The Temporal Relationship between Saving and Investment: Evidence from Advanced EU Countries

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Abstract

This paper examines the relationship between saving and investment in eight advanced economies of the European Union. We test for cointegration, causality and dynamic effects of shocks to saving and investment, using the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration, an unrestricted error correction model (UECM) of the ARDL, and a VAR analysis of forecast error variance decompositions. We find evidence of cointegration between saving and investment in six countries based on the UECM of the ARDL. In addition, we have evidence of long-run causality running from saving to investment in the Netherlands and the United Kingdom, a reverse causality in Denmark, Germany, and Luxembourg, bidirectional causality in Belgium, and neutrality in France and Italy.

Keywords: Feldstein-Horioka puzzle; cointegration; saving; investment; causality
JEL Classification: C22; F21; F32; F36

I. Introduction

There have been numerous empirical studies following the work of Feldstein and Horioka (1980) that found a high correlation coefficient between domestic investment and saving in OECD countries over the period 1960-74. Indeed, their result has been considered as a puzzle because in a world of increasing capital mobility and persistent current account imbalances between countries, one would expect that domestic investment will be disconnected from domestic private and public saving. Researchers have tried to ascertain whether this result still holds for different countries and periods or they have tried to explain the Feldstein-Horioka puzzle (see the survey by Apergis and Tsoumas, 2009). The main conclusions that can be drawn from these studies are twofold. First, the "saving-retention coefficient" is still high, but it has declined over time.Second, this is not absolutely puzzling because the country size, the degree of openness, common shocks to investment and saving, the exchange rate regime, and the existence of a policy target for the current account are other plausible explanations.

Within the European Union (EU), where economic and financial integration is deeper than in any other group of countries, it is more attractive for borrowers or poorer countries to borrow more from abroad and for lenders or richer countries to lend more to abroad (Abiad *et al*. 2007). In particular, the Economic and Monetary Union (EMU) process of the Maastricht Treaty and the subsequent launch of the Euro Area (EA) have widened current account imbalances between richer countries in Northern Euro area and poorer countries in Southern Euro area. In the latter, European integration has led to declining saving rates and increasing investment rates (Jaumotte and Sodsriwiboon, 2010). Blanchard and Giavazzi (2002) explain that in poorer EU countries, saving declines because economic integration makes anticipated future incomes higher and financial integration offers new instruments (*e.g.* more flexible mortgages), while investment increases because financial integration lowers the cost of borrowing and economic integration makes it easier to repay the debt (with a higher substitutability of products, the required decline in prices to boost exports is lower).

They found that the correlation coefficient between investment and saving remained relatively high in the OECD – about 0.57 over the period 1991-2001, but it has substantially declined in the EU to 0.36 and in the Euro area to 0.14. This paper examines the relationship between domestic investment and saving in richer EU countries in the attempt to shed more light on some pertinent empirical questions or issues. For example, does the symmetric pattern observed in poorer EU countries extend to the richer EU countries? In other words, does investment decline and does saving increase in richer EU countries? Alternatively, do investment and saving follow the same trend? If so, does saving cause investment or vice-versa? The question of causal direction is particularly relevant in the EU countries with respect to the objective of "prudent" fiscal policies. Today, the conventional wisdom seems to be that government deficits are not desirable because of their adverse macroeconomic effects. Behind this view of government deficits is the belief that saving causes investment, and since government deficits represent negative government saving, this reduces the amount of national saving available for investment and thereby impedes economic growth.

In this respect, the analysis of the causality between saving and investment can offer a useful guideline to choose the most efficient strategy to achieve budget deficit reductions. For example, if causality runs from saving to investment, then the control of the deficits which could be achieved by cutting government spending rather than by raising tax burdens is *sine qua non*. This is a more prudent policy strategy because raising taxes tend to lower disposable income and household saving, thereby negating the benefits of lower deficits on national saving. Alternatively, if investment causes saving, then the merits of fiscal policies designed to cut government spending and reduce the budget deficit are questionable. In other words, in a case where causality runs from investment to saving, the emphasis should shift away from saving-promoting policies and placed on increasing investment spending and removing other impediments to growth.This paper contributes to the literature by providing additional empirical evidence from eight EU countries on the existence of a long-run cointegration and dynamic causal relationship between saving and investment.

To accomplish this, we perform Granger causality tests including cointegration relationships using the Autoregressive Distributed Lag (ARDL) bounds test approach (Pesaran et al, 2001). Given that cointegration does not indicate the direction of Granger-causality, we estimate an unrestricted error correction representation of the ARDL to uncover the direction of Granger-causality between saving and investment. In addition, we use the order invariant generalized forecast error variance decompositions procedure to provide an indication of the relative contributions of each variable to the system beyond the sample period [see Pesaran and Shin (1998)].The rest of the paper is organized as follows. Section II reviews the empirical literature on international economics regarding the causal link between saving and investment. Section III presents the data and the econometric methodology. Section IV explains the empirical analysis and the results. Section V concludes.

II. Literature Review

We do not intend to provide a review of the vast literature about the Feldstein-Horioka puzzle because of Apergis and Tsoumas' (2009) extensive survey. Instead, we review the empirical works that are closest to our study with regard to the question of causality, the choice of EU countries in the sample, and cointegration methodology. Empirical evidence on the causal relationship between saving and investment is mixed. For example, Arginon and Roldan (1994) examined the saving-investment relationship in EU countries over the period 1960-1988, and found unidirectional causality running from saving to investment. Apergis and Tsoulfidis (1997) applied the ARDL bounds testing approach to cointegration to 14 EU countries. They found saving and investment to be cointegrated, and that saving Granger causes investment.

Tsoukis and Alyousha (2002) focused on the long-run Granger causality between the gross saving/GDP ratio and the gross investment/GDP ratio in seven industrialized economies: Australia, Canada, Germany, Japan, Netherlands, the United Kingdom, and the United States since 1945. For the whole sample period, they found saving and investment to be cointegrated only in Australia and the UK, and the test for Granger causality indicated causality running from saving to investment in both countries. For the post-1980 period, they found cointegration between the two variables only for Germany, and with evidence of causality running from investment to saving.Schmidt (2003) examined the endogeneity of the U.S. saving and investment rates over the quarterly period 1946Q1 to 1998Q4 using Johansen/Juselius maximum likelihood and variance decompositions methodologies, and they found the U.S. domestic saving and investment rates to be cointegrated. However, results of the variance decompositions indicated that other factors, rather than the innovation in saving, produced the vast majority of investment variance.

Alexious (2004) used pair wise Granger causality tests and variance decomposition functions to analyze the temporal relationship between personal saving and private saving and net investment in five EU countries: France, the UK, Belgium, Germany, and the Netherlands over the period 1972 to 1998. Results of the Granger causality analysis revealed no evidence of Granger causality between personal saving and net investment, but there is strong evidence of causality running from net investment to private saving in all five countries. In a recent study, Kollias *et al*. (2008) used the ARDL bounds testing procedure and panel regressions to analyze the saving-investment nexus for 15 EU countries. They found cointegration between saving and investment in Austria, Germany, Greece, Italy, Luxembourg, Spain, and the United Kingdom; no cointegration in Denmark, Finland, France, Ireland, the Netherlands, and Sweden; and inconclusive results in Belgium and Portugal. They did not test for the causal direction for each country but noted that it was hard to explain the cointegration results since there appeared to be no common features shared by the countries in each group in terms of country size, level of development, or economic and capital market structure. However, they found the estimated the coefficient of the saving-investment correlation for the EU15 to be very low – about 0.15.

III. Data and Econometric Methodology

In this study, we analyze eight EU countries, namely Belgium, Denmark, France, Germany, Italy, Luxembourg, the Netherlands, and the United Kingdom, over the period 1970 to 2008. These countries are among the richest countries in the EU and form a more homogeneous group than the entire EU. For our empirical analysis, we obtain data on gross domestic product (GDP), gross domestic saving, and gross domestic investment. Using the OECD Annual National Accounts, we calculate gross domestic saving by deducting private consumption and government consumption from GDP. We compute the gross domestic investment as the sum of gross fixed capital formation and change in capital stocks, and transform all data series into logarithm form.

Figure 1 plots the ratios of domestic saving and domestic investment to GDP in logarithm scale for each country. As can be seen, saving and investment rates seem to move closely together: they declined from 1970 to the early 1980s and (early 1990s in Italy), then they have followed an upward trend, with a few exceptions (the saving rate decreased in Italy and the UK, the investment rate remained relatively stable in Luxembourg but declined in Germany). The launch of the Single Market program and the EMU process embodied in the Maastricht Treaty are among the factors that explain these trends. In other words, economic integration boosts growth of GDP and consequently investment rates, while the monetary integration imposes a reduction of public deficits, and hence higher public saving rates.

Insert figure (1) about here

Since the early 1990s, almost all countries in the sample (except France, Italy, and the UK) experienced current account surpluses, with the increase in investment rates being much stronger than that of saving rates. Growing current account surpluses appeared in the early years of the Euro area in Germany, Luxembourg, and the Netherlands; and these are the only rich EU countries in our sample where EMU goes along with a higher domestic saving rate and a lower (or stable) domestic investment rate.[1] In France and Italy, higher investment rates and lower saving rates have contributed to current account deficits since 1999. This pattern of current account deficits or declining current account surpluses due to saving-investment imbalances was also observed in Denmark, even though Denmark is a country that does not participate in the Euro area. Finally, both saving and investment have risen lately in Belgium while they have fallen in the UK.

ARDL bounds test approach to cointegration

We analyze the long-run cointegration and dynamic interactions between saving and investment using the ARDL bounds test technique [see Pesaran, *et al*. (2001)].[2] The unrestricted error-correction model (UECM) representation of the ARDL linking saving and investment is as follows:

[1] The German saving rate finances German foreign direct investment.

[2] Many empirical studies have highlighted the advantages of the ARDL bounds test technique. For example, the bounds test does not impose restrictive assumptions that all variables be integrated of the same order in contrast to other conventional cointegration techniques of Engel-Granger (1987), Johansen (1988), and Johansen and Juselius (1990). In other words, with the bounds test, the order of integration of the variables is no more a paramount issue, potentially biased pre-tests for unit roots can be by-passed, and concentrate on the more fundamental question of cointegration and causality. In addition, the ARDL model treats all the variables as endogenous and performs parameter estimates for both the long run and short-run simultaneously thus eliminating the problems associated with omitted variables and autocorrelation. The ability of the ARDL to analyze the long-run relationship between the variables jointly with the short-term adjustment towards the long-

$$\Delta \ln S_t = \alpha_{0S} + \sum_{j=1}^{n} b_{jS} \Delta \ln S_{t-j} + \sum_{j=0}^{n} c_{jS} \Delta \ln I_{t-j} + \delta_{1S} \ln S_{t-1} + \delta_{2S} \ln I_{t-1} + \beta D_t + \varepsilon_{1t} \qquad (1)$$

$$\Delta \ln I_t = \alpha_{0I} + \sum_{j=1}^{n} b_{jI} \Delta \ln I_{t-j} + \sum_{j=0}^{n} c_{jI} \Delta \ln S_{t-j} + \delta_{1I} \ln I_{t-1} + \delta_{2I} \ln S_{t-1} + \beta D_t + \varepsilon_{2t} \qquad (2)$$

where Δ is the first difference operator; lnS_t and lnI_t are the natural logarithm of saving rate and investment rate respectively; D_t is a dummy variable capturing the European economic and financial integration process (D =1 for t = 1992 and 0 elsewhere), n is the optimal lag length of the UECM. The parameters $\delta_i, i = 1,2,$ serve as the long run multiplies, while the b_i, c_i, parameters function as the short-run dynamic coefficients of the ARDL model. Finally, $\varepsilon_{i,t} (i = 1,2)$ is a white noise error term.

Following the lead of Pesaran *et al.* (2001), we test for cointegration relationship among the variables in equations (1) and (2) and excluding the lagged level variables, based on the Wald or F-test statistic. If a long-run relationship exists between the variables, the computed F-statistic will indicate the variable for normalization. For example, with lnS_t as the dependent variable in equation (1), we test the null hypothesis ($H_N = \delta_{1S} = \delta_{2S} = 0$) of no cointegration among the variables against the alternative hypothesis ($H_A \neq \delta_{1S} \neq \delta_{2S} \neq 0$). Both hypotheses are subject to the standard F-test, and we denote the test for normalization on the saving rate by the function $F_S(S|I)$. Similarly, with lnI_t as the dependent variable in equation (2), we test the null hypothesis of no cointegration ($H_N = \delta_{1I} = \delta_{2I} = 0$) against the alternative hypothesis ($H_A \neq \delta_{1I} \neq \delta_{2I} \neq 0$), and denote the test for normalization as $F_I(I|S)$.

The asymptotic distribution of the F-statistic is non-standard under the null hypothesis of no cointegration relationship between the variables, irrespective of whether the underlying explanatory variables are difference stationary [I(0)] or level non-stationary [I(1)] or mutually integrated. Pesaran *et al.* (2001, pp. 300-302) tabulated the appropriate bounds critical values with which to compare the calculated F-statistics. For some significance level, α, if the calculated F-statistic falls outside the critical bound, a conclusive inference can be made regarding cointegration without the need to know the order of integration of the series. If the calculated F-statistic is higher (lower) than the upper (lower) bound critical value then the null hypothesis of no cointegration is rejected (accepted). In the case where the F-statistic falls in between the upper and lower bound critical values, a conclusive inference cannot be made. In such an inconclusive case, Pesaran *et al.* (2001) caution that for the ARDL bounds test to be valid, it is important to ensure that there is no serial correlation. To ensure the absence of first or higher order serial correlation, we select the optimal number of lags in the ARDL using the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC).

Granger Causality

From the ARDL bounds test procedure, evidence of a cointegration relationship among the variables suggests that there must be Granger causality in at least one direction between them to provide the necessary dynamics. However, while cointegration may indicate the presence or absence of Granger-causality it does not indicate the direction of causality between the variables. The direction of temporal Granger-causality can be determined through error correction representation of the ARDL, and this can be expressed as:

$$\Delta \ln S_t = \alpha_{0S} + \sum_{j=1}^{n} b_{jS} \Delta \ln S_{t-j} + \sum_{j=0}^{n} c_{jS} \Delta \ln I_{t-j} + \beta_s D_t + \varphi EC_{S,t-1} \qquad (3)$$

$$\Delta \ln I_t = \alpha_{0I} + \sum_{j=1}^{n} b_{jI} \Delta \ln I_{t-j} + \sum_{j=0}^{n} c_{jI} \Delta \ln S_{t-j} + \beta_i D_t + \varphi EC_{I,t-1} \qquad (4)$$

where b_j and c_j are the short-run dynamic coefficients of the model's convergence to equilibrium, φ is the speed of adjustment parameter, and EC_{t-1} is the one-period lagged error correction term – obtained as the fitted residuals from the cointegration analysis of equation (1) and (2). The coefficient of the EC_{t-1} term indicates the speed of adjustment to restore equilibrium in the dynamic model following a shock to the system. According to Banerjee *et al.* (1998), a highly significant error correction term confirms the existence of a long-term cointegration relationship.

Dynamic Simulation: Variance Decomposition Functions

run equilibrium permits measurement of the speed at which this process of convergence to a new long-run equilibrium value takes place following a shock to the system. According to Mah (2000) and Narayan (2005), the ARDL procedure is more robust and performs more efficiently than the conventional cointegration techniques for studies that have a small sample size such as our study with 39 observations.

Many empirical studies have pointed out the limitations inherent in Granger causality analysis, particularly for policy purposes. First, other than showing the causal direction between variables, causality analysis does not provide information on the time paths of the variables and their response to shocks from other variables in the system. Second, causality results can be interpreted as within-sample tests that may provide little information on the dynamic properties of the system and the nature of the causal effects [see Masih and Masih (1995)]. In other words, it is not possible to determine whether the reported causal relationship is positive or negative because multivariate vector auto-regression (VAR) coefficients are difficult to interpret. To overcome these drawbacks, we conducted forecast error variance decompositions in the context of a VAR analysis to shed more light on the dynamic relations between the two variables.Variance decomposition is an innovation accounting method that divides the *h*-step ahead forecast error variations of shocks (innovations) to a variable into proportions attributable to its own innovations and to innovations in other variables in the system. Specifically, the procedure can be used to approximate the contribution of each variable to the variability of the whole system beyond the sample period. In order to quantify how much feedback exists from one variable to another, we utilize the order-invariant generalized forecast error-variance decomposition technique (Pesaran and Smith, 1998).

IV. Empirical Results

Cointegration test results

Since the underlying assumption of the ARDL bounds test procedure is for the variables to be I(1) or I(0), and in order to avoid spurious results, we begin our empirical analysis by performing unit root tests to ensure that the series are not integrated of order two or higher. We test for unit roots test using the procedure developed by Zivot and Andrews (1992) because it allows breaks in the deterministic terms to test for trend break stationarity of the variables. The major advantage of the Zivot-Andrews procedure is that the timing of the structural break is determined endogenously rather than on *a priori* observation of the data which might introduce pre-testing problems. The Zivot-Andrews unit root test results indicate that the variables are level non-stationary, I(1), and difference stationary, I(0).[3] Given these results, we proceed to test for cointegration between the variables using the ARDL bounds test approach.[4]

Table 1 reports the results of the bounds test *F*-statistic. Both the $F_S(S|I)$ and $F_I(I|S)$ models give similar conclusions.[5] In the case of Belgium and Denmark, the computed *F*-statistic is higher than the upper bound critical values of 4.14 at the 90% level and 4.85 at the 95% level. Accordingly, we reject the null hypothesis of no cointegration between the two variables and conclude that there is a long-run relationship between them. Conversely, in the case of France and Italy, the computed *F*-statistic is less than the lower bound critical values, which indicate that we cannot reject the null hypothesis of no cointegration. This suggests that there is no long-run relationship between domestic saving and investment in these countries over the period of estimation. Finally, the results for Germany, Luxembourg, Netherlands, and the United Kingdom are inconclusive because the calculated *F*-statistic fall in-between the upper and lower bounds critical values. For these inconclusive cases, we follow Kremers *et al.* (1992) suggestion that the error correction term is a useful way to establish cointegration; therefore, we continue with the ARDL procedure to test for the short-run causal relations by means of the *F*-statistics on the explanatory variables of the unrestricted error correction version of the ARDL.[6]

Insert table (1) about here

Granger causality tests

Table 2 reports the results of the long-run and short-run causality based on the error correction representation of the ARDL. The *F*-statistics on the explanatory ("exogenous") variables depict the significance of the short-run causal effects, while the significance or non-significance of the *t*-statistics on the coefficients of the lagged error correction terms (EC_{t-1}) indicates whether there is a long-run relationship.

[3] Results of the Zivot-Andrews unit root tests are available upon request.

[4] The AIC and SBC suggest that one is the optimal lag length for all the countries in our sample.

[5] As we recall, saving is the dependent variable in the $F_S(S|I)$ model while investment is the dependent variable in the $F_I(I|S)$ model.

[6] Given that the bounds test failed to find evidence of cointegration relationships for France and Italy, their Granger causality VAR equations are estimated without an error-correction term. The equations for the six other countries were augmented with the lagged error correction term.

Beginning with the long-run results, the coefficient on the lagged error correction term is negative and statistically significant in both the saving [$F_S(S|I)$] and investment [$F_I(I|S)$] models for Belgium, implying that a long-run bidirectional Granger-causality between saving and investment exists. This result reinforces the earlier finding by the bounds test of a long-run relationship between both variables. With respect to the $F_S(S|I)$ model, the error correction coefficient has the expected negative sign and is highly significant in Denmark, Germany, and Luxembourg. This implies that in the long-run, investment Granger causes saving in these economies. It should be noted that among those countries where investment causes saving, the degree of financial integration as measured by the ratio of net foreign assets to GDP is relatively high (Luxembourg, Belgium, and Denmark).[7]

Insert table (2) about here

With respect to the $F_I(I|S)$ model, the expected negative sign on the lagged error-correction term is statistically significant in the Netherlands and the United Kingdom. This indicates long-run unidirectional Granger-causality running from saving to investment in these countries. In our sample, these two countries have the highest share of financial activity in GDP, as measured by ratios such as private credit/GDP, financial system deposits/GDP, or stock market capitalization/GDP.[8] Moreover, the statistically significant coefficient on the error term suggests that, over time, whenever there is a deviation from the equilibrium relationship, it is mainly changes in investment that adjust to clear the disequilibrium. In other words, investment endures most of short-run adjustments to long-run equilibrium.

Finally, for France and Italy, the results are consistent with the bounds test for cointegration reported in Table 1, that is, there is no causal relationship in the Granger sense between saving and investment in the long-run. These two countries share some similar features and are different from the other six countries (except the UK). First, during the European Monetary System (EMS) era, from 1979 to 1998, they both found it hard to make the fixed exchange rate objective consistent with their internal economic objectives. High interest rates to defend the fixed parity with the deutschemark depressed domestic investment and employment. Second, current account surpluses have recently disappeared because, unlike Germany and others, domestic saving has declined while domestic investment has risen. Being the least rich countries in our sample, those trends are similar to those countries in Southern Euro area. It is important to note that public deficits are, on average, higher in France and Italy than in the other EA countries of our sample.

As explained earlier, the coefficients of the lagged error correction terms are indicative of the speed of adjustment to long-run equilibrium following perturbations to the system. For example, in the $F_S(S|I)$ model, domestic saving in Belgium is able to get back to the level of saving predicted by its cointegration relationship with investment within one year, but the adjustment process takes about two years in Luxembourg while it takes about three years in Germany. With respect to the short-run results of the ARDL-based Granger causality, the F-statistic on the "exogenous" variables suggest that at the five percent level or better, there is unidirectional Granger-causality running from saving to investment in the United Kingdom. There exists bi-directional Granger-causality between investment and saving in Belgium, Denmark, France, Germany, and Italy. For Luxembourg and the Netherlands, there is no evidence of short-run Granger causality.

Variance decompositions of investment and saving

In order to ascertain the dynamic impacts of the Granger causality relations on the behavior of the two series beyond the sample period, we conduct variance decompositions in the context of a VAR analysis. The variance decomposition functions indicate the proportion of the forecast-error variance of a variable that is explained by its own innovations and the proportion explained by innovations in other variables after some periods. Results are presented in Table 3. Over a 10-year horizon, the relative contribution of innovations in investment to saving forecast-error variance dominates the relative contribution of innovations in saving to investment forecast-error variance in four countries: Belgium, Denmark, Germany, and Luxembourg. This is consistent with our earlier findings derived from cointegration tests (Belgium and Denmark) and Granger causality tests. In Belgium and Luxembourg, most of the variance of domestic saving is explained by shock to domestic investment (almost 79 % and 61 % respectively at a 10-period horizon).

[7] Net capital income from abroad may be partly saved in the domestic economy.
[8] Such indicators are available in the World Bank Financial Structure Database.

In Denmark and Germany, investment also causes saving but to a lesser extent (21 % and 34 % respectively).[9]

Insert table (3) about here

On the contrary, in three other countries, namely France, Italy, and the United Kingdom, the share of investment forecast-error variance explained by innovations in saving is larger than the share of saving forecast-error variance explained by innovations in investment, meaning that saving causes investment. For these countries, the ARDL bounds tests did not give evidence of cointegration (inconclusive for the UK). This variance decomposition result is consistent with the Granger causality result (United Kingdom). Finally, in the Netherlands, domestic investment and saving seem to be independent variables. Their respective variances are hardly explained by shocks to investment or saving. For this country, there was mixed evidence of cointegration.

V. Conclusion

This paper has provided some new empirical evidence on the patterns of the long-run and the short-run dynamic causal relationships between domestic saving and investment in eight advanced EU countries based on the ARDL bounds test approach to cointegration and forecast-error variance decomposition analysis in a vector-autoregressive framework. In the first step, we established evidence of a cointegration relationship between saving and investment in six of the eight countries.

Second, there is strong evidence of long-run causality running from investment to saving in Denmark, Germany, and Luxembourg; unidirectional causality from saving to investment in the Netherlands and the United Kingdom; bidirectional causality in Belgium; and neutrality in France and Italy. In terms of fiscal consolidation strategies and growth-promoting policies, the three countries where investment Granger causes saving would be better served if they avoid reducing public expenditures that have positive effects on private investment, while the two countries where saving Granger causes investment should avoid raising taxes that would have a negative effect on private saving, which ultimately would have adverse impact on aggregate saving.

Third, we used the dynamic forecast-error variance decompositions to gauge the relative strength of the Granger causality between the variables beyond the sample period. The results obtained from the dynamic forecast error-variance decompositions lend further support to the different causal patterns between saving and investment in the EU countries.

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FIGURE 1

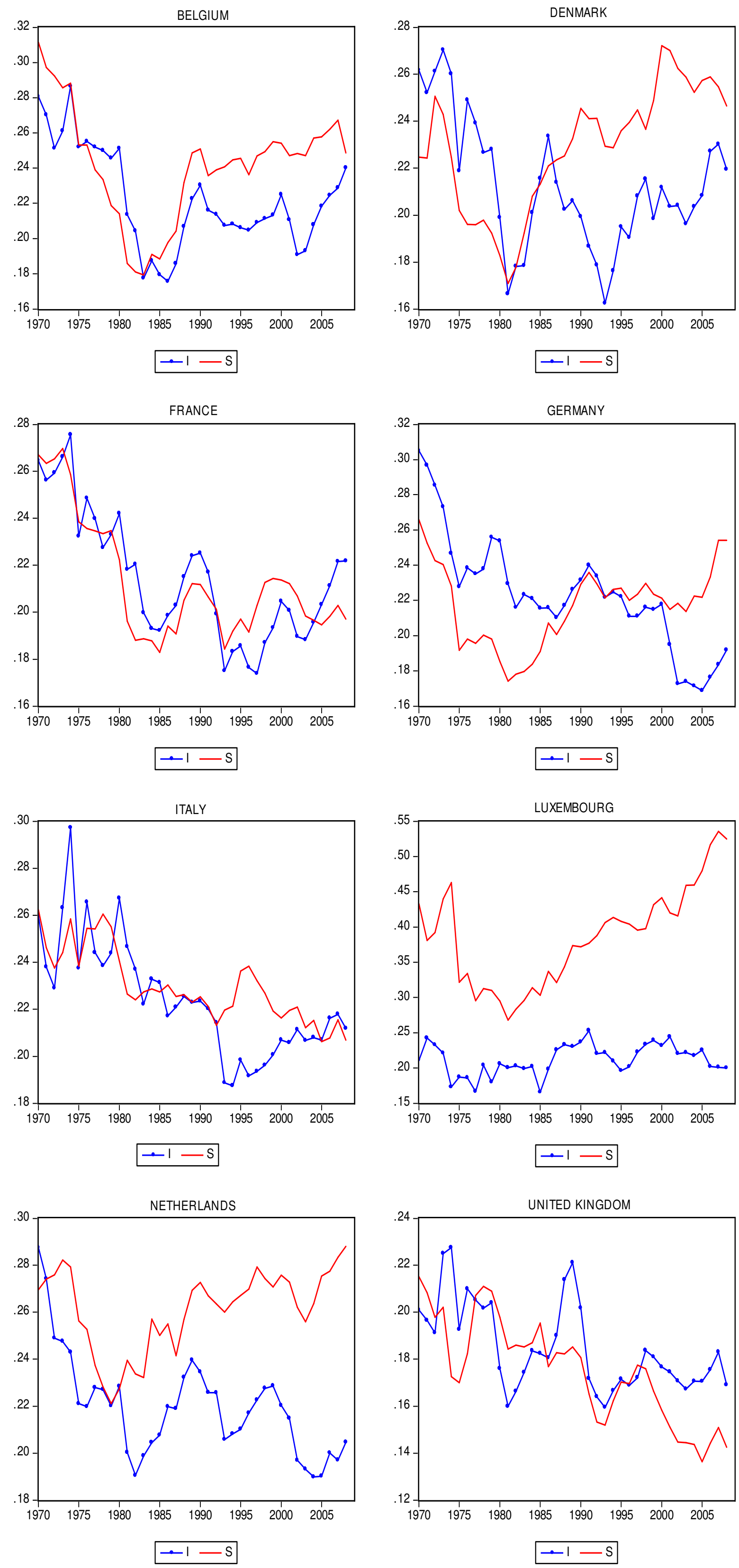
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Table 1: Results of ARDL Bounds *F*-test for Cointegration

	Equation *F*(*I*|*S*)		**Equation *F*(*S*|*I*)**	
Country	Calculated *F*-statistic	Cointegration ?	Calculated *F*-statistic	Cointegration ?
Belgium	6.005	Yes	9.871	Yes
Denmark	5.921	Yes	6.025	Yes
France	1.259	No	2.466	No
Germany	4.109	Inconclusive	3.902	Inconclusive
Italy	2.115	No	1.458	No
Luxembourg	3.661	Inconclusive	4.131	Inconclusive
Netherlands	3.901	Inconclusive	3.391	Inconclusive
United Kingdom	4.051	Inconclusive	3.475	Inconclusive

***Note**: The relevant critical value bounds are obtained from Pesaran et al. (2001:300-301),Table CI(iii), Case III: Unrestricted intercept and no trend, where the critical values in the case of two explanatory variables are 3.17 - 4.14 and 3.79 -4.85 at the 90% and 95% level of significance, respectively.*

Table 2: Results of the Short-run and Long run ARDL-based Granger Causality Tests

	Dependent Variable: $\Delta \ln I_t$ “Exogenous” variable: $\Delta \ln S_t$		**Dependent Variable**: $\Delta \ln S_t$ “Exogenous” variable: $\Delta \ln I_t$	
Country	*F*-statistic [probability]	EC_{t-1} [*t*-statistic]	*F*-statistic [probability]	EC_{t-1} [*t*-statistic]
Belgium	12.015* [0.000]	-0.764* [-2.149]	24.955* [0.000]	-0.717* [-4.401]
Denmark	2.675* [0.042]	-0.046 [-1.370]	6.791* [0.002]	-0.715* [-2.952]
France	7.349* [0.007]	----	7.340* [0.007]	----
Germany	3.711* [0.011]	-0.392 [0.777]	9.809* [0.001]	-0.463* [-3.758]
Italy	3.652* [0.022]	----	3.410* [0.029]	----
Luxembourg	1.094 [0.367]	-0.155 [-0.426]	0.592 [0.625]	-0.597* [-2.005]
The Netherlands	1.655 [0.477]	-0.861* [-2.022]	2.652 [0.667]	-0.985 [-1.094]
United Kingdom	4.498* [0.003]	-0.511* [-2.643]	1.535 [0.211]	-0.649 [-0.964]

Note: The *F*-statistic for the short-run and long-run causality tests follow the standard distribution with the usual critical values. * denotes significance at the 5% level.

Table 3: Generalized Forecast Error Variance Decompositions of Investment and Saving at Various Horizons

	% of Forecast Variance of Investment explained by shocks to		% of Forecast Variance of Saving explained by shocks to	
Country / Horizon	Saving	Investment	Saving	Investment
Belgium				
1	37.05	62.95	100.00	0.00
2	42.92	57.08	91.66	8.34
3	47,72	52.28	72.61	27.39
4	51.24	48.76	53.44	46.56
5	52.81	47.19	39.45	60.55
6	52.22	47.78	30.71	69.29
7	49.94	50.06	25.69	74.31
8	46.80	53.20	23.02	76.98
9	43.63	56.37	21.78	78.22
10	40.93	59.07	21.40	78.60
Denmark				
1	0.00	100.00	82.12	17.88
2	1.85	98.15	87.22	12.77
3	3.32	96.68	91.12	8.88
4	4.13	95.87	92.69	7.31
5	4.47	95.53	91.97	8.02
6	4.56	95.44	89.69	10.31
7	4.56	95.44	86.76	13.24
8	4.55	95.45	83.87	16.13
9	4.54	95.46	81.35	18.65
10	4.55	95.45	79.31	20.69
France				
1	32.93	67.07	100.00	0.00
2	46.08	53.92	98.31	1.69
3	53.94	46.06	96.14	3.86
4	59.05	40.95	93.84	6.16
5	62.49	37.53	91.60	8.40
6	64.72	35.28	89.54	10.46
7	66.16	33.84	87.73	12.27
8	67.02	32.98	86.19	13.80
9	67.49	32.50	84.94	15.06
10	67.71	32.29	83.95	16.05
Germany				
1	0.00	100.00	83.65	16.35
2	0.13	99.87	80.90	19.10
3	0.39	99.61	83.42	16.58
4	0.78	99.22	85.59	14.41
5	1.26	98.74	85.10	14.90
6	1.80	98.20	82.17	17.83
7	2.36	97.64	78.03	21.97
8	2.92	97.08	73.71	26.29
9	3.45	96.55	69.76	30.24
10	3.96	96.04	66.34	33.66

Table 3 (contd.)

Country / Horizon	% of Forecast Variance of Investment explained by shocks to		% of Forecast Variance of Saving explained by shocks to	
	Saving	Investment	Saving	Investment
Italy				
1	20.76	79.24	100.00	0.00
2	17.83	82.17	96.62	3.38
3	21.46	78.54	96.92	3.08
4	26.67	73.33	97.30	2.70
5	32.39	67.61	97.52	2.48
6	37.20	62.80	97.54	2.46
7	40.94	59.06	97.47	2.53
8	43.74	56.26	97.38	2.62
9	45.82	54.18	97.32	2.68
10	47.38	52.62	97.27	2.73
Luxembourg				
1	0.00	100.00	99.43	0.57
2	2.75	97.75	90.70	9.30
3	2.67	97.33	76.38	23.62
4	2.77	97.23	64.85	35,15
5	2.77	97.23	56.29	43.71
6	2.77	97.23	50.22	49.78
7	2.76	97.24	45.90	54.10
8	2.76	97.24	42.80	57.20
9	2.75	97.25	40.55	59.45
10	2.75	97.25	38.88	61.11
Netherlands				
1	3.96	96.04	100.00	0.00
2	2.42	97.58	99.80	0.20
3	2.06	97.94	99.82	0.18
4	2.10	97.90	99.26	0.74
5	2.32	97.68	98.18	1.82
6	2.63	97.37	96.92	3.08
7	2.95	97.05	95.68	4.32
8	3.25	96.75	94.58	5.42
9	3.50	96.50	93.67	6.33
10	3.71	96.29	92.92	7.08
United Kingdom				
1	18.32	81.68	100.00	0.00
2	27.68	72.32	99.69	0.31
3	34.03	65.96	99.24	0.76
4	37.49	62.51	98.87	1.13
5	39.06	90.94	98.62	1.38
6	39.74	60.26	98.48	1.52
7	40.10	59.90	98.41	1.59
8	40.34	59.66	98.36	1.64
9	40.51	59.49	98.33	1.67
10	40.64	59.36	98.32	1.68