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Co-Integration between Mortgage Markets in the Monetary Union: 1995–2008*

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Abstract
This study provides evidence on the level of integration within the European Monetary Union mortgage markets between 1995 and 2008. The relationships between national mortgage markets are analyzed and an assessment is made of the extent to which these co-integrate with one another and with the average. In order to achieve this, mortgage interest rate series are studied using co-integration methodology. The process reveals that there are few relationships of this kind, and those that exist are most prevalent in the period 2000–2005 and, to a lesser extent, at the end of the period analyzed.

1. Introduction

A financial market, the mortgage market for example, may be considered to be integrated if all of its potential participants, from both the demand and supply sides, have similar characteristics. Furthermore, the way they operate must be subject to a unique set of rules on the use of market instruments and/or financial services and they must enjoy equal access to these and be treated equally (Baele, Ferrando, Hördahl, Krylova, and Monnet, 2004).

Various mortgage markets might be subject to integration, irrespective of the relative level of cross-country heterogeneity of financial structures. The systems of financing used by those entities that grant mortgages, for example, is different in practically every country, while the levels of integration may remain relatively high between these markets.

Financial integration is achieved when there is not enough friction to generate discrimination between economic agents with respect to capital access or financial market investment, and in particular with regard to the geographical location of these markets. This does not necessarily imply that there are no frictions within the market, but rather it implies that these affect all of the users symmetrically in all of the different regions.

The integration of housing finance within European mortgage markets was examined in a House of Lords Select Committee report of 1985. It stated that the harmonization, co-ordination, and mutual recognition of financial institutions and mortgage and savings instruments was minimal. The report went on to state that the various housing finance systems might continue to develop at different rates.

The first measure aimed at attaining a greater level of integration within the mortgage markets was the enactment of the European Code of Conduct in 2001.

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This voluntary code focused on providing transparency and standardized information for borrowers, and was taken up by the majority of the countries in the EU Monetary Union, although the impact on mortgage markets has been limited (Suárez, 2008).

It is generally accepted that there are many benefits to be gleaned from financial market integration. In 2002, the European Financial Services Round Table published a report setting out what these potential gains might be for the European Union retail financial markets. The report emphasized factors such as substantial advantages for consumers, increased economic growth[1] and a greater role for the euro (Heinemann and Jopp, 2002).

The Mercer Oliver Wyman report for the European Mortgage Federation identified a further series of potential advantages from mortgage market integration in the EU. The list cited included a greater range of products available, increases in cost efficiency derived from economies of scale, and greater diversification within loan and asset portfolios (Low, Sebag-Montefiore, and Dübel, 2003).

In spite of this evidence, mortgages are still not subject to specific Community legislation. However, in view of the expected advantages from a more highly integrated mortgage lending system, the EU set up the Forum Group on Mortgage Credit in March 2003. This body had three main objectives; to identify the barriers to an internal mortgage market, to analyze what impact these would have, and to propose recommendations to surmount or circumvent potential problems they might create. In December 2004 the Forum Group presented its report, which contained 48 general recommendations divided into five basic areas. These areas were: consumer confidence, legal, collateral and distribution issues, and finance. The commission placed special emphasis on achieving greater integration through research into the resultant costs and benefits of the process.

In May 2005 the European Commission published a Green Paper on Financial Services Policy (2005–2010). The document, which covers the EU's financial service policy for the five years following publication, highlights the EU's need to achieve a single market for financial services. The Green Paper also emphasizes the benefits of greater integration. In July 2005 a second Green Paper on mortgage credit was published. Its aim was to assess the advantages of the Commission's intervention in EU mortgage credit markets by following the 48 proposals in the Forum Group report.

In August 2005, the EU commissioned the London Economics to write a report analyzing the costs and benefits of integrating the mortgage credit markets while, at the same time, considering the impact of integration on credit entities and consumers. The report included an assessment of the net present value[2] of mortgage market integration under certain given conditions. The analysis went on to offer a vision of how integration might affect mortgage markets and the economy in general, offering a frame of reference for future debates on EU mortgage market development.

[1] Studies such as the Cecchini Report (Cecchini, Catinat, and Jacquenin, 1988), London Economics (2002) or the paper by Giannetti, Guiso, Jappelli, Padula, and Pagano (2002) quantify the relationship between financial integration and economic growth.

[2] Until 2015 the net present value is estimated at €94,600 million, the equivalent of 0.89% of 2005 GNP (London Economics, 2005).

At the end of 2006 the European Commission officially published a report written by the Mortgage Funding Expert Group and the Mortgage Industry and Consumer Dialogue Group,[3] which was set up in 2006. The aim of the research was to further assess European mortgage market integration and was effectively an extension of the consultation process carried out in the Green Paper on Mortgage Credit, designed to take in refinancing and consumer protection. Thus, the sector was offered the chance to express its concerns and to reflect them in the White Paper on Mortgage Credit, which was published at the end of 2007. This report is based on the results of a series of consultations and studies over the period 2003–2007. It identifies the problems in EU mortgage markets, sets out the objectives of the Commission's policy in the field of mortgage credit, considers the different policy options with which to achieve them, and assesses their potential impact. The policy decisions presented in the White Paper will be further developed in close cooperation with all relevant stakeholders and will be subject to proportionate impact assessments before adoption.

There are several studies[4] that reinforce the popular belief that mortgage markets remain largely unintegrated, especially with respect to the availability of products and cross-border financial activity.[5] Despite a recent reduction in prices, widespread disparities persist.

The aim of this paper is to determine the level of integration of mortgage markets in the member states of the Economic and Monetary Union and the evolution of this integration over the period analyzed (1995–2008). The study attempts to identify those markets which are most highly integrated in order to facilitate the flow of information with respect to the integration process and, in short, to help optimize the benefits derived from this process. This is carried out by analyzing the co-integration of mortgage rate series in both nominal and spread terms for each country, comparing with the average and between pairs of countries.

The paper is structured as follows. Section 2 revises some of the literature that already exists on financial market integration, with special emphasis on mortgage markets. Section 3 describes the database and methodology used. Section 4 provides the co-integration analysis, in which the results are applied to the mortgage rates of each country in the Monetary Union. Section 5 sets out the study's main conclusions.

2. Mortgage Market Integration: Literature Review

There are a number of works that analyze financial market integration. The majority of these concentrate on wholesale finance markets such as the currency or bond markets. While the results of these studies are not in total agreement, the existing evidence certainly suggests that EU wholesale finance markets are moderately integrated today.[6] To date, however, there have been few studies that have looked at the de-

[3] European Commission (2006).

[4] Among others Low et al. (2003) and Forum Group on Mortgage Credit and London Economics (2005).

[5] The level of direct foreign sales is low at less than 1% of the general activity in housing mortgage credit. Cross-border mortgage credit often goes towards the purchase of a holiday home or purchases in border regions (Eurobarometer June Report, 2004).

[6] For a comprehensive review of the main works on worldwide financial market integration for both the wholesale and retail markets, see Schüler and Heinemann (2002).

gree of integration in European retail financial markets, probably because of the underlying assumption that they are clearly very different.[7] It would not be an exaggeration, therefore, to claim that retail financial market integration is some way behind its wholesale counterpart.

Both direct and indirect approaches have been used to measure the level of integration of financial markets. The direct approach involves identifying economic and legal barriers to international capital mobility, while the indirect approach consists of weighing the observable consequences of those existing barriers which can be measured in terms of price, quantity or news-based measures (Baele et al., 2004).

The European Mortgage Federation (1996) was the first body to directly study the main obstacles to the cross-country availability of services and the freedom to set up mortgage credit institutions that remained after the Second Banking Directive. This study was subsequently extended by an analysis that looked at tax barriers.[8] More recently, the final chapters of a report by Mercer Oliver Wyman have identified the main barriers to integration in the mortgage market, findings that are corroborated by those of the Forum Group on Mortgage Credit (2004).

Indirect approaches to measuring the level of integration in the financial markets may involve the use of price, news or quantity-based measures. Quantitative approaches measure the level of internationalization of investor portfolios. This type of analysis complements the price approach, which is based on the idea that, in a perfectly integrated financial market, arbitrage would ensure that the prices of identical assets negotiated on different markets were the same, i.e., the Law of One Price would be fulfilled.[9]

A quantitative approach to the analysis of mortgage integration is potentially problematic, as there is no generally accepted definition of cross-border mortgage credit. Furthermore, the area itself stimulates little interest since cross-border mortgage credit represents less than 1% of all European mortgage credit activity (Eurobarometer Report, 2004).

News-based measures are founded on the idea, which is inherent within the concept of integration, that asset prices should only react to commonly available news. Therefore, an alternative measure of integration is the proportion of asset price changes that is explained by common factors. The main problem with these measures is the difficulty of finding a proxy for commonly available news. Baele et al. (2004) analyze the integration of mortgage markets using measures of this type and find that the markets are fairly fragmented.

One of the first studies to analyze prices in retail financial markets was the Cecchini Report (Cecchini, Catinat, and Jacquenin, 1988). This analysis demonstrated the level of fragmentation of the European financial service markets, based on significant price differences. The report also includes the potential benefits for consumers, based on a greater degree of financial market integration.

[7] See Schüler and Heinemann (2002), Cabral, Dierick, and Vesala (2002), Sander and Kleimeier (2001, 2004), Kleimeier and Sander (2000, 2002, 2005), and Baele et al. (2004), among others.

[8] European Mortgage Federation (1998).

[9] For an analysis of different approaches to measuring financial integration, see Schüler and Heinemann (2002).

A more recent study by Mercer Oliver Wyman includes an analysis of the level of integration of mortgage credit markets of the different member states. After analyzing price levels the study concludes that there are no great differences. The authors state that "the overall price levels adjusted[10] for product differences are currently uniform across markets" (Low et al., 2003:35). Similar results were obtained when the research was extended to 2006 and the number of countries analyzed enlarged to 13.[11] There was an important decrease in mortgage margins during the last few years of the period analyzed (Mercer Oliver Wyman, 2007).

This type of study, which analyzes prices, tends to be problematic in that it is enormously difficult to find completely identical products, a prerequisite if prices are to be compared (Zimmerman, 1995). This is more likely to be the case if risk and cultural differences remain and if bank-client relationships involve long-term strategies, like in mortgage markets for example (Fernández de Guevara, Maudos, and Pérez, 2007), particularly in the case of mortgage markets for example. The Law of One Price is only applicable to assets that are perfect substitutes between countries, such as public debt or monetary market instruments.

It remains true, however, that prices of financial products in retail banking will be more closely aligned when greater integration exists between markets (Kleimeier and Sander, 2000). Thus in integrated markets, in the long term, a certain relation should exist between the different interest rates in different countries. Nonetheless, this does not mean that the rates will be the same; in the short term, retail rates will vary transitionally.

The concept of co-integration is equivalent to the statistical notion of stable equilibrium over time. Hence, when a relation of this type exists between economic variables, the variations in it cannot be permanent. Therefore, co-integration techniques may be used to assess the level of integration in retail financial markets. Some works, notably those of Centeno and Mello (1999), Kleimeier and Sander (2000, 2002, 2005), Sander and Kleimeier (2001, 2004), Heinemann and Schüler (2002, 2003), Schüler and Heinemann (2002) and López, Maside, and López (2006), have used co--integration techniques in this sense. These works use different methodologies and tests to study co-integration, but their results coincide: the level of integration in the various retail markets is very low.

3. Data Base and Methodology

3.1. Data

The analysis was confined to countries using the euro, since a single currency is a fundamental factor when it comes to financial integration. Monthly mortgage rate data obtained from the "Retail interest rate statistics" of the European Central Bank (N2 series) was used in the analysis. These series are available for the following countries in the EMU: Germany, Austria, Belgium, Spain, Finland, France, Greece[12],

[10] The study is based on the mortgage markets of Denmark, Germany, France, the Netherlands, Spain, Portugal, and the UK and the adjustments carried out are as follows: commissions for prepayment, interest rate structure, and credit risk.

[11] This work looks at 13 mortgage markets: Belgium, the Czech Republic, Greece, Ireland, and Sweden as well as the eight included in the initial report.

[12] The Greek mortgage rate series is not included in this work as information is only available from January 1999 onwards. Furthermore, Greece did not become a member until January 2001.

the Netherlands, Ireland, Italy, and Portugal – some from January 1980 to September 2003 and from January 2003 to June 2008.[13]

The above period was one in which the development of the EMU was particularly intense. Of particular importance for the integration of financial markets were the Second Banking Directive (January 1, 1993) and the introduction of the single currency (January 1, 1999), both of which played key roles in the movement towards harmonization. Furthermore, in 1999 the European Commission approved the Financial Services Action Plan, a set of interventions that were orchestrated to take place between 1999 and 2005. These aimed to create a single wholesale financial market, to open up retail markets and make them more secure, and to revise and streamline the financial regulations of the member states.

The mortgage rates start at levels of more than 10%, increase at the end of the 1980s, and peak in 1990 prior to a marked general fall accompanied by a process of convergence. During 2000 there was a minor controlled recovery characterized by certain slight decreases (see *Graph 1* in the *Appendix on the web page of this journal*).This recovery was the result of legislation passed at Maastricht and subsequently the adoption of the single currency. Graphically, convergence is seen to take place most intensively during the mid-1990s, the differences becoming less pronounced after 2002. To some extent this may have been due to a global fall in interest rates. From 2006 until mid 2008, mortgage interest rates rose, reaching a peak prior to a general fall as a consequence of the economic crisis afflicting the world at the moment.

While some of the data, for certain countries, relates to the period between January 1980 and June 2008, the co-integration analysis has been limited to the period between April 1995 and June 2008. This period was chosen since all the data needed to study the pertinent relationships among all of the countries was available. The analysis was carried out for two different samples. For one of these the N2 series were used, which cover the period 1995.04–2003.06, and for the other the whole of the 1995.04–2008.06 period was analyzed using chain-linked series.[14]

In order to analyze co-integration, both in nominal terms and with respect to the spread of interest rates[15], 10-year government bond yield series[16] from the IMF's International Financial Statistics for the same countries and period were used.

[13] The series from 1980 to September 2003 (N2 series) are heterogeneous series, which is not a problem for co-integration studies precisely because they take into account these variations in countries' products. These series stopped being published on this date, however, and, in their place, the European Central Bank published new, more homogeneous statistics. This is the source used for this analysis, more specifically, the Annualized Agreed Rates on loans to households and individual enterprises for house purchasing, over 5 years, outstanding amounts.

[14] The coefficient obtained as a quotient of the means of the common observations for both series was used as the linkage point.

[15] Spreads or margins of interest rates with respect to fixed incomes are used (see Graph 2 in the *Appendix* on the web page of this journal) since these offer a better understanding of the integration process than retail interest rates, particularly during the period in which these are converging. They reflect what is happening in the mortgage markets independently from the fixed interest markets and hence reflect the variations that are due to monetary policy.

[16] We are aware of the limitations of 10-year government bonds as the correct benchmark interest rate for fixed and variable rate mortgages (see London Economics, 2005:46), but this is a simplification which is used in numerous studies related to this area, among others those of Bondt (2002:12), Sander and Kleimeier (2004:464), Kleimeier and Sander (2005:5) and Baele et al. (2004:60, 62).

3.2. Methodology

The existence of highly integrated mortgage markets does not imply that mortgage rates will be the same, but rather it implies that there will be a long-term balance which may fluctuate in the short term. This means a country's mortgage rate (r_{nat}) does not need to be the same as that of the other members of the EMU (r_{EMU}) as the Law of One Price indicates (1).

$$r_{nat} = r_{EMU} \tag{1}$$

However, in the long term, the following relationship would be maintained:

$$r_{nat} = \beta_0 + \beta_1 r_{EMU} \tag{2}$$

This is an equation that could be estimated using a regression model, but given that interest rate series are usually non-stationary the results obtained may be unreliable. Thus, in order to establish a long-term relationship, a co-integration analysis was carried out, following Engle and Granger's three-step methodology (1987): unit root test, regression estimation and regression residual series stationarity analysis.

First, mortgage and spread rate series stationarity was analyzed by means of unit root tests. The Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979), Phillips-Perron (PP) (Phillips and Perron, 1988) and KPSS (Kwiatkowski, Phillips, Schmidt, and Shin, 1992) tests were used to determine the series' stationarity.

Secondly, regressions using Ordinary Least Squares were carried out. Given that the relationship of co-integration was analyzed between each country and the average without it (2), and between pairs of countries (3), there are two types of equation to be studied.

$$r_{nat_i} = \beta_0 + \beta_1 r_{nat_j} \tag{3}$$

The ADF test was reapplied to determine the stationarity of the resulting residual series $(\hat{u}_t)$ of each regression. The following equation is used (4)

$$\Delta\hat{u}_t = \delta\hat{u}_{t-1} + \sum_{i=1}^{k} \delta_i \Delta\hat{u}_{t-i} \tag{4}$$

The null hypothesis, H_0: $\delta = 0$, implies that the residuals are non-stationary, in other words, the series do not co-integrate, and the alternative hypothesis, H_1: $\delta < 0$, implies that the residuals are stationary and that the series co-integrate. The critical values used are found in Mackinnon's tables (1991).

Following Engle and Granger's methodology, co-integration was assessed between pairs of countries, and between each country and the average, in terms of both nominal and spread mortgage rates, for the series 1995.04–2003.06 and 1995.04––2008.06.

As Enders (2004:347) states, the results of the co-integration tests might differ in finite samples depending on the dependent variable used in the long-term relation, in spite of the fact that they are asymptotically equivalent. This means that, besides applying the ADF test to the residuals of equations (2) and (3), it is also applied to the inverse regression residuals.

The possible existence of structural changes in this period was considered, since this might affect the co-integration test results.

Some authors take into consideration the potential existence of a structural change in co-integration relations, either due to an event such as the introduction of the single currency which may cause instability, or as a result of the evolution of the variables analyzed (Centeno and Mello, 1999).

An alternative to the above procedure for determining the breaking point in the relationship is the Supreme *F* test, a sequential application of the Chow test which considers all the possible breaking points (Kleimeier and Sander, 2000, 2002). The sequence of the *F* statistics could potentially reveal the point at which the structural changes occur.

The procedure followed in this work[17] consists of using co-integration rolling regressions, which take into account any changes in the relation between the variables. Therefore, the technique assumes that the possible change in the co-integration relationship might be produced gradually, there being no need to establish a precise breaking point.

The rolling regressions[18] were carried out over a period of almost four years starting with the period 1995.04–1998.12 and ending with the period 2004.11––2008.06. 115 regressions were obtained, each of which contained 45 pieces of monthly data. Their residuals were used for the co-integration tests. These regressions are applied to both mortgage rates as well as the spread series.

4. Results

The results of the co-integration analysis are now assessed in accordance with the approach described above, using Version 6 of Eviews.

First, the stationarity of mortgage rates was analyzed. The results of the tests[19] applied to the series in levels and differences, both for countries and for the average of the EMU without the corresponding country.[20]

In the majority of cases the contrasts utilized indicate that the series are integrated of order 1, I (1). Given that there is divergence in the results, series I (1) was chosen to be considered if and when at least one of the contrasts so indicated. Finally, all of the series were included in the co-integration analysis.

The stationarity of the interest rate spread series was subsequently analyzed. The same procedure was followed as described for the nominal mortgage rates.[21]

On looking at the results, the series may be deemed to be I (1), with the exception of Austria and the average without Italy 1995.04–2003.06, in which all of

[17] Followed by Kleimeier and Sander (2005), among others.

[18] Given an initial range of observations, the rolling regressions consist of adding an observation at the end of each sample in each sequence while eliminating one at the beginning. This makes the size of the sample in each regression the same.

[19] The linear trend and intercept were included in the test equations. The number of lags in the ADF contrast regression was determined by following the Schwartz Information Criteria.

[20] To calculate the weighted mortgage averages we took the weight of each country to be the one which was assigned in the weight scales for aggregate averages of the OECD (OECD, 2003). These weights reflect the economic importance relative to the members of the OECD. The average mortgage rate used in equation (2) excludes the country that the equation itself refers to. This requires recalculation of the weights for all the countries excluding each one of them when appropriate.

[21] In the equations for the test the intercept was included but the linear trend was not.

Table 1 ADF Test for Co-Integration for Each Country with the Average
H_0: The Series Do Not Co-Integrate

	Series 1995.04–2003.06			
	nominal mortgage rates		mortgage rate spreads	
	ADF	Reverse ADF	ADF	Reverse ADF
Germany	-2.0724	-1.7479	-2.3984	-2.3705
Austria	-2.8590	-2.5120		
Belgium	-2.0680	-0.7049	-2.1615	-2.5818
Spain	-2.3470	-2.2744	-3.3197**	-2.8620
Finland	-2.5335	-2.0041	-1.7974	-1.6804
France	-3.9547*	-4.0249*	-3.0758	-2.9299
Netherlands	-1.7962	-1.5152	-2.5123	-2.1247
Ireland	-1.5546	-1.7865	-1.7073	-2.1464
Italy	-1.1075	-1.2044		
Portugal	-1.5021	-1.5323	-0.9253	-3.0140
	Chain-linked series 1995.04–2008.06			
	nominal mortgage rates		mortgage rate spreads	
	ADF	Reverse ADF	ADF	Reverse ADF
Germany	-1.9189	-1.5124	1.0003	-3.0228
Austria	0.3437	-2.7228		
Belgium	1.2836	0.0149	-0.3601	-2.6428
Spain	-2.3874	-3.5742*	-1.5626	-2.1313
Finland	0.1229	-3.4868*	-1.3581	-2.3548
France	-0.8305	-1.3074	-0.3438	-2.1209
Netherlands	1.0426	0.9090	-0.3744	-1.5481
Ireland	-0.6880	-2.1029	-1.2311	-2.6265
Italy	-0.4425	-1.6574	-2.0858	-0.9431
Portugal	0.6448	-1.6907	-1.4796	-2.3521

Notes: * Indicates rejection of the null hypothesis at the 5% level of significance.
** Indicates rejection of the null hypothesis at the 10% level of significance.

the tests indicate stationarity. As a result, these series were excluded from the co--integration analysis.

The following step involved estimating the corresponding regressions by means of Ordinary Least Squares between each country and the average, and between pairs of countries, and in reapplying the ADF test to determine the stationarity of the residual series ($\hat{u}_t$) derived from each regression. This was applied by changing the direction of the causality of the variables in the regression (reverse ADF).

For nominal and spread mortgage rate series the results obtained can be seen in *Table 1*. The results of the ADF and reverse ADF contrasts are remarkably similar, which demonstrates the validity of the test, in spite of the fact that the sample sizes were not particularly large. In general, the nominal mortgage rates of the different countries and the average nominal mortgage rate do not co-integrate. The three notable exceptions are France, which co-integrates at a 5% level of significance when the 1995.04–2003.06 series is used, and Finland and Spain for the 1995.04–2008.06 series.

The results obtained with the spread series indicate there is no co-integration relationship between each country and the average of all of the remaining countries, with the exception of Spain for the 1995.04–2003.06 series.

Table 2 Nominal Mortgage Rates. ADF Test for Co-Integration between Pairs of Countries.
H_0: The Series Do Not Co-Integrate. Series 1995.04–2003.06

	Ger.	Aus.	Bel.	Spa.	Fin.	Fra.	Net.	Ire.	Ita.	Por.
with										
Ger.		-2.713	-2.130	-2.155	-3.454*	-2.537	-4.368*	-1.587	-1.443	-1.739
Aus.	-2.744		-1.970	-1.254	-2.307	-2.294	-2.487	-1.448	-1.774	-2.165
Bel.	-1.517	-1.218		-0.948	-1.053	-0.975	-1.198	-0.812	-0.658	-0.634
Spa.	-2.739	-2.335	-2.142		-1.846	-2.274	-2.354	-1.394	-1.597	-1.923
Fin.	-3.379**	-2.494	-2.087	-1.458		-1.390	-2.482	-1.528	-1.018	-1.315
Fra.	-2.981	-2.558	-2.232	-2.519	-1.497		-2.076	-1.235	-2.949	-3.565*
Net.	-4.309*	-2.499	-1.792	-1.853	-2.414	-2.290		-1.763	-1.321	-1.598
Ire.	-2.069	-2.267	-2.342	-1.738	-2.005	-1.507	-2.038		-1.518	-1.610
Ita.	-1.853	-2.190	-2.202	-1.902	-1.376	-2.998	-1.646	-1.444		-2.869
Por.	-2.096	-2.492	-2.122	-2.323	-1.656	-3.657*	-1.850	-1.487	-2.833	

Notes: * Indicates rejection of the null hypothesis at the 5% level of significance.
** Indicates rejection of the null hypothesis at the 10% level of significance.

Table 3 Nominal Mortgage Rates. ADF Test for Co-Integration between Pairs of Countries.
H_0: The Series Do Not Co-Integrate. Chain-Linked Series 1995.04–2008.06

	Ger.	Aus.	Bel.	Spa.	Fin.	Fra.	Net.	Ire.	Ita	Por.
with										
Ger.		-2.677	-1.307	-2.109	-1.543	-1.278	-1.607	-2.245	-1.499	-0.754
Aus.	-1.570		-1.436	-1.568	-1.058	-2.363	-1.376	-1.312	-1.519	-0.892
Bel.	-0.983	-2.488		-1.959	-0.749	-3.638*	-2.417	-1.742	-1.111	-0.085
Spa.	-2.347	-1.752	-1.479		-3.15**	-2.904	-1.768	-1.395	-2.320	-1.415
Fin.	-2.133	-1.189	-1.613	-3.23**		-3.35**	-2.114	-2.331	-1.577	-2.828
Fra.	-0.351	-2.676	-2.385	-1.758	-0.898		-2.001	-1.691	-1.165	-0.951
Net.	-1.307	-2.414	-1.880	-1.890	-0.474	-1.237		-1.627	-0.927	0.153
Ire.	-2.524	-1.352	-1.847	-1.162	-2.286	-3.40**	-2.388		-1.625	-2.703
Ita.	-1.955	-1.507	-1.424	-2.174	-1.461	-2.838	-1.778	-1.670		-1.267
Por.	-2.162	-1.107	-1.875	-1.460	-2.928	-3.41**	-2.223	-2.719	-1.466	

Notes: * Indicates rejection of the null hypothesis at the 5% level of significance.
** Indicates rejection of the null hypothesis at the 10% level of significance.

With regard to co-integration between pairs of countries for nominal mortgage rate series (*Tables 2* and *3*) only Germany co-integrates with the Netherlands and Finland, and France with Portugal. The latter relationship is the only one that holds when carrying out the analysis using the chain-linked series, in which further relationships appear: Spain with Finland, and France with Belgium, Finland, Ireland, and Portugal.

With respect to co-integration between pairs of countries for the mortgage rate spreads (*Tables 4* and *5*), Germany co-integrates with the Netherlands, Finland with the Netherlands, France with Spain and Italy, and Italy with Portugal and Belgium. With the exception of Germany with the Netherlands, none of the former relations holds for the long series. The pairs of countries that also co-integrate when the long series is used are France and Belgium, Finland and Portugal, and France and the Netherlands.

Table 4 Mortgage Rate Spreads. ADF Test for Co-Integration Between Pairs of Countries. H_0: The Series Do Not Co-Integrate. Series 1995.04–2003.06

	Ger.	Bel.	Spa.	Fin.	Fra.	Net.	Ire.	Ita.	Por.
with									
Ger.		-2.024	-2.574	-2.527	-2.756	-3.872*	-1.788	-2.419	-2.192
Bel.	-1.927		-2.684	-1.853	-2.979	-2.760	-1.686	-3.227**	-2.367
Spa.	-2.043	-1.766		-1.587	-3.269**	-2.479	-1.722	-1.631	-1.466
Fin.	-2.214	-1.308	-2.423		-2.173	-3.490*	-1.923	-1.757	-1.069
Fra.	-3.009	-2.254	-3.880*	-2.564		-2.803	-1.304	-2.994	-2.101
Net.	-3.130**	-1.828	-2.435	-3.115**	-2.520		-1.967	-2.223	-1.381
Ire.	-1.940	-1.455	-2.543	-2.165	-2.235	-2.626		-1.737	-1.032
Ita.	-2.595	-3.013	-2.529	-2.801	-3.472*	-2.867	-2.245		-3.702*
Por.	-2.587	-2.750	-2.796	-2.770	-2.955	-2.825	-2.183	-4.182*	

Notes: * Indicates rejection of the null hypothesis at the 5% level of significance.
** Indicates rejection of the null hypothesis at the 10% level of significance.

Table 5 Mortgage Rate Spreads. ADF Test for Co-Integration between Pairs of Countries. H_0: The Series Do Not Co-Integrate. Chain-Linked Series 1995.04–2008.06

	Ger.	Bel.	Spa.	Fin.	Fra.	Net.	Ire.	Ita.	Por.
with									
Ger.		-2.171	-2.648	-2.722	-2.929	-3.066**	-1.928	-2.860	-2.624
Bel.	-1.870		-2.659	-2.962	-3.890*	-1.844	-2.123	-2.836	-2.870
Spa.	-1.450	-2.0914		-1.326	-1.633	-2.096	-1.107	-0.956	-1.693
Fin.	-2.160	-2.468	-1.284		-1.852	-2.311	-1.467	-1.790	-3.283**
Fra.	-2.324	-3.757*	-2.563	-2.849		-3.463*	-2.017	-2.764	-2.764
Net.	-2.828	-1.528	-2.221	-2.413	-3.398**		-1.786	-2.433	-2.345
Ire.	-1.413	-1.686	-1.181	-1.489	-1.798	-2.336		-2.345	-2.955
Ita.	-0.827	-0.805	-0.077	-1.092	-1.070	-0.836	-1.840		-1.531
Por.	-1.376	-2.3344	-1.613	-3.269**	-1.774	-2.197	-2.982	-2.437	

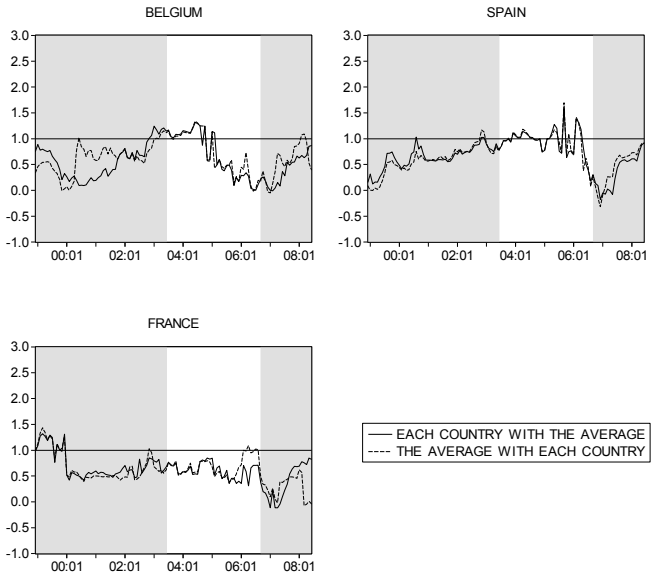
Notes: * Indicates rejection of the null hypothesis at the 5% level of significance.
** Indicates rejection of the null hypothesis at the 10% level of significance.

Two relevant conclusions may be gleaned from these results. The first is that, in general, the results of the tests coincide on changing the direction of causality of the regression variables. The second is that the results coincide very little when the analysis is carried out using the two series 1995.04–2003.06 and 1995.04–2008.06. This may be due to the non-stability of the co-integration relations analyzed, a factor which is dealt with below.

Consistent with the methodology in the previous section, the rolling regressions will now be analyzed and the ADF test applied in order to determine the stationarity of the residual series. The graphs, which are given below, give the results of all the ADF tests as a quotient between the statistic and the critical value for a 5% level of significance,[22] between each country and the average without that country and between pairs of countries. A quotient higher than 1 indicates that there is co--integration. Finding a single sample for which the series co-integrate does not pro-

[22] The critical values used are found in Mackinnon's tables (1991).

Graph 1 Some Results of Co-Integration Rolling Tests, Nominal Mortgage Rate Series



vide evidence of co-integration in this analysis. What is sought is a large number of contiguous 45-month samples for which the hypothesis of co-integration may be accepted. This is the methodology followed by Brada, Kutan, and Zhou (2005), among others. All results are available in the *Appendix* on the web page of this journal (a resume of them is given here in *Graphs 1 to 4*).

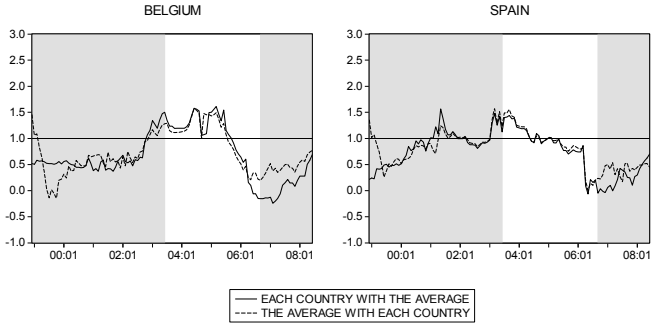
In all the graphs the dates that appear on the horizontal axis correspond to the end of the sample used in each of the rolling regressions which are the bases for the tests. Thus the first point, 1998.12, will be the quotient between the co-integration ADF statistic value and the critical value for the period 1995.04 to 1998.12, the period immediately prior to the creation of the euro area. In these graphs the shaded areas reflect the results that are obtained if and when the two series are analyzed individually, that is, without being linked, while the unshaded area includes the results that are obtained when the series are linked.

There are few co-integration relations between each country and the average (*Graphs 1* and *2*) and these do not hold throughout the period analyzed. Only Belgium and Spain co-integrate in rates and spreads between the year 2000 and early 2005. The few relations that do exist are to be found in this same period, the one exception being France, which co-integrates from the beginning of the period analyzed until the end of 1999.

As one can see from *Graphs 1* and *2* and the previous *tables*, reversing X and Y in the regressions does not imply significant changes in the results. Hence, for reasons of parsimony, this stage of the analysis is omitted below.

Graph 3 gives the results of the rolling tests between pairs of countries for the nominal mortgage rate series. The same information for the spread rate series is to be found in *Graph 4*.

Graph 2 Some Results of Co-Integration Rolling Tests, Spread Mortgage Rate Series



In general, there are few observable co-integration relations, and there are more in the nominal than the spread rates. To a certain extent, in the existing co-integration relations the results coincide, in that they occur within the 2000–2005 period, with slight variations depending on the countries. For the 2000–2005 period, the following relations with respect to nominal rates are noteworthy: Germany-Austria, Austria--Spain, Austria-Italy, Spain-Italy, France-Italy, and Ireland-Italy. With regard to spreads, Belgium-Spain and Belgium-Portugal are prominent. On comparing the results for nominal and spread rates, only the following relations coincide in both cases and for this same period: Belgium-Italy, Spain-Finland, France-Netherlands, and France--Italy. The disappearance of these relations at the end of 2005 coincides with a change in the trend of the evolution of mortgage rates.

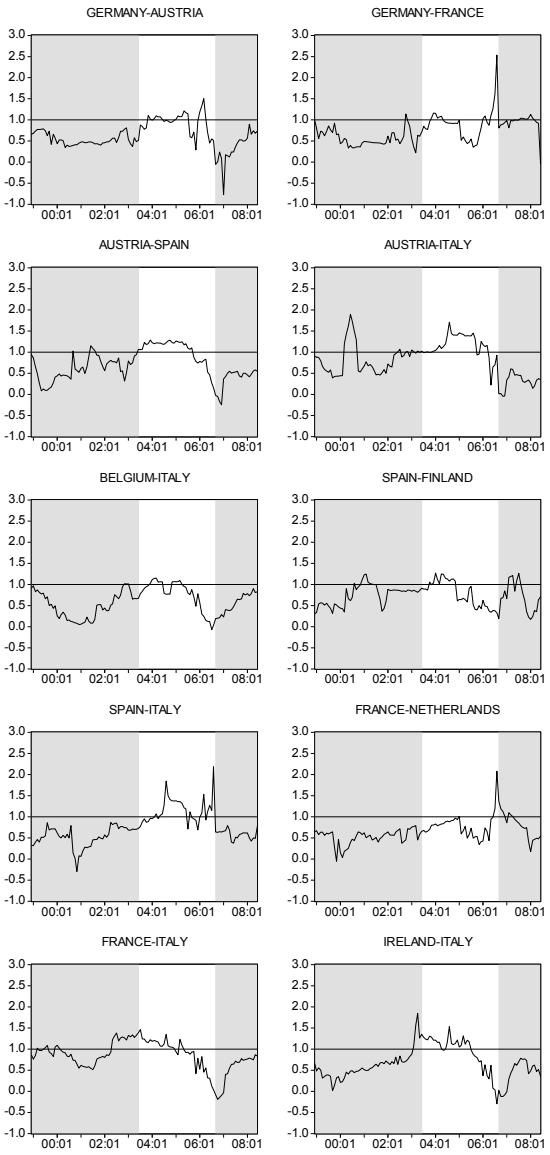
It is possible that the introduction of the single currency and even the enactment of the European Code of Conduct in 2001 were both partially responsible for the move towards the integration of the mortgage market since they had a certain influence on the EMU mortgage markets during the 2000–2005 period, thus making some of the inter-market co-integration relations considerably more likely.

If focus is placed upon the final period in the study there are few relations to be found. Only France and the Netherlands co-integrate in terms of spread rates and Germany with France in both nominal and spread rates. Analyzing the mortgage markets of these countries in detail reveals a characteristic which is common to their mortgage loans that is probably responsible for these relations. In the three countries, long-term fixed rate mortgages predominate[23] and the evolution of the series analyzed is quite similar.

It can be affirmed that the co-integration relations between countries and between each country and the average are relatively scarce. They occur at specific junctures or within certain intervals and are slightly more common between 2000 and 2005. These relations do not persist over time however, which suggests that the degree of integration of mortgage markets is not progressively advancing. It known that the penetration of foreign credit institutions in domestic markets for the countries studied is low. On average, for the 1997–2004 period, the degree of penetration was 5% in Germany, 6.3% in Italy, 9.4% in the Netherlands, 10.7% in Spain, 11.4% in

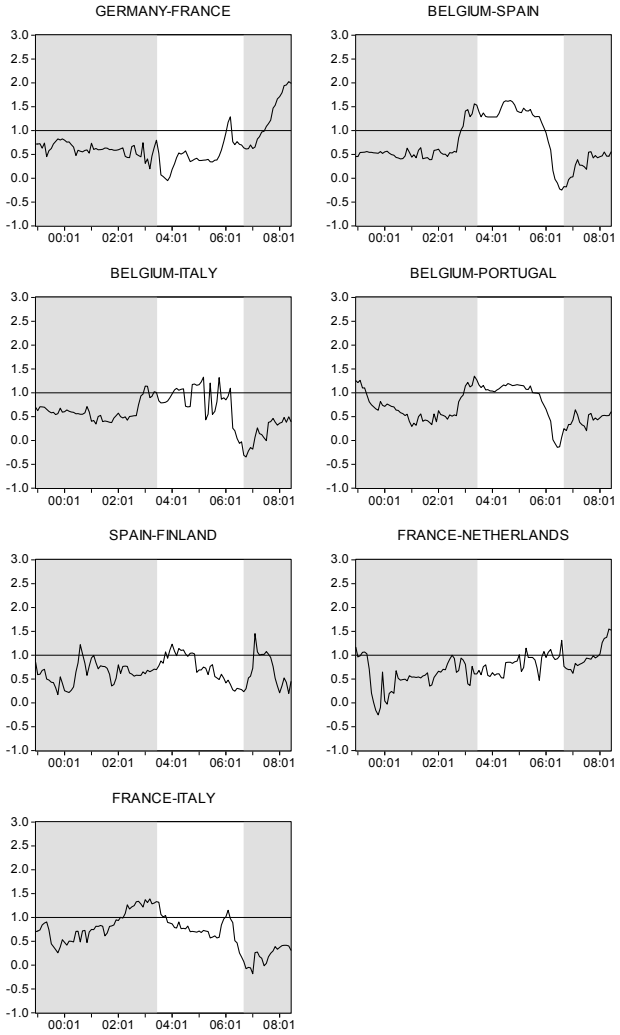
[23] In the case of Germany, the mortgages are adjustable long-term fixed-rate mortgages with a fixed rate period of 10 to 15 years.

Graph 3 Some Results of Co-Integration Rolling Tests, Nominal Mortgage Rate Series. Relations Between Pairs of Countries



France and Austria, 14.6% in Finland, 21.9% in Portugal, and 25.1% in Belgium (Allen, Bartiloro, and Kowalewski, 2005). It is also known that the volume of cross--border mortgage credit is low, constituting less than 1% of all European mortgage credit activity. Hence, in addition to the different cultural, legal, and fiscal characteristics intrinsic to each of the domestic mortgage markets,[24] the actual basis for substantial future integration in the short term is weak.

Graph 4 Some Results of Co-Integration Rolling Tests, Spread Mortgage Rate Series. Relations Between Pairs of Countries



5. Conclusions

The results of the co-integration analysis carried out in this study using nominal and spread mortgage rates do not indicate the existence of a long-term relationship between the mortgage rate series of the members of the Monetary Union, at least until 2008. It would seem, therefore, that there is no meaningful level of mortgage market integration. However, some co-integration relationships do become observable between 2000 and 2005, relationships that tend to be most prevalent in countries such as Germany, France, the Netherlands, Italy, and Austria. The introduction of

[24] For a deeper look at the characteristics of these domestic mortgage markets, see López et al. (2006).

the single currency (1999), the European Code of Conduct (2001) and even the Financial Services Action Plan (1999) have probably favored the appearance of some of these relationships.

In addition to the fact that there are few observable co-integration relations, even those that exist do not persist over time. They are not relations which are stable and, as such, do not suggest that the EMU mortgage markets are advancing towards greater integration. This affirmation receives support from the fact that there are only two relations that have appeared for the first time in recent years, these being Germany and France, and France and the Netherlands. Thus, European mortgage markets are not moving towards greater integration.

The general thrust of opinion, a belief that is supported by various academic studies, tends to stress the advantages that may be obtained through increased mortgage market integration. The European Commission has been carrying out a series of activities designed to promote greater integration. These have included trying to increase competition by encouraging product diversification, easing credit entities' access to EU markets using efficient refinancing techniques, and improving consumer confidence in products and mortgage markets.

These initiatives will need time to affect the markets before a long-term relationship between most of the mortgage rate series in the Monetary Union becomes clearly detectable. Furthermore, a level of integration that is comparable to that which currently exists in wholesale financial markets may prove to be difficult to achieve.

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