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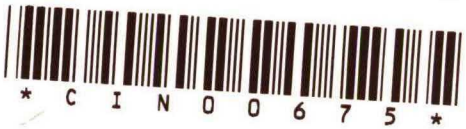

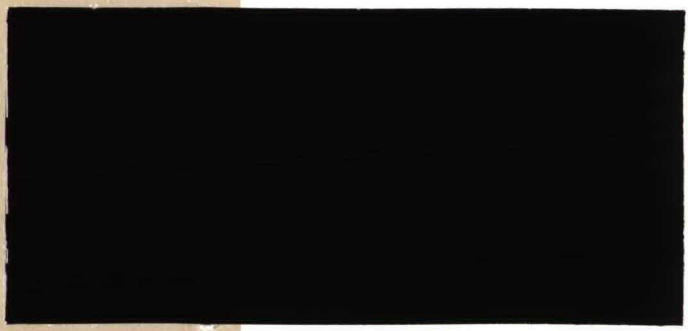

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No. 9320

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April 1993

ISSN 0924-7815

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February 1993

Abstract

Feldstein and Horioka (1980) hypothesized that in a perfectly integrated financial market, a current account deficit (surplus) will be balanced by a corresponding capital inflow (outflow) and country's savings decisions will be separated from its investment decisions. We consider the Feldstein-Horioka criterion i.e. the role of savings-investment correlations to assess the degree of financial integration and present empirical results on financial integration within the European Community. We establish a link between the Feldstein-Horioka criterion and three other criteria for financial integration i.e. the covered nominal interest parity condition, the uncovered nominal interest parity condition and the ex ante real interest parity condition. Furthermore, we evaluate the use of the Feldstein-Horioka criterion for financial integration on the basis of its underlying assumptions. Our major finding is that, the Feldstein-Horioka criterion - contrary to what is usually found for world financial markets - is able to explain increasing financial integration among the member states of the European Community.

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I. Introduction

With the enforcement of the Single European Act on 1 July 1987 the member states of the European Community (EC) confirmed the objective of the realization of the Economic and Monetary Union by the end of 1992. Since then, the pace of financial integration in the EC has rapidly increased. Following the Single European Act, the European Commission enacted on 24 June 1988 a directive to lift all restrictions on short-term and long-term capital movements. This means that as of 1 July 1990 the first phase of the European Economic and Monetary Union has started. We expect potential capital flows within the EC to increase. However, the impact on actual capital flows is ambiguous.

An influential criterion for measuring the degree of financial integration originated in 1980 when Feldstein and Horioka (F-H) asserted that one could deduce from the national accounting framework the degree of financial integration. By examining the correlation between national savings and domestic investment, Feldstein and Horioka were able to quantify the degree of financial integration. F-H hypothesise that changes in gross national savings and/or gross domestic investment generate changes in the current account balance. In a perfectly integrated financial market, a current account deficit (surplus) will be balanced by a corresponding capital inflow (outflow) and country's savings decisions will be separated from its investment decisions. It is this criterion for financial integration which we will address in this paper. The paper develops additional evidence on the integration of European financial markets. Contrary to what is usually found regarding savings-investment correlations for world financial markets those correlations in the EC are relatively small. Although, the F-H criterion is controversial it may provide evidence of an increasing degree of financial integration in the EC.

The paper is organized as follows. In section II we discuss three alternative criteria for financial integration i.e. the covered nominal interest parity condition, the uncovered nominal interest parity condition and the ex ante real interest parity condition.

In section III we establish a link between these interest parity conditions and the F-H criterion for financial integration. In section III we also evaluate the use of the F-H criterion for financial integration on the basis of its underlying assumptions. Section IV examines the degree of financial integration in the European Community with the F-H criterion using cross-sectional data. Section V examines the same using time-series data. Section VI concludes the paper.

II. Interest parity conditions

The F-H criterion is related to three interest parity conditions which correspond to three different criteria for financial integration that have been put forward in the literature. Table 1 summarizes algebraically the three different interest parity conditions and sets out the cumulative assumptions to be fulfilled for each condition to hold.

Interest parity conditions examine different types of perfect capital mobility. Perfect capital mobility of a particular type is taken to be the joint hypothesis that bonds, identical in all respects apart from their currency denomination, are perfect substitutes and that arbitrage continually ensures the interest parity condition to hold. The object of arbitrage is to allocate funds between financial markets in order to realize the highest possible return, subject to the least possible risk.

The first criterion for financial integration - covered nominal interest parity (CIP) - examines perfect capital mobility of type I. If CIP holds the forward premium/discount $[f_t-s_t]$ equals the difference between the domestic and foreign nominal interest rate at the appropriate maturity $[i_t-i_t^*]$. Investors cover themselves in the forward exchange market. The first criterion can be framed in terms of the decomposition method of Frankel and MacArthur (1988). Perfect capital mobility of type I requires a zero covered nominal interest differential or in other words a zero country premium $[i_t-i_t^*-(f_t-s_t)]$. The country premium captures the impact of actual and future capital controls, default risks and transactions costs.

Table 1 - Interest parity conditions and their cumulative assumptions

I Covered nominal interest parity (CIP)	
Assumption:	
$i_t - i_t^* = f_t - s_t$	(CIP)
Yields:	
$i_t - i_t^* = f_t - s_t$	(CIP)
II Ex ante uncovered nominal interest parity (UIP)	
Assumptions:	
$i_t - i_t^* = f_t - s_t$	(CIP)
$E_t(s_{t+1}) = f_t$	(yields UIP)
Yields:	
$i_t - i_t^* = E_t(s_{t+1}) - s_t$	(UIP)
III Ex ante real interest rate parity (RIP)	
Assumptions:	
$i_t - i_t^* = f_t - s_t$	(CIP)
$E_t(s_{t+1}) = f_t$	(Yields UIP)
$E_t(s_{t+1} - p_{t+1} + p_{t+1}^*) = s_t - p_t + p_t^*$	(Zero expected real exchange rate change)
Yields:	
$E_t(r_{t+1} - r_{t+1}^*) = 0$	(Ex ante real interest parity)

Symbols:

i_t	= domestic nominal interest rate at period t
s_t	= spot exchange rate at period t (the domestic currency price of foreign exchange)
f_t	= forward exchange rate at period t
p_t	= domestic price level at period t
$f_t - s_t$	= the forward premium/discount at period t
$E_t(s_{t+1})$	= the expectation in period t of the spot exchange rate in period t+1
$E_t(s_{t+1}) - s_t$	= expected spot exchange rate change from period t to t+1
$E_t(r_{t+1})$	= the expectation in time period t of the real exchange rate in period t+1
*	= refers to foreign variables

Note: All variables except the interest rates are expressed in natural logarithms.

Source: Frankel (1989). See also Blundell-Wignall and Browne (1991).

The second criterion - ex ante uncovered nominal interest parity (UIP) - examines perfect capital mobility of type II. Investors take open positions in the foreign exchange market and are risk neutral. Consequently, we may replace the forward exchange rate by the expected spot exchange rate $[E_t(s_{t+1}) = f_t]$. The expected nominal exchange rate change $[E_t(s_{t+1}) - s_t]$ equals the nominal interest differential at the appropriate maturity $[i_t - i_t^*]$. The second

criterion can also be framed in terms of the decomposition method of Frankel and MacArthur. Frankel and MacArthur decompose the nominal interest differential in the following way: $i_t - i_t^* = [i_t - i_t^* - (f_t - s_t)] + [(f_t - s_t) - (E_t(s_{t+1}) - s_t)] + [E_t(s_{t+1}) - s_t] = 0$. Perfect capital mobility of type II requires a zero country premium, a zero exchange risk premium $[(f_t - s_t) - (E_t(s_{t+1}) - s_t)]$ and a zero expected nominal exchange rate change. The exchange risk premium captures the extent to which the forward exchange rate is a biased predictor of the future spot rate.

The third criterion - ex ante real interest parity (RIP) - examines perfect capital mobility of type III or in other words perfect financial and non-financial capital mobility. Non-financial capital mobility refers to the mobility of goods and services and the mobility of the production factors labour and physical capital. Ex ante RIP requires that the expected real interest differential $[E_t[r_{t+1} - r_{t+1}^*]$ is zero. RIP requires not only a zero country premium and a zero exchange risk premium but also a zero expected real exchange rate change $[E_t(s_{t+1} - p_{t+1} + p_{t+1}^*) - (s_t - p_t + p_t^*)]$. This follows from the decomposition of the ex ante real interest differential: $E_t[r_{t+1} - r_{t+1}^*] = [i_t - i_t^* - (f_t - s_t)] + [(f_t - s_t) - (E_t(s_{t+1} - s_t)] + [E_t(s_{t+1} - p_{t+1} + p_{t+1}^*) - (s_t - p_t + p_t^*)]$. Thus, the third term measures the expected real depreciation of domestic currency, i.e. the extent to which ex ante purchasing power parity is violated. The last two terms together constitute the currency premium.

The CIP and the UIP condition coincide with two important theoretical aspects of *financial* integration i.e. the *ability* and the *willingness* to move financial assets across national borders in response to expected differences in exchange-adjusted returns (see e.g. Boothe et al. 1985, Caramazza et al. 1986, Akhtar and Weiller 1987, Reinhart and Weiller 1987a). Two assets are substitutable if investors are willing to change relative shares of their portfolio in response to a change in expected relative returns. Whether asset stocks actually change depends on the

ability of investors to adjust their portfolios.[1] The CIP condition examines the ability of capital movements while the UIP condition examines the willingness of capital movements. As will become clear in the next section, the RIP condition and the F-H criterion not only measures the degree of *financial* integration but also the degree of *non-financial* integration. Interest parity conditions rely on the co-movement of domestic and foreign *prices* (i.e. interest rates) and fit into the price approach. The F-H criterion, however, relies on the co-movement of domestic *quantities* and fits into the quantity approach. In the next section we will examine the link between the interest parity conditions and the F-H criterion.

III. The link between interest parity conditions and the Feldstein-Horioka criterion

Following Dooley et al. (1987, pp. 505-506) we set out the link between interest parity conditions and the F-H criterion. The F-H criterion infers from the correlation between savings and investment - both expressed as ratios of gross domestic product - the degree of capital mobility of type IV. The F-H criterion needs slightly different assumptions than the ex ante RIP condition. If it is true (1) that in each country i the investment rate depends linearly on the expected domestic real interest rate, i.e.;

$$(1) \qquad I_{i,t+1}/Y_{i,t+1} = -\phi E_t(r_{t+1}) + \mu_i$$

and if it is true (2) that the stochastic error term μ_i that captures all other determinants of the investment rate is uncorrelated with the savings ratio in that country;

$$(2) \qquad Cov(\mu_i, S_{i,t+1}/Y_{i,t+1}) = 0$$

and if (3) the savings ratio is not affected by the expected real

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[1] Akhtar and Weiller (1987, p. 19) argue: 'In practice, componants of rates of return, e.g. exchange rates, may adjust quickly without actual movements of capital, that is capital mobility may be just incipient.'

foreign interest rate;

$$(3) \qquad Cov(E_t(r^*_{t+1}), S_{i,t+1}/Y_{i,t+1}) = 0$$

and if (4) deviations from real interest parity are uncorrelated with the savings ratio;

$$(4) \qquad Cov(E_t(r_{i,t+1} - r^*_{t+1}), S_{i,t+1}/Y_{i,t+1}) = 0$$

then a regression of the investment ratio ($I_{i,t+1}/Y_{i,t+1}$) on the savings ratio ($S_{i,t+1}/Y_{i,t+1}$) must yield a zero coefficient. Thus, the F-H criterion for perfect capital mobility of type IV requires a zero coefficient β in the following equation:

$$(5) \qquad I_{i,t+1}/Y_{i,t+1} = \alpha + \beta (S_{i,t+1}/Y_{i,t+1}) + \epsilon_i$$

Equation (5) specifies the F-H criterion for testing the degree of capital mobility of type IV. Dooley et al. summarize these four assumptions in the following equation:[2]

$$(6) \qquad \begin{aligned} &Cov(I_{i,t+1}/Y_{i,t+1}, S_{i,t+1}/Y_{i,t+1}) = \\ &Cov(\mu_i, S_{i,t+1}/Y_{i,t+1}) - \\ &\Phi Cov(E_t(r^*_{t+1}), S_{i,t+1}/Y_{i,t+1}) - \\ &\Phi Cov(E_t(r_{i,t+1} - r^*_{t+1}), S_{i,t+1}/Y_{i,t+1}) = 0 \end{aligned}$$

Note that real interest parity is not required. If it is assumed as in our paper, (4) is automatically satisfied because the first variable in the covariance is non-stochastic. This means that contrary to what is argued in the literature (e.g. Blundell-Wignall and Browne, 1991) real interest parity is not a necessary condition for perfect capital mobility of type IV, it merely is a *sufficient* condition for perfect capital mobility of type IV. Furthermore, note that although the regression must yield a zero coefficient β, if (1)-(4) hold, a zero coefficient β can also be obtained if some terms cancel.

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[2] The equation is based on the specification of the F-H criterion used with *cross-section* analysis. The equation could equally well be specified in a time-series context.

The empirical and theoretical criticism that has been put forward against the F-H criterion is strongly related to above covariances which represent the underlying assumptions of the F-H criterion. Therefore, we briefly analyze these covariances (see e.g. Tesar 1991 for a review).

With reference to the first covariance: *Imperfect financial and or non-financial capital mobility, which means* $Cov(E_t(r_{i,t+1}-r^*_{t+1}), S_{i,t+1}/Y_{i,t+1})\neq 0$. It is very difficult to infer from the F-H results something about the degree of capital mobility of type I or II which may represent the ability and the willingness to move financial assets across national borders in response to expected differences in exchange-adjusted returns. The identification problem of the F-H criterion with respect to financial integration either in cross-section or in time-series analysis is a serious problem (Obstfeld 1986). Recall that RIP is a sufficient condition for perfect capital mobility of type IV which means that the ex ante real interest differential is zero: $E_t[r_{t+1}-r^*_{t+1}]=[i_t-i^*_t-(f_t-s_t)]+[(f_t-s_t)-(E_t(s_{t+1}-s_t)]+[E_t(s_{t+1}-p_{t+1}+p^*_{t+1})-(s_t-p_t+p^*_t)]=0$. RIP simply may not hold because ex ante purchasing power parity may not hold. Consequently, an increase in institutional restrictions on labour mobility, physical capital mobility or on trade in goods and services may cause positive correlation between the savings and investment ratios which may well go together with increasing financial integration. Nonetheless, as we will see in sections IV and V, the pattern of cross-sectional and time-series correlations seems consistent with an increasing degree of financial integration in the EC.

Another disadvantage of the F-H criterion is that it examines *net* financial and non-financial capital mobility. *Gross* financial and non-financial capital mobility may well be higher. Furthermore, in highly integrated financial markets, quick changes of components of the rate of return such as the exchange rate, may well go together with small net movements of capital.

Recently, Sinn (1992) criticised the estimation procedure of the F-H criterion. Sinn criticised the use of *long-term* averages because it may cause an upward bias to the coefficient β. The

adjustment period of current account imbalances may be short. Sinn argues: "Since saving and investment shares are approximately equal if averaged over the adjustment period, a correlation coefficient calculated from average savings and investment shares is likely to be higher than one that is not." Sinn continues: "It would erroneously signal a low degree of international capital mobility because it ignores net capital flows that have occurred in reverse directions during the period over which averages are taken."

Feldstein and Bacchetta (1989) argue that the coefficient β not only measures the degree of capital mobility of type IV between EC member states but also between EC member states and abroad which of course also include countries like the United States and Japan. The coefficient β measures the extent to which individual EC countries retain their national savings within their country.

The F-H criterion is also more indicative of capital market integration than of money market integration because investment and savings decisions are usually made with a fairly long time horizon. An advantage of the F-H criterion is that it considers all (long-term) capital flows that result from trade in shares and in (long-term) bonds. Interest rate parity conditions only consider segments of financial markets which correspond to bonds with a specific maturity.

With reference to the second covariance: *The foreign expected real interest rate is endogenous, which means* $Cov(E_t(r^*_{t+1}), S_{i,t+1}/Y_{i,t+1}) \neq 0$. The second covariance says that savings and investment ratios may be correlated even in the presence of perfect capital mobility of type III because of the effect of country size. The first interpretation of the country-size argument is as follows. Small countries take the world interest rate as given, while changes in savings and investment behaviour of large countries will have an impact on the world interest rate (Tesar 1991, p. 68).[3] The second interpretation of the country-size argument follows from Harberger (1980). Harberger argues that in small unidirectional countries

[3] Large countries are countries with a large share of world output and likely have a large share in world's savings and investment.

savings and investment shocks do not compensate each other while in large diversified countries this does happen. When a country becomes larger it also becomes more diversified and the need to borrow from abroad in the event of a shock declines. Differences between savings and investment are therefore greater in small than in large countries. These greater differences, however, do not mean that the degree of capital mobility of type IV is higher.

With reference to the third covariance: *S and I are endogenous, which means* $Cov(\mu_i, S_{i,t+1}/Y_{i,t+1}) \neq 0$. Even with perfect capital mobility of type III savings and investment ratios may be positively correlated for reasons unrelated to capital mobility. This simultaneity of savings and investment ratio especially arises in time-series analysis but may also arise in cross-section analysis. The stochastic error term μ_i that captures all other determinants of the investment rate - other than the ex ante real interest rate of that country - may be correlated with the savings ratio in that country. Private sector behaviour such as business cycles, productivity shocks and population growth may cause positive correlations. Obstfeld (1986), for example, argues that the growth rate of income may simultaneously affect saving and investment. Not only private sector behaviour but also public sector behaviour may cause savings and investment to be positively correlated. For example, a government - which aims at long-term current account balance - reacts to a current account deficit caused by growing investment with raising taxes or lowering their spending (Westphal 1983, Summers 1988). A government may also use policy instruments to balance savings and investment of the private sector in the light of its current account target (Artis and Bayoumi 1991). Artis and Bayoumi (1991, p. 301) note that common cause variations in savings and investment of the private and public sector (positively correlated shocks), or inversely correlated shocks to public and private balances, will suffice to induce a high correlation between total savings and investment. In a short-run context structural factors are likely to affect both saving and investment more than in a long-run context. Dooley et al. (1987, p. 508) argue: "*Any* economic variable, in addition to the cost of capital that influences the investment rate, will probably be correlated with the national saving rate."

Endogenous savings and investment make the use of OLS inappropriate. An econometric solution to the simultaneity problem of saving and investment ratios is offered by the use of instrumental variables. Instrumental variable estimation requires an instrumental variable that is highly correlated with the savings ratio ($S_{i,t+1}/Y_{i,t+1}$) and uncorrelated with the error term (ϵ_i). However, these 2SLS-estimates of the coefficient β do not particularly differ from OLS-estimates (Dooley et al. 1987, p. 518).

Summing up, the interpretation of the F-H criterion is based upon four assumptions which must hold before no correlation between savings and investment ratios would be expected. Therefore, interpretation of the F-H criterion must be done with caution. In the next section a cross-sectional analysis of savings-investment correlations is carried out.

IV. The Feldstein-Horioka Criterion and Cross-Section Analysis

The F-H criterion for testing the degree of financial integration in the EC with cross-section data can be specified as follows:

$$(5) \qquad I_{i,t+1}/Y_{i,t+1}=\alpha+\beta\,(S_{i,t+1}/Y_{i,t+1})+\epsilon_i$$

where ϵ_i stands for the error term and i stands for the country index. F-H convert gross national savings [$S_{i,t+1}$] and gross domestic investment [$I_{i,t+1}$] into relative form by dividing by gross domestic product [$Y_{i,t+1}$]. The coefficient β is called the "savings retention coefficient" and indicates the proportion of the incremental savings that is invested domestically (Feldstein and Bacchetta 1989). When financial markets are not integrated the current account is forced to balance and the coefficient β should be unity. With perfect capital mobility of type IV a zero value of β is predicted. The annual data are taken from the 1992 release of National Accounts of OECD countries, Main Aggregates 1960-1990, Volume I. A non-zero statistical discrepancy is split equally between savings and investment (see data appendix).

We distinguish two country-groupings. The first cross-section consist of 9 core EC member states excluding Greece, Portugal and Luxemburg (EC-9). The second cross-section consists of 6 core ERM countries: Germany, France, Italy, Belgium, Denmark and the Netherlands (ERM-6).[4] The sample period 1967-1990 is divided into two equal sub-periods: 1967-1978 and 1979-1990. The division reflects the formation of the European Monetary System (EMS), the establishment of the Exchange Rate Mechanism (ERM) and the European Currency Unit (ECU) in 1979. The ratios of savings and investment to GDP are averaged over the period 1967-1990 and the sub-periods 1967-1978 and 1979-1990 in order to avoid bias caused by the correlation of savings and investment over the business cycle. The cross-section data are plotted in figure 1. Savings and investment ratios are averaged over the period 1967-1978 and the period 1979-1990. Figure 1 is a first illustration of the relationships subsequently found by OLS-estimation of the F-H criterion. An observation on the 45°-line indicates that the country's current account is balanced. An observation above the 45°-line reflects a current account deficit i.e. the country's domestic investment exceeds its supply of national savings and the country is a net borrower in the international capital market (Tesar 1991, p. 61). An observation below the 45°-line reflects a current account surplus. National savings exceed domestic investment. The country must have a corresponding capital account deficit (i.e. a capital outflow). The capital account is simply the inverse of the current account.

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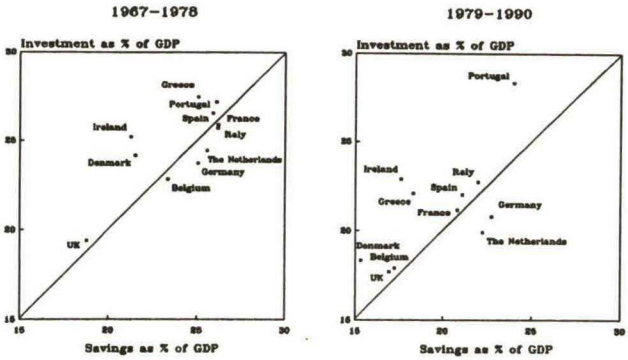
[4] EC member states which participate in the ERM of the EMS during the period 1979-1990 are: Denmark, Germany, France, Italy, Ireland, Belgium, Luxemburg and the Netherlands (as of 13 March 1979), Spain (as of 16 June 1989), the United Kingdom (as of 8 October 1990). Denmark, Germany, France, Ireland, Belgium, Luxemburg and the Netherlands have a fluctuation margin of ± 2.25%, Italy ± 6% and as of 8 January 1990 ± 2.25%, Spain and the United Kingdom ± 6%.

Figure 1 - $S_{i,t+1}/Y_{i,t+1}$ versus $I_{i,t+1}/Y_{i,t+1}$ for EC member states (excluding Luxemburg), Averages during the period 1967-1978 and the period 1979-1990



Source: OECD (1992), National Accounts of OECD Countries, Main Aggregates 1960-1990, Volume I.

Cross-section analysis may not be useful if there are significant differences between the correlation of savings and investment ratios across EC countries. This is why we exclude Portugal and Greece (assuming high correlation) and Luxemburg (assuming low correlation) from our sample. The scatter plots in figure 1 show that Portugal and Greece have an "outlier" effect on the results. Luxemburg even lies out of the range of the graph. Furthermore, Greece is the only EC member state which national accounting definitions of savings and investment are based on the earlier S.N.A.-definitions (see data appendix). Greece almost certainly has less claim to be included among the nine core EC countries than either Spain or Portugal.

We estimated the standard cross-section specification of the F-H criterion in level form for EC-9 and ERM-6 with ordinary least squares (OLS). The results are summarized in table 2.

Table 2 - The F-H criterion and cross-section analysis

(OLS estimation of equation $I_{i,t+1}/Y_{i,t+1}=\alpha+\beta(S_{i,t+1}/Y_{i,t+1})+\epsilon_i$, EC-9 and ERM-6)

EC-9			
Period (t)	$\hat{\alpha}$	$\hat{\beta}$	$\bar{R}^2$
1967-1990	0.12	0.49†	0.34
	(0.05)	(0.22)	
1967-1978	0.10	0.60	0.51
	(0.05)	(0.20)	
1979-1990	0.12	0.42*	0.23
	(0.05)	(0.23)	
ERM-6			
Period (t)	$\hat{\alpha}$	$\hat{\beta}$	$\bar{R}^2$
1967-1990	0.13	0.44*	0.43
	(0.05)	(0.20)	
1967-1978	0.15	0.40*	0.25
	(0.06)	(0.25)	
1979-1990	0.11	0.47‡	0.52
	(0.04)	(0.18)	

* indicates that the coefficient β is insignificantly different from zero and significantly different from one at the 5% level of significance.
† indicates that the coefficient β is imprecisely estimated and differs insignificantly from zero and insignificantly from one at the 5% level of significance.
‡ indicates that the coefficient β is imprecisely estimated and differs significantly from zero and significantly from one at the 5% level of significance.

Standard errors are shown in parentheses.

Source: OECD (1992), National Accounts of OECD Countries, Main Aggregates 1960-1990, Volume I.

The results for the EC-9 in table 2 show a decline in the estimated value of β in the period 1979-1990 relative to the period 1967-1978 indicating an increasing degree of capital mobility of type IV. Following Feldstein and Horioka (1980) and Feldstein (1983) we simultaneously test the null hypothesis H_0: $\beta=0$ against the alternative hypothesis H_1: $\beta\neq0$ and the null hypothesis H_0: $\beta=1$ against the alternative hypothesis H_1: $\beta\neq1$ at the 5 % level of significance.[5] The results for the EC-9 reported in table 2 show that the coefficient β is imprecisely estimated in period 1967-1990. The coefficient β is significantly different from zero and insignificantly different from one in the sub-period 1967-1978.

[5] Obstfeld (1986, p. 66) argues: 'Since the least-square estimate of β is not, strictly speaking, a correlation coefficient, there is no reason for it to be less than 1.'

We statistically speak of perfect capital immobility of type IV in the sub-period 1967-1978. The coefficient β is insignificantly different from zero and significantly different from one in the sub-period 1979-1990. The assumption of perfect capital mobility of type IV can not be rejected by the F-H regression.[6] Nevertheless it is questionable if all assumptions underlying the F-H test are met (see section IV). The above results are also illustrated in figure 2 by the greater dispersion of points around the 45°-line in the sub-period 1979-1990 relative to the sub-period 1967-1978.

The ERM-6 estimates for β are smaller than the EC-9 estimates. From this finding we may conclude that capital mobility of type IV between ERM-6 countries is higher than between EC-9 countries. It seems that the ERM-6 countries are already substantially integrated. This may be accounted for by the lack of currency risk and by the strong interdependence of their economies. The results for the ERM-6, however, show a rise in the estimated value of β in the period 1979-1990 relative to the period 1967-1978 indicating a decreasing degree of capital mobility of type IV. The apparent higher correlation in the period 1979-1990 relative to 1967-1978 for the ERM-6 may be explained by to emerging investment opportunities in Europe after the formation of the EMS in 1979 (Obstfeld 1989). The formation of the EMS in 1979 caused a pattern of investment increases financed by foreign savings. This upward bias to savings-investment correlations for the ERM-6, however, bears no relation with increased financial integration in the European Community. Although it is difficult to interpret savings-investment correlations, the apparent lower cross-sectional savings-investment correlation for European financial markets do challenge the view what was usually found for world financial markets. Most savings-investment correlations are sufficiently far from the value of unity to conclude that financial markets are not closed.

Although cross-sectional data may be subject to less serious econometric problems, the next section also examines time-series

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[6] In real world, of course, the degree of capital mobility of a particular type lies somewhere between perfect capital mobility and perfect capital immobility.

data of savings and investment of individual EC countries. The motivation for doing both time-series and cross-sectional analysis stems from the fact that cross-sectional analysis does not allow comparison between individual EC countries and may not be useful if there are significant differences between correlation of savings and investment in EC countries. Therefore, a high statistical correlation between savings and investment based upon EC cross-sectional data does not necessarily indicate a low degree of capital mobility of type IV for each individual EC country.

V. The Feldstein-Horioka Criterion and Time-Series Analysis

The F-H criterion for testing the degree of financial integration of EC member states with time-series data can be specified as follows:

(6) $$I_{t+1,i}/Y_{t+1,i}=\alpha+\beta\,(S_{t+1,i}/Y_{t+1,i})+\epsilon_t$$

Table 3 summarizes the results of testing the degree of financial integration of individual EC member states with time-series data.

Table 3 - The F-H criterion and time-series analysis

(OLS estimation of the equation $I_{t+1,i}/Y_{t+1,i}=\alpha+\beta(S_{t+1,i}/Y_{t+1,i})+\epsilon_t$, 12 EC member states)

Period (t)	$\hat{\alpha}$	β	DW	$\bar{R}^2$
Germany				
1967-1990	0.03	0.81	0.37	0.60
	(0.03)	(0.14)		
1967-1978	-0.01	1.00	1.09	0.91
	(0.02)	(0.10)		
1979-1990	0.19	0.10*	0.50	-0.08
	(0.06)	(0.24)		
UK				
1967-1990	0.14	0.26*	0.62	0.02
	(0.04)	(0.21)		
1967-1978	0.15	0.22*	1.58	0.01
	(0.04)	(0.21)		
1979-1990	0.27	-0.54*	0.85	0.03
	(0.08)	(0.48)		
France				
1967-1990	0.03	0.88	1.81	0.93
	(0.01)	(0.05)		
1967-1978	0.02	0.92	2.27	0.68
	(0.05)	(0.19)		
1979-1990	0.03	0.87	1.14	0.81
	(0.03)	(0.13)		
The Netherlands				
1967-1990	0.00	0.92	0.50	0.61
	(0.04)	(0.15)		
1967-1978	0.03	0.86	0.60	0.53
	(0.06)	(0.24)		
1979-1990	0.15	0.21*	0.71	-0.01
	(0.05)	(0.22)		
Italy				
1967-1990	0.07	0.72	1.40	0.60
	(0.03)	(0.12)		
1967-1978	0.14	0.44†	1.69	-0.03
	(0.14)	(0.52)		
1979-1990	0.048	0.81	1.57	0.64
	(0.04)	(0.18)		
Belgium				
1967-1990	0.06	0.69‡	0.55	0.70
	(0.02)	(0.09)		
1967-1978	0.16	0.28*	2.01	0.15
	(0.04)	(0.17)		
1979-1990	0.09	0.53	0.36	0.26
	(0.04)	(0.24)		

* indicates that the coefficient β is insignificantly different from zero and significantly different from one at the 5% level of significance.
† indicates that the coefficient β is imprecisely estimated and differs insignificantly from zero and insignificantly from one at the 5% level of significance.
‡ indicates that the coefficient β is imprecisely estimated and differs significantly from zero and significantly from one at the 5% level of significance.

Standard errors are shown in parentheses.

Source: OECD (1992), National Accounts of OECD Countries, Main Aggregates 1960-1990, Volume I.

Table 3 - Continued

Period (t)	$\hat{\alpha}$	β	DW	R^2
Ireland				
1967-1990	0.20	0.20*	0.39	-0.03
	(0.07)	(0.34)		
1967-1978	0.18	0.33†	1.07	-0.08
	(0.15)	(0.68)		
1979-1990	0.29	-0.34†	0.31	-0.07
	(0.12)	(0.67)		
Spain				
1967-1990	0.04	0.89	0.71	0.67
	(0.03)	(0.13)		
1967-1978	0.11	0.59†	1.00	0.19
	(0.08)	(0.31)		
1979-1990	0.03	0.91†	0.55	0.24
	(0.09)	(0.43)		
Denmark				
1967-1990	0.06	0.85	1.18	0.83
	(0.02)	(0.08)		
1967-1978	0.10	0.64‡	2.50	0.59
	(0.03)	(0.16)		
1979-1990	0.10	0.56†	0.93	0.26
	(0.04)	(0.26)		
Portugal				
1967-1990	0.21	0.26*	0.66	0.08
	(0.04)	(0.15)		
1967-1978	0.20	0.27*	1.03	0.23
	(0.03)	(0.13)		
1979-1990	0.20	0.36†	0.56	-0.03
	(0.10)	(0.43)		
Greece				
1967-1990	0.09	0.75‡	1.50	0.89
	(0.01)	(0.06)		
1967-1978	0.00	0.97	1.60	0.85
	(0.03)	(0.12)		
1979-1990	0.10	0.64‡	1.72	0.86
	(0.02)	(0.08)		
Luxemburg				
1967-1990	0.23	0.035*	1.00	-0.02
	(0.03)	(0.05)		
1967-1978	0.18	0.15*	0.99	-0.03
	(0.07)	(0.18)		
1979-1990	0.25	0.00*	1.15	-0.10
	(0.04)	(0.07)		

The coefficient β is insignificantly different from zero and significantly different from one in the following countries: Germany (1979-1990), the United Kingdom (1967-1990, 1967-1978, 1979-1990), the Netherlands (1979-1990), Belgium (1967-1978), Ireland (1967-1990), Portugal (1967-1990, 1967-1978) and Luxemburg (1967-1990, 1967-1978, 1979-1990). We then statistically speak of perfect capital mobility of type IV. However, according to the second interpretation of the country-size argument from Harberger

(1980) we may not always conclude to perfect capital mobility of type IV when the coefficient β is insignificantly different from zero and significantly different from one at the 5% level of significance. This may for example be the case for countries like Ireland, Greece and Portugal.

The empirical results seem consistent with an increasing degree of capital mobility of type IV in the 1980s. It seems that countries participating in the Exchange Rate Mechanism of the EMS have lower saving-investment correlations - and hence their financial markets are more integrated. From section III and IV we know that departures from perfect capital mobility of type IV may be caused by investors who are risk averse with respect to exchange risk. Therefore, an important explanation for higher financial market integration may be the smoothing of exchange rate volatility of ERM countries. Bhandari and Mayer (1990) conclude (...) "it appears that the exchange rate stability achieved in the EMS has been an important factor promoting capital mobility". Feldstein and Bacchetta (1989) argue: "Although capital might in principle flow with equal ease among all countries or at least all industrial countries, the availability of market information, the existence of institutional relationships, and the perception of risk might make capital flows greater among some pairs of countries than among others." Within the EMS, the ERM countries have lower savings-investment correlations than the other EC countries with the United Kingdom as the notable exception. The United Kingdom already abolished its exchange controls in 1979 and further liberalised its financial markets in the 1980s.

However, some evidence of increasing capital mobility of type IV in the 1980s relative to the 1970s seems ambiguous, since $\hat{\beta}$ falls while R^2 rises. Table 3 also includes the DW statistic. The time-variation of $\hat{\beta}$ and the Durbin-Watson (DW) statistic may cast doubts on the empirical results. We test the null hypothesis that no serial correlation is present (H_0: $\rho=0$) against the alternative hypothesis that positive or negative serial correlations are present (H_1: $\rho\neq0$). Table 3 shows that the equation $I_{t+1,i}/Y_{t+1,i}=\alpha+\beta(S_{t+1,i}/Y_{t+1,i})+\epsilon_t$ is not always for every country and for every period the correct model because of positive serial correlation. The

exclusion of important independent variables may cause positive serial correlation. However, introducing new variables would frustrate the essence of the F-H criterion which is based on an accounting framework. On the other hand, it is this accounting framework and the lack of a good underlying structural model in which the relationships between savings, investment and capital mobility are specified which presents a serious problem (Mishkin 1986, p. 70). In the presence of positive serial correlation, ordinary least squares underestimates standard deviations and thus overestimates t-statistics. We tend to erroneously reject the null hypotheses while the null hypotheses are true. Spain and Portugal show structural positive serial correlation for each period considered. This positive serial correlation may be explained by the thinness of their financial markets. Positive serial correlation may also cause imprecise estimates of the coefficient β. Therefore, the interpretation of the results must be done with caution.

VI. Conclusions

This paper evaluates the use of the F-H criterion to measure the degree of financial integration in the European Community. Furthermore, we established a link between interest parity conditions and the F-H criterion. It is difficult to accept that most evidence from savings-investment correlations with respect to a sample of OECD countries often contradicts with the finding of high capital flows in world financial markets. We underpinned that much of these high correlations in world financial markets were due to the underlying assumptions of the F-H criterion. Our evidence from the EC suggests that high savings-investment correlations are typical for world financial markets.

We presented some new evidence on the cross-sectional correlations of savings and investment of nine core-EC countries and of six core-ERM countries. Furthermore, we presented some new evidence on the time-series correlations of savings and investment in all twelve EC countries. The results for the cross-section of nine core-EC countries show an increasing degree of capital mobility of type IV in the 1980s. Moreover, the group of six core-ERM

countries show an even smaller estimate for the coefficient β reflecting probably smaller currency risks and strong economic interdependence within the group of ERM countries. The time-series results for the twelve individual EC countries confirm this finding. In Germany and the Netherlands the estimate for β is insignificantly different from zero and significantly from one in the period 1979-1990. The United Kingdom and Luxemburg have estimates for β which are insignificantly different from zero and significantly from one in all periods considered. Therefore, the results obtained from the F-H criterion support what we observe in real world. Although the criticism of the F-H criterion will not wash, the line of reasoning of the F-H criterion and casual empirism provide enough evidence to classify EC countries with respect to their capital mobility of type IV (and thus with respect to their financial and non-financial integration). As a result, we might expect further declines in savings-investments correlations of EC countries.

Concluding, the F-H criterion has some meaning in quantifying the degree of financial integration in the European Community. Its value for quantifying the degree of financial integration will further increase when it is examined in combination with related criteria for financial integration such as the covered interest parity, the uncovered interest parity and the ex ante real interest parity condition.

Data Appendix

Gross national savings, gross domestic investment and gross domestic product
Data of gross national savings, gross domestic investment and gross domestic product are taken from OECD (1992), National Accounts of OECD Countries, Main Aggregates 1960-1990, Volume I. Gross national savings, gross domestic investment and gross domestic product are taken at current prices. The OECD-definitions of gross national savings, gross domestic investment and gross domestic product of all EC member states except Greece are the one used in the United Nations *Present* System of National Accounts (S.N.A.). Definitions of Greece are based on an earlier system. The national accounting framework underlying the F-H criterion can be specified as follows:

$$S = GNP - C + NCT$$
$$GNP = C + I + X - M + NFI$$
$$S = I + X - M + NFI + NCT$$

$$I = FCF + ST$$

Now, the current account of the balance of payments can be written as the balance of national savings and domestic investment.

$S = I + CA$
$CA = S - I$

Furthermore, Artis and Bayoumi (1991) show that the current account can also be specified as the sum of private and public sector savings-investment balances.

$CA = (S_p - I_p) + (S_g - I_g) = S - I$

The statistical discrepancy is split equally between savings and investment so that the identity containing only the three aggregate variables, S, I and the CA, holds exactly across all countries.

CA = (S + 1/2 * statistical discrepancy) - (I - 1/2 * statistical discrepancy)
CA = S' - I'

EC countries reporting a non-zero value for the statistical discrepancy include: United Kingdom, The Netherlands, Italy, Spain and Portugal.

Following Feldstein and Horioka (1980) gross national savings and gross domestic investment are converted into relative form by the dividing by gross domestic product.

Y = GNP + NFI

Symbols:
- S = gross national savings
- I = gross domestic investment
- C = total private and government final consumption expenditure
- M = import of goods and services
- X = export of goods and services
- Y = gross domestic product
- CA = current account of the balance of payments
- GNP = gross national product
- NCT = net current transfers from the rest of the world
- NFI = net factor income from the rest of the world
- FCF = gross fixed capital formation
- ST = increase in stocks
- S_p = gross national savings by the private sector
- S_g = gross national savings by the public sector
- I_p = gross domestic investment by the private sector
- I_g = gross domestic investment by the government sector
- ' = corrected for a nonzero value of the statistical discrepancy

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