CAPITAL MOBILITY IN GERMANY

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ABSTRACT

This study evaluates the relationship between investment and savings in Germany over the period of 1971 to 2014. Using advance time-series estimation methods the findings reveal that the saving-retention coefficient is low, contradictory to the finding of Feldstein and Horioka (1980). Thus, result indicate high degree of capital mobility in Germany. The results for the sensitivity of investment to different forms of saving ratios suggest that the government savings is mostly invested domestically. While, private savings is inclined to be invested abroad. Furthermore, The effect of Maastricht treaty in 1992 indicate that the integration of European Union has increased dispersion between savings and investment ratios, and has negatively affected domestic investment. The overall results suggest that Germany can implement policies that emphasis on increasing investment through domestic savings by enhancing opportunities for private savers in the country.

I. INTRODUCTION

This paper assesses the relationship between domestic saving and domestic investment, and examines its sensitivity to the Maastricht Treaty (undertaken to integrate Europe) followed by the introduction of common currency, the euro, in case of Germany. The high correlation between domestic saving and investment is well known as the Feldstein–Horioka puzzle (henceforth FHP). In the original study by Feldstein and Horioka (1980), they have shown that investment and saving ratios are highly correlated using cross-sectional data of 16 OECD countries for the period 1960 to 1974. They argued that domestic saving is the main source of finance for domestic investment, which in turn implies, low capital mobility. Hence, they concluded that even with the increase in globalization and the rise in foreign direct investment (FDI) and foreign portfolio investment (FPI) one cannot conclude that the capital mobility has increased internationally.

Let *I*, *S*, and *Y* denote national investment, national saving, and gross national product, respectively. Feldstein and Horioka (henceforth F-H) estimated the following equation:

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta \left(\frac{S}{Y}\right)_i + \varepsilon_i$$

where; $\varepsilon_i \sim i.i.d.\ N(0, \sigma^2)$. F-H interpreted $\boldsymbol{\beta}$, the regression coefficient (also called the saving-retention coefficient), as a measure of international capital mobility. With perfect capital mobility, an increase in the saving rate in country *i* would cause an increase in investment in all countries (henceforth, $\boldsymbol{\beta}$ close to 0). On the contrary, estimates of $\boldsymbol{\beta}$ close to 1 would indicate that most of the incremental saving in each country remains to be invested there. Assessment of the degree of capital mobility can be built on price or quantity indicators. One argument in this regard is that in integrated financial markets rates of return on identical financial assets must be the same. The second perspective presented by F-H is based on the idea that in integrated financial markets

domestic investment should not be constrained by the supply of domestic saving. Bayoumi *et al*. (1993) suggests that price measures show a greater degree of economic integration between European countries than quantity measures. Outside of European countries no region in the world has done more to integrate its economies. The European Union initiated free movement of goods and services, capital, and labor after the Second World War (Bekaert *et al*. 2013). Blanchard and Giavazzi (2002) argue that due to increased trade and cross border investment among EU member countries, the association between national savings and investment has declined at a relatively higher rate than other industrialized countries.

In this paper, the main objective is to empirically identify the stability of causal relationship between savings and investment for Germany and examine the impact of the Maastricht treaty in 1992 on the degree of capital mobility. In an attempt to identify the causal relationship between savings and investment, a comprehensive time-series estimation techniques is used.

The outline of the paper is as follows. Section II highlights the literature on FHP. In Section III, the empirical approach is specified. Section IV details results and Section V concludes.

II. FORMER STUDIES ON F–H PUZZLE

A comprehensive review of the relevant literature is presented by Apergis and Tsoumas (2009), they concluded that the majority of the empirical studies found contradictory results to the original findings of F-H. However, they concluded that the correlation exists in a weaker form. The debate has traditionally revolved around two issues. First relates to whether domestic investment results in domestic savings, and the second relates to how investment affects savings. A brief literature that examines the F-H puzzle using cross-sectional, time-series or longitudinal estimation methods are outlined below:

TIME SERIES STUDIES						
AUTHORS	***COUNTRIES***	***DATA***	***METHODOLOGY***	***FINDINGS***		
Miller (1988)	USA	1946Q1-1987Q3	ADF and Co-integration test (Engle-Granger 1987)	Saving-retention coefficient is 0.57		
Afxentiou and Serlitis (1993)	Canada	1950-1973	ADF and Co-integration test (Engle-Granger 1987)	Saving-retention coefficient is 0.33		
Esso and Keho (2010)	UEMOA Countries (Benin, Burkina Faso, Cote d`Ivoire, Mali, Niger, Senegal, Togo)	Benin (1982-2005) Burkina Faso (1979-2005) Cote d`Ivoire (1965-2005) Mali (1967-2005) Niger(1980-2005) Senegal (165-2005) Togo (1980-2005)	Time Series Co-integration: Bounds test (Pesaran et al.- 2001) Granger causality test (Toda and Yamamoto - 1995)	<u>Bound Test:</u> Benin and Niger are co-integrated. <u>Causality:</u> Benin S→I Cote d`Ivoire S→I Niger S→I		
Nasiru and Haruna (2013)	Nigeria	1980-2011	ADRL Bound Test ECM (Error Correction Model)	Co-integrated in long run. Negative and significant ECM		
Kumar et al. (2012)	Australia	1960-2007	EG (Engle-Granger test) Johansen Maximum Likelihood Fully-Modified OLS GETS (Hendry's - General to Specific technique) ADRL Bound Test	<u>1960-2007</u> GETS → 0.57 EG → 0.53 FMOLS → 0.54 JML → 0.50 ADRL → 0.51	<u>1960-1980</u> GETS → 0.82 EG → 0.57 FMOLS → 0.69 JML → 0.79 ADRL → 0.69	<u>1981-2007</u> GETS → 0.62 EG → 0.53 FMOLS → 0.65 JML → 0.64 ADRL → 0.62

STUDIES ON OECD COUNTRIES

AUTHORS	*COUNTRIES*	*DATA*	*METHODOLOGY*	*FINDINGS*
Coakley et al. (2004)	12 OECD Countries	1980-2000 (Quarterly)	Time-series panel data techniques	Saving-retention coefficient 0.32
Giannone and Lenza (2009)	24 OECD Countries.	1970-1999	Factor Augmented Panel Regression technique (Heterogeneous response of S-I to global shocks)	Saving-retention coefficient around 0.18 (relaxation of homogeneity assumption)
Pelgrin and Schich (2008)	20 OECD Countries.	1960-1999	Panel Error Correction process Panel (dynamic) fixed effects	Error correction coefficient is negative and significantly different from zero.
Katsimi and Moutos (2007)	25 OECD Countries	1986-2002	OLS Adding Variable to FPH Model: Human Capital Investments	1986-2002 → 0.57 1986-1990 → 0.61 1991-1995 → 0.70 1996-2000 → 0.37 1997-2002 → 0.26
Christopoulos (2007)	13 OECD Countries. Pre-Maastricht	1885-1992 1921-1992 & 1950-1992	Panel dynamic OLS	Saving-retention coefficient range around 0.50 Pre-Maastricht → 0.79 (1921-1992) & 0.90 (1950-1992)
Di Iorio and Fachin (2007)	12 EU Countries.	1960-2002	Panel bootstrap tests Country-specific FMOLS	Saving-retention coefficient → 0.59
Fouquau et al. (2009)	24 OECD Countries.	1960-2000	Panel Smooth Threshold Regression Model. Additional Variables: 1. Trade openness 2. Country Size 3. Ratio of Current account balance to GDP	Saving-retention coefficient → 0.7
Kumar and Rao (2011)	13 OECD Countries Pre-Bretton Woods Post-Bretton Woods Pre-Maastricht Post-Maastricht	1960-2007 1960-1974 1975-2007 1960-1994 1995-2007	Panel Co-integration. Test for Structural breaks using the Westerlund (2006) method.	Pre-Bretton Woods: 0.46 Post-Bretton Woods: 0.26 Pre-Maastricht: 0.44 Post-Maastricht: 0.24 0.74 0.48 0.65 0.11
Sangjoon Jun (2011)	30 OECD Countries	1960-2006	Panel Co-integration test CCR (Canonical co-integrating regression) Dynamic OLS Fully-Modified OLS	1960-2006 CCR= 0.56 DOLS=0.61 FMOLS= 0.56 1960-1974 CCR= 0.82 DOLS=0.80 FMOLS= 0.82
M. Costantini and L. Gutierrez (2013)	21 OECD Countries.	1970-2008	Panel Co-integration. Panel dynamic OLS. Panel Fully-Modified OLS. Panel CUP-FM estimator.	Saving-retention coefficient is close to zero. (Assumes cross-sectional dependence through common factors).

III. EMPIRICAL METHODS

Given the contradictory results of FHP as observed by previous studies. This study seeks to investigate the causal relationship between investment and savings ratios for Germany using annual data for the period of 1971 to 2014. Correspondingly, to examine the impact of the Maastricht treaty (formally, the Treaty on European Union) in 1992 on the relationship the data is further divided into two parts from 1971 to 1992, and 1993 to 2014. The model used in this study is similar to the model used by Feldstein and Horioka (1980).

$$(INY)_t = \alpha + \beta\ (DSY)_t + \gamma\ DUM_t + \varepsilon_t \qquad \ldots\ldots 1$$

where; $\varepsilon_i \sim i.i.d.\ N(0, \sigma^2)$. *INY* is the ratio of gross domestic investment to GDP, *DSY* is the ratio of gross domestic savings to GDP. F-H interpreted $\boldsymbol{\beta}$, the regression coefficient (also called the saving-retention coefficient), as a measure of international capital mobility. Under perfect capital mobility β estimates will be close to 0 and on the contrary, estimates of β close to 1 would indicate low capital mobility in the country. A dummy variable (*DUM*) is also incorporated in the equation to study the impact of the common currency, the euro since its circulation started in 2002. It takes the value of 0 from 1970 to 2001 and 1 for 2002 onwards. To examine the sensitivity of the investment to different forms of savings, which is also relevant for assessing policies that are designed to increase investment by stimulating forms of savings. This study also evaluates the impact of the government savings, enterprise savings and household savings on investment. To evaluate this relationship, the equation is:

$$(INY)_t = \alpha + \beta_0(HHSY)_t + \beta_1(GSY)_t + \beta_2(ESY)_t + \beta_3\ DUM_t + \varepsilon_t \qquad \ldots. 2$$

where; *INY* is the ratio of gross domestic investment to GDP, *ESY* is the ratio of gross enterprise savings to GDP, *HHSY* is the ratio of gross household savings to GDP and *GSY* is the ratio of

government savings to GDP. The annual data is obtained for the period of 1970 to 2014 from World Development Indicator 2015, and the Deutsche Bundesbank (the central bank of Germany). The estimation technique used is based on the computation of ratio`s and putting it in the equations stated above. A comprehensive set of four different time-series estimation methods are used to examine the causal relationship between *S* and *I*.

The Phillips and Hansen`s (1990) Fully Modified Ordinary Least Squares (FMOLS) estimation procedure is used which customs a semi-parametric adjustment to remove the problems caused by the long run correlation between cointegration equation and stochastic regressors innovations. I used Bartlett lag window to estimate the cointegration equations. A linear trend specification is applied and the dummy variable, euro is used as an additional regressor. Likewise, Stock and Watson (1993) Dynamic Ordinary Least Squares (DOLS) estimation procedure is used, the method involves augmenting the cointegration regression with lags and leads of the explanatory variable(s). Given the sample size, I used one lag and one lead specification in DOLS estimation.

Søren Johansen (1991) developed multivariate cointegration tests, frequently referred to as the Johansen Maximum Likelihood (JML) test. This test permits more than one long run association, thus it allow evaluating the postulation of linear deterministic drift in the data. At first stage the order of the VAR is determined, and then the existence of cointegrating vector(s) is tested. The trace statistics and eigenvalue test statistics is obtained to identify the existence of the long run relationship. JML also provides a unified framework to test the cointegrating relationship in the context of Error Correction Method (ECM). The procedure of cointegration is tested with a linear deterministic trend.

Following ECM, Engle Granger (1987) causality method is used to test causation if the variables are found cointegrated. The model for Granger causality investment equation is as follows:

$$\Delta INY_t = \phi + \sum_{i=1}^{n} \delta_i \Delta INY_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta DSY_{t-1} + \lambda_i ECT_{t-1} + \varepsilon_{1t} \quad \ldots. 3$$

$$\Delta DSY_t = \phi + \sum_{i=1}^{n} \gamma_i \Delta DSY_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta DSY_{t-1} + \lambda_i ECT_{t-1} + \varepsilon_{2t} \quad \ldots. 4$$

where; ε_{1t} and ε_{2t} are the independent error terms. In VECM, the dependent variables are regress against the lag values of itself and lag values of the other variable. The lagged Error Correction term (ECT_{t-1}) is also used in estimating causality which is derived from the cointegrating equations.

Table 1. Descriptive Statistics: 1971 to 2014

Variables	*DSY*	*ESY*	*GSY*	*HHSY*	*INY*	*DUM*
Mean	24.096	0.434	0.441	40.709	22.846	0.364
Median	24.054	0.400	0.306	46.639	22.943	0.000
Maximum	29.836	0.824	1.583	56.986	29.967	1
Minimum	20.305	0.150	0.048	20.107	19.069	0
Std. Dev.	2.075	0.210	0.399	13.567	2.581	0.487
Observations	44	44	44	44	44	44

Note: *DSY* is gross domestic savings; *ESY* is enterprise savings; *GSY* is government savings; *HHSY* is household savings; *INY* is gross fixed capital formation (investment), and *DUM* is the dummy variable for EURO currency.

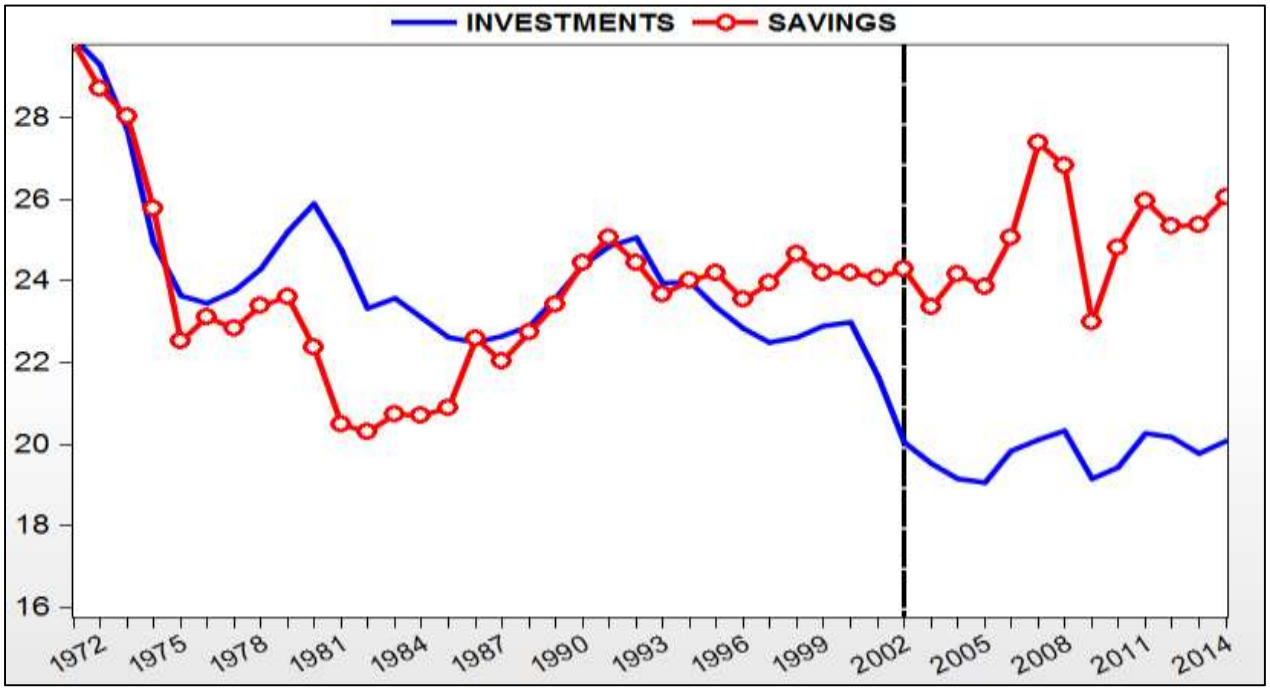
Pesaran *et al*. (2001) developed an Autoregressive distributed lag (ARDL) bounds tests approach. The ARDL techniques can be a reliable option where the underlying regressor is *I*(0) or *I*(1); and it can be used under small sample size for both the cases to test the hypotheses on the long-run coefficient, thus it has good small sample size properties compared to alternative methods. The ARDL procedure works in two steps. First, the presence of long-run association between the variables is tested, and the *F*-test procedure is used to determined long-run relationship. Second,

model selection method is specified, and accordingly the ARDL cointegrating equation is estimated. For this study, I used Akaike Information Criterion (AIC) as a model selection method.

IV. RESULTS

The data for Germany is obtained from World Bank Development Indicator (WDI), as it provides a detailed annual statistics for gross fixed capital formation *(INY)*, and gross domestic savings *(DSY)*. Whereas, I used data from the Deutsche Bundesbank, for gross enterprise savings *(ESY)*, gross household savings *(HHSY)*, and gross government savings *(GSY)*. All the observations used are as percentage of GDP. The sample period is from 1971 to 2014. This sample period is chosen as it is the maximum available data across all variables in the model. The descriptive statistics related to *INY*, *DSY*, *ESY*, *HHSY*, *GSY* and *DUM* for the period 1971 to 2014 are provided in Table1. Overall, the summary statistics does not show any unusual behavior.

Figure 1. Investment and saving ratios for Germany: 1971 to 2014



The plot of investment and saving ratios (as percentage of GDP) for Germany from 1971 to 2014 is shown in Figure 1. The movement of saving and investment ratios show changes in pattern for both the variables after Maastricht treaty was undertaken to integrate Europe in 1992. The graphs also indicate further dispersion in saving and investment rates after the circulation of euro became operational in 2002, providing evidence of increased capital flows. Large increases in domestic saving can be observed for Germany since 2002, whereas, domestic investment has continuously declined since the time when the Maastricht treaty was signed, indicating a substantial increase in capital outflows from Germany. From the plot, one can conclude that the savings and investment correlation has weakened since the formation of European Union, indicating an increase in capital mobility for Germany.

Table 2. Results of ADF and PP unit root tests

Variables		*INY*	*DSY*	*ESY*	*GSY*	*HHSY*
ADF Statistics	*I(0)*	-2.946	-3.538*	-2.385	-3.144	-2.423
	I(1)	-2.950*	-3.062*	-5.429*	-3.315*	-5.432*
PP Statistics	*I(0)*	-3.087	-3.706*	-2.385	-3.047	-2.538
	I(1)	-3.232*	-3.085*	-5.430*	-4.396*	-5.350*

Note: The ADF statistics and PP statistics are compared with their respective critical values.
* denotes the rejection of null hypothesis (variable has a unit root) at 5% significance level.

To test for the presence of a unit root in all the variables, I used Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The test results are reported in Table 2. The ADF and PP test are applied both in levels (with an intercept and trend) and their first differences. The ADF and PP statistics for the level variables only exceeds the critical value for domestic savings *(DSY)*, whereas all the other variables are found non-stationary. In the first difference form of each of the variables use in both the models, the ADF and PP statistics are higher than their respective critical values, signifying that their first differences are stationary.

The alternative time-series estimation methods are employed to examine the validity of F-H puzzle for Germany. To estimate both Equation 1 and Equation 2, I used FMOLS, DOLS, JML, Granger causality and ARDL techniques for the whole sample (1971 to 2014) and for two sub-samples (1971 to 1992 and 1993 to 2014). I selected the sample break date as 1992 because of two important events that affected Germany. First, the re-unification of East and West Germany took place in 1992, and second the Maastricht Treaty (formally, the Treaty on European Union) undertaken to integrate Europe was initiated in 1992 by the members of the European Community. Both of these major events resulted in substantial gains such as improving current account balance and increasing the trade among the EU member countries, and initiating new financial products and services, hence had a major impact on the Germans capital flow. Following the Maastricht treaty, the initiation of the common currency, euro eliminated the exchange rate risk among the EU member countries, thus the capital flow among the members increased significantly. To analyze the impact of the common currency, euro, I also had a dummy variable *(DUM)* which take the value of 1 from 2002 onwards, as the circulation of the euro started in 2002. For a detailed review of the impact of euro on the current account in Germany, see Kollmann *et al*. (2014).

Table 3. JML cointegration tests

	Trace		*Max-Eigenvalue*	
	Test statistics	95%	Test statistics	95%
1971 to 2014				
$r = 0$	36.917	25.872	26.512	19.387
$r \leq 1$	10.405	12.518	10.405	12.518
1971 to 1992				
$r = 0$	20.744	15.495	18.183	14.265
$r \leq 1$	2.562	3.841	2.562	3.841
1993 to 2014				
$r = 0$	24.098	25.872	19.989	19.387
$r \leq 1$	4.109	12.518	4.109	12.518

Note: *r* is number of cointegrating vectors

Table 4. Alternative estimates of savings-retention coefficient (β)

	FMOLS	*DOLS*	*JML*	*ARDL*
1971 to 2014				
β	0.430	0.316	0.091	0.298
	(3.81)*	(2.39)*	(-1.15)	(2.48)*
DUM	-2.674	-3.173	-3.191	-2.195
	(-3.52)*	(-4.35)*	(6.36)*	(-3.00)*
1971 to 1992				
β	0.504	0.280	0.254	0.880
	(3.38)*	(1.71)	(-2.39)*	(1.46)
1993 to 2014				
β	0.389	0.521	-0.149	1.275
	(1.51)	(1.08)	(0.58)	(1.63)
DUM	-1.977	-2.425	-4.290	-1.454
	(-2.41)*	(-2.60)*	(5.80)*	(-0.92)

Note: β is the savings retention coefficient. *DUM* captures the effects of the common currency, euro, it is 1 in the period 2002 to 2014 and zero otherwise. Absolute *t*-ratios are reported in the parenthesis.

* denote the statistical significance at 5% confidence level.

FMOLS, DOLS, JML and ARDL estimates of Equation 1 are presented in Table 4. The null hypothesis of the saving retention coefficient, β should be equal to zero for perfect capital mobility. The dummy variable *(DUM)* captures the impact of the elimination of exchange rate risk after the introduction of common currency, euro. If the expected sign of *DUM* is negative, it implies that the circulation of euro (since 2002) has a negative impact on the domestic investment in Germany. Whereas, a positive sign will show an incremental effect on investment and indicate more openings for investment opportunity in Germany from abroad.

I estimate the FMOLS with the bartlett lag window and a lag length of zero for the whole period and for the two sub periods. The results for the whole period indicate that around 43% of the domestic savings tends to be invested in domestic markets. However, for the post Maastricht treaty period (1992 onwards) the capital mobility has increased in Germany. The estimate for DOLS with one lag and one lead specification shows high degree of capital flow for the whole period in Germany. However, for post treaty period the result were found insignificant. The coefficient for

the dummy variable for FMOLS and DOLS indicates negative impact of the initiation of the euro on domestic investment. Unlike, JML and ARDL there is no formal tests for cointegration in FMOLS and DOLS. In JML, the lag interval order selected is two based on Akaike Information Criterion (AIC) in VAR for whole period and two-sub periods. I estimated the JML cointegration equation using intercept and trend[2] option. The null hypothesis for JML is no cointegration. The eigenvalues and trace statistics tests reject the null hypothesis of one long-run relationship at 95% level. The estimates of JML cointegration tests is presented in Table 3. The results show that there is long run relationship between savings and investment in Germany.

When analyzing the relationship using ARDL bounds tests for cointegration, I used Akaike Information Criterion (AIC) to select the optimal lag length. The AIC showed an optimal lag length of two and zero periods for the entire period. For the whole sample, the computed *F* statistics (9.981) is greater than the upper bound of 95% critical value (4.68). Likewise, the computed *F* statistics for the second period (1993 to 2014) is 5.61 (4.68). However, the computed *F* statistics for the first period were found insignificant 1.736 (4.68). For whole sample and post-treaty periods the null hypothesis of no long-run relationship is rejected. The results show similarity in the estimates of savings-retention coefficient across all the four techniques, indicating relatively higher capital mobility in Germany as the coefficient is close to zero. For the sub periods, most of the results were found to be insignificant at 95% level. However, based on the practical significance one can conclude that capital flow has increased since the formation of European Union, and the initiation of the common currency, euro, in the Eurozone has adversely affected domestic investment in Germany.

[2] Both Investment and saving variables follow a linear trend.

Table 5. Speed of adjustment coefficient: 1971 - 2014

ECT_{t-1}	*JML*		*ARDL (2,0)*
	ΔINY	*ΔDSY*	
λ	-0.489	-0.722	-0.443
	(-5.01)*	(-4.03)*	(-5.99)*

Notes: Absolute *t*-ratios are reported in parentheses. **λ** indicate the speed of adjustment from short-run to long-run.
* denote the statistical significance at 5% confidence level.

The speed of adjustment coefficient is only estimated using JML and ARDL for the whole period. The cointegration equations are used to formulate the respective Error Correction Terms (*ECT*). In the second-stage equations ΔINY_t is regressed on its lagged values, the lagged *ECT* value from the cointegration vectors of JML and ARDL along with the current and lagged values of ΔDSY_t. The results of the speed of adjustment coefficient from short-run to long run for whole sample is presented in Table 5. In the investment equation the coefficient of the lagged *ECT* (λ) for JML is significant at 5% level, and has an expected negative sign indicating that one percentage change in domestic saving is fully effects the domestic investment in approximately 2 years. Similarly, the ARDL Error Correction term (λ) coefficient is also significant at 5% level, with an expected negative sign indicating that one percentage change in savings fully effects investment in approximately 2.5 years.

Table 6. Granger causality test: 1971 - 2014

Dependent Variable →	ΔINY_t	ΔDSY_t
ΔINY_t	-	6.85
		(0.032)*
ΔDSY_t	2.409	-
	(0.30)	

Notes: Note: Probabilities are reported in parentheses underneath the Chi-square estimates.
* indicate that the probability is less than 5%.

The existence of cointegration implies causality. As the long-run relationship was found between the variables, I employed JML-based Granger causality test in short-run (long-run lagged ECT results are presented in Table 5). The results of Granger causality is presented in Table 6. In the investment equation, the saving is insignificant at 5% level, implies that the saving does not

granger cause the investment in the short run. However, in the saving ratio equation investment is significant at 5% level, implying that there is bi-directional causality from investment ratio to saving ratio in short run. The overall outcome suggest that capital mobility in Germany has increased as most of the domestics saver tend to invest abroad indicating weak relationship between domestic investment and domestic savings.

ANALYSIS OF THE SENSITIVITY OF THE INVESTMENT TO DIFFERENT TYPES OF SAVINGS

The estimate of JML cointegration test is presented in Table 7. For JML estimator, the lag interval order of two is selected based on Akaike Information Criterion (AIC) in VAR for whole period and two-sub periods. The JML cointegration equation are estimated with intercept and trend[3] option. The null hypothesis for JML is no cointegration. The eigenvalues and trace statistics tests reject the null hypothesis of one long-run relationship at 95% level. The results show that there is long run relationship between investment and various types of saving ratios in Germany.

FMOLS, DOLS, JML and ARDL estimates of Equation 2 are presented in Table 8. The estimate for FMOLS indicate that household saving ratio is insignificant at 5% level. However, the estimates for the government and enterprise savings ratio are significant at 5% level. The government saving ratio has a positive impact on investment whereas, enterprise saving negatively affects domestic investment. The findings for DOLS, JML and ARDL are similar to the results of FMOLS. The finding for the dummy variable is also similar to the results for Equation 1. The common currency, euro, negatively affects investment ratio indicating that most of the savings within Germany tends to be invested outside. The behavior of government savings and enterprise savings do not show significant change after the post-Maastricht treaty. Although, the findings

[3] All the variables in the model 2 indicate presence of linear trend.

suggest that the magnitude of government saving invested locally has significantly increased and the investment of enterprise saving abroad is greater than before. Overall, the findings for FMOLS and DOLS indicate that public investment is mostly invested domestically and enterprise savings in highly mobile.

Table 7. JML cointegration tests for Equation 2

	Trace		*Max-Eigenvalue*	
	Test statistics	95%	Test statistics	95%
1971 to 2014				
r = 0	91.890	63.876	43.092	32.118
r ≤ 1	48.799	42.915	26.848	25.823
r ≤ 2	21.950	25.872	12.960	19.387
r ≤ 3	8.990	12.518	8.990	12.518
1971 to 1992				
r = 0	63.683	63.876	29.655	32.118
r ≤ 1	34.028	42.915	18.130	25.823
r ≤ 2	15.898	25.872	10.850	19.387
r ≤ 3	5.048	12.518	5.048	12.518
1993 to 2014				
r = 0	81.974	63.876	46.329	32.118
r ≤ 1	35.645	42.915	19.486	25.823
r ≤ 2	16.159	25.872	14.272	19.387
r ≤ 3	1.887	12.518	1.887	12.518

***Note**: r* is number of cointegrating vectors

The JML and ARDL estimates for household saving ratio is significant at 5% level. The result for JML and ARDL are quite similar. It indicates a positive effect on investment, implying that one percent increase in household saving ratio increases domestic investment around 0.12% to 0.15% per year. However, the magnitude of household saving ratio has decline significantly following the Maastricht agreement in 1992. The findings for government saving and enterprise saving are similar to the FMOLS and DOLS. Similarly, the result of dummy variable (*DUM*) suggest that the

circulation of euro has adversely affected domestic investment in Germany. It can be concluded that the integration of Europe has increased the capital flow across member countries.

Table 8. Alternative estimates for Equation 2

	FMOLS	*DOLS*	*JML*	*ARDL*
1971 to 2014				
HHSY	0.019	-0.088	0.143	0.120
	(0.721)	(-1.222)	(-3.646)*	(3.857)*
GSY	7.659	3.963	1.678	6.450
	(6.515)*	(2.017)*	(-1.046)	(5.453)*
ESY	-9.251	-1.976	-1.085	-7.465
	(-4.260)*	(-0.657)	(0.371)	(-5.00)*
DUM	-3.286	-6.236	-0.190	-1.112
	(-5.127)*	(-3.678)*	(0.197)	(-1.681)
1971 to 1992				
HHSY	-0.405	-0.805	0.939	-1.852
	(-2.275)*	(-5.646)*	(2.767)*	(-1.394)
GSY	4.717	-0.936	0.802	0.395
	(2.925)*	(-1.264)	(0.698)	(0.101)
ESY	8.226	27.555	-32.500	77.922
	(0.955)	(4.321)*	(-2.286)*	(1.243)
1993 to 2014				
HHSY	0.008	0.209	0.031	0.094
	(0.245)	(1.431)	(-2.020)*	(2.100)*
GSY	16.941	-2.979	20.800	17.865
	(3.675)*	(-0.354)	(-10.095)*	(3.760)*
ESY	-12.534	-14.055	-18.339	-14.081
	(-5.550)*	(-1.466)	(12.895)*	(-5.170)*
DUM	-3.123	-4.554	-3.487	-1.756
	(-8.582)*	(-2.841)*	(17.940)*	(-4.050)*

Note: *HHSY* is household saving ratio; *GSY* is government saving ratio and *ESY* is enterprise savings ratio. *DUM* captures the effects of the common currency, euro, it is 1 in the period 2002 to 2014 and zero otherwise. Absolute *t*-ratios are reported in the parenthesis.

* denote the statistical significance at 5% confidence level.

When analyzing the relationship using ARDL bounds tests approach for cointegration the optimal lag length of four (*HHSY*), two (*GSY*), four (*ESY*) and zero (*DUM*) periods is selected based on Akaike Information criteria for the entire period. For the whole sample, the computed *F* statistics (8.219) is greater than the upper bound of 95% critical value (3.83). Likewise, the computed *F*

statistics for the first period (1971 to 1992) is 4.18 (3.38) and for second period (1993 to 2014) is 11.23 (3.83). For whole period and two sub periods the null hypothesis of no long-run relationship is rejected at 95% level. The results show similarity for the estimates of different types of savings coefficient across all four techniques, indicating relatively high degree of capital mobility for Germany. Based on the findings one can conclude that capital mobility has increased since the formation of European Union, and the relationship between various categories of saving ratios and domestic investment has further weaken since the initiation of the common currency, euro, in the Eurozone.

Table 9. Speed of adjustment coefficient: 1971 - 2014

ECT_{t-1}	*JML*				*ARDL (4,2,4,0)*
	ΔINY	*ΔHHSY*	*ΔGSY*	*ΔESY*	
λ	-0.435	1.493	0.002	0.0001	-0.951
	(-3.940)*	(1.404)	(0.183)	(0.005)	(-6.03)*

Note: Absolute *t*-ratios are reported in parentheses. **λ** indicate the speed of adjustment from short-run to long-run. * denote the statistical significance at 5% confidence level.

The speed of adjustment coefficient is only estimated using JML and ARDL for the whole period. The cointegration equations are used to formulate the respective Error Correction Terms (*ECT*). In the second-stage equations ΔINY_t is regressed on its lagged values, the lagged *ECT* value from the cointegration vectors of JML and ARDL along with the current and lagged values of different saving ratios. The results of Equation 2 for the speed of adjustment coefficient from short-run to long run for entire sample is presented in Table 9. In the investment equation the coefficient of the lagged *ECT* (λ) for JML is significant at 5% level, and has an expected negative sign indicating that one percentage change in all saving ratios entirely effects the domestic investment in approximately 2.5 years. Similarly, the ARDL Error Correction term (λ) coefficient is also significant at 5% level, with an expected negative sign indicating that one percentage change in all saving ratios impacts domestic investment in just over 1 year.

Table 10. Granger causality test: 1971 - 2014

Dependent Variable →	*ΔINY*	*ΔHHSY*	*ΔGSY*	*ΔESY*
ΔINY	-	2.568	1.436	5.767
		(0.277)	(0.488)	(0.56)
ΔHHSY	5.565	-	4.327	1.336
	(0.062)*		(0.115)	(0.513)
ΔGSY	5.047	0.724	-	0.220
	(0.080)*	(0.700)		(0.896)
ΔESY	6.464	0.708	0.192	-
	(0.039)**	(0.702)	(0.910)	

***Note**:* Probabilities are reported in parentheses underneath the Chi-square estimates.
* indicate that the probability is less than 10%; ** indicate that the probability is less than 5%.

The existence of cointegration implies causality. As the long-run relationship was found between the variables, I employed JML-based Granger causality test in short-run (long-run lagged ECT results are presented in Table 9). The results of Granger causality is presented in Table 10. The different types of saving ratio equations are insignificant at 5% level, inferring that the investment does not granger cause any saving ratio in the short run. However, in the investment equation all the saving ratios are significant at 10% level, implying that there is bi-directional causality from saving ratios to investment in the short run. One can conclude that policies which aim to increase investment through government savings are marginally successful. Therefore, the result suggest high capital mobility in Germany.

V. CONCLUSION

This study has examined the causal relationship between saving and investment ratios following the seminal work by Feldstein and Horioka in 1980. The study attempted to estimate the saving-retention coefficient (β) for Germany over the period of 1971 to 2014 using FMOLS, DOLS, JML and ARDL techniques. Furthermore, the study investigates the sensitivity of domestic investment to various types of saving ratios. The findings suggest that β coefficient is statistically significant

over the entire period and less than 0.5, indicating high capital mobility in Germany. The effect of Maastricht treaty of 1992 has a significantly affected saving and investment relationship. The result indicate that the integration of European Union has increased dispersion between savings and investment ratios, and has negatively affected the overall domestic investment. The findings are contradictory with FHP, signifying that most of the domestic saving does not cause domestic investment in Germany.

Furthermore, the results for the sensitivity of domestic investment to different forms of saving ratios suggest that the government savings is mostly invested domestically. Whereas, private savers in Germany are inclines to invest abroad. This trend has increased considerably since the formation of European Union. Thus, it implies that domestic investment is less associated with different types of savings (other than government savings). Overall, one can conclude that capital mobility in Germany has increased especially after Maastricht treaty in 1992. Overall, one can argue that Germany could effectively implement policies that emphasis on increasing domestic investment through domestic savings.

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