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FINANCIAL INTEGRATION IN EUROPEAN BANKING MARKETS

John L. Simpson

Abstract

Correlation and regression analysis of unlagged time series banking price index data shows the importance of the UK banking industry in Europe and demonstrates the strength of European financial integration. Vector autoregressive models and cointegration and causality tests for optimally lagged price data provide evidence of cointegration between the segmented European, the United Kingdom and the European Monetary Union banking markets. Whilst the UK banking market is a powerful influence in Europe, it is evident that exogeneity in each pairwise model lies largely with the European Monetary Union, but there is no significant evidence of one-way or dual causality between the EMU and the UK markets. The European Monetary Union has clearly achieved a strong degree of financial integration and remains the dominant influence on segmented European banking markets. It is apparent that the EMU banking market would benefit from UK membership by achieving greater liquidity, informational efficiency and global interaction. Unsystematic risk of the EMU banking market would be reduced with increased diversification, which would in turn reduce banking system risk and assist in financial regulation. The main issue is whether or not the UK banking markets is likely to benefit if they were to seek and gain membership of the EMU banking market.

Key words: Systematic and unsystematic risk, systemic risk, banking markets, integration, and interdependence.

Introduction

Economic integration is the process of reducing and eventually removing barriers to free trade in goods and services and the free movement of factors of production between countries and regions (Hill, 2003). Financial integration is a similar process that occurs in banking markets and stock markets. Integration in banking relates to the free flow of financial services and factors of production, mainly capital, across borders. Interbank borrowing and lending is prevalent, cross shareholdings are increasing and lending practices and accounting practices are becoming standardised (Hughes and McDonald, 2002). International regulatory barriers are gradually being broken down. The economic benefit is that customers are experiencing lower costs of services as trade barriers are removed. Political benefits of integration relate ideally to European peace and harmony.

The path to financial integration of European banking markets has not been an easy one and there is still some distance to go. It was around 18 years ago that the White Paper on the Completion of a Single Market announced the integration of the European banking markets. Issues remain that relate to nationalism, sovereignty, race, religion, language and culture apart from fundamental financial and economic differences. Recently other banking specific issues have been raised as to home country and host country control of international banks, whether or not deposit insurance was the best way to the control international banks and which authority would administer the scheme. Finally, issues arose with regard to uniform taxation treatment. Nevertheless genuine progress in banking financial integration has been made in the EMU.

Literature

Most of the literature in recent years on regional integration of banking has focused on Europe as the countries within Europe aim ultimately for full economic integration into firstly the European Union (EU) and then the EMU. Questions also arose as to whether or not greater concentration of the European banking industry would ensue and how this would affect competition in

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the regional market place. Some studies examined commercial and retail banking only and applied cointegration methodology to investigate integration in the presence of country specific credit rates. For example, Kleimeier and Sander (2003) found a growing pace of integration with the introduction of a single currency and provided one of the first pictures of an emerging uniform banking market in the Eurozone.

The difference was more pronounced in the corporate lending market and all evidence suggested that the integration process would be enhanced with a single monetary authority. Kleimeier and Sander also examined the financial part of the monetary transmission process in the pass through of monetary policy induced interest rate changes in the Eurozone between 1993 and 2002. Findings were that there were increases in the size and speed of monetary policy shocks. Such measures also provided an indication of integration in the Eurozone banking market but they found that the market was still fragmented. However, their view was that nominal, real and structural convergence can lead to a more homogenous transmission process in the Eurozone but full convergence may be precluded by legal and cultural differences.

Others such as Gual (2003) have found that in market opening there exists a difficult trade-off between respect for domestic preferences and the elimination of regulations that protect local competitors. The study by Gual also examined various indicators of financial integration in EU banking but also analysed the impact of integration policies on the conduct, structure and performance of the banking industry. Overall Gual found that the EU single banking market policies were starting to achieve their objectives.

That the United Kingdom banking market is a powerful global market is supported by Simpson et al. (2005)[1] and Simpson (2005). The latter study demonstrates the importance of the UK market as it interacts with a global banking stock price series derived from a global banking price index. Evidence is provided that the UK market, in terms of the strength of its interaction with the world banking market (based on unlagged time series data in pairwise regression models) ranks 8 in the top 10 country and regional banking systems. The EMU market ranks 5. However, when all major banking markets are included in a single VAR model of optimally lagged data interacting with the world market, the results show that the UK has a stronger interaction with global banking markets than the EMU. The US emerges as the most influential market followed by the UK, the EMU and Japan in that order.

Various studies have used stock price index data to examine international and regional interdependence and integration (For example, Ratanapakorn & Sharma, 2002) whilst others (For example, Sell, 2001) have examined the issues as to whether or not contagion is induced by economic factors (dependent on regional trade and investment ties) or whether contagion was a financial or banking phenomenon and not intra-regional (For example, Russia and Brazil did not have strong trade ties nor are they in the same region but they were both countries which were dependent large external US dollar denominated floating rate debt). It is put that the downside of financial integration is that it is synonymous with banking interdependence that induces the risk of contagion or systemic risk. The manifestation of systemic risk is a bank run or a bank failure that may lead to runs on or failures of other related banks in a banking system.

Early models of bank runs (For example, Diamond & Dybvig, 1983) assumed consumption risk to be reflected in a stochastic deposit withdrawal and riskless but illiquid investments with the actual bank run triggered by a shift in expectations. The next set of models was developed by researchers, such as, Chari and Jagannathan (1988) who more realistically brought investment risk into the analysis. The early models helped to explain the reasons for runs on individual banks whether they are due to fears of insolvency in the case of the latter or self-fulfilling beliefs in the case of the former. However, the first models failed to address the problem of systemic risk or the chain reaction runs on or failures of other banks which may be related through substantial interbank lines of credit or cross shareholdings. The need for a Central bank to take on the role of custodian of systemic safety became important in addition to its monetary policy role.

[1] Note the cointegration and causality analysis of London, New York and Japan Eurobanking interbank offered rates.

The issues of financial contagion (arising from bank interdependence) and bank regulation were addressed by researchers such as Aharony and Swary (1983) and Swary (1986) who studied contagion effects when the Central Bank acted in a preventative role as lender of last resort. Kaufman (1994) felt that systemic risks have been overstated. The lack of evidence does not preclude the possibility of such bank contagion. If a larger bank fails it will this lead to a domino effect failure of other banks? Authors such as Goodhart (1987) felt that Central bank intervention into individual banks may be appropriate at times to prevent spillovers. Ultimately governments and therefore taxpayers are providing the liquidity for this intervention and this in itself is an argument for banking supervision and regulation. Authors such as Folkerts-Landau and Garber (1992) and Goodhart and Schoenmaker (1995) argue that the adverse selection and moral hazards involved in Central bank support, need to be contained through supervision and regulation. Financial integration in the EMU is being achieved because of diligent application of EU agreements on uniformity and standardisation of regulations relating to financial services liberalisation. There has also been a focus of EU policy on the key involvement of and the necessity for sound Central bank supervision in the interests of both monetary policy implementation and systemic safety.

The models used for the analysis of bank runs and systemic risk have evolved from simple non-parametric tests of banking system generated data to least squares regression analysis of time series data such as that used by Grossman (1993). Problems of mis-specification have led to the use of autoregressive, cointegration, and causality techniques such as those used in this paper. The issue raised in the paper is whether or not the powerful UK banking market would benefit from EMU membership and what would be the implications for efficient portfolio allocation of systemic banking stocks and for banking system regulation.

The model

A basic banking market model[1] is specified to initially analyse unlagged price and first difference price index data (See Equation 1 below). The segmented European banking markets (including the EMU market) are firstly treated as pairwise functions of the UK banking market, and then the segmented European markets (including the UK market) are treated as pairwise functions of the EMU banking market.

$$B_{i_t} = \alpha_t + \beta_t B_{w_t} + e_t , \tag{1}$$

where: B_{i_t} is the banking price index value for a segmented European banking market i at time t.

B_{w_t} is the banking price index value for the UK banking market (and in stage 2 the EMU market) at time t.

α_t, β_t and e_t are the regression intercept, coefficient and error terms at time t, respectively.

Based on Granger (1988) findings that financial and economic time series may contain unit roots and in the development of the theory of non-stationary time series analysis, the unlagged regression model is re-specified into a vector error correction model to implement vector autoregression (VAR) based tests for both cointegration and causality in optimally lagged data.

The respecified model is as follows:

$$B_{i_t} = a_1 B_{i_{t-1}} + ...a_n B_{i_{t-n}} + bB_{w_t} + e_t , \tag{2}$$

where: B_i is a vector of endogenous variables being first difference bank price index series for a segmented European banking market i (at times t to $t-n$).

[1] The market model used is a simplified version of Sharpe's Capital Assets Pricing Model (Sharpe, 1964) as discussed and reported in Reilly and Brown (2003). The latter feel that the analysis of indexed data is feasible in the study of risk/return relationships in stock markets, assuming the indices studied are representative.

B_{w_t} is the vector of the exogenous UK banking market (and then the EMU banking market in stage 2 of the analysis) first difference price index values in price index series at time t.

$a_1 \ldots\ldots, a_n$ and b are matrices of coefficients to be estimated.

e_t is the error term and specifically it represents a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables.

Data and preliminary analysis

Daily time series banking price index data were collected for each of the segments of the European banking market, the EMU banking market and the UK banking market from the Datastream database covering the period 31/12/1999 to 20/9/2004. Data were analysed using the EViews 4[1] statistical package. Prior to regression analysis of unlagged data, Jarque Bera[2] test statistics indicated that there were problems with skewness and kurtosis with each of the level series for each European market and the UK market. The sample size deemed sufficient, an initial drawback of the analysis is that none of the series is normally distributed providing an initial indication that the error terms of the level series regressions would be serially correlated. First differencing reduced problems of skewness and kurtosis and serial correlation in the errors according to DW[3] tests.

Correlation Analysis

The results of preliminary analysis of unlagged price data[4] are illustrated as follows: Figures 1a and 2a show the correlations between the UK banking market and segmented European banking markets (including the EMU market) and confirm that the strongest positive correlation exists between the UK banking market and the "Europe excluding the EMU" banking market.

Figures 1b and 2b show the relationships between the segmented European banking markets (including the UK market) and the EMU banking market. The strongest positive relationship is confirmed between the EMU market and the "Europe excluding the UK" market.

Overall, the strongest relationship is between the EMU banking market and the "Europe excluding the UK" banking market.

Testing Weak-Form Efficiency

Testing for autocorrelation and partial correlation in level series price data was undertaken and examinations of the Ljung-Box-Q [5] correlogram statistics and their probabilities revealed a violation of weak-form efficiency [6] with lack of independence in the series prices for each European segmented banking market, the UK market and the EMU markets, over 36 lags. These results are ranked and shown in Table 1. High value Q statistics with low probabilities mean that a series is significantly auto-correlated. Each market in both level series and first differences series was ranked from least inefficient to most inefficient. The criteria for inefficiency are based on the lack of independence in the time series data. According to this test the UK banking market is the least inefficient in prices and the "Europe excluding the UK" banking market is the most inefficient.

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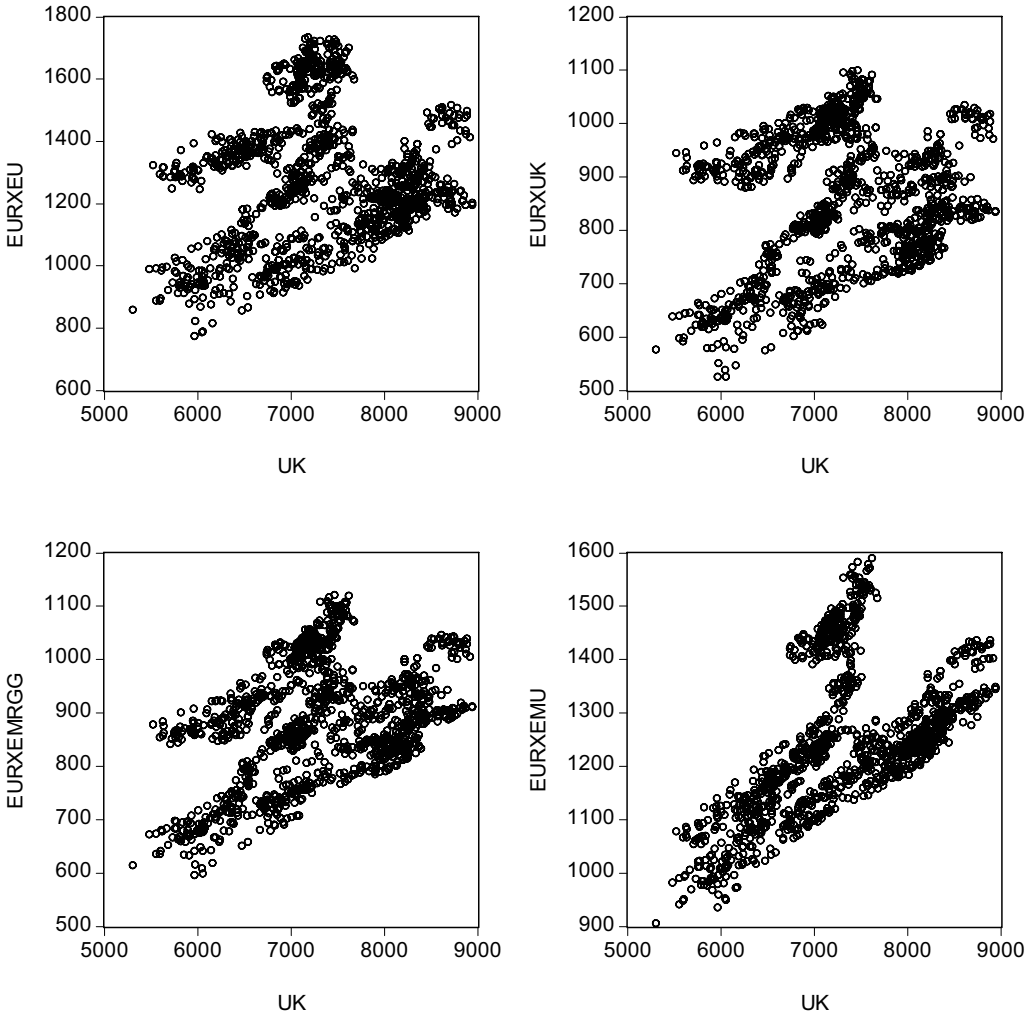
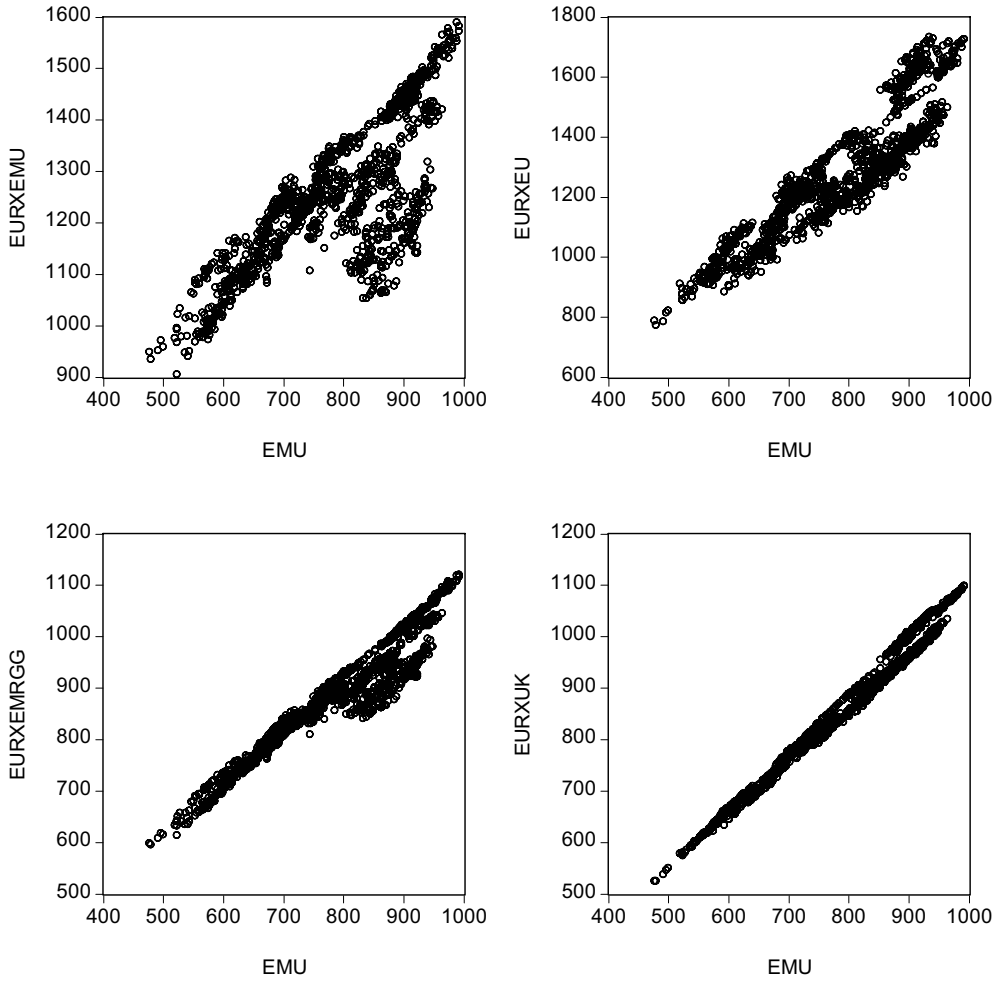
[1] All test statistics and regression models applied throughout the analysis are described in the EViews 4 (2001) package.
[2] Test statistics for uniformity and normality of distributions.
[3] Durbin Watson tests.
[4] All level series prices are later shown to be non-stationary processes. First difference prices are shown to be stationary processes.
[5] Test statistics for autocorrelation and partial autocorrelation in the EViews4 (2001) package.
[6] According to Fama (1970) markets lack weak-form efficiency if the prices and price first differences do not represent a random walk. Authors including Reilly and Brown (2003) state that the most common tests of independence of time series are autocorrelation tests. For example, EViews (2001) provides the Ljung-Box autocorrelation tests and these were applied to both level series prices and price first differences data.



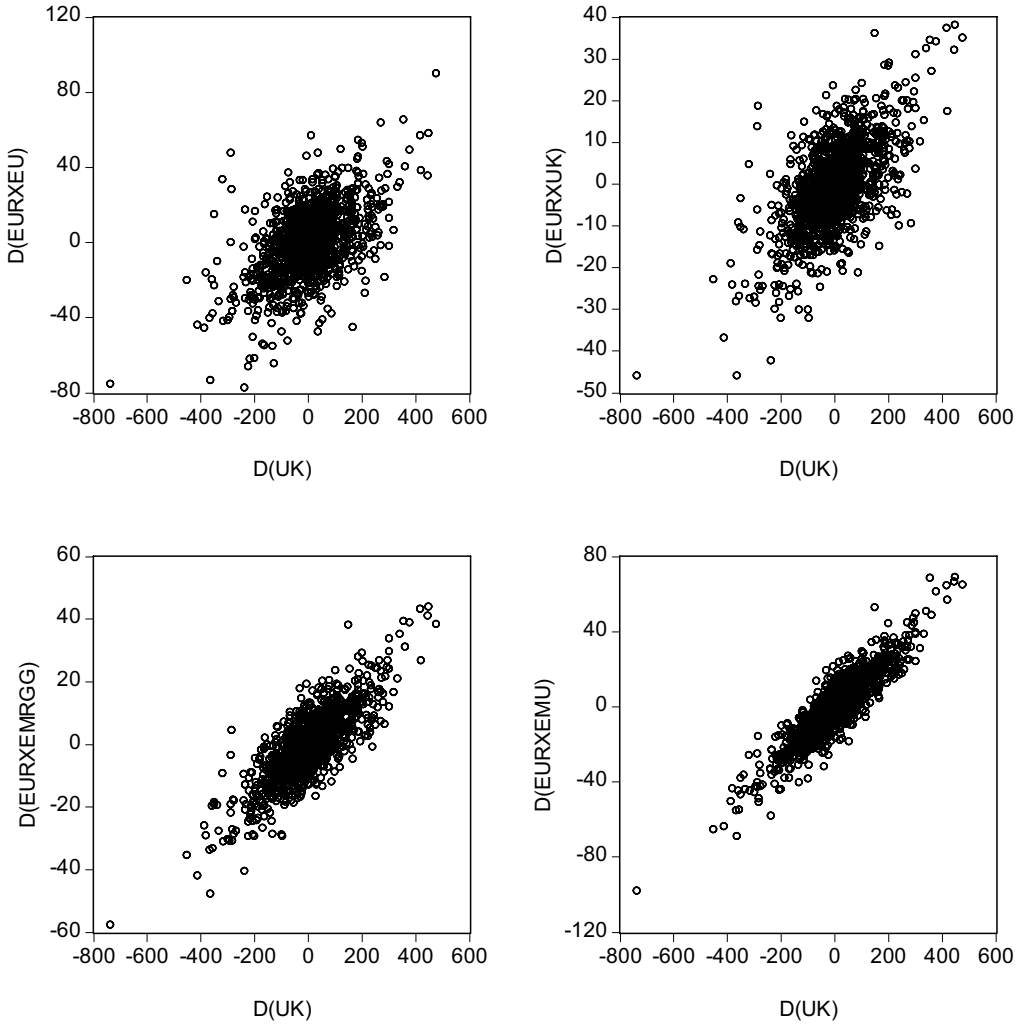
Note: EURXEU, EURXUK, EURXEMRGG, EURXEMU, UK and EMU denote "Europe excluding the Economic Union", "Europe excluding the United Kingdom", "Europe excluding emerging European market" and "Europe excluding the European Monetary Union", United Kingdom and European Monetary Union banking markets level series price indices respectively.

Fig. 1a. Segmented European banking market correlation with the UK banking market in price index values



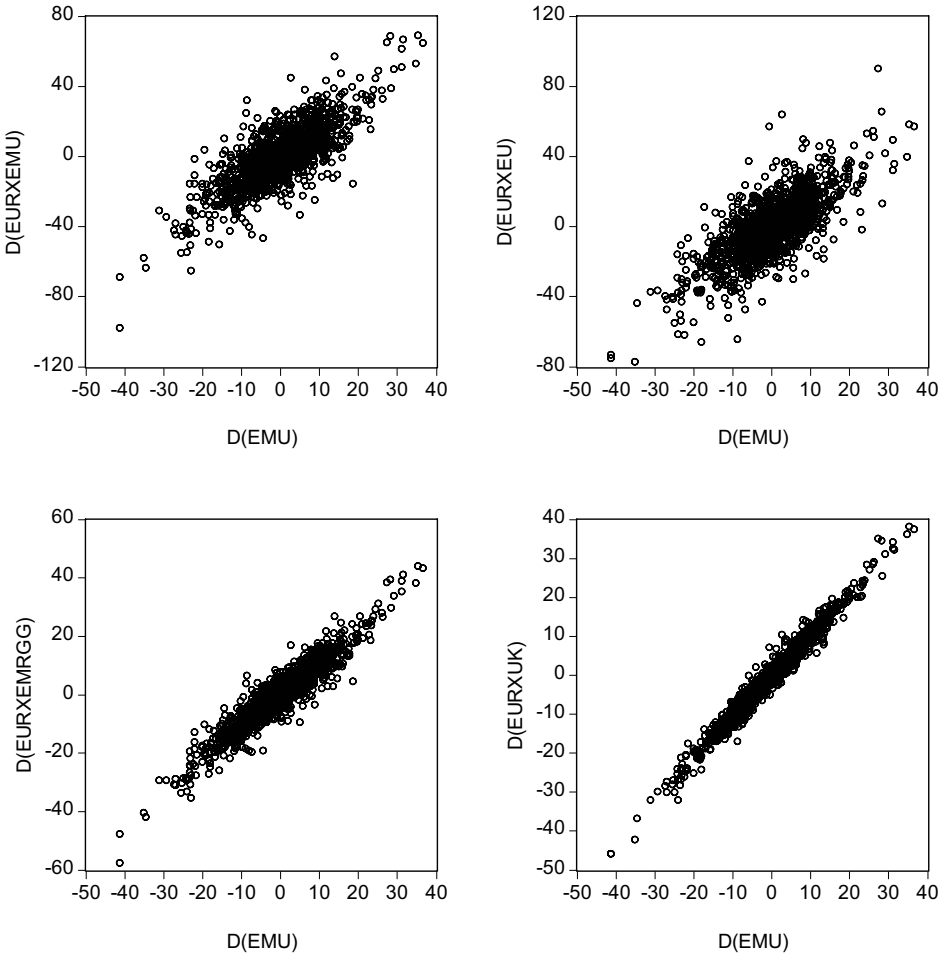
Note: See computer coded segmented markets in notes for Figure 1a.

Fig. 1b. Segmented European banking market correlation with EMU banking market in price index values



Note: See notes for Figure 1a. Computer codes are in parenthesis. D represents banking market first difference price index values.

Fig. 2a. Segmented European banking market correlations with the UK banking market in first differences of price indices values



Note: See notes for Figures 1a and 2a for segmented market computer-codes.

Fig. 2b. Segmented European banking market correlation with EMU banking market in first difference price index values

Table 1

Ranking of autocorrelation and partial autocorrelation in level series of prices for segments of the European banking market

European Market	Rank	Q Statistics range over 36 lags
UK	1	1207-31876
Europe excluding EMU	2	1212-33259
Europe excluding emerging markets	3	1219.2-35429
Europe excluding EU	4	1222.6-36952
EMU	5	1223.1-37248
Europe excluding UK	6	1223.4-37296

Note: Ranking runs from one to five in most efficient to least efficient in terms of weak-form efficiency. All results are significant at the 1% level.

In Table 2 the results of the autocorrelation analysis of the first differences price series are provided and reveal that problems of autocorrelation and partial correlation are substantially reduced. The segment order remains unchanged except that the "Europe excluding the EU" banking market moves up one rank and "Europe excluding emerging European markets" goes down one rank.

Table 2

Ranking of autocorrelation and partial autocorrelation in the price first differences of the segments of the European banking market

Segment	Rank	Q statistics range over 36 lags
UK	1	0.1632-70549
Europe excluding EMU	2	3.866-75.658
Europe excluding the EU	3	6.9620-53.915
Europe excluding emerging markets	4	13.785-76132
EMU	5	17.305-63.413
Europe excluding UK	6	20.277-68.919

Note: All results are significant at the 5% level.

Tables 3a and 3b illustrate the ranking of the degree of autocorrelation and partial autocorrelation in the errors terms of the associated pairwise regressions of price first differences for each European market segment regressed firstly on the UK banking market and then on the EMU banking market. The results provide further evidence of the relative efficiency of each segmented market and again demonstrate that the UK banking market has relatively greater informational efficiency than the EMU banking market. Serial correlation in the errors of the first difference regressions was not evident but heteroskedasticity was present[1].

Table 3a

Ranking of autocorrelation and partial auto correlation of the errors of the pairwise price first differences regressions of segmented European banking markets against the UK banking market

Segment	Ranking	Q statistics over 36 lags
Europe excluding EU	1	2.1397-44.8250
EMU	2	5.9896-33.3300
Europe excluding UK	3	9.9433-41.1550
Europe excluding EMU	4	11.0280-51.2810
Europe excluding European emerging markets	5	11.6310-40.8020

Note: Significance levels are at 5%.

Table 3b

Ranking of autocorrelation and partial autocorrleation of the errors of the pairwise price first differences regressions of segmented European banking markets against the EMU banking market

Segment	Ranking	Q statistics range over 36 lags
UK	1	1.7122-45.4320
Europe excluding emerging markets	2	5.7776-71.5010
Europe excluding EMU	3	7.2096-69.9600
Europe excluding UK	4	7.5649-42.8710
Europe excluding EU	5	8.8675-35.7220

Note: Significance levels are at 5%.

[1] Results reported later in the paper show that when first difference prices are considered in regression analysis Durbin Watson statistics were significantly greater than 2. White tests however, confirmed the existence of heteroskedasticity.

Results of regression analysis

Heteroskedasticity remained persistent in the errors of the banking system regressions in first differenced prices. The ordinary least squares (OLS) regressions were re-specified into weighted least squares models[1] to allow for heteroskedasticity of an unknown form. Segmented European banking markets were firstly regressed on UK banking markets and then on EMU banking markets. The results of the weighted least squares regressions (that is, results of the application of Equation 1) are shown in Tables 4a and 4b.

When the UK banking market in first difference prices is treated as the independent variable (see Table 4a) the model involving the "Europe excluding the EMU" banking market has the greatest explanatory power (the adjusted R square value is 81.94%). The EMU banking market regressed on the UK banking market has significantly lower explanatory power (adjusted R square value of 37.29%). The t-statistics of the regression coefficients logically reflect greater systematic risk (value of Beta) in the model involving the "Europe excluding the EMU" market and the UK banking market. As a corollary to portfolio theory developed originally by Markowitz (1952) and market models developed by Sharpe (1964), unsystematic risk[2] is therefore lowest in the latter system and this means that stronger financial integration exists in that system (relative to other systems of segmented European banking markets regressed on the UK banking market) with less diversification of idiosyncratic factors required for efficient portfolio allocation. This also means that banking system risk arising from idiosyncratic factors is less of a concern for banking regulators in that system, even though the system includes non-members of the EU and European emerging markets.

Table 4a

Weighted least squares regression results of segmented European banking market price first differences regressed on UK banking market price first differences

Segment/Dependent Variable	Ranking of explanatory power	Adjusted R square value	Beta	t statistic	DW statistic
Europe excluding EMU	1	0.8194	0.1303	56.3831	1.8058
Europe excluding European emerging markets	2	0.6468	0.0738	32.1390	1.8052
Europe excluding UK	3	0.3862	0.0540	17.9807	1.8202
EMU	4	0.3729	0.0501	17.7925	1.8603
Europe excluding the EU	5	0.2908	0.0831	16.4340	1.9153

Note: All results are significant at the 1% level.

Table 4b

Weighted least squares regression results of segmented European banking market price first differences against the EMU price first differences

Segment/Dependent Variable	Ranking of explanatory power	Adjusted R square Value	Beta	t statistic	DW statistic
Europe excluding UK	1	0.9708	1.0444	160.9932	2.1447
Europe excluding emerging markets	2	0.8898	1.0550	80.2719	2.1325
Europe excluding EMU	3	0.6159	1.3780	30.0910	2.1489
Europe excluding EU	4	0.5696	1.4186	35.5219	2.1659
UK	5	0.3729	7.4464	21.1425	2.0744

Note: All results are significant at the 1% level.

[1] This model is used in lieu of OLS when heteroskedasticity of an unknown form is present in the errors terms of the regressions according to White tests.

[2] Unsystematic risk in this model is the unexplained part of the regression and is reflected largely in the value of the errors. It is idiosyncratic risk or banking segmented market specific risk.

When the EMU banking market in first difference prices is treated as the independent variable, it is apparent that the strongest explanatory power exists in the "Europe excluding the UK" banking market model (the adjusted R square value is 97.08%. See Table 4b). The model with the least explanatory power is the UK market interacting with the EMU market (where the adjusted R square value is 37.29% as previously shown in Table 4a)[1].

Over the two sets of regressions involving firstly the UK banking market and then the EMU banking markets treated as independent variables respectively, it is confirmed that the stronger relationship exists between the EMU banking market and the segmented European banking market that excludes the UK banking market. Systematic risk for each market interacting with the EMU banking market is greatest in the "Europe excluding the UK" banking market. Higher systematic risk means that there is a greater degree of financial integration in systems involving the EMU banking market and the segmented European markets, which do not include the UK banking market. Again it follows that in this system, if systematic risk is the highest, unsystematic risk is the lowest, indicating that there are less idiosyncratic factors to diversify away for efficient portfolio allocation. Again, regulators would be even less concerned with banking system risk arising from idiosyncratic factors in that system, even though the system concerned again includes non-member markets of the EMU and emerging European markets.

Cointegration analysis

Earlier in the analysis, Augmented Dickey Fuller (ADF) unit root tests[2] were applied to the level series of prices, then to the first differences and then to the error terms of the regressions of these series to test for stationarity or non-stationarity. The level series were found to be non-stationary. First differencing converted all series to stationarity, which was also evident in the errors of the price first differences regressions.

The first difference series were thus found to be integrated processes and pairwise VAR based cointegration tests (Johansen tests[3]) were implemented on the basis that stationary linear combinations may represent cointegrating equations and imply long-run equilibrium or stable relationships among the pairs of variables in each banking market model. If cointegration was to be found on optimally lagged data, the study would move to test Granger pairwise causality[4] and thus to test the short-run dynamics of the models and the speed at which EMU and UK information was absorbed into each of the segmented European banking markets and/or vice versa.

The application of Equation 2 with the UK market initially treated as the exogenous banking market was the first stage of this part of the analysis. The EMU market was treated as exogenous in the second stage of the analysis. Pairwise VAR models were specified and in each case, and VAR stability tests on a lag order of 1:2 over one through twenty daily lags were undertaken. The pairwise VARs were all stable[5]. Maximum likelihood ratios[6] and minimum information criteria[7] (FPE, AIC, SC and HQ) were used to test the optimal lags. Johansen tests were applied for cointegration analysis. Maximum eigenvalues and minimum trace statistics indicated the number of cointegrating equations in each case. Tables 5a and 5b illustrate these results as well as the results of causality analysis.

Table 5a indicates all segmented European banking markets and the EMU market were cointegrated with the UK banking market. Significant causality (in terms of exogeneity and Granger causality) runs from some of the European segmented markets to the UK market (for example, in the cases of "Europe excluding the UK" and the "Europe excluding emerging European markets").

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[1] Later results of causality tests on optimally lagged data show that there is no significant one-way or reverse Granger causality between the latter two markets.
[2] Tests of stationarity.
[3] Tests for long-term cointegrating relationships.
[4] Tests of exogeneity.
[5] The tests indicate that no root lay outside the unit circle when tested from one through to twenty lags.
[6] The maximum LR is the maximum sequential modified likelihood ratio test statistic.
[7] FPE is the final prediction error, AIC is the Akaike information criterion, HQ is the Hannan-Quinn information criterion and SC is the Schwartz criterion for optimal lag determination. Minimum values are sought with these information criteria.

There is no significant one-way or dual causality in the cases of "Europe excluding the EU" and "Europe excluding the EMU" and the EMU market when they interact with the UK market.

Table 5b indicates that all segments of the European banking market (including the UK market) are cointegrated pairwise with the EMU banking market. This confirms the existence of long-term equilibrium relationships of each segmented market with that of the EMU. Causality tests in showing the short-term dynamics of the model indicate that the EMU is the driving market in each case except in the case of "Europe excluding the UK" market. There is no significant dual causality from the segments "Europe excluding the EU", "Europe excluding the EMU", "Europe excluding emerging markets", "Europe excluding the UK" and the UK markets.

Table 5a

Pairwise cointegration and causality test results (UK banking market is treated as exogenous)

Segmented European banking market	Optimal lag on Lag order 1:2 (See Footnote 7 for Information Criteria)	Cointegrating Equations according to Trace Test and Maximum Eigenvalues at 5% and 1% significance levels (VAR Assumption)	Granger Causality
Europe excluding EU	3 (FPE, AIC)	2 (Linear deterministic trend)	No significant one-way or dual causality.
Europe excluding European emerging markets	3 (FPE, AIC)	2 (Linear deterministic trend)	Causality runs from "Europe excluding European emerging markets" to the UK on a 12-day lag length **.
Europe excluding EMU	3 (FPE, AIC)	2 (No deterministic trend)	No significant one-way or dual causality.
Europe excluding the UK	3 (FPE, AIC)	2 (Linear deterministic trend)	Causality runs from "Europe excluding the UK" to the UK on a 9-day lag length **.
EMU	9 (FPE, AIC)	2 (Linear deterministic trend)	Causality runs from EMU to UK on a 9-day lag length **.

Note: ** Significance levels are at 1%.

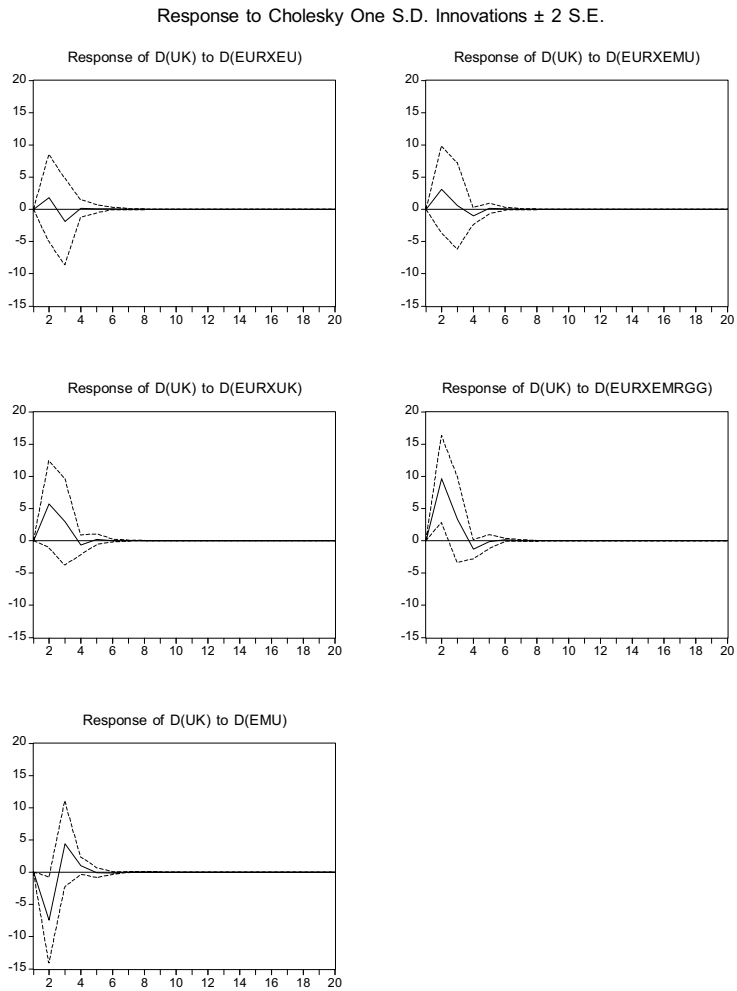
Table 5b

Pairwise cointegration and causality test results (EMU banking market is treated as exogenous)

Segmented European Banking market	Optimal Lag (See Footnote 7 for Likelihood Ratios and Information Criteria)	Cointegrating Equations (VAR Assumption)	Granger Causality
Europe excluding EU	1 (FPE, AIC, SC, HQ)	2 Linear deterministic trend	EMU causes "Europe excluding the EU" on a 1day lag period *. No significant dual causality.
Europe excluding EMU	8 (FPE, AIC)	2 No deterministic trend	EMU causes "Europe excluding EMU" on a 1 day lag period *. No significant dual causality.
Europe excluding European emerging markets	9 (FPE, AIC)	2 Linear deterministic trend	Significant causality exists from EMU on a 9-day lag length **. No significant dual causality.
Europe excluding UK	3 (FPE, AIC)	2 Quadratic deterministic trend	No significant one-way or dual causality.
UK	9 (FPE, AIC)	2 Linear deterministic trend	No significant one-way or dual causality.

Note: *, and ** denote significance levels at the 1% and 5% levels respectively.

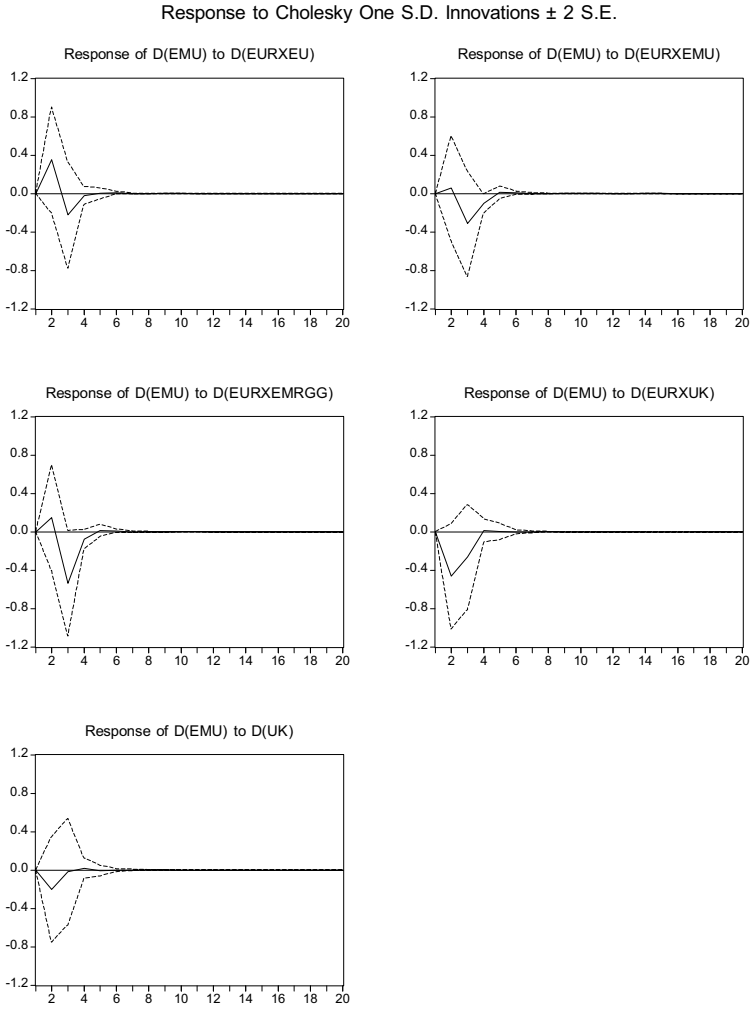
Figures 3 and 4 illustrate the results of the impulse response analysis[1] where shocks (that is, one standard deviation impulses) are delivered to endogenous variables in pairwise systems involving the segmented European banking markets (including the EMU banking market) interacting with the UK banking market and then to pairwise systems involving the segmented European markets (including the UK market) interacting with the EMU market. Figure 3 shows the response time of the UK banking market to shocks to the segmented European banking markets. The UK market starts to adjust after 2-3 days to equilibrium and achieves stability within 6-8 days. Figure 4 shows the response time of the EMU market to shocks in the segmented European markets (including the UK) at 6-8 days. As in the former systems interacting with the UK market, the path to equilibrium in all cases commences after 2-3 days. Thus, new information from segmented European markets is absorbed by each of the UK and EMU markets in a similar time period. This evidence suggests that each segmented European banking market has achieved a similar level of informational efficiency, even though some of the markets are mixed with non-members of the EMU and with emerging European banking markets.



Note: The UK banking market commences adjustment to equilibrium after 2-3 days when shocks are imparted to segmented European markets. The system achieves stability in 6-8 days.

Fig. 3. The response of the UK banking market to shocks to segmented European banking markets

[1] EViews 4 (2001).



Note: When shocks are delivered to the segmented European markets, the EMU banking market commences adjustment to equilibrium within three days. Equilibrium in each system is achieved within 6-8 days.

Fig. 4. The response of the EMU banking market to shocks to the segmented European banking markets (including UK)

Summary of results

Autocorrelation and partial correlation in level series and in the errors in associated regressions reveal a violation of weak-form efficiency with lack of independence in prices for each European segmented banking market including the UK and EMU markets. All markets tend towards weak-form efficiency when first difference prices series and market model first difference prices regression errors are considered. According to these tests the UK is the least inefficient in prices and the "Europe excluding the UK" banking market is the most inefficient. Again, it needs to be remembered that this latter market also includes non-members of the EMU market as well as European emerging markets.

Preliminary correlation analysis of unlagged price and first differenced price data shows strong positive relationships between the UK banking market and the "Europe excluding the EMU" market and also between the EMU banking market and "Europe excluding the UK" market

with the latter relationship being the stronger. These relationships are confirmed in the following regression analysis.

In regression analysis of unlagged first difference price data where the UK banking market is treated as the independent variable, the model of the "Europe excluding the EMU" market has stronger explanatory power than the model of the EMU banking market interacting with the UK banking market. Systematic risk (market risk) is highest in the former model and there is therefore least unsystematic risk (idiosyncratic risk). This indicates strong financial integration in the "Europe excluding the EMU" banking market interacting with the UK market, as there are less idiosyncratic factors to diversify away in efficient portfolio allocation. There is also less concern by regulatory authorities for banking system risk arising out of idiosyncratic factors.

When the EMU banking market is treated as the independent variable, the strongest explanatory power exists in the segmented market of "Europe excluding the UK" banking market model. This relationship is stronger than that in the model where the "Europe excluding the EMU" banking market interacts with the UK banking market. Unsystematic risk is lower than in the latter system. Again, financial integration is stronger as there are less idiosyncratic factors to diversify away in efficient portfolio allocation. It also means that there is even less concern for financial regulators in banking system risk arising out of idiosyncratic factors.

When pairwise VAR models are considered with first difference price data, all segmented European banking markets (including the EMU market) are cointegrated with the UK banking market. This confirms long-term equilibrium relationships in these market models. Pairwise causality runs from some of the European segmented banking markets to the UK market (in the cases of "Europe excluding the UK" and the "Europe excluding emerging European market"). There is no significant one-way or dual causality in the cases of "Europe excluding the EU" and "Europe excluding the EMU" and the EMU market. This may be explained by the fact that although the UK market is strongly capitalised, that market capitalisation is less than combined European markets.

When pairwise VAR models are considered, all segments of the European banking market (including the UK market) are cointegrated with the EMU banking market. This confirms the existence of long-term equilibrium relationships of each segmented European market with that of the EMU market. Causality tests show the short-term dynamics of the model and indicate that the EMU is the driving market in each case (in terms of exogeneity and Granger causality) except in the case of "Europe excluding the UK" market. There is no significant dual causality from the banking market segments "Europe excluding the EU", "Europe excluding the EMU", "Europe excluding European emerging markets", "Europe excluding the UK" and the UK markets. Causality analysis confirms that the strongest evidence of financial integration exists within the systems where the EMU banking system (rather than the UK system) interacts with the segmented European markets. The EMU banking market is a stronger driving force in those systems compared to systems where the UK banking market interacts with segmented European banking markets.

When one standard deviation shocks are delivered to endogenous variables in pairwise systems involving the segmented European markets and the UK market and then the segmented European markets with the EMU market, both the UK markets and the EMU market commence adjustment to equilibrium within 2-3days and each system achieves stability within 6-8 days. That is, when new information emanates from the segmented European banking markets, it is absorbed in the same time period by both UK and EMU markets. That is, segmented European banking markets models have similar degrees of informational efficiency when they interact with either the UK and the EMU banking markets.

Conclusion

Through tests of informational efficiency, cointegration and causality in segmented European markets interacting firstly, with the UK banking market and then with the EMU banking market, this paper confirms that Europe is achieving a strong degree of financial integration. Level series and first differences in price index values for the banking markets were considered in both unlagged

and lagged data. The issue raised in the paper is whether or not UK banking would benefit from EMU membership. The following conclusions may be drawn from the results of the analysis.

The UK banking market has less informational inefficiency in prices than the EMU banking market. This may be associated with the fact that the UK banking market is a large market, it has been established longer and it interacts internationally to a greater degree. Another factor may be that the EMU banking market is continuing to absorb smaller and less liquid banking market members (other than those banking markets of France and Germany).

A strong relationship exists between the UK banking market and the European banking markets that exclude the EMU banking market. This latter relationship is stronger than that between the UK banking market and the EMU banking market. Again, this may be due to the fact that the UK banking market is more internationalised and has been formally established for a longer period than the EMU market. That the EMU market is stronger in its interaction with European markets (excluding the UK) may represent evidence of growing trade and investment ties and greater dialogue in the financial integration of Europe without the direct involvement of the UK banking market.

Whilst there is significant evidence of long-term cointegrating relationships between segmented European banking markets and those of the UK and the EMU, causality analysis demonstrates that the EMU banking market has greater strength of exogeneity in pairwise systems with segmented European banking markets than when the UK banking market interacts with those segmented markets. In addition, there is no significant causal interrelationship between the UK banking market and the EMU banking market. It is probable that the UK banking industry, for the time being, has elected to stay on a path of global integration rather than integration within the EMU. It could equally be said that the focus of the EMU is on economic integration and unity within Europe.

Impulse response functional analysis reveals that when new information emanates from the segmented European banking markets, both UK and EMU banking markets absorb this information in similar periods of time. This indicates that, despite the fact that some segmented European markets include non-members of the EU and European emerging markets, all European markets have achieved a similar degree of informational efficiency when interacting either with the UK market or the EMU market. This leaves the path open for further formal expansion of financial integration in Europe.

Overall, the evidence suggests that Europe is achieving a strong degree of financial integration and that the UK banking market has a strong influence in Europe. The EMU banking market would benefit from the membership of the UK banking market, which would provide it with greater liquidity, informational efficiency, and lower unsystematic risks, if not a greater degree of interaction with global markets with which the UK market is also strongly integrated (For example, with North American and Japanese banking markets). Portfolio diversification of decreasing unsystematic risk would be more easily achieved and banking regulators would be less concerned with banking system risk arising out of unsystematic factors.

The question is whether or not the UK banking industry would benefit from membership. The UK banking industry in that case would be formally absorbed into the EMU banking market. The UK banking industry would be a major part of the EMU banking industry and would thus be part of the strongest global banking industry, possibly eclipsing that of the USA in terms of market capitalisation. If the question is asked as to why, therefore does UK banking not integrate in a formal sense into the EMU banking market, one can only speculate. However, it is likely that the British policy makers and bankers have a greater desire, partially due to historical reasons, to pursue the path of global rather than regional integration and to maintain their own currency, their individuality, control over their economy and sovereignty. Ultimately the reasons why the UK banking market does not formally integrate into the EMU market may be more about international and domestic economics and rather than about European financial economics relating to banking.

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