. Hence, in Panel B of Table 1, we report the findings of Lee and Strazicich (2003), which outwits the enumerated problems associated with Zivot and Andrews (1992). Coincidentally, like the previous tests on unit roots, Lee and Strazicich (2003) fail to reject the null hypothesis of non-stationarity of both series. Conclusively, this is an evidence that the variables are integrated of order one. It is also noted that most of the breaks in savings and investment are in the neighborhood of 1986, the year in which Tunisia adopted structural adjustment program under International Monetary Fund (IMF) guidance following a severe balance of payments crisis.

Table 1. Unit root tests

Panel A:	Zivot-Andrews test for unit roots			
Variables	Model A		Model C	
	T-stat	Break	T-stat	Break
I	-3.693	1985	-5.036	1985
S	-4.397	1996	-4.352	1996
Panel B:	Lee-Strazicich test for unit roots			
Variable	Model: Crash		Model: Break	
		Breaks	T-stat	Breaks
I	-3.361	1986	-5.135	1979
		1994		1985
S	-1.980	1978	-3.983	1976
		1985		1986

The critical values of Zivot and Andrews (1992) for 1% and 5% levels are -5.340, -4.800 and -5.570, -5.080 for Model A and C. The critical values of Lee and Strazicich (2003) for 1% and 5% levels are -4.545, -3.842 and -5.825, -5.286 for Model: Crash and Model: Break. The optimal lag is set to 2. The null is no stationarity with the presence of endogenous structural break.

The bound test version of cointegration is reported in Table 2. The findings suggest the existence of cointegration, when investment is the dependent variable as the calculated F-statistics (4.992) is greater than the upper bound critical value (3.730) at 10% level. Evidence for cointegration is apparent as well, when Tunisia saving rate is the dependent variable as the calculated F-statistics (19.044) is greater than the upper bound critical value (6.333) at 1% level. These results mean that the null of no cointegration can be rejected when either investment or savings is the dependent variable. In other words, the results suggest long run relationship between the variables. In F-H terms, this implies low capital mobility in Tunisia. However, the establishment of such relationship does not indicate the path of causality between the variables. Hence, in next section Granger causality is investigated.

Table 2. Bound test for cointegration

Critical Values		10%I(0)	10%I(1)	5%I(0)	5%I(1)	1%I(0)	1%I(1)
	F-Statistics	3.210	3.730	3.937	4.523	5.593	6.333
Dependent Variable							
I				4.992*			
S				19.044***			

The critical values are extracted from Narayan (2005b) Case II model, which provides for restricted intercept and no trend. The null is no cointegration. *, *** Imply 10%, and 1% level of significance, respectively.

In Table 3, the results of Granger causality tests are presented. The results accept the null that saving does not Granger-cause investment in the short run. Conversely, the results reject the null at 5% thus implying that causality runs from savings to investment in the long run. Furthermore, while the results reject the null of no causality flowing from investment to savings in the short run, it rejects the null in the long run at 1% level. Evidently, the findings suggest bidirectional relationship between savings and investment especially in the long run. This is a reaffirmation of low capital mobility in Tunisia in the long run. However, Granger causality does not indicate whether the variables are positively or negatively related. Determination of such relationship is important in the savings-investment relation in order to ascertain the savings retention ratio.

Table 3. Granger causality results

Dependent Variable	ΔI	Δ*S*	ECT(-1)
Δ*I*	-	1.356	-2.288**
Δ*S*	1.067	-	-6.727***

The null is no causality. **, *** Implies 5% and 1% level of significance.

In determining the savings-retention coefficient ratio, the study reports the ARDL estimates supplemented with FMOLS and DOLS in Table 4. The long run estimates are reported in the Panel A of Table 4; while the short run estimates are reported in Panel B of Table 4. In general, the long estimates show the expected positive sign indicating that savings is positively associated with investment. As the coefficient is not too close to unity, this is an indication of low capital mobility unlike Maminingi (1997) who observes perfect capital immobility for Tunisia. The institution and economic developments in the late 1990s may have been responsible for the increased in level of capital mobility. These findings are also in support of factors characterizing developing countries and Tunisia in particular such as the magnitude of foreign aid, the size of the non-traded sector, the degree of openness and the financial structure of each country Apergis and Tsoumas (2009). In the short run, the coefficient of the ARDL shows that savings is insignificantly but positively associated with investment. The error correction term (ECT) suggests negative and significant meaning that about 24.3% of the previous period error is corrected in the current period.

Table 4. Long run and short run estimates

Panel A: Long run estimates						
Dependent Variable: *I*						
	ARDL		FMOLS		DOLS	
	Constant	*S*	Constant	*S*	Constant	*S*
	-1.154	1.407**	1.205	0.649*	1.090	0.688**
Panel B: Short run estimates						
Dependent Variable: *I*						
	Constant		Δ*S*		*ECT*	
	-0.243***		0.191		-0.243**	

*, **, *** Implies 10%, 5%, 1% level of significance.

Beyond the robustness exercise of augmenting the ADRL estimators with FMOLS and DOLS, in Table 5, the study applies a number of diagnostic tests to the ARDL estimates. The serial correlation test suggests that no sign of autocorrelation of the error terms in the ARDL estimators. The Ramsey Reset test suggests that the model is well specified. The model passes the Jarque-Bera normality tests, signifying that the errors are normally distributed. Moreover, hetrosecdasticity tests show that errors are homoskedastic and independent of the regressors. Given that Cumulative Sum of Recursive Residuals test statistics does not exceed the bounds of the 5% level of significance in Figure 1, the ARDL estimates appears stable.

Table 5. Diagnostics tests

Test Statistics	LM test
Serial Correlation	CHSQ(1) = 1.211 [0.271]
Functional Form	CHSQ(1) = 0.109 [0.742]
Normality	CHSQ(2) = 1.565 [0.457]
Heteroscedasticity	CHSQ(1) = 0.022[0.882]

These statistics are distributed as Chi-squared variates. The probability values are reported in the parenthesis.

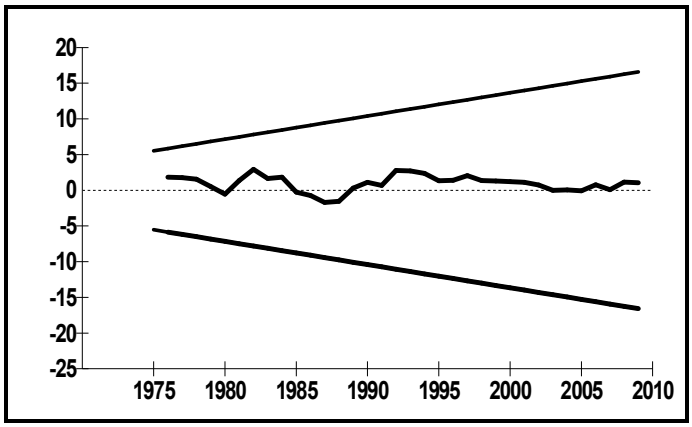

Figure 1. Plot of Cumulative Sum of Recursive Residuals

6. Conclusion

The purpose of this paper is to measure the degree of capital mobility in Tunisia for the 1970 to 2009 period. According to F-H hypothesis of assessing degree of capital mobility, a country with low capital mobility hence, high comovement between domestic saving and investment, would have a slope coefficient near unity. On the other hand, a high capital mobile country would indicate low comovement of domestic investment and domestic gross saving; and would have a slope coefficient far from unity. Hence, the study applies ARDL bound test to check the comovement of savings and investment; and to compute the savings retention ratio. Moreover, FMOLS and DOLS are further utilised in computing the savings retention ratio in Tunisia. Unlike Maminingi (1997) who observes perfect capital immobility for Tunisia, our results reveal low capital mobility, as the coefficient of savings retention ratio is not too close to unity. The marginal improved level of capital mobility in in the country is attributed to capital liberalization endeavours of the 1990s. Probably if not for these measures, the country's financing requirement would have been at a worse state. Therefore, it is recommended that further measures be undertaken by relevant authorities to initiate policies that will improve capital mobility in Tunisia as domestic savings cannot fully meet the requirement of domestic investment.

References

Adedeji, O., Thornton, J., (2006), Saving*, Investment and Capital Mobility in African Countries.* Journal of African Economies, 16(3), 393-405.

AFDB (2005), *AFDB Supports Macroeconomic Stability Consolidation and Private Sector Growth in Tunisia*. Retrieve from http://www.afdb.org/en/news-and-events/article/afdb-supports-macroeconomic-stability-consolidation-and-private-sector-growth-in-tunisia-3600/ on July 28, 2011.

Agbetsiafa, D., (2002), *Capital Mobility, Saving and Investment Link: Evidence from Sub-Saharan Africa*, Journal of African Finance and Economic Development, 5, 77-88.

Altinay, G. (2005), *Structural Breaks in Long-Term Turkish Macroeconomic Data, 1923-2003.* Applied Econometrics and International Development, 5(4), 117-130.

Ang, J., (2007), *Are Saving and Investment Cointegrated? The Case of Malaysia (1965-2003)* Applied Economics, 39, 2167-2174.

Apergis, N., Tsoumas, C., (2009), *A Survey of the Feldstein-Horioka Puzzle: What Has Been Done and Where We Stand*. Research in Economics, 63, 64-76.

Bangake, C., Eggoh, C. (2011), *The Feldstein–Horioka Puzzle in African Countries: A Panel Cointegration Analysis*. Economic Modelling, 28, 939-947.

Bayoumi, T., (1990), *Saving-Investment Immobile Government Policy or Endogenous Behaviour*. IMF Staff Papers, 37, 360-387.

Bechri, M., Naccache, S. (2003), *The Political Economy of Development Policy in Tunisia*. Unpublished Manuscript

Caporale, G.M., Panopoulou, E., Pittis, N. (2001), *The Feldstein–Horioka Puzzle Revisted: A Monte Carlo Study*. Centre for Monetary and Financial Economics Working Paper, South Bank University.

Coakley, J., Fuertes, A.M., Spagnolo, F., (2004), *Is the Feldstein-Horioka Puzzle History?* The Manchester School, 72, 569-590.

De Vita, G., and Abbott, A. (2002), *Are Saving and Investment Cointegrated? An ARDL Bounds Testing Approach*. Economics Letters, 77, 293-299.

Elliott, G., Rothenberg, T., and Stock J., (1996) *Efficient Tests for an Autoregressive Unit Root.* Econometrica, 64, 813-836.

Feldstein, M., Horioka, C. (1980), *Domestic Saving and International Capital Flows*. Economic Journal, 90, 314-29.

FIPA (2011a), *Liberalism*. Retrieve from http://www.investintunisia.tn/site/en/article.php?id_article=842 on July 28, 2011

FIPA (2011b), *Importance of FDI*. Retrieve from http://www.investintunisia.tn/site/en/article.php?id_article=836 on July 28, 2011

Ghazi, B. (2008), *Capital Mobility in North Africa*. Paper presented at the African Economic Conference, Tunis, Tunisia, November 12-14, 2008.

Granger, C.W.J., (1988), *Causality, Cointegration and Control.* Journal of Economic Dynamics and Control, 12, 551-559.

Isaksson, A. (2001), *Financial Liberalisation, Foreign Aid, and Capital Mobility: Evidence from 90 Developing Countries.* Journal of International Financial Markets, Institutions and Money, 11, 309-338.

Jansen, W.J., (2000), *International Capital Mobility: Evidence from Panel Data*. Journal of International Money and Finance, 19, 507-511.

Krol, H. (1996), *International Capital Mobility: Evidence from Panel Data*. Journal of International Money and Finance, 15, 467-474.

Lee, J., Strazicich M. (2003), *Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks*. The Review of Economics and Statistics, 85, 1082-1089.

Lumsdaine, R., Papell, D., (1997), *Multiple Trend Breaks And The Unit Root Hypothesis*. Review of Economics and Statistics, 79, 212–218.

Mamingi, N., (1997), *Savings-Investment Correlations and Capital Mobility: The Experience of Developing Countries*. Journal of Policy Modeling, 19, 605-626.

Miller, S. (1988), *Are Saving and Investment Co-Integrated?* Economics Letters, 27, 31-34.

Narayan, P. (2004), *Fiji's Tourism Demand: The ARDL Approach to Cointegration.* Tourism Economics, 10(2), 193-206.

Narayan, P. (2005a), *The Relationship between Saving and Investment for Japan.* Japan and the World Economy, 17, 293-309.

Narayan, P. (2005b), *The Saving and Investment Nexus for China: Evidence from Co-Integration Tests*. Applied Economics, 37, 1979-1990.

Nayaran, P., Narayan, S., (2010), *Testing For Capital Mobility: New Evidence from a Panel of G7 Countries.* Research in International Business and Finance, 24, 15-23.

Payne, J., (2005), *Savings-Investment Dynamics in Mexico*. Journal of Policy Modeling, 27, 525-534.

Pelagidis, T,. Mastroyiannis, T. (2003), *The Saving–Investment Correlation in Greece, 1960-1997: Implications for Capital Mobility*, Journal of Policy Modeling, 25, 609-616.

Pelgrin, F., Schich, S. (2008), *International Capital Mobility: What Do National Saving-Investment Dynamics Tell Us*? Journal of International Money and Finance, 27, 331-344.

Perron, P. (1989), *The Great Crash, the Oil Price Shock and the Unit Root Hypothesis*. Econometrica, 57, 1361-1401.

Pesaran, M.H., and Shin, Y. (1999), Autoregressive distributed lag modelling approach to cointegration analysis, in: S.Strom (Ed.), Econometrics and Economics Theory: The Ragnar Frisch Centennial Symposium, chapter 11, Cambridge University Press.

Pesaran, M.H., Pesaran, B. (1997), *Working with Microfit 4.0: Interactive Econometric Analysis*. Oxford University Press, Oxford. Pesaran, M.H., Shin, Y., Smith, R.J., (2001), *Bounds Testing Approaches to the Analysis of Level Relationships.* Journal of Applied Econometrics 16, 289-326.

Philips, P., Hansen, E., (1990), *Statistical Inference in Instrumental Variables Regression with I(1) Process*. Review of Economic Studies, 57(1), 99-125.

Rao, B., Tamazian, A., Kumar, S., (2010), *Systems GMM Estimates of the Feldstein-Horioka Puzzle for the OECD Countries and Tests for Structural Breaks*. Economic Modelling, 27, 1269-1273.

Sarno, L., Taylor, M. (1998). *Saving–Investment Correlations: Transitory Versus Permanent*. The Manchester School Supplement, 17-38.

Schmidt, M. (2003), *Savings and Investment in Australia.* Applied Economics, 35, 99-106.

Schmidt, P., Phillips, P., (1992), *LM tests for a unit root in the presence of deterministic trends* Oxford Bulletin of Economics and Statistics, 54, 257-287.

Singh, T. (2008). *Testing the Saving-Investment Correlations in India: An Evidence from Single-Equation and System Estimators.* Economic Modelling, 25, 1064-1079.

Sinha, D. (2002), *Saving–Investment Relationship for Japan and Other Asian Countries.* Japan and the World Economy, 14, 1-23.

Stock, J. H., Watson. M., (1993), *A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems*. Econometrica, 61(4), 783-820.

Wahid, A., Salahuddin, M., Noman, A., (2010), *Savings and Investment in South Asia: Evidence from Likelihood Ratio Based Panel Cointegration.* Journal of Economic Studies, 37(6), 658-666.

World Bank, (2010), World Development Indicators on CD-ROM, Washington, DC.

Zivot, E., Andrews, D., (1992), *Further Evidence of the Great Crash, the Oil-Price Shock and the Unit-Root Hypothesis.* Journal of Business and Economic Statistics, 10, 251-270.