The Macrotheme Review
A multidisciplinary journal of global macro trends

SAVING-INVESTMENT RELATION: EVIDENCE FROM EURO AREA COUNTRIES[1]

Pelin Varol İyidoğan
Hacettepe University, Department of Public Finance, Ankara, Turkey

Abstract

The aim of this study is to examine domestic saving-investment interaction, namely Feldstein-Horioka relation for Euro area countries by using bounds testing developed by Pesaran et al. (2001), and Granger-causality analysis. The evidence supporting the cointegration relation and long-run causality from domestic saving to national investment is found for Cyprus, Germany, Italy, Luxembourg, Malta, Netherlands, Portugal and Spain. However, the low values of estimated β-coefficients imply the high capital mobility for these group of countries. Beside the high level of capital mobility, this result can also be attributed to the current account dynamics or the size of the countries in question.

Keywords: saving-investment; bounds testing; causality; Feldstein-Horioka; Euro area

1. Introduction

The recent developments in global economy have aroused interest on the sources of current account imbalances. In the regarding literature, the internal balance of an economy has been treated as an endogenous underlying factor since the current account balance is defined via the difference between national saving and investment. In this respect, Bussiere and Fratzscher (2005) stress on the gradual increases in productivity that triggers high investment expenditures, on the other hand Roubini (2006) underlines the saving gap in the US economy, as the main determinants of current account deficits. Likewise, Coakley et al. (1996), Blanchard and Giavazzi (2002) Papadogonas and Stournaras (2006), Kollias et al. (2008) explain the role of saving-investment relation in reflecting the current account movements.

The relationship between national saving and domestic investment, that seems crucial in explaining the current account dynamics, is simply connected with the international capital mobility due to the study of Feldstein and Horioka (1980). The study examines the saving-investment association in 16 OECD countries over the period of 1960-1974 via the cross-section regression of

[1] This paper is presented at Macrotheme International Conference on 23-24th April 2016. The attendance for the conference is financed by Hacettepe University Scientific Research Projects Coordination Department.

$$\left(\frac{I}{Y}\right)_t = \alpha + \beta\left(\frac{S}{Y}\right)_t + u_t \qquad (1.1)$$

where $\left(\frac{I}{Y}\right)_t$ and $\left(\frac{S}{Y}\right)_t$ indicate the ratio of gross domestic investment and saving to gross domestic product respectively, β is the Feldstein-Horioka (henceforth F-H) coefficient implying the degree of international capital mobility and u_t are errors. The estimation results yield the F-H coefficient close to 1 indicating the dependency of domestic investment on national saving that contradicts with the sample of relatively open economies. Hence, the evidence of low capital mobility among the developed countries has been regarded as a puzzle. The issue of F-H puzzle has led to a great and expanding literature[2] investigating the saving-investment relation that ends up with various results associated with the choice of different methodologies and samples (Sinha and Sinha, 1998; Jansen, 2000; Kim, 2001; Ho, 2002; Blanchard and Giavazzi, 2002; De Vita and Abbott, 2002; Pelagidis and Mastroyiannis, 2003; Özmen and Parmaksız, 2003; Payne, 2005; Papadogonas and Stournaras, 2006; Christopoulos, 2007; Kollias et al., 2008; Murthy, 2009; Brahmasrene and Jiranyakul, 2009; Esso and Keho, 2010).

Contrary to the arguments regarding F-H relationship, Dooley et al. (1987), Coakley et al. (1998), Apergis and Tsoumas (2009) develop critical perspectives generating plausible solutions for the saving-investment puzzle. Among these, country-size effect causing an upward bias on the estimated β-coefficients attributes the F-H puzzle to the considerable influence of large economies on the world interest rate and prices. That is, increasing interest rates due to low savings would spark off decline in domestic investments. Likewise, Harberger (1980) points out the country-size effect that generates high β-coefficient as a result of financial capability of large economies to finance the domestic investment through the domestic saving. Tobin (1983), Murphy (1984), Baxter and Crucini (1993) address the effect of country-size effect on F-H relation empirically. Moreover, the empirical criticisms on F-H results ground on estimation methods and models, omitted variables bias and variables' measurement. Alternative interpretations of Tesar (1991) and Coakley et al. (1996) refer to current account solvency rather than the degree of capital mobility that causes the F-H puzzle. This approach suggests that the solvency constraint implying the stationarity, in other words sustainability, of the current account balance would lead to the saving-investment cointegration relation regardless of the degree of capital mobility. Furthermore, Summers (1986) and Bayoumi (1990) point to the current account targeting as a government objective that is likely to cause high value of estimated β-coefficient.

This study contributes to the related literature by examining the saving-investment association for 14 eurozone countries in the framework of F-H relation in (1.1). Apart from the estimation and evaluation of β coefficient, the analysis involves the bounds testing of cointegration and causality analysis from domestic saving to investment. The Granger causality is examined by error correction mechanisms that are derived through autoregressive distributed lag (ARDL) models. The remainder of the paper is organized as follow. Section 2 mentions the methodology. Section 3 describes data and presents empirical results. Section 4 is concluded.

[2] For a detail review of literature, see Apergis and Tsoumas (2009).

2. Methodology

The study analyzes the saving-investment relation by employing ARDL bounds testing procedure developed by Pesaran et al. (2001). Contrary to the conventional methods, this approach to cointegration examines the long-run relation irrespective of whether the underlying variables are I(0), I(1) or mutually cointegrated. The methodology is based on the error correction representations of the ARDL model for (1.1)

$$\Delta i_t = \alpha_0 + \alpha_1 t + \beta_1 i_{t-1} + \beta_2 s_{t-1} + \sum_{i=1}^{p} \delta_i \Delta i_{t-i} + \sum_{i=1}^{p} \phi_i \Delta s_{t-i} + u_t \quad (2.1)$$

$$\Delta i_t = \alpha_0 + \beta_1 i_{t-1} + \beta_2 s_{t-1} + \sum_{i=1}^{p} \delta_i \Delta i_{t-i} + \sum_{i=1}^{p} \phi_i \Delta s_{t-i} + u_t \quad (2.2)$$

where α_0 is the drift component, t is the deterministic trend, p is the order of the VAR system, Δ is the first-difference operator and u_t are white noise errors. The cointegration relation is explored by means of F- statistics testing the joint significance of level variables, and in some cases the trend variable, in (2.1) and (2.2). Moreover, a bounds procedure is also provided for the t-test of Banerjee et al. (1998) under the null hypothesis of $H_0 : \beta_1 = 0$ against the alternative of cointegration. Since the asymptotic distribution of the statistics are non-standard, two sets of asymptotic critical values are used for the cases in which all variables are purely I(0), and on the other I(1). The computed statistic exceeding the upper bound provides evidence of the presence of long-run relationship. An F- or t- statistic below the lower bound indicates that the null hypothesis of no cointegration is accepted. If the computed statistic falls between the critical values, no conclusive inference can be drawn.

The evidence of cointegration requires proceeding to the following step where the Granger-causality analysis is employed. The causality analysis depends on error correction model (ECM) in (2.3) that involves error correction term, e_1, derived from ARDL (p,q) model in (2.4).

$$\Delta i_t = \alpha_1 + \sum_{i=1}^{m} \delta_i \Delta i_{t-i} + \sum_{j=0}^{m} \delta_j \Delta s_{t-j} + \beta_1 e_{1t-1} + u_{1t} \quad (2.3)$$

$$i_t = \omega_1 + \sum_{i=1}^{p} \phi_i i_{t-i} + \sum_{j=0}^{q} \phi_j s_{t-j} + e_{1t} \quad (2.4)$$

Since the scope of the study is to examine F-H relation, the causality analysis solely focuses on the causal effect of domestic saving on domestic investment. The significance and negative sign of the error correction term shows the existence of long-run causal relation. On the other hand, the rejection of the null of $H_0 : \delta_j = 0$ provides evidence of short-run or weak causality.

3. Data and empirical results

The saving-investment relation for euro area countries[3], namely Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal and

[3] Estonia, Slovakia and Slovenia are not included to the analysis due to the absence of data for the period before 1985.

Spain is examined by series, the ratio of gross domestic capital formation to GDP (I/GDP) and the ratio of gross domestic saving to GDP (S/GDP). The data is obtained from World Development Indicators (WDI) database of the World Bank. The annual data spans the time period of 1965-2014 for Finland, Greece, Italy and Luxembourg, 1970-2014 for Austria, Belgium, Cyprus, France, Germany, Ireland, Malta, Netherlands, Portugal and Spain.

Prior to the bounds testing analysis, the stationarity of the series is investigated by means of Augmented Dickey Fuller (ADF), Philips-Perron (PP) and KPSS unit root tests. The results are reported in Table 1.

Table 1. Unit Root Test Results

Countries	**I/GDP**			**S/GDP**		
	ADF	PP	KPSS	ADF	PP	KPSS
Austria	-2.41	-2.53	0.13	-2.19	-2.01	0.17**
Belgium	-2.31	-2.33	0.15**	-2.34	-2.21	0.13
Cyprus	-3.80**	-3.82**	0.22**	-2.59	-5.73*	0.22*
Finland	-3.83**	-4.69*	0.09	-3.23	-2.45	0.07
France	-2.04	-2.04	0.17**	-2.32	-1.99	0.15**
Germany	-3.92**	-3.02	0.09	-3.15	-3.48	0.15**
Greece	-6.01*	-6.25*	0.06	-5.55*	-5.92*	0.07
Ireland	-2.19	-1.64	0.11	-0.97	-1.18	0.11
Italy	-3.47	-4.02*	0.11	-2.72	-2.55	0.09
Luxembourg	-2.82	-2.61	0.13	-1.95	-1.81	0.18**
Malta	-2.37	-2.37	0.19**	-2.56	-2.54	0.16**
Netherlands	-3.29	-3.33	0.09	-4.11*	-2.07	0.07
Portugal	-4.11*	-2.07	0.08	-4.87*	-2.49	0.15**
Spain	-2.54	-1.91	0.14	-2.74	-2.06	0.14

Source: Author's estimation

Notes: Regressions are estimated with trend and intercept. The lag order of ADF unit root tests are determined by Schwarz information criteria. * and ** denote that the test statistics are significant at %1 and %5 level, respectively.

Table 1 points out two important problems over the determination of stationarity properties of the series. First, the integration orders of the series differ among the alternative tests. ADF and PP tests treating stationarity as alternative hypothesis suggest the non-stationarity of I/GDP and S/GDP, in most instances while contrarily, the null hypothesis of stationarity is accepted considering the results of KPSS. Second, the integration order of I/GDP and S/GDP series for Cyprus, Finland, Germany and Netherlands differs under the consideration of ADF test results. Likewise, PP unit root tests lead to contradictory results for Finland and Italy. Since other cointegration methods as Engle and Granger (1987), Johansen (1988) and Johansen and Juselis (1990) are based on the variables integrated of the same order, the F-H relation is required to be analyzed by bounds testing technique that does not notice the series are I(0) or I(1), therefore avoids the problem of determining integration order of the series.

The first step in the bounds testing procedure involves the selection of appropriate lag length by the selection criteria that are Akaike Information Criteria (AIC) and Schwarz Information Criteria

(SIC). In addition, LM statistic of order 1 is used for the diagnostic checking of autocorrelation to determine the optimal lag length. In the following step, computed F and t-statistics for cases 3, 4 and 5 are compared to upper and lower bounds. The results are reported in Table 2.

Table 2. Results of bounds tests, F- and t-statistics

Countries	(p,q)	F_{IV}	F_V	t_V	F_{III}	t_{III}	Result
Austria	(1,1)	2.18[c]	5.03[c]	3.12[c]	1.82[c]	2.55[c]	No cointegration
Belgium	(2,2)	2.19[c]	2.46[c]	3.29[c]	2.13[c]	0.33[c]	No cointegration
Cyprus	(1,1)	6.47[b]	9.69[a]	12.47[a]	2.96[c]	1.18[c]	Cointegration
Finland	(1,1)	4.19[c]	2.47[c]	2.18[c]	2.96[c]	0.34[c]	No cointegration
France	(1,1)	1.23[c]	2.55[c]	1.33[c]	1.89[c]	2.85[c]	No cointegration
Germany	(1,1)	5.16[b]	8.66[b]	7.36[a]	4.88[b]	3.84[a]	Cointegration
Greece	(5,5)	1.66[c]	2.49[c]	0.03[c]	1.23[c]	1.67[c]	No cointegration
Ireland	(1,1)	2.94[c]	4.41[c]	3.65[c]	0.48[c]	0.96[c]	No cointegration
Italy	(1,1)	4.18[c]	6.09[c]	11.96[a]	3.18[c]	6.28[a]	Cointegration
Luxembourg	(4,4)	6.69[a]	8.64[b]	6.36[a]	9.09[a]	16.71[a]	Cointegration
Malta	(2,2)	3.38[c]	8.10[b]	4.45[a]	0.33[c]	0.66[c]	Cointegration
Netherlands	(1,1)	5.95[b]	8.59[b]	13.89[a]	5.38[b]	7.28[a]	Cointegration
Portugal	(1,2)	4.94[c]	6.86[c]	7.98[a]	2.65[c]	4.93[a]	Cointegration
Spain	(3,3)	11.02[a]	16.53[a]	33.05[a]	4.91[b]	8.22[a]	Cointegration

Source: Author's estimation.

Notes: p and q values show the appropriate lag lengths for the models with and without trend, respectively that are determined by selection criteria and LM serial correlation tests. a indicates that the test statistic lies above the %1 upper bound. b shows the presence of cointegration at %5 level and finally c is indicative of no-cointegration. F_{III}, F_{IV} and F_V show the F-statistics for cases 3, 4 and 5, respectively that are defined by Pesaran et al. (2001) while t_{III} and t_V correspond to the t-statistics of cases for 3 and 5.

On the basis of Table 2, the null hypothesis is accepted for the case of Austria, Belgium, Finland, France, Greece and Ireland, implying the long-run saving-investment relation is not in question. On the other hand, evidence supporting the existence of cointegration is found for the group of countries including Germany, Luxembourg, Netherlands and Spain. For Cyprus, the long-run relation is found except case 3. For Italy and Portugal, the t-statistics above the upper bounds support the cointegration relation. Finally, for Malta the long-run relation is established solely by case 5. Though the presence of cointegration yields long-run relation, the main objective is to examine the effect of domestic saving on domestic investment. Hence, in the succeeding step, the Granger-causality analysis is performed to yield the presence of saving-investment causal relation for these countries where the long-run relationship is determined.

Table 3. Granger causality analysis of F-H relation

	ARDL model	Granger causality	
Countries		Short-run(or weak)	Long-run
Cyprus	(2,1)	0.76 (0.48)	-0.95 (0.01)
Germany	(2,1)	12.01 (0.00)	-1.21 (0.01)
Italy	(1,1)	10.71 (0.00)	-1.07 (0.01)
Luxembourg	(1,4)	8.84 (0.00)	-1.23 (0.00)
Malta	(1,0)	0.75 (0.48)	-1.14 (0.00)
Netherlands	(2,1)	3.11 (0.06)	-0.79 (0.01)
Portugal	(2,1)	9.19 (0.00)	-1.26 (0.01)
Spain	(2,0)	1.07 (0.38)	-1.20 (0.00)

Source: Author's estimation.

Notes: The ARDL lag selection process is based on AIC, SIC and LM autocorrelation tests. The second column shows the F-statistics and the probability values in brackets fort he short-run causality. In the third column, error correction coefficients are given. The values in parentheses are the probability values for the long-run causality test statistics.

The results suggest that in the short-run, domestic saving is a causing variable for domestic investment for the countries except Cyprus, Malta and Spain. Moreover, in the long run the empirical findings support the evidence of causality for all countries. Finally, Table 4 indicates the β-estimates from the ARDL models.

Table 4. Estimated long-run β coefficients

Countries	ARDL model	β-coefficient	p-value
Cyprus	(2,1)	-0.36	0.00
Germany	(2,1)	0.14	0.08
Italy	(1,1)	0.11	0.02
Luxembourg	(1,4)	-0.07	0.00
Malta	(1,0)	0.29	0.00
Netherlands	(2,1)	-0.02	0.00
Portugal	(2,1)	0.32	0.00
Spain	(2,0)	0.44	0.00

Source: Author's estimation.

Note: p-value shows the probability of the Wald statistic testing the null of β is equal to 1.

The β-coefficients are found to be in the range of -0.36 and 0.44 and statistically different from 1 implying F-H puzzle does not exist for these group of countries. Kollias et al. (2006) lean similar findings for EU 15 countries on three factors that are the high capital mobility, lower transaction costs in the international capital markets and retreating from the policy of long-run current account targeting. Likewise, Papadogonas and Stournaras (2006) attribute the result of low national saving and national investment relation for EU member states to the process of financial integration. Another plausible explanation to the existing finding for euro area countries could be based on the interaction of saving-investment relation with current account balance. To this respect, the evidence of low β-coefficients could be supported by the case of countries as

Portugal, Spain and Italy in European Monetary Union experiencing debt crisis and suffering high current account deficits. In this case, domestic saving is contributed to the financing of the current account deficit rather than the domestic investments. Besides, the case of Cyprus and Malta may be attributed to small or developing country effects implying the dependency of economy on capital inflows to finance national investment.

4. Conclusion

This paper addresses the saving-investment relation in 14 countries of euro area irrespective of the integration order of the series by using bounds testing procedure. The analysis is proceeded with the Granger causality tests through error correction models to examine long and short- run causal links for the countries where cointegration relation is established. The results indicate that in the long-run 8 countries, namely Cyprus, Germany, Italy, Luxembourg, Malta, Netherlands, Portugal and Spain exhibit causality from domestic saving to national investment. However, the low values of the estimated long-run β coefficients in the range of -0.36 and 0.44 show that the effect of national saving on national investment is not notable.

The empirical result of low F-H coefficient could be interpreted as an evidence of high capital mobility. However, the findings may also reflect the unsustainability of the current account deficits, or small country effect rather than the degree of capital mobility. As a policy implication, it could be asserted that saving promoting policies are inefficient to stimulate economic growth through the rise in national investment for euro area countries. Moreover, two components of domestic saving-investment relation that are private and public sectors should be considered separately in the process of policy development since the debt crisis of euro area countries requires the analysis of public sector balances more deeply.

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