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Structural Breaks and Convergence in the European Retail Banking Sector

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Abstract

The aim of this paper is to investigate the convergence process in the European retail banking sector by analysing monthly deposit and lending data sets for the household and non-financial corporations sectors, the two sectors of retail banking, for the period 1991 to 2008. One of the main contributions of this paper is the application of the stochastic multiple structural break model developed by Bai and Perron (1998). This methodology is chosen in order to verify whether the interest rate data have been subject to structural change and whether the timings in the break dates coincide with significant events in the history of European banking. The second contribution of this paper is to test for convergence in the interest rate data by employing the Pesaran (2007) panel unit root tests while allowing for structural breaks. The findings show that the retail interest rate data have between two to four breaks which tend to be clustered around specific events such as new EU legislation. In addition, it is revealed that the presence of structural breaks materially affect the convergence results.

JEL Classification: F36, G15, G21, C33

Keywords: Integration; European retail banking; savings; lending rates; non-financial corporations sector; household sector; structural breaks; panel unit roots.

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1. Introduction

Since the 1980s, and with the subsequent launch of the Single Market Programme in 1993, the European banking sector has evolved from a highly regulated, restrictive and often anti-competitive market to a more competitive and open market. According to Evans et al (2008), these regulatory changes can be grouped under three main classifications. The first stage is deregulation at national level which included measures such as the elimination of interest rate controls and reduction in reserve and investment requirements. The second stage was aimed at strengthening competition at bank level through the elimination of capital controls and restrictions on entry as well as the introduction of the first and second banking Directives. The third stage is termed as prudential regulation and is exemplified by the rules on deposit insurance and minimum capital requirements. The aim of this paper is to analyse the convergence process in the European retail banking sector since the 1990s and until December 2008. Accordingly, the deposit and lending rates to the two components of retail banking, i.e. the household and the non-financial corporations (NFCs) sectors and with varying duration, are investigated. In this paper, we take the view that such an analysis should be viewed alongside the triggers of the whole process of banking integration, i.e. the major regulations which aim at removing regulatory barriers at national level and establishing a harmonised and homogeneous European Union (EU) banking market.

The existing studies on EU retail banking sector portray a mixed picture of EU retail banking sector with typically a fragmented banking market revealed for the 1990s period and some progress noted for the years 2000. These studies generally tend to rely on time series cointegration methods ((see Kleimeier and Sander (2000, 2003); Schuler and Heinemman (2002)) or tests of beta and sigma convergence (see Murinde et al (2000), Adam et al (2002) and Vajanne (2007)) which are applied to different household and non financial corporations savings and lending rates or spreads. Some of the more recent studies (Affinito and Farabullini (2006), Sorensen and Guiterrez (2006), Sorensen and Lichtenberger (2007)) have applied techniques such as tests of quality between estimated country coefficients and hierarchical cluster analysis to similar data. However, a number of limitations have been identified with most of these studies. Firstly, only one of these studies (Sander and Kleimeier, 2000) tests for the presence of structural breaks. However, Sander and Kleimeier (2000) do not follow any rigorous methodology in factoring in the effects of the breaks. They simply split the data sample into two periods and eliminate the data from the years where the breaks are most frequent. Secondly, in some of the studies reviewed (Schuler and Heinemann (2002); Sander and Kleimeier (2003); Affinito and Farabullini (2006), Sorensen and Lichtenberger (2007)), given the methodologies used, it is noted that the number of observations tested is rather limited and

may bias the results. Thirdly, the sample periods covered in most of the studies stop in the early 2000s except for the one by Vajanne (2007) who considers a data sample up to 2006. The empirical model used by Sorensen and Litchtenberger (2007) also considers data up to the year 2006 but it must be noted that their analysis is predominantly an investigation of the determinants of mortgage rate dispersion rather than a direct assessment of the degree of integration within retail banking. Also, on the whole, given that the sample period covered in most of these studies coincide with major developments in the European banking sector; it is highly probable that the data-sets tested have been subject to structural change. As argued in the literature, omissions to factor in the presence of structural breaks may lead to wrong conclusions being drawn. In the specific context of convergence studies (see King and Ramlogan-Dobson (2011); Evans and Kim (2011)), the evidence point to significant differences in convergence results being obtained when multiple structural breaks are not considered. Hence, one can argue that this key omission in previous studies on the retail integration process renders their results highly questionable.

This paper makes four main contributions to the literature on EU retail banking. Firstly, a detailed analysis of the convergence process in the retail banking sector is presented for both the 1990s and the more recent period, 2003-2008. Secondly, the analysis covers both sectors of retail banking (households and NFCs). To this end, 19 deposit and lending data sets have been constructed. Thirdly, this paper is the first one to factor in the presence of an unknown number of structural breaks in each country's deposit and lending spreads[1] before applying panel tests of convergence. The multiple stochastic structural break model developed by Bai and Perron (1998) is used to test for structural breaks and each data set of deposit and lending spreads is subsequently demeaned in order to remove the effect of structural breaks, which, as discussed in the literature, can produce misleading results if not accounted for. Hence, the objective here is to obtain more robust and conclusive test results. Fourthly, the pattern of these breaks are analysed to detect whether the countries' data series have been subject to common shocks such as key regulatory changes. Finally, the Pesaran (2007) panel unit root test, which has not been previously used in this area, is favoured for the robustness of this test. This methodology gives more informative data, less collinearity among the variables, more degrees of freedom, more efficiency and allows for heterogeneity compared to time series analysis. In addition, in comparison to other panel unit root tests, the Pesaran's model also allows for cross-sectional dependence.

[1] Defined as the differences between each deposit/lending rate and the corresponding weighted European average.

The paper is organised as follows: Section 2 outlines the Bai and Perron (1998) and Pesaran (2007) methodologies. Section 3 describes the datasets used. Sections 4, 5 and 6 present the empirical results. Section 7 concludes.

2. Empirical methodology

2.1 Structural break test

Perron (1990) [cited in Garcia and Perron, 1996], argues and proves that if there is a shift in the mean of a series because of structural change, it will be difficult to reject the null hypothesis of a unit root even if the data series appear to be integrated of order 1. Hence to overcome the problem of wrongly detecting unit root, the structural break or breaks have to be identified (Garcia and Perron, 1996). In the context of this paper, it must be noted that during the period under investigation, i.e. January 1991-December 2008, there has been significant milestones[2] in the history of the European single market. Therefore it is likely that the deposit and lending spreads corresponding to this period may exhibit structural changes. Furthermore, any tests for structural breaks in the European banking interest spread series would reveal the extent to which the breaks periods coincide with the important events in the European financial integration process. The paper also aims at identifying the factors that are responsible for the structural breaks and finding out if there are any similarities in the break dates for the 15 EU countries. In line with the aims of this paper, the Bai and Perron (1998) stochastic multiple structural break model provides a powerful and flexible framework to test for the break dates and their time of occurrence. This method tests for the presence of multiple structural breaks occurring at unknown dates and provides an estimate of the breakpoints. This methodology also allows for general forms of serial correlation, heteroskedasticity in the errors and lagged dependent variables (Bai and Perron, 1998). Drawing from the discussion in Baele (2006) and as per the methodology proposed by Bai and Perron, the deposit or lending spread is regressed on a constant, which is tested for structure breaks. The following regression model with *m* breaks (m+1 regimes) is considered:

$$r_t = \beta_j + \varepsilon_t \qquad (1)$$

For j = 1,….., m+1, where r_t is the retail deposit or lending spread in period t and β_j is the mean interest rate level in the *jth* regime. The *m* breakpoints are represented by the partition (T_1,….,T_m) and to estimate the number and timing of the breaks, Bai and Perron have set up a least square

[2] 1992 – Maastricht Treaty, 1994-EMU second stage, 1995 –Fourth enlargement round, 1998- ECB is established, 1999- EMU third stage (Baldwin & Wyplosz, 2004), etc.

algorithm which estimates the least squares estimates of β_j by minimising the sum of squared residuals:

$$S_T(T_1,....,T_m) = \sum_{j=1}^{m+1} \sum_{t=T_{I-1}}^{T_i} (r_t - \beta_j)^2 \qquad (2)$$

The estimated breakpoints are given by

$$(\hat{T}_1,....,T_m) = \arg\min_{T_1,...,T_m} S_T(T_1,....,T_m) \qquad (3)$$

Where the estimated betas for a given *m*-partition is given by $\hat{\beta}(T_1,...,T_m)$. Hence the breakpoint estimators represent global minimisers of the objective function (2). To minimise equation (2), Bai and Perron (2003) have put forward an algorithm that is based on the principle of dynamic programming.

In selecting the number of mean breaks (*m*), Bai and Perron (1998) propose to use the F-statistic ($SupF_T$ (k)) for testing the null hypothesis of no structural break (*m*=0) against the alternative hypothesis that there are breaks (*m*=k). Bai and Perron (1998) points out that the test is limited by the nature of the regressors and by the presence or absence of serial correlation and heterogeneity in the residuals. Based on the $SupF_T$ (k), Bai and Perron (1998) derived two double maximum tests, both testing the null hypothesis of no breaks against an unknown number of breaks, given an upper bound *M*. The first double maximum statistic is given by:

$$UD\max = \max_{1\le m\le M} SubF_T(m). \qquad (4)$$

The second test, WDmax, assigns weights to the individual F tests so that the marginal p-values are equal across values of *m*. Bai and Perron (1998) provide asymptotic critical values of both tests for up to M=5, which should be sufficient for the purpose of this paper. The UDmax and WDmax tests help determine whether there are breaks or not. On the next level, Bai and Perron (1998) have developed a $SubF_T$(m+1/m) to determine the optimal number of breaks. This tests the null hypothesis of *m* breaks against the alternative *m*+1 breaks. The critical values for each test statistic $SubF_T$(m+1/m) are provided by Bai and Perron (1998). With regards to the practical implementation of these tests[3], Bai and Perron (2004) propose to examine the UDmax and WDmax

[3] The GAUSS program code is available from Pierre Perron's home page at http://econ.bu.edu/perron/.

to check for the presence of breaks. If the double maximum statistics are significant, the $SubF_T(m+1/m)$ should be used to determine the number of breaks by selecting the one that rejects the largest value of *m*.

2.1.1 Demeaning of individual spread data series

In order to obtain robust estimates for panel data unit root tests, each individual deposit and lending spread series for the period covering January 1991 to December 2008 is demeaned and thus rendered "break-free" as follows:

$$r_t^* = r_t - \hat{\beta}_j, \qquad (5)$$

Where r_t^* is the demeaned retail deposit or lending spread in period t, $t= T_{j-1} +1,\ldots,T_j$, $j=1,\ldots..,m + 1$ and $\hat{\beta}_j$ $(j=1,\ldots.m + 1)$ is the estimated mean level of volatility in the *jth* regime.

2.2 Pesaran's (2007) CIPS unit root test

In spite of the numerous initiatives towards the creation of a Single Market in banking, the fact remains that there are country-specific variables which, if not taken into consideration, can lead to serious misspecifications. In this respect, in order to allow for the country heterogeneity factors, the panel unit root test developed by Pesaran (2007) is used. The argument that is put forward is that the presence of stationarity in the differences between each country deposit or lending rate and the corresponding weighted European average deposit/lending rate (herein referred to as deposit/lending spreads), would support the hypothesis of convergence in the EU retail banking market. The Pesaran (2007) method is superior to the other panel unit root tests as it circumvents their restrictive assumption that individual time series in the panel are cross-sectionally independently distributed. However, as reported by Pesaran (2007), this assumption is not effective when pair-wise cross-section covariances of the error terms differ across the individual series. In order to address this problem, Pesaran (2007) proposes a panel unit root test which allows for cross-sectional dependence by augmenting the ADF regressions with the cross section averages of lagged levels and first-differences of the individual series. Once the averages of the individual cross-sectionally augmented ADF statistics (termed as CADF) are computed, standard panel unit root tests, such as a modified IPS (2003) [termed as CIPS], can then be applied[4].

The CADF regression is described as:

[4] The CIPS Gauss code have been written and provided by Yamagata (2006).

$$\Delta z_{it} = a_i + b_i z_{i,t-1} + c_i \bar{z}_t + d_i \Delta \bar{z}_t + e_{it} \quad (6)$$

Where $\bar{z}_t = N^{-1} \sum_{i=1}^{N} z_{it}$ is the cross-section mean of z_{it}

The test for the null hypothesis $H_0 : \beta_i = 0$, for all *i*, against $H_1 : \beta_1 < 0; \beta_{N0} < 0, N_0 \leq N$, is given by the average of the individual CADF statistics, i.e. the CIPS test:

$$CIPS(N,T) = N^{-1} \sum_{i=1}^{N} t_i(N,T) \quad (7)$$

Where $t_i(N,T)$ is the cross-sectionally augmented Dickey-Fuller statistic for the i^{th} cross section unit given by the *t*-ratio of the coefficient of $z_{i, t-1}$ in the CADF regression The distribution of the CIPS test is non-standard and the critical values for 1%, 5% and 10% have been tabulated by Pesaran (2007) for different combinations of N and T.

3. Data sets and variable definitions

Nineteen monthly deposit and lending interest rate data sets for the household and non-financial corporations sectors have been compiled for up to 15 EU countries[5] for the purpose of this paper. Due to limited availability of data for the other EU countries, the empirical analysis conducted in this paper focuses on the group of 15 EU member states only. Several of the data sets have been compiled into two sub-periods. The first period starts in January 1991 or April 1995 and ends in December 2002. The majority of the interest rate data for this sub-period has been sourced from the European Central Bank's (ECB) database entitled "National Retail Interest Rates" and some missing data has been supplemented by data from the IMF, the Central banks and Datastream. The ECB discontinued this database in 2002 and replaced it by a more harmonised database entitled "MFI Interest rates" which starts in 2003. The second sub-period starts in January 2003 and ends in December 2008. The bulk of the data series in the second sub-group have been sourced from the ECB's new harmonised database and the remaining data supplemented by data obtained from central banks.

The following datasets have been compiled for the household sector:

- Short-term deposit rates (1991-2002)

[5] Austria (AT), Belgium (BE), Denmark (DK), Germany (DE), France (FR), Finland (FR), Italy (IT), Ireland (IE), Greece (GR), Luxembourg (LUX), Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE) and the United Kingdom (UK).

- Consumer loans (1995-2002)
- Mortgage rates with 2-5 years maturities (1995-2002)
- Mortgage rates with 1-5 years; 5-10 years; and over 10 years maturities, respectively (2003-2008)
- Consumer credit with up to 1 year; and 1-5 years maturities, respectively (2003-2008)
- Deposit rates with up to 1 year; 1-2 years; and over 2 years maturities, respectively (2003-2008)

While the following datasets have been compiled for the non-financial corporations sector:

- Short-term lending rates (1995-2002)
- Bank overdrafts (2003-2008)
- Lending rates with up to 1 year; 1-5 years; and over 5 years maturities, respectively (2003-2008)
- Deposit rates with up to 1 year; 1-2 years; and over 2 years maturities, respectively, (2003-2008)

In order to calculate the spreads, 19 series of European average deposit and lending rates were constructed using as weights the share of each country's GDP in the total EU15 GDP (all measured at constant prices and constant purchasing power parities)[6]. For the 1991-2002 data series, the 1998 GDP figures were used to construct the weights, whereas for the 2003-2008 data series, the 2005 GDP figures were used.

4. Structural break test results for the deposit and lending spreads

4.1 Household sector

The Bai and Perron (1998) structural break tests have been conducted on deposit and lending spreads using the Pierre Perron's[7] GAUSS program and have been conducted in OxEdit[8]. For all the deposit, lending and mortgage spreads series for the periods 1991-2008, the *UD*max and *WD*max (see Table 1) indicate the presence of mean breaks. The $SupF_T(m+1|m)$ statistics suggest a selection of around 3-4 breaks for the household deposit, consumer credit and mortgage rates for the period 1991/5-2002 and the selection of predominantly 2-3 breaks for the series for the period 2003-2008 (see Figures 1 to 11). Based on the illustration of the break dates for the household series, several observations can be made. For instance, the concentration of breaks around specific dates is

[6] For an application of this methodology to the construction of European weighted average interest rates see, among others, Kleimeier and Sander (2003, 2006). This methodology is based on the OECD measures of GDP in US$ at constant prices and constant PPPs with 2000 as the reference year.
[7] The GAUSS program code is available from Pierre Perron's home page at http://econ.bu.edu/perron/.
[8] The results are generated using Ox version 4.00 (see Doornik, 2005)

clearly visible for the deposit series (deposit spreads for 1991-2002 period; 1yr; 1-2yr and >2yrs spreads for 2003-2008 period). For example, for the 1991-2002 series (see Figure 1), the first break for twelve[9] countries of the fourteen countries is visibly clustered around the period September 1992 up to November 1993. Three of these countries (Belgium, Sweden and UK) then have a second break between June and September 1994 while another four of these countries, namely, Austria, Spain, France and Ireland, have their second break between February to December 1996. The remaining countries mostly have a break between March and October 1998. The countries with more than 2 breaks have their final break between March and September 2000 or in February/March 2001. Overall, for this dataset, it can be observed that the concentration of breaks around specific dates is visible while, at the same time, the composition of the sub-group of countries experiencing these breaks is also quite consistent throughout. Similarly, with regards to the 1yr deposit spreads (see Figure 2), the clustering of the breaks, especially for the first one, is very pronounced. Indeed, eleven of the countries have a first break in December 2003 followed by another break between February and November 2006 by six of these countries plus another 4 countries.

As for the deposit spreads for the 1-2yr period (see Figure 3), the presence of mostly 2-3 breaks is revealed while in addition, there is distinct clustering around a few dates for sub-group of countries as opposed to group clustering around key dates. For instance, Germany, Greece, Netherlands, Sweden and UK have their first break around January and November 2004 while Austria, Belgium, Denmark, Spain, Finland, Ireland, and Portugal have a break around November/December 2005 or March 2006. In Figure 4 (> 2years deposit spreads), similar clustering patterns are identified with the first sign of clustering of the break dates noted around October /November 2003 for Spain, France, Ireland and Netherlands while for Austria, Greece, Sweden and UK, the first break is in March/May or November 2004. The other obvious sign of clustering involves nine[10] countries with a common break occurring between January to September 2007.

In contrast to the above observations, no pronounced clustering is detected for the 1995-2002 consumer credit spreads series (see Figure 5). Out of the nine countries in the sample, four countries have 3 breaks while 5 countries have two breaks. The first break for the countries occurs between April to November 1996 or between March and July 1997. Six of the countries have a break in February/November 2000 or in May/August or September 2001. The remaining consumer credit series show break patterns more akin to the observations made for the deposit rates. Indeed as

[9] AT, BE, DK, ES, FI, FR, GR, IE, IT, NL, SE, UK
[10] AT, BE, FI, FR, GR, IE, IT, PT, SE.

illustrated in Figures 6 & 7, it can be observed that most of the breaks tend to rally around 2006/7. For example, for the 1 year consumer credit spreads, eleven[11] countries have a break between May and December 2006 while the other noticeable break occurs between August and December 2007. For the 1-5 consumer credit spreads, eight[12] of the 15 countries show a break between January and September 2006 but predominantly in the first half of the year. Then in 2007, seven[13] of the countries (four[14] of which had a previous break in 2006) have a break between February to December 2007, but predominantly in the later half of the year.

The mortgage spreads, on their part, show significant clustering and similarities. The 1995-2002 spread series (see Figure 8) show a high level of break dates and the evidence of a clear pattern in the timing of the breaks clustered in the years 1996 to 1998, in 2000 and in 2001. For the subsequent mortgage series (1-5yrs and 5-10yrs), most of the breaks tend to occur in 2003/4, 2006 and 2007 and are visibly clustered within the group of countries (see Figures 9 & 10). Moreover, the groupings of the countries in each cluster are also quite consistent across the two data sets. For instance, in both data sets, France, Ireland, Luxembourg, Portugal and the UK have a first break in October/November 2003 while Germany, Spain, Greece and Portugal have a break in 2006. In contrast, for the mortgage series with the longer maturities (see Figure 11), it can be observed that there is not any obvious pattern of clustering in the break dates for this data set except for one break involving eight countries that occurs in 2003/4.

4.2 Non-Financial Corporations Sector

Based on the results obtained from the *UD*max and *WD*max statistics (see Table 2), the presence of mean breaks is revealed for all the deposit and lending spreads for the non-financial corporations sector. The $SupF_T(m+1|m)$ statistics, on their part, suggest a selection of to 3-5 breaks for the lending spreads for the period 1991-2002 and the selection of predominantly 2 breaks for the deposit and lending spreads the period 2003-2008 (see Figures 12 to 19). Along similar lines as with the household data series, some common trends are also observable for the NFC data sets. For instance, a clear pattern in the timing of the first break is observable for the 1991-2002 lending data series (see Figure 12), with eight[15] countries showing a break between September to December 1992. Another common break for seven countries in this panel, namely Germany, Spain, Ireland, Italy, Portugal, Sweden and UK takes place between June to December 1996. In 1998, six of the

[11] AT, DE, DK, FI, FR, GR, IE, IT, LUX, PT, UK.
[12] AT, DE, ES, IE, NL, PT, SE, UK
[13] BE, DE, GR, IE, IT, PT, UK
[14] DE, IE, PT, UK
[15] DE, DK, FI, FR, IE, IT, PT,UK

countries have a break between May to December, but predominantly in December. Subsequently, Denmark, Greece, Italy, Portugal and UK have a break between February to September 2000 while Germany has a final break in March 2001. The timing of the breaks namely in 93/94, 96, 98 and 2000/1 coincide with the dates observed for the household deposit and mortgage rates for the same period. This pattern would suggest that events in these periods are likely to have triggered a reaction from the retail spreads. The following Section provides a discussion of the link between key events and the occurrence of structural breaks.

Looking at the overdraft spreads for the period 2003-2008 (illustrated in Figure 13), some evidence of clustering of the break dates is also visible. For instance, eight countries have a break either in December 2003 or between January to June 2004. The next clustering of breaks is between July to November 2006 and involves six [16] countries. Thereafter, Germany, Finland, Greece, and Netherlands have a break between August to November 2007 while Spain and UK have a break in February 2008. As for the break dates for the 1yr, 1-5yrs and over 5yrs lending data, a fairly consistent pattern emerges. For instance, for the 1 year lending spreads (see Figure 14), the first break for ten countries occur in October/November 2003 or between January to June 2004. Similarly, for the 1-5 years lending spreads (see Figure 15), six[17] countries have break either in October/December 2003 or between January to June 2004 while for the over 5 years lending spreads (see Figure 16), seven countries[18] have a break between January to November 2004. The next common break for all 3 lending data spreads occurs between February to December 2006 and involves seven countries in each case. The groupings of the countries are also fairly similar across the three sets, especially for the 1-year[19] and over 5-years[20] lending spreads data. Subsequently, four countries in the 1-year[21] lending category and seven[22] countries in the 1-5 years group have a break between January to November 2007.

With regards to the deposit spreads for the NFCs, there is also a distinct clustering in the timing of the break dates for the short-term and medium term deposit spreads. As illustrated in Figure 17, 13 out of the 15 countries exhibit a clear break in November/December 2003 while the other two countries (Portugal and Sweden) have a break in January/April 2004. The second evident break for

[16] AT, DK, FI, FR, IE, PT,
[17] AT, ES, FR, NL, LUX, SE, UK
[18] DE, DK, GR, LUX, NL, SE, UK
[19] AT, BE, DE, ES, FI, IE,PT
[20] AT,BE, ES, FR, IE, NL,PT
[21] AT, DE, FR, GR
[22] DK, ES, FI, FR, GR,LUX, PT

eight[23] of the countries occurs January to October 2006 but predominantly in the first half of the year. As illustrated in Figure 18, most of the breaks for the medium term deposit spreads happen in late 2003/early 2004 and in 2006. Once more, most[24] of the countries have a break either between October to December 2003 or between March and May 2004. Twelve[25] of the countries also have a break between January to November 2006. In sharp contrast, the break dates for the deposit spreads with over 2 years' maturity do not follow the clear groupings observed for the previous two deposit spreads datasets. In this case (see Figure 19), the most obvious common break occur between February to October 2006 and involve eight[26] countries. The next noticeable break affecting seven[27] countries takes place between January to August 2007. So overall, the clustering for the lending and deposit data sets is clearly identifiable and importantly, concurs with previous observations noted for the deposit and some lending rates for the household sector. Building on this premise, the following Section presents an analysis of the common break dates observed across the 19 datasets and their possible association with specific events.

5 Analysis of patterns in break dates for the deposit and lending spreads

5.*1* *1991-2002 Sample period*

Overall, it can be observed that the break dates for the spreads of the various categories of household and NFC rates, namely deposit, lending and mortgages, for the period 1991 to 2008 are clustered around some specific months and years. The next step in the analysis to verify whether the timing of the breaks for these spread series have been subject to common shocks triggered by certain key events within the European banking sector. Among the household deposit spreads series, the short-term deposit spreads for the period 1991-2002 reveal a clustering of breaks mostly in 1993 or 1994; in 1996 and mostly in the second half of 1998. Among the consumer lending spreads for the period 1995 to 2002, the breaks are noticeably grouped between April to November 1996; between July to December 1997; in 2000 and 2001. As for the household mortgage spreads for the period 1995 to 2002, the breaks mostly take place in 1996 (predominantly in April/May or November) followed by April-May or September/December 1997; January/February or September/November 1998; April in the second half of 2000; and between August to November 2001. An overview of the NFC lending data-set for the 1991 to 2002 period reveals a clustering of the break-dates between September 1992 to August 1993, in 1996, 1998 and 2000. It can thus be

[23] AT, DE, ES, FR, IE, IT, PT, UK
[24] BE, DK, FI, FR, GR, IE, NL, LUX, PT, SE, UK
[25] AT, DE, DK, ES, FI, GR, IE, IT, NL, LUX, PT, UK
[26] BE, DE, DK, FI, GR, IE, IT, PT
[27] BE, DK, ES, GR, IE, NL, PT

observed that the household and NFC series for the period 1991-2002 have experienced structural change in the same periods.

With regards to the first break that takes place in 1993 or 1994, the timing coincides with the establishment of the Single European Market and the removal of the barriers to the free movement of goods and services. Furthermore, at the same time, two key Directives for the banking sector, namely, the Capital Adequacy Directive of 1993 and the Deposit Guarantee Schemes Directive of 1994 were formally adopted. The Capital Adequacy Directive aims at establishing uniform capital requirements for banks and other investment and credit institutions by specifying the capital adequacy requirements, their calculation and the rules for their prudential supervision. The main objective of this Directive was to enhance financial stability and integrity. The main objective of the Deposit Guarantee Schemes Directive was to provide protection to all EU depositors and to consolidate the workings of the EU internal market by establishing a harmonised minimum deposit guarantee level of Eur 20,000. The Directive requires every credit institution to join a deposit guarantee scheme. The next break for all the earlier series occur mostly in 1996. The timing of this second break is quite significant as it matches the entry into force of the Investment Services Directive which was heralded as being a major catalyst to the completion of the single market in financial services. This Directive aimed at removing existing restrictions on the provision of cross-border financial services and to allow investment firms in Member States to freely trade on each others' exchanges. These measures would thus bring in greater competition and integration within the European financial services market and could be responsible for the structural change experienced by almost all of the household and NFC data series.

The next series of breaks take place in 1997 and mostly involves the consumer lending data series. Again, the timing of the break dates appears to match key events within the history of the European banking sector. For instance, in July 1997, the Commission adopted a Recommendation on electronic payment instructions which set out minimum transparency standards and customer redress requirements, amongst others and applies to card payments, home and phone-based applications, store cards and e-money. The main objective of this Recommendation was to develop consumer protection in the financial services industry and to boost confidence in electronic payments. Later, in 1997, the Commission made progress with regards to the simplification of the legislative framework in the banking sector under the Simpler Legislation for the Single Market (SLIM) initiative. The proposal put forward was to consolidate various banking Directives into a single "Banking Code" which would facilitate banking legislation.

The household and NFC data spread series reveal a set of breaks throughout the whole of 1998; predominantly in May for the household sector and in December for the NFCs. These correspond to two major events. Firstly, in May 1998, the Directive on settlement finality in payment and securities settlement systems was adopted. This Directive aims at facilitating the existing cross-border payment and securities settlement systems and make them more cost effective and efficient by specifically covering collateral security. Secondly, in late 1998, the European Commission presented its Financial Services Action Plan (FSAP) which aims at improving the single market in financial services. With regards to the retail banking market, the proposals identified six main areas for progress, namely information and transparency, redress procedures, customer protection rules, electronic commerce, insurance intermediaries, and cross-border retail payments.

The 1991-2002 data series exhibit another set of breaks in 2000. These breaks coincide with the adoption of the Consolidated Banking Directive in March 2000, an important regulatory change in the EU banking sector. This codified Directive replaced and consolidated six existing banking Directives namely the First Banking Directive, the Own Funds Directive, the Second Banking Directive, the Banking Supervision Directive, the Solvency Ratio Directive and the Large Exposures Directive. Amongst others, the key provisions of the Consolidated Directive relate to requirements for setting up credit institutions, capital requirements for operational and credit risk, and disclosure requirements. The data series in all 3 categories of household deposit and credit spreads also reveal the presence of breaks in the year 2001. Here it can be observed that these structural changes could be the result of the following events. Firstly, in March 2001, the European Council adopted the Directive on the winding up of credit institutions. This Directive sets outs the procedures to be followed in the event that a credit institution with branches fails. For instance, from then on, only the Bankruptcy laws of the home country would rule and thus uniform insolvency proceedings for all creditors could be guaranteed. Prior to this Directive, more than one jurisdiction could prevail and thus creditors could face unequal treatment. Hence, the adoption of this Directive was meant to bring greater and more consistent consumer and investor protection. Secondly, in March 2001, more specific to the mortgage market, a "voluntary code of conduct on pre-contractual information for home loans"[28] was launched by the European Commission.

Thirdly, in September 2001, political agreement was reached by the Council of ministers on the Distance Marketing of Financial Services Directive. This Directive is expected to further enhance consumer protection and harmonise the legal environment for the business operators through the prohibition of abusive marketing practices, rules on consumers' right to withdrawn, etc.

[28] http://ec.europa.eu/internal_market/finservices-retail/docs/home-loans/agreement_en.pdf

5.2 2003-2008 Sample period

As for the household deposit and credit data spread series for the period 2003-2008, it can be observed that with regards to the deposit rates with 1-year, 1-2 years and over 2 years maturities, the majority of the breaks take place between late 2003 and early 2004, between July to December 2005, throughout 2006 (predominantly in February) and in 2007. The data spread series on consumer credit with 1 year and 1-5 years maturities, show the occurrence of break dates around similar time periods, more specifically around late 2003 and early 2004, in the first half of 2005, in 2006 and in the second half of 2007. As for the mortgage spreads with 1-5 years, 5-10 years and over 10 years maturities, the presence of structural breaks are revealed in late 2003, in the first half of 2004, throughout 2006 and in the second half of 2007 or in early 2008. With regards to the NFC lending and deposit spread series for the period 2003-2008, it can be observed that the majority of the individual series exhibit a first break in late 2003 and/or in 2004. The next popular timing for the occurrence of a break is in 2006 and the third most common break point for all the 2003-2008 data series happen predominantly in the second half of 2007. Along the same lines as the break dates for the earlier period, similarly here, the break dates can be matched with key happenings in the European deposit and credit markets.

The first set of breaks for the credit rates are clustered in late 2003 and 2004 and the following events could be responsible for the shocks experienced by the consumer and NFC credit and mortgage series. Firstly, in November 2003, the European Commission decided to set up a European Banking Committee, responsible for the application of community legislation in Member States and ensuring convergence in supervisory practices, amongst other duties. Secondly, in April 2004, the European Parliament adopted a Directive on markets in financial instruments with the aim of regulating the activities of individuals and businesses that provide a range of financial services to investors across the EU. A set of comprehensive measures on matters such as investment activities, organisational requirements for investment firms, and transparency requirements for share transactions, formed the basis of this directive. Thirdly, in December 2004, the expert forum group on mortgage credit which was set up in 2003 to provide advise on how to further the integration of the EU mortgage market, published its report. The recommendations put forward consist of both legislative and non-legislative measures covering areas such as consumer protection, mortgage brokers, cross-border contracts, collateral issues, financing of mortgages and others. With regards to the deposit data spread series, a common break is reported mostly in the second half of 2005 and this coincides with a review conducted by the Commission in November 2005 on the €20,000

minimum guaranteed level under the EU deposit guarantee scheme, and whether it should be revised.

Interestingly, all the deposit and credit spreads data unanimously show the occurrences of breaks throughout the year 2006 (predominantly in the first half of the year), and in 2007. A review of the major events that took place in the European banking sector in these two years points to some key developments that seem very likely to have caused the structural breaks. Firstly, in June 2006, an amended Capital Requirement Directive for banks and investment firms was formally adopted by the European Council and Parliament. This Directive updates the supervisory framework in the EU and also reflects the Basel II rules on capital standards agreed upon at the G-10 level. Secondly, in the first half of 2006, substantial progress was also achieved with regards to the implementation of the Single Euro Payments Area (SEPA), with the deployment phase on direct debit instruments and cards framework well under-way. The SEPA initiative is highly significant for the European banking sector, as it would remove the existing legal and technical barriers for cross-border payments. Thirdly, another event in 2006 which may have had a role to play in the happening of the breaks is the adoption by the European Council and Parliament of the Services Directive, also known as the Bolkestein Directive. This directive is a major issue for the European Union as it seeks to eliminate the barriers in services across the EU and complete the single market.

The third most common break point for all the 2003-2008 data series happen predominantly in the second half of 2007. New developments in the retail banking sector could well explain the breaks witnessed by the data series. For instance, in January 2007, the European Commission published two strategic reports on mortgage funding and consumer protection, which were prepared by two expert groups set up in April 2006. The report from the Mortgage Funding Expert Group reviews existing barriers to an efficient mortgage funding market and sets out detailed proposals to remove these obstacles. The mortgage industry and consumer report, on its part, looked at four essential consumer issues, namely pre-contractual information, advice, early repayment and the annual percentage rate (APR) charge. The conclusions drawn from these reports have subsequently been incorporated in the Commission's White Paper on the Integration of EU Mortgage Credit Markets which was adopted in December 2007. In addition, in Mid-March 2007 consultations were rolled out by the Committee of European Banking Supervisors (CEBS) on the establishment of a mediation mechanism between banking supervisors. This culminated into the publication of a paper by the CEBS on the "Range of practices on supervisory colleges and home-host cooperation", as well as a template for a "Multilateral Cooperation and Coordination Agreement" which aim at enhancing the efficiency of the supervisory regime as stipulated by the Capital Requirements

Directive. These developments have further prompted more deliberations within the banking sector which could explain the shocks experienced by the interest rate data series. For example, within the retail banking sector, the European Savings Banks Group which boasts a network of around one third of the European retail banking sector, adopted a resolution on the future of EU banking supervisory framework in November 2007, whereby one of the main conclusion was the importance of consolidating the convergence process in supervisory practices within the EU banking sector.

Another potential trigger for a common break for the lending and deposit rates is the Green Paper on retail financial services in the single market which was presented by the European Commission in May 2007. This agreement seeks to further strengthen consumer protection and regulation of service providers. Consultations on this Green Paper took place later in September 2007 and the conclusions were later incorporated in the review of the single market, entitled "A single market for 21st century Europe"[29] in November 2007. Furthermore, again in May 2007, political agreement was reached on the amended Consumer credit Directive which seeks to harmonise credit rules while also covering a broader range of credit instruments. This Directive is crucial for the workings of a single market for consumer credit. Another key development in December 2007 is the adoption of the Payment Services Directive which seeks to harmonise the rules on payment services and provide a uniform platform for effective and competitive cross-border payments to payment service providers via the use of SEPA.

6 Convergence test results for the deposit and lending spreads

6.*1* *Household sector*

In order to test whether convergence in the European banking sector is present, Pesaran's panel unit root test (CIPS) is applied to both level and demeaned spreads data for the household deposit, consumer credit and mortgage panels. The use of spreads as opposed to nominal data is widely recommended in the literature as it cancels the effects of macro economic variables and in particular, changes in inflation, which would impact on the retail interest rates. There are different methods of calculating interest rate spreads, for example, it can be defined as the difference between deposit and credit rates (see Valverde and Fernandez (2007)[30], or differences between each country's rate and an allocated benchmark rate such as the money market rate or the German's rate (see Kleiemeir and Sander (2000), Baele et al (2004)). In this paper, we follow a similar approach and define spreads as the difference between each country's deposit/lending rate and the corresponding

[29] http://ec.europa.eu/internal_market/strategy/index_en.html

[30] Valverde and Fernandez's (2007) study look primarily at the determinants of bank margins in European banking and one of the dependent variables considered is the loan to deposit spread.

average weighted EU rate in each interest rate category. This approach is favoured, as convergence in the spreads would signify a narrowing of the differences between each country's lending or savings rate and the European counterpart. The CIPS test is ideally suited for this exercise as the results would reveal whether each panel dataset is either stationary or not. If stationarity is detected, then this would indicate that the European retail banking sector is integrating. Furthermore, given the presence of structural breaks in all data sets tested, the deposit and lending rates have also been subject to a demeaning process in order to remove the effect of structural breaks. As a consequence, any differences in the CIPS results obtained would be entirely due to structural change.

The panel unit root test results are provided in Table 3, whereby the statistics are based on an autoregressive process including an intercept term only. With regards to the deposit spreads to the household sector for the period 1992-2002, the null hypothesis of a unit root cannot be rejected for the level panel data sets. However, in sharp contrast, when the CIPS test is run on the demeaned spreads for the same period, the null of a unit root is rejected (even at the 1% significance level), thereby indicating convergence. Similarly, for the 2003-2008 1-year deposit rate panel with level spreads, the null of a unit root cannot be rejected. However, it is rejected for the demeaned spreads panel (10% significance level). A similar pattern emerges for the 2003-2008 deposit rates with maturities between 1-2 years, where the null hypothesis of a unit root cannot be rejected for the level panel data sets. However, in sharp contrast, when the CIPS test is run on the demeaned spreads for the same period and maturities, the null of a unit root is rejected at the 1% significance level. As for the deposit with over 2 years maturities for the 2003-2008 period, the null of a unit root is strongly rejected (1% significance level) when both level and demeaned data are tested.

With regards to the consumer credit rates for the period 1995-2002 and 2003-2008 with maturities ranging from up to 1 year and between 1-5 years, the null of a unit root cannot be rejected in all 3 instances when level spreads panel data is tested. However, along the same lines as the results obtained above, when the demeaned consumer credit spreads are tested, the null of a unit root is strongly rejected (1% significance level) for all the data sets. A similar picture emerges for the mortgage panel sets whereby the null of a unit root cannot be rejected when the following original spread data are tested; the 1995-2002 (2-5 years) mortgage panel set and the 2003-2008 (1-5 years; 5-10 years & over 10 years) mortgage panel data sets. Strikingly, when the demeaned spreads of these mortgage categories are tested, the null of a unit root is strongly rejected (even at 1% significance level) in all 4 instances.

Some critical observations can be made here. Firstly, the contrasting results obtained for the level and demeaned spread data sets strongly highlight the importance of accounting for structural breaks. Secondly, based on these results, we can argue that convergence in the household deposit, consumer credit and mortgage market was present since the 1990s and has since continued in all categories of retail instruments. These results are highly significant, especially for the earlier period, as these contrast with the findings in the literature which tend to point to a fragmented retail market at the time. The inconsistencies in the results can be attributed to the use of panel methods which have more power than time series tests and the heavy presence of structural change which can clearly bias results. In addition, these results suggest that the retail household sector has responded well to the policy efforts by the European Commission to establish a single market in European banking. As evidenced in Section 5, these initiatives such as the FSAP and a plethora of banking directives have influenced the integration process in the right direction.

6.2 Non-Financial corporations sector

The results for the CIPS test for the panel of NFC spreads which represent the differences between each country deposit or lending rate and the corresponding European weighted average deposit/lending rate, are shown in Table 4. In line with the approach discussed in Section 6.1, the Pesaran's panel unit root test are applied to both level and demeaned spreads in order to highlight any inconsistencies in the results which may arise due to structural breaks. With regards to the NFC deposit panel data sets with maturities ranging from 1 year to over 2 years for the period 2003-2008, the null hypothesis of a unit root cannot be rejected consistently throughout all 3 panel sets when level spread data is considered. However, the results change completely when the demeaned deposit spread panels are tested whereby the null of a unit root is rejected strongly, even at 1% significance level. With regards to the short-term lending spreads for the period 1991-2002, the null of a unit root is strongly rejected for both level and demeaned spreads panel data sets, suggesting that the convergence in the lending sector was well underway in the 1990s. As for the lending rates for the period 2003-2008, the null of a unit root cannot be rejected for all the level spread data panel sets with maturities ranging from 1 year, 1-5 years and over 5 years. The same results are obtained for the level spread data panel overdraft rates for the same period. However, in sharp contrast, the null of a unit root is strongly rejected once the demeaned spread sets are tested for all the 3 categories of lending rates and for the overdraft rates. The contrasting results obtained for the retail rates to the non-financial services sector once again underpin the observations noted for the household sector, i.e. that the presence of structural change significantly influence convergence results. Therefore, based on the CIPS results on the demeaned spreads which are considered to be more robust, it can be stated that the integration process in the retail European banking sector was well underway in the

1990s and until the end of the sample period. These positive convergence results for both the household and non-financial services sector point to the success of the single market initiatives in driving an integrated retail sector, which is often seen to be segmented and lagging behind the wholesale sector (see Berglof et al (2005), amongst others).

7. Conclusions

The aim of this paper is to conduct an investigation of the integration process of the retail European banking sector by analysing monthly deposit and lending spreads to households and non-financial corporations for the period ranging from 1991 to end 2008. To this end, nineteen data sets consisting of deposit and lending spreads of varying maturities have been constructed for the 15 EU countries. An important contribution of this paper is the application of methodologies that have not, so far, been employed in the literature on European banking integration. Firstly, the stochastic multiple structural break model developed by Bai and Perron (1998) is applied to the individual deposit and lending spread series to detect the occurrence of structural change. The purpose of this exercise is two-fold. Firstly, it will be possible to identify any similarities in the pattern of the break points, if present, and secondly to analyse whether these can be linked to key regulatory and policy changes in the EU banking landscape. Faced with the presence of breaks, each spread data series is subsequently demeaned to factor in structural change, which if unaccounted for, can lead to wrong conclusions. The second methodology that is employed is the Pesaran's panel unit root test, which has more power than time series tests. The CIPS test is applied to both the level and demeaned spreads. The objective is to reveal and explore any consistencies or inconsistencies in the test results for both types of data which might arise due to the presence of breaks.

The application of the Bai and Perron (1998) break model indeed shows the presence of several breaks in all the household and non-financial corporations spread data sets. For the 1991-2002 sample periods, mostly 3 to 5 breaks are revealed while for the 2003-2008 samples, on average 2 breaks are detected. Interestingly, it can be observed that distinct clustering of the break dates occurs around significant events such as the introduction of new legislation. For instance, the 1991-2002 series all show common breaks in 1993 while the 2003-2008 series have breaks predominantly in 2006 and 2007. These breaks can be linked to the launch of the Single Market and revised legislation such as the amended Capital Requirement Directive and the Consumer Credit Directive and new legislation such as the Services Directive and the Payment Services Directive. Based on these findings, it is reasonable to argue that these major overhauls in the European banking sector are bound to have led to common shocks in the retail interest rate data at country-level.

An econometric result that warrants special mention is the empirical results obtained under the panel unit root tests which have been applied to both the level and demeaned spreads. Here, it is noted that all the demeaned spread panels consistently show strong evidence of integration (even at the 1% significance level) in both the deposit and lending markets for both the 1990s and the more recent period, 2003-2008. This is in sharp contrast to the results obtained for the deposit and lending level spread panels whereby the hypothesis of convergence is rejected for all panels except for two[31]. Hence, the presence of retail banking integration is clearly evident when data that allows for structural break, are used. This reinforces the argument that the presence of significant structural breaks can lead to wrong inferences being drawn from panel unit root tests.

Overall, based on the empirical results obtained from robust methodologies and an extensive analysis of the regulatory and policy changes at the level of the EU, it is evident that substantial progress[32] has been achieved in the establishment of a single market in retail banking in Europe. Nonetheless, this paper would argue that the efforts at ensuring harmonisation and promoting competition in the banking sector should go deeper, especially in the areas of consumer credit, competition policies to cross-border activity, an EU-wide payments system and the setting up of efficient market infrastructures. The implications of our empirical results also transcend to other convergence areas whereby the need to allow for structural change is shown to be important. Finally, this paper has investigated macro-data to assess the convergence process in the banking sector. It is believed that an analysis of micro-data such as efficiency and profitability of EU banks' will shed more light on the integration process in Europe. This new area of research is being considered for future work.

[31] The 1990s NFC lending spreads and the 2003 household deposit spreads with >2yrs maturities.
[32] However, these results do not reveal either the extent or the speed of the integration process.

References

Adam K., Jappelli T., Menichini A., Padula M., Pagano M. (2002), "Analyse, compare and apply alternative indicators and monitoring methodologies to measure the evolution of capital market integration in the European Union", *Centre for Studies in Economics and Finance, University of Salerno*, January.

Affinito M. and Farabullini F. (2006), "Does the law of one price hold in retail banking? An analysis of national interest rate differentials in the euro area", *Bank of Italy, Economic Research Department*, August.

Baele L., Ferrando A., Hordahl P., Krylova E., and Monnet C. (2004) "Measuring European Financial Integration", *Oxford Review of Economic Policy*, Vol. 20, Issue 4.

Baele L. (2006), "Real interest rates in an integrating Europe", *Tilburg University, CentER and Netspar*, February version.

Bai J., Perron P. (1998), "Estimating and testing linear models with multiple structural changes", *Econometrica*; Vol. 66, No. 1, pp. 47-68.

Bai J. and Perron P. (2003), "Computation and analysis of multiple structural change models", *Journal of Applied Econometrics* 18, 1-22.

Baldwin R. and Wyplosz C. (2004), *The Economics of European Integration*, McGraw Hill.

Berglof E., Fulghieri P.,Gual J., Mayer C.,Barros P., Vives X. (2005), "EU Banking sector Integration falls short of expectations", Report by the Centre for Economic Policy Research.

Doornik, J.A. (2005), *Object-Oriented Matrix Programming Using Ox*, 3rd ed. London: Timberlake Consultants Press and Oxford, Available from : www.doornik.com.

Evans P., Hasan I., and Lozano-Vivas A. (2008), "Deregulation and convergence of banking: the EU experience." *Finnish Economic papers*, Vol. 21, No. 2.

Evans P., Kim J. L., (2011) "Stochastic convergence of the catch-up rate and multiple structural breaks in Asian countries" *Economic Letters*, Vol. 111, Issue 3.

Garcia R., Perron P. (1996), "An analysis of the real interest rate under regime shifts", *Review of Economics and Statistics*, Vol. 78, pp. 111-125.

King A., and Ramlogan-Dobson C., (2011) "Nonlinear time series convergence: The role of structural breaks" *Economic Letters*, Vol. 110, Issue 3.

Kleimeier S. and Sander H. (2000), "Regionalisation versus globalisation in European financial market integration: Evidence from co-integration analysis", *Journal of Banking and Finance*, 24, 1005-1043.

Kleimeier S. and Sander H. (2003), "European financial market integration: Evidence on the emergence of a single eurozone retail banking market". *Research in Banking and Finance*, 3, 13-91.

Kleimeier S. and Sander H. (2006), "Regional versus global integration of euro-zone retail banking markets: Understanding the recent evidence from price-based integration measures", *The Quarterly Review of Economics and Finance*, 46, 353-368.

Murinde V., Agung J. and Mullineux A. (2000), "Banking system convergence in Europe", *University of Birmingham*, September.

Pesaran, M. H., (2007), "A simple panel unit root test in the presence of cross-section dependence", *Journal of Applied Econometrics*, 22(2), pp. 265-312.

Schuler and Heinemann (2002), "How integrated are European Retail financial markets? A cointegration analysis", *ZEW papers*, Germany.

Sørensen C. K. and Gutiérrez J., (2006), "Euro area banking sector integration – using hierarchical cluster analysis techniques", *Working Paper Series* 627, European Central Bank.

Sørensen C. K. and Lichtenberger J.D (2007), "Mortgage interest rate dispersion in the euro area", *Working Paper Series* 733, European Central Bank.

Vajanne L. (2007), "Integration in euro-area retail banking markets –convergence of credit interest rates", *Bank of Finland Research Discussion paper* No. 27.

Valverde S. C and Fernandez F.R (2007), "The determinants of bank margins in European banking", *Journal of Banking and Finance*, Vol. 31, Issue 7.

Yamagata, T., (2006), *Gauss codes for computation of the CADF panel unit root test statistics* proposed in Pesaran (2007). Available from: http:www.econ.cam.ac.uk/faculty/pesaran/pub2007/CADFgauss6.zip

Table 1: Bai and Perron statistics for multiple structural breaks tests for the household sector deposit and lending spreads

	ST deposit spreads 91-02		1-yr deposit spreads 03-08		1-2yrs deposit spreads 03-08		>2yrs deposit spreads 03-08		Consumer credit spreads 95-02	
Country	**Udmax**	**WD max (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**
Austria	416.1071***	913.0943**	59.8089***	76.3070**	22.7465***	27.0311**	84.9028***	122.2259**	91.1008***	108.2610**
Belgium	91.5542***	200.9041**	23.3487***	31.5568**	9.6411**	11.4571**	59.3787***	70.5637**	128.2646***	184.6493**
Germany	637.1399***	1398.1228**	155.3572***	184.6211**	88.4274***	127.2998**	6.9625	15.2784**	295.8***	323.72**
Denmark	40.2021***	84.5510**	75.8374***	109.1754**	75.3470***	89.5398**	99.3006***	142.9529**	-	-
Spain	336.20***	578.0894**	174.0276***	250.5297**	120.6837***	143.416**	41.1104***	55.6797**	184.5857***	262.8049**
Finland	991.448***	991.448**	850.9291***	1224.99**	332.4908***	395.1207**	37.7949***	54.4095**	56.6136***	76.9760**
France	405.5992***	647.1626**	36.1179***	42.9213**	20.9269***	20.9269**	77.9082***	77.9082**	86.8040***	103.1549**
Greece	521.82***	1145.07**	32.4979***	46.7838**	24.4317***	35.1718**	39.2061***	55.2754**	-	-
Ireland	235.69***	405.25**	98.8048***	117.4162**	106.2875***	153.0111**	103.0316***	122.4392**	-	-
Italy	436.6171***	750.7365**	126.3687***	181.92**	198.8747***	286.2994**	411.4125***	488.9085**	-	-
Netherlands	1446.95***	1719.51**	83.2781***	83.2781**	47.4897***	68.1884**	31.5181***	33.4277**	-	-
Portugal	311.65***	535.86**	72.2639***	104.0309**	60.8038***	66.8030**	10.1569**	19.5126**	77.951***	112.2183**
Sweden	237.8283***	521.8841**	61.9527***	83.2691**	77.4509***	111.4981**	135.7611***	195.4413**	579.803***	689.018**
UK	181.6452***	398.5974**	202.5814***	211.7249**	92.5477***	109.9805**	73.1320***	73.1320**	57.7174***	83.0899**
Luxembourg	-	-	61.2225***	72.7547**	29.7625***	42.8460**			-	-

Table 1 Cont'd

	1yr lending spreads03-08		1-5yrs lending spreads 03-08		Mortgage spreads 95-02		1-5yrs Mortgage spreads 03-08		5-10yrs Mortgage spreads 03-08		>10 yrs Mortgage spreads 03-08	
Country	**Udmax**	**WD max (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**
Austria	97.2687***	97.2687**	86.9352***	125.1517**	431.93***	742.68**	165.06***	189.05**	48.2624***	48.2624**	27.5620***	27.5620**
Belgium	36.9432***	36.9432**	10.9657**	13.0312**	287.149***	362.3860**	24.39***	24.39**	58.1306***	69.0804**	20.6485***	24.5380**
Germany	19.0578***	27.4355**	137.6147***	163.5366**	1639.11***	3596.82**	235.84***	339.51**	87.7422***	126.3135**	105.6794***	152.1357**
Denmark	12.9736***	13.3007**	38.9966***	38.9966**	-	-	68.5362***	98.6645**	34.8026***	50.1017**	22.9199***	32.9954**
Spain	60.8001***	72.2528**	201.6145***	290.2437**	779.70***	779.70**	87.1353***	125.4397**	69.0617***	82.0705**	166.856***	166.856**
Finland	32.3919***	38.4934**	80.8621***	116.4089**	397.602***	872.487**	38.5949***	55.5611**	25.0384***	36.0452**	62.3008***	78.2631**
France	105.7196***	147.8700**	10.0607**	14.4834**	19.487***	25.6903**	185.44***	220.37**	68.3846***	98.4463**	38.7504***	55.7850**
Greece	132.3786***	190.5719**	64.4982***	76.6474**	-	-	142.28***	204.82**	218.58***	264.10**	192.73***	197.41**
Ireland	22.1591***	29.3015**	42.7828***	61.5900**	236.56***	519.10**	45.1873***	53.6991**	181.38***	261.12**	-	-
Italy	24.9628***	35.9363**	116.6475***	138.6198**	540.94***	1187.02**	142.10***	142.10**	33.0012***	39.2175**	23.8502***	34.3347**
Netherlands	12.6088***	12.6088**	68.8297***	99.0870**	191.17***	303.89**	15.6987***	22.5998**	71.2439***	71.2439**	61.9653***	68.0654**
Portugal	51.1072***	60.7341**	41.6786***	60.0004**	992.02***	1428.11**	140.0963***	201.6822**	879.586***	1266.25**	-	-
Sweden	39.5948***	47.5399**	46.0532***	66.1756**	88.05***	171.56**	74.9374***	107.8797**	152.33***	219.30**	-	-
UK	101.9625***	118.0349**	98.6573***	142.0268**	105.587***	167.41**	26.9869***	38.8503**	58.75***	58.75**	34.8963***	41.4696**
Luxembourg	17.9609***	22.7755**	16.6204***	19.7511**	498.51***	592.42**	46.6295***	55.4129**	346.13***	498.28**	-	-

Table 2: Bai and Perron statistics for multiple structural breaks tests for the non-financial services sector

	ST lending spreads 91-02		Overdraft spreads 03-08		1yr lending spreads 03-08		1-5yrs lending spreads 03-08	
Country	**Udmax**	**WD max (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**
Austria	-	-	26.9230***	38.7583**	95.7780***	137.8818**	16.3165***	16.3165**
Belgium	122.602***	253.28**	32.5033***	32.5033**	110.5074***	131.3232**	24.9730***	35.9510**
Germany	287.4137***	494.1903**	26.4624***	29.7666***	56.8645***	73.8009**	51.6740***	58.1818**
Denmark	326.9837***	717.524**	54.8510***	54.8510**	28.9610***	28.9636**	84.2902***	100.1676**
Spain	163.5642***	281.2386**	44.2293***	44.2293**	160.8336***	231.5355**	74.1583***	106.7581**
Finland	89.9578***	177.7642**	31.8957***	45.9169**	22.2978***	32.0999**	27.7451***	32.9713**
France	53.9493***	79.5753**	23.6413***	31.8751**	54.4811***	66.5082**	114.4944***	164.8259**
Greece	758.67***	1539.054**	53.6968***	63.8114**	29.2756***	34.7902**	10.4427**	17.9555**
Ireland	919.5831***	2017.91**	124.291***	124.291**	51.3814***	61.0599**	26.9946***	26.9946**
Italy	1612.08***	3537.508**	10.5434**	10.5434**	146.9499***	174.6302**	134.533***	134.533**
Luxembourg	-	-	-	-	70.0370***	100.8251**	15.7963***	20.1644**
Netherlands	180.238***	314.99**	28.2918***	33.6210**	22.1560***	30.2471**	21.9516***	31.6015**
Portugal	957.7572***	2101.68**	56.5846***	79.8834**	65.3318***	81.2760**	85.9525***	123.7370**
Sweden	168.7987***	370.4073**	43.9671***	63.2950**	91.6973***	132.0072**	286.8658***	412.9713**
UK	89.2497***	152.6137**	43.8601***	63.1408**	44.8724***	64.5982**	18.0838***	26.0333**

Table 2 Cont'd

	>5yrs lending spreads 03-08		1yr deposit spreads 03-08		1-2yrs deposit spreads 03-08		>2yrs deposit spreads 03-08	
Country	**Udmax**	**WD max (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**	**UDmax**	**WDmax (5%)**
Austria	17.8036***	23.0646**	43.4361***	61.7665**	25.1871***	25.1871**	11.4496**	11.4496**
Belgium	70.9435***	84.7570**	66.4631***	66.4631**	14.6910***	21.1491**	301.0009***	433.3201**
Germany	100.6731***	119.6365**	61.7908***	73.4301**	14.1616***	16.8292**	28.8639***	41.5524**
Denmark	21.4726***	30.9120***	31.4627***	38.1629***	24.4445***	35.1903**	101.867***	101.867**
Spain	86.0702***	123.9064**	78.1417***	112.493***	37.6943***	37.6943**	10.3442**	12.4101**
Finland	49.2838***	49.2838**	27.5590***	30.6068**	49.3369***	59.5665**	37.8017***	54.4192**
France	30.7431***	44.2578**	41.8445***	56.8452**	8.4178*	12.0914**	20.3562***	20.3562**
Greece	12.1758**	14.0513**	34.0621***	40.4782**	49.1828***	70.8034**	12.5453***	17.2999**
Ireland	112.3448***	161.7312**	43.7854***	63.0333**	37.1760***	43.8036**	100.4806***	144.6516**
Italy	109.20***	109.20**	34.3878***	49.5046**	33.3003***	47.9390**	71.0503***	84.4337**
Luxembourg	24.9660***	35.9410**	64.1929***	76.2847**	35.7761***	51.5032**	-	-
Netherlands	12.7564***	15.1593**	189.5850***	272.9261**	27.2410***	38.1453**	128.214***	147.6617**
Portugal	86.1193***	123.9770**	179.3344***	258.1694**	34.5013***	49.6679**	17.6941***	22.9248**
Sweden	105.6588***	125.5612**	48.9846***	63.8639**	123.1169***	146.3079**	-	-
UK	26.0874***	31.0013**	150.920***	179.3481**	91.4615***	131.6678**	48.4590***	48.4590**

Note: The UD max 10, 5 and 1 per cent critical values are 7.46, 8.88 and 12.37, respectively; The WD max critical value is 9.91. ***significant at the 1% level; ** significant at the 5% level; *significant at the 10% level. The Bai and Perron (1998) test statistics have been computed using Perron's GAUSS code (available on his home page:http://econ.bu.edu/perron/) and were run in OxEdit.

Table 3: Pesaran (2007) panel unit root test (CIPS) on household spreads

Panel data	CIPS panel unit root tests
Deposit spreads	
• 1991-2002 panel set	-1.916 (p=6)
• 1991-2002 demeaned panel set	-3.513***(p=7)
• 2003-2008 (1yr)panel set	-0.406 (p=7)
• 2003-2008 (1yr) demeaned panel set	-2.212* (p=7)
• 2003-2008 (1-2yrs)panel set	-1.822 (p =6)
• 2003-2008 (1-2yrs) demeaned panel set	-3.457 ***(p=7)
• 2003-2008 (>2 yrs) panel set	-2.431*** (p=5)
• 2003-2008 (>2 yrs) demeaned panel set	-3.418***(p=4)
Consumer credit spreads	
• 1995-2002 panel set	-2.091 (p=6)
• 1995-2002 demeaned panel set	-3.131*** (p=8)
• 2003-2008 (1yr) panel set	-1.246 (p=5)
• 2003-2008 (1yr) demeaned panel set	-2.849***(p=7)
• 2003-2008 (1-5yrs) panel set	-1.585 (p =7)
• 2003-2008 (1-5yrs) demeaned panel set	-2.935***(p=6)
Mortgage spreads	
• 1995-2002 (2-5yrs) panel set	-1.749 (p=6)
• 1995-2002 (2-5yrs) demeaned panel set	-4.055***(p=6)
• 2003-2008 (1-5yrs) panel set	-0.981 (p=7)
• 2003-2008 (1-5yrs) demeaned panel set	-2.798***(p=4)
• 2003-2008 (5-10yrs) panel set	-1.244 (p=5)
• 2003-2008 (5-10yrs) demeaned panel set	-2.911***(p=3)
• 2003-2008 (>10yrs) panel set	-1.540 (p=4)
• 2003-2008 (>10yrs) demeaned panel set	-3.023 ***(p=6)

Notes:

1. The CIPS critical values are listed in table 3b in Pesaran (2007).
   For N=9 and T=93, the critical values for 1%, 5% and 10% significance levels are around -2.53, -2.32 and –2.21 for case II [with intercept only]; For N=13 and T=93, the critical values for 1%, 5% and 10% significance levels are around -2.42, -2.25 and –2.15 for case II [with intercept only]; For N=15 and T=72, the critical values for 1%, 5% and 10% significance levels are approximately –2.43, -2.25 and –2.15 for case II [with intercept only]; For N=14 and T=144, the critical values for 1%, 55 and 10% significance levels are around -2.42, -2.25, and -2.15 for case II [with intercept only].

   *** denotes significance at 1%, ** at 5%, * at 10%.

2. The lag order selected for each panel data set is indicated within brackets and the model used includes an intercept.
3. The CIPS statistics were computed in OxEdit using the Gauss code written by Yamagata (2006).

Table 4. Pesaran (2007) panel unit root test (CIPS) on NFC spreads

Panel data	CIPS test statistics
Deposit spreads	
2003-2008 (1yr mat.) panel set	-0.089 (P=6)
2003-2008 (1yr mat.) demeaned panel set	-2.527*** (P=4)
2003-2008 (1-2yrs mat.) panel set	-1.227 (P=4)
2003-2008 (1-2yrs mat.) demeaned panel set	-3.181*** (P=5)
2003-2008 (>2yrs mat.) panel set	-1.430 (P=6)
2003-2008 (>2yrs mat.) demeaned panel set	-3.038*** (P=6)
Lending spreads	
1991-2002 (short-term)panel set	-3.968*** (P=4)
1991-2002 (short-term) demeaned panel set	-4.266*** (P=4)
2003-2008 (1 yr mat.) panel set	-1.147 (P=4)
2003-2008 (1yr mat.) demeaned panel set	-2.547*** (P=5)
2003-2008 overdrafts panel set	-1.313 (P=4)
2003-2008 demeaned overdrafts panel set	-2.991*** (P=3)
2003-2008 (1-5 yrs mat.) panel set	-1.725 (P=3)
2003-2008 (1-5yrs mat.) demeaned panel set	-3.521*** (P=6)
2003-2008 (>5 yrs mat.) panel set	-1.007 (P=5)
2003-2008 (>5yrs mat.) demeaned panel set	-2.954*** (P=5)

Note:

1. The CIPS critical values are listed in table 3b in Pesaran (2007).
   For N=15 and T=144, the critical values for 1%, 5% and 10% significance levels are around -2.425, -2.25 and –2.15 for case II [with intercept only].

   For N=15 and T=72, the critical values for 1%, 5% and 10% significance levels are approximately –2.435, -2.25 and –2.145 for case II [with intercept only].

   *** denotes significance at 1%, ** at 5%, * at 10%.

2. The lag order selected for each panel data set is indicated within brackets.
3. The model used includes an intercept.
4. The CIPS statistics were computed in OxEdit using the code written by Yamagata (2006).

Figure 1. Structural break dates for the short term deposit spreads to households for the period 1991-2002[33]

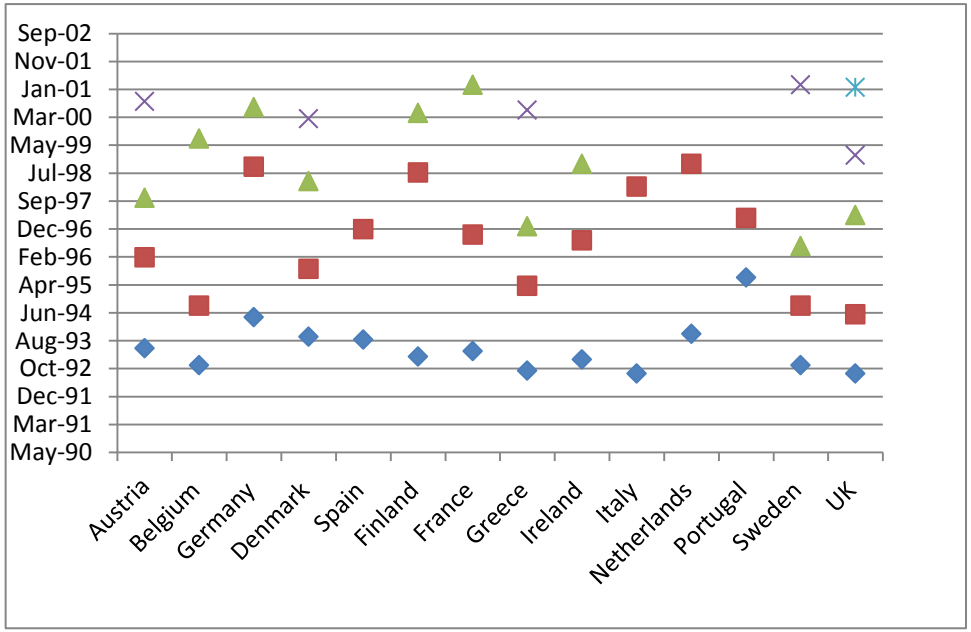
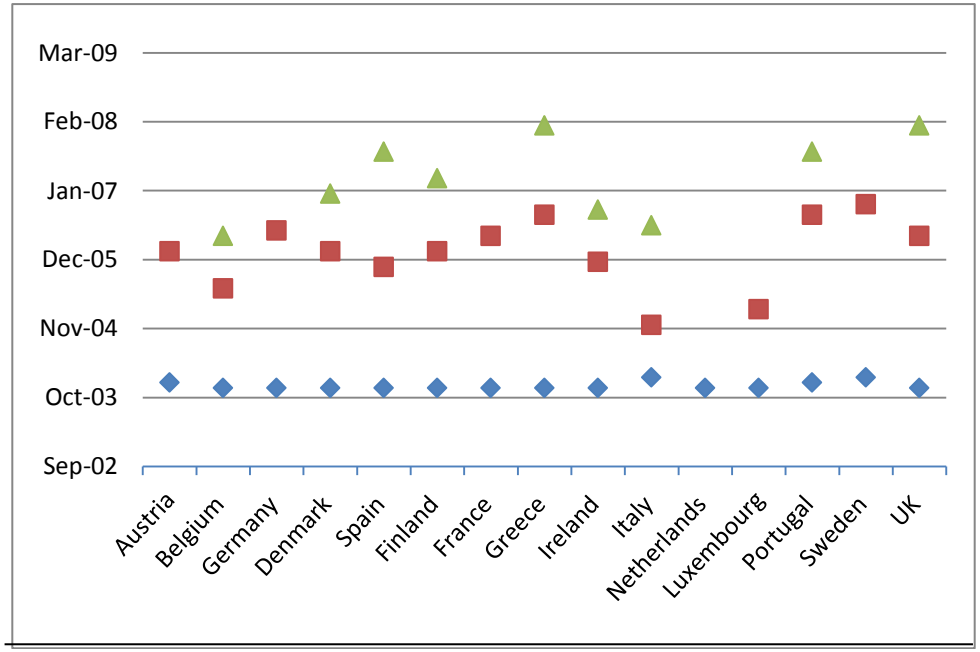


Figure 2. Structural break dates for the 1 year deposit spreads to households for the period 2003-2008[34]



[33] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break, and × denotes the fourth break. ✳ denotes the fifth break.

[34] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 3. Structural break dates for the 1-2 years deposit spreads to households for the period 2003-2008[35]

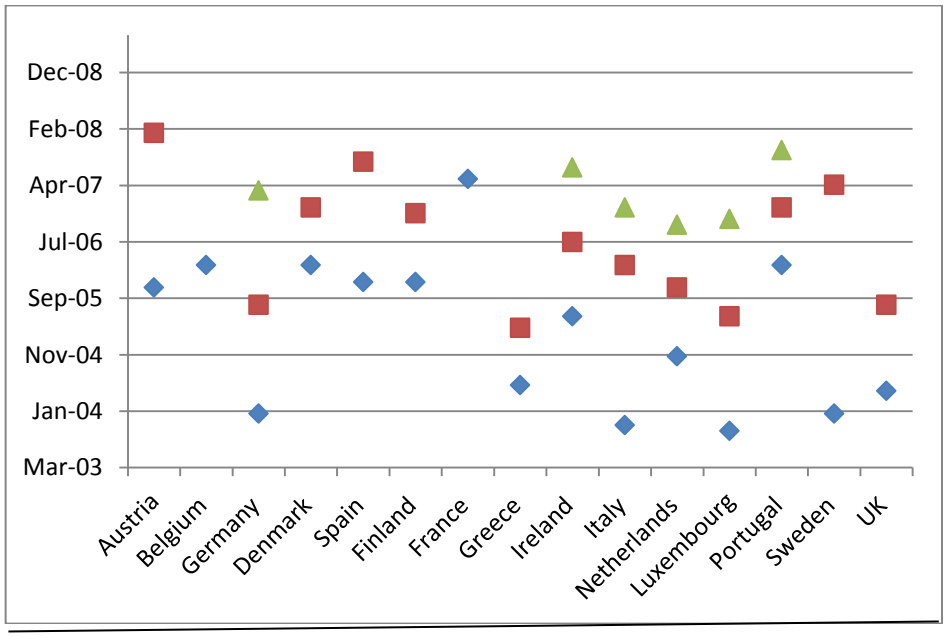
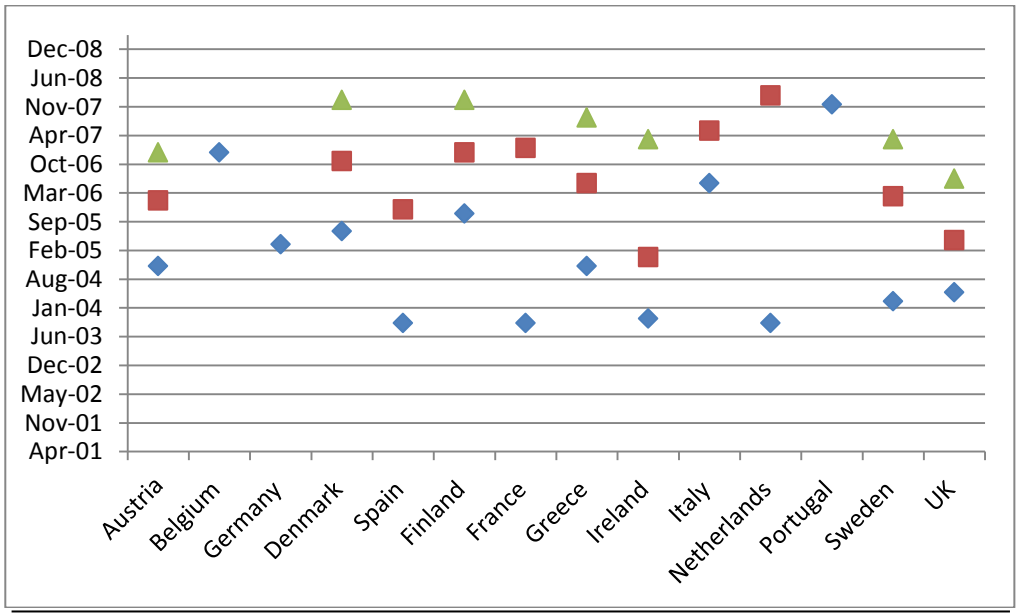


Figure 4. Structural break dates for the over 2 years deposit spreads to households for the period 2003-2008[36]



[35] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[36] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 5. Structural breaks for the consumer credit spreads to households for the period 1995-2002[37]

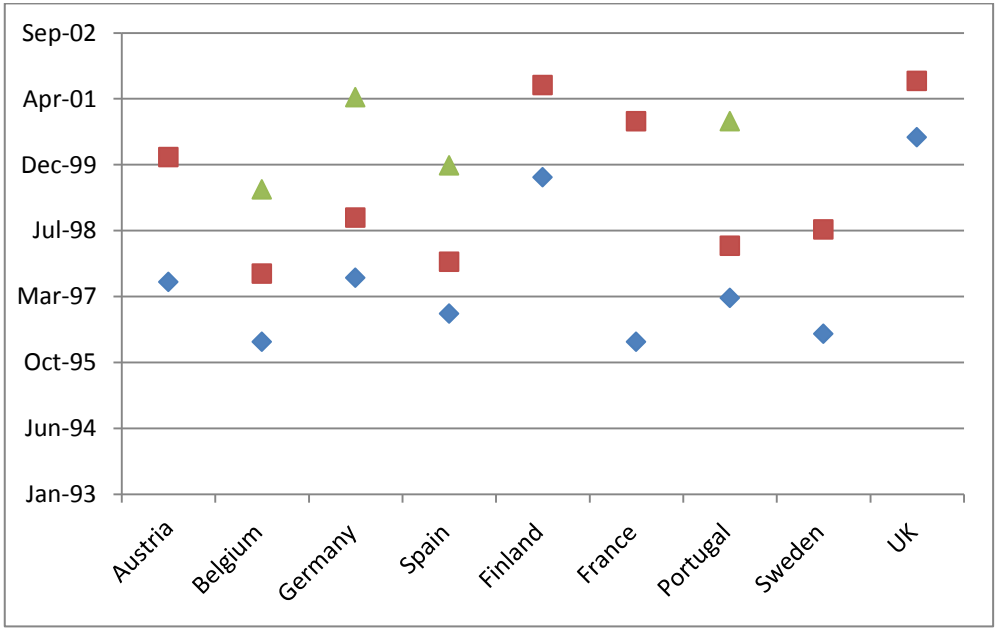
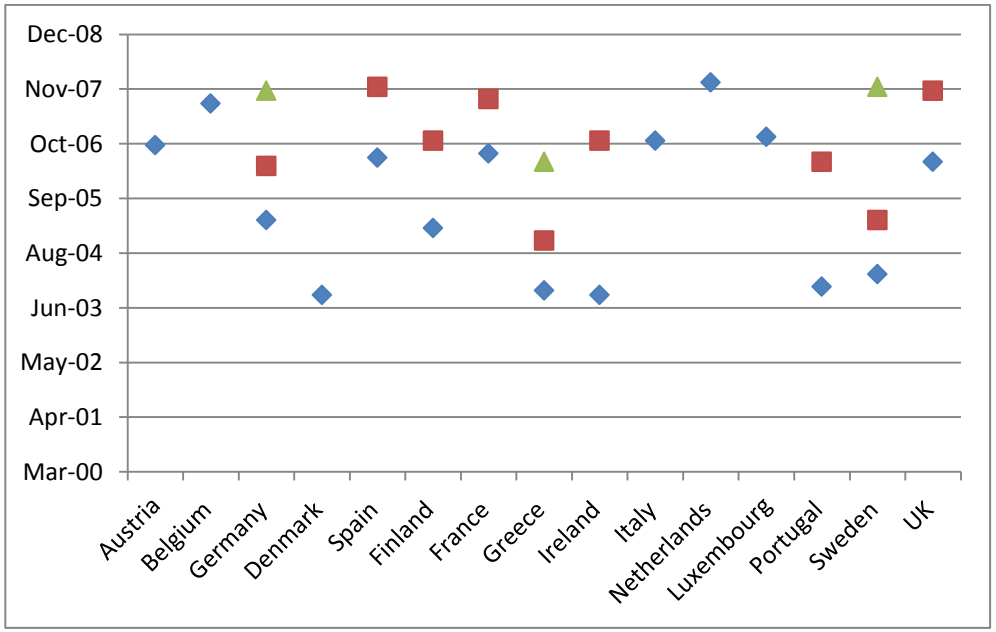


Figure 6. Structural breaks for the 1-year consumer credit spreads to households for the period 2003-2008[38]



[37] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[38] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 7. Structural breaks for the 1-5 years consumer credit spreads to households for the period 2003-2008[39]

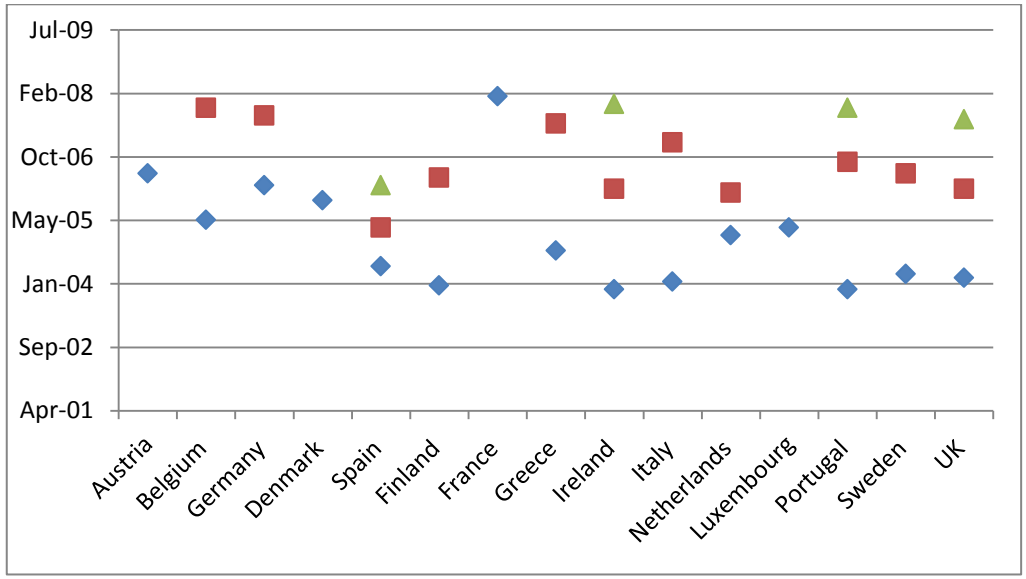
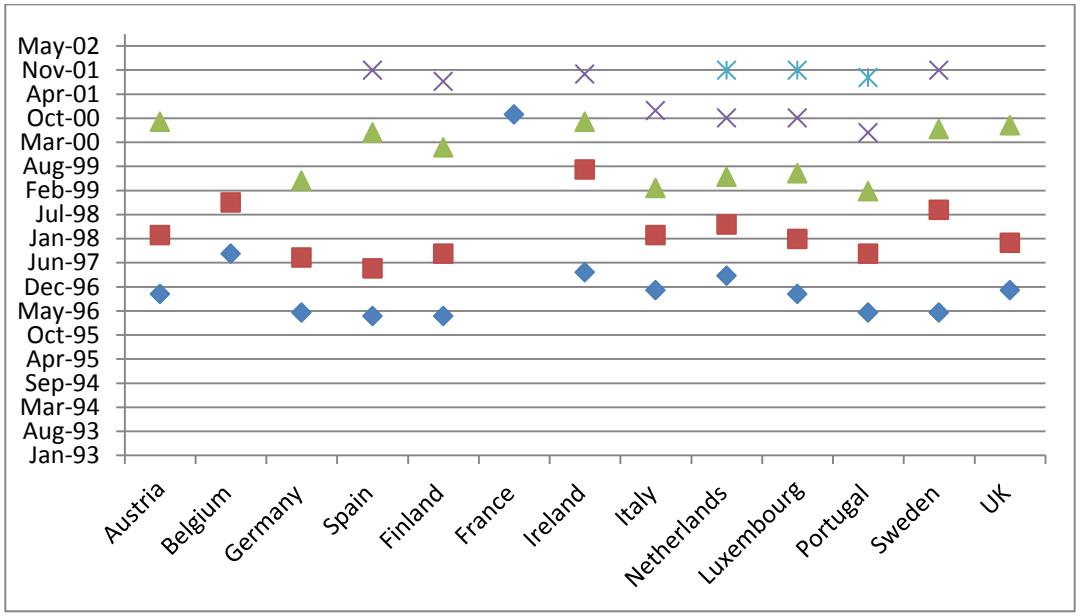


Figure 8. Structural breaks for the 2-5 years mortgage spreads to households for the period 1995-2002[40]



[39] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[40] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break, × denotes the fourth break and ✳ denotes the fifth break.

Figure 9. Structural breaks for the 1-5 years mortgage spreads to households for the period 2003-2008[41]

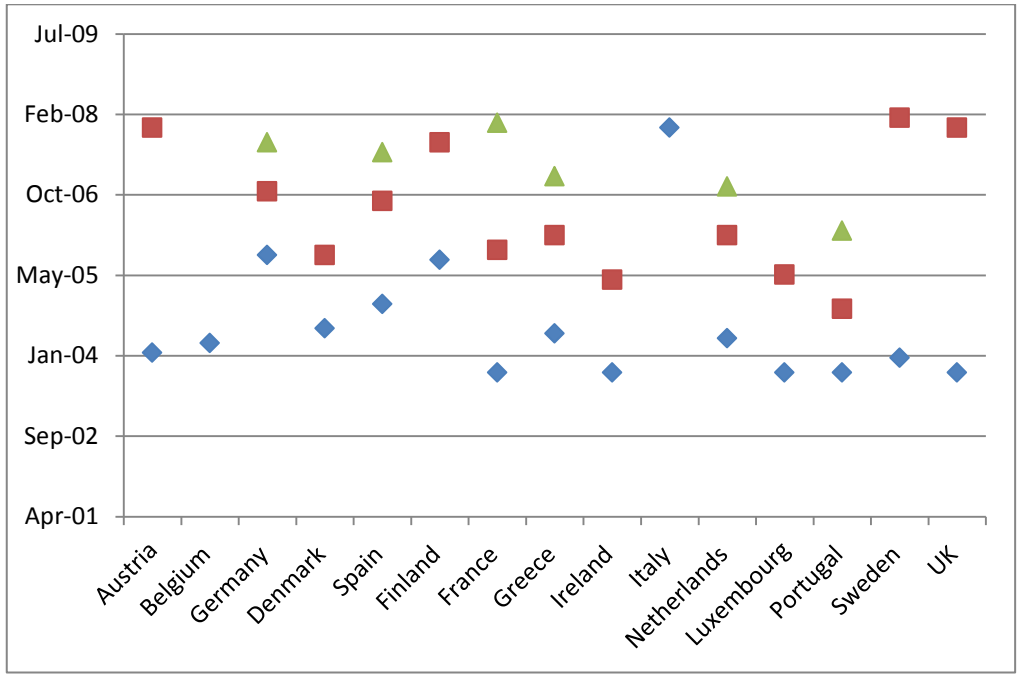
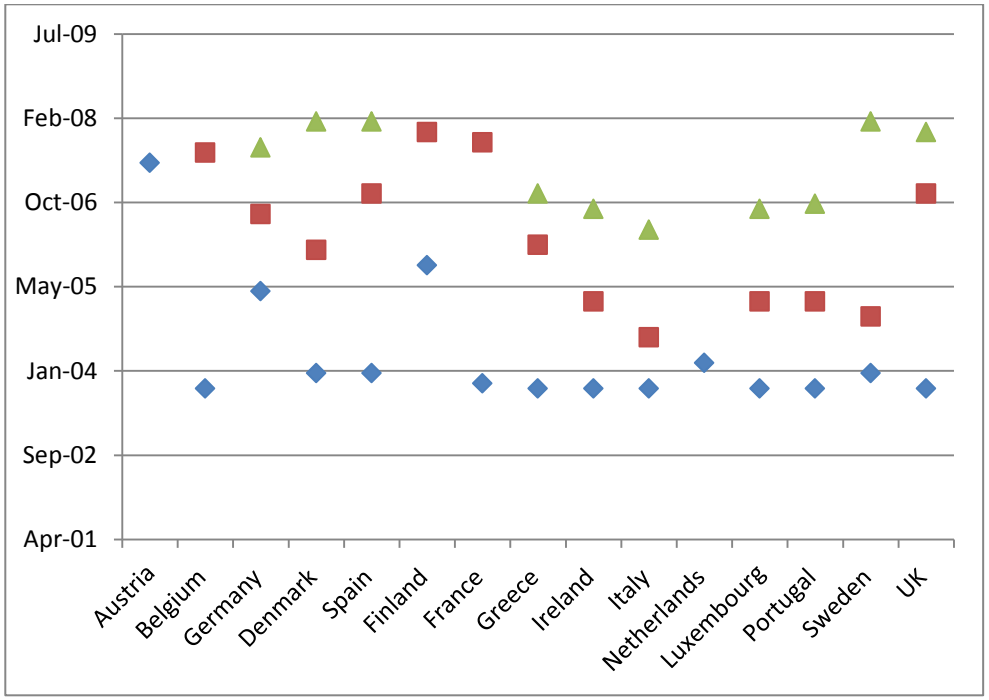


Figure 10. Structural breaks for the 5-10 years mortgage spreads to households for the period 2003-2008[42]



[41] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break.

[42] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break.

Figure 11. Structural breaks for the over 10-years mortgage spreads to households for the period 2003-2008[43]

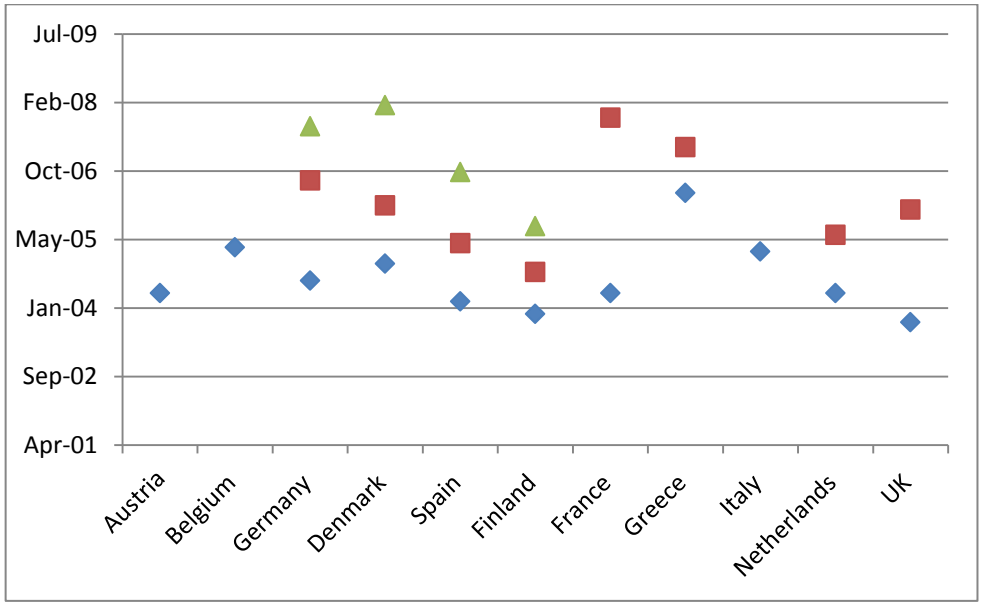
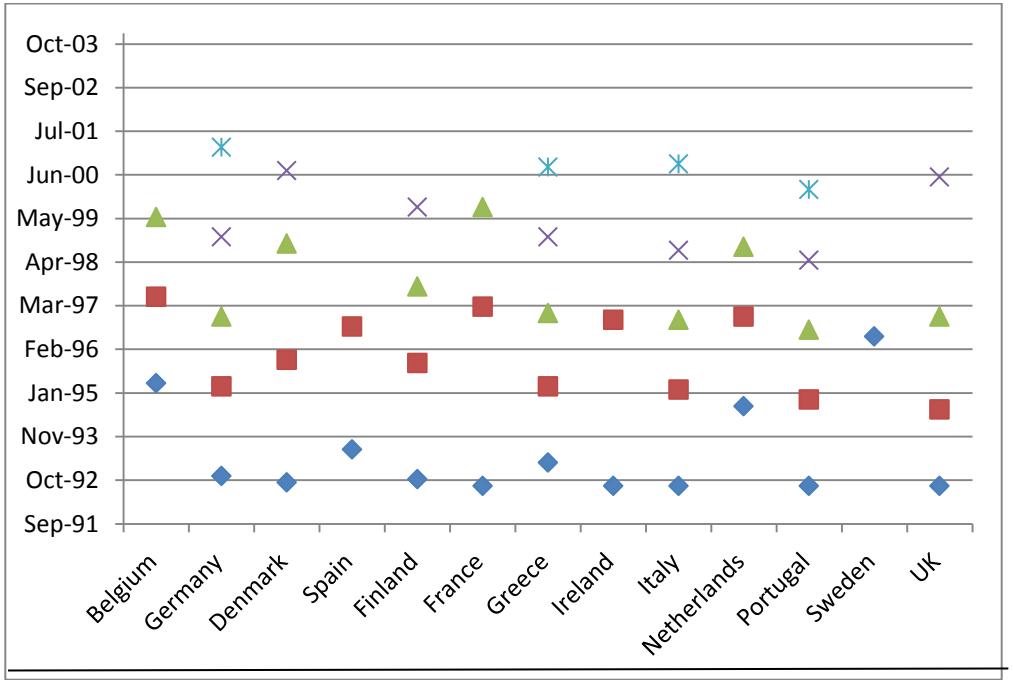


Figure 12. Structural break dates for the short-term lending spreads to non-financial corporations for the period 1991-2002[44]



[43] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break.

[44] ◆ Denotes the first break; ■ denotes the second break; ▲ denotes the third break, and × denotes the fourth break. ✳ denotes the fifth break.

Figure 13. Structural break dates for the overdraft spreads to non-financial corporations for the period 2003-2008[45]

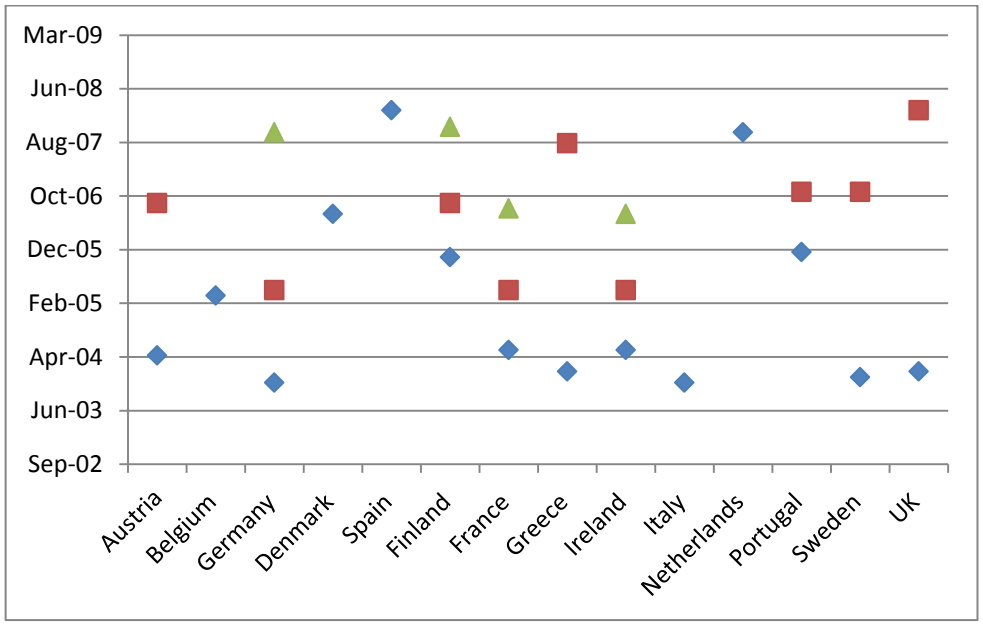
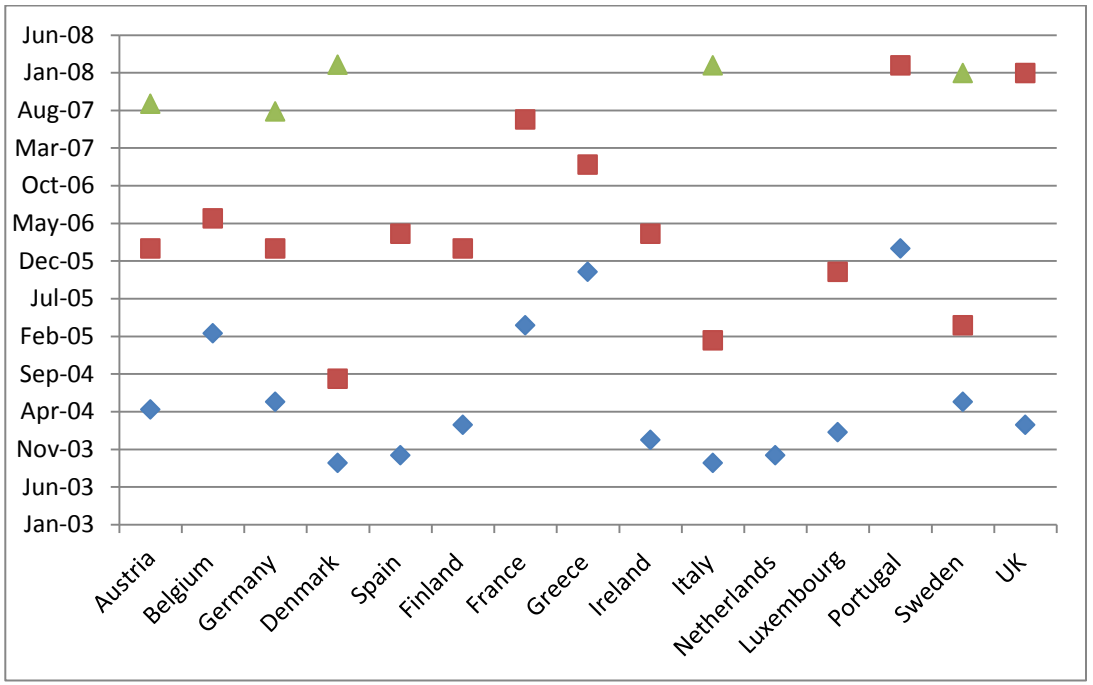


Figure 14. Structural break dates for the 1-year lending spreads to non-financial corporations for the period 2003-2008[46]



[45] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[46] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 15. Structural break dates for the 1-5years lending spreads to non-financial corporations for the period 2003-2008[47]

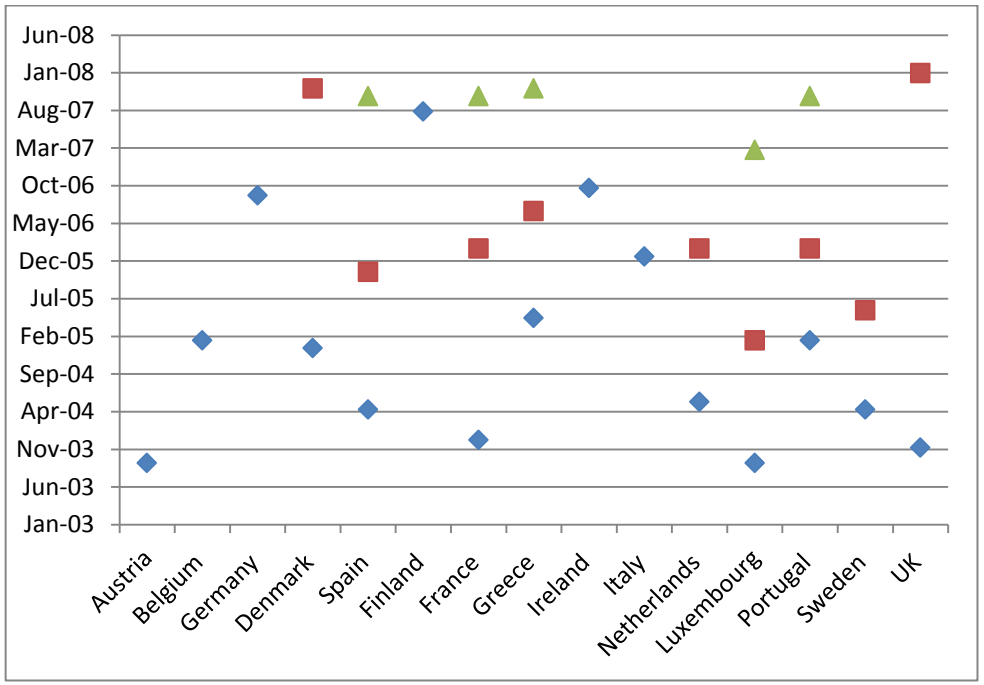
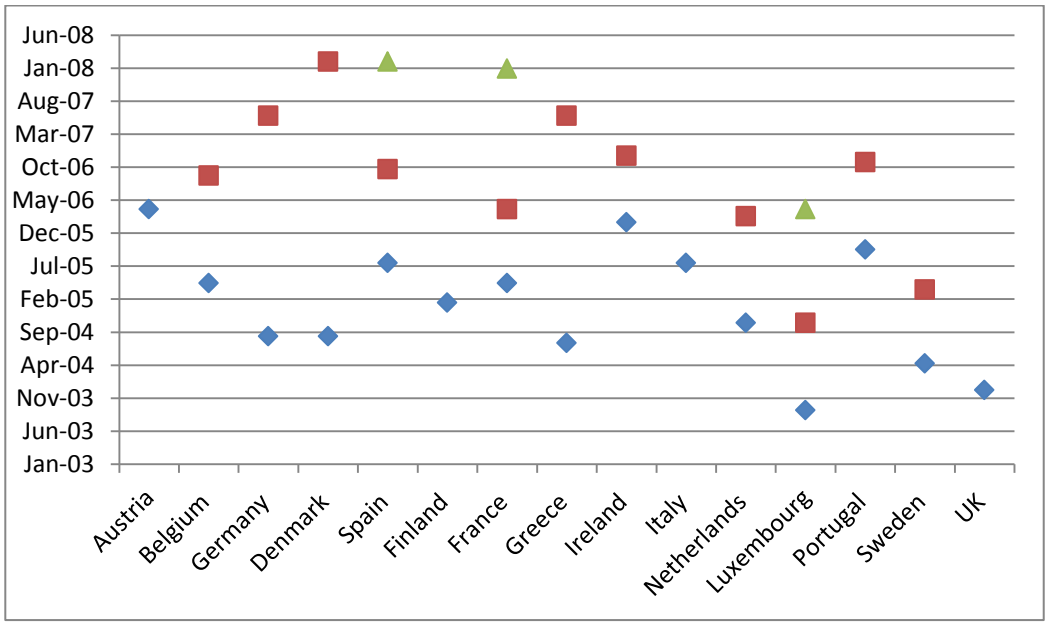


Figure 16. Structural break dates for the over 5-years lending spreads to non-financial corporations for the period 2003-2008[48]



[47] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[48] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 17. Structural break dates for the 1-year deposit spreads to non-financial corporations for the period 2003-2008[49]

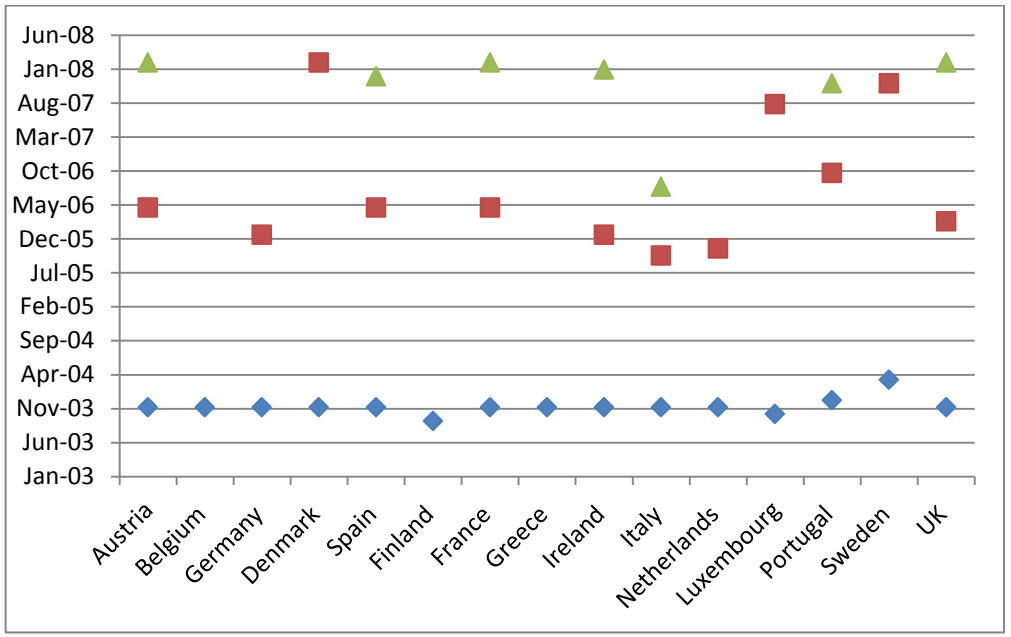
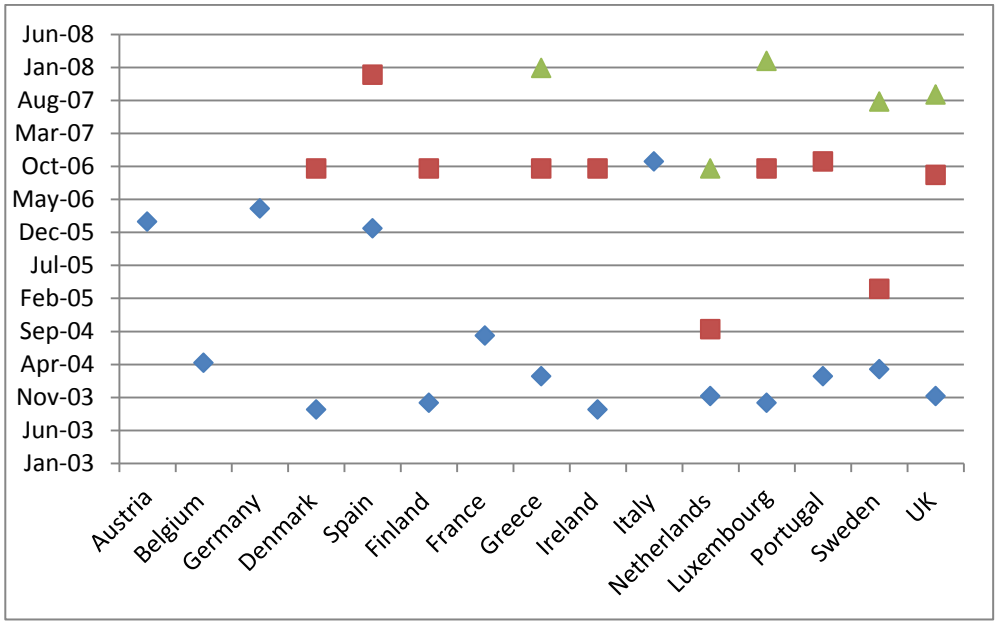


Figure 18. Structural break dates for the 1-2 years deposit spreads to non-financial corporations for the period 2003-2008[50]

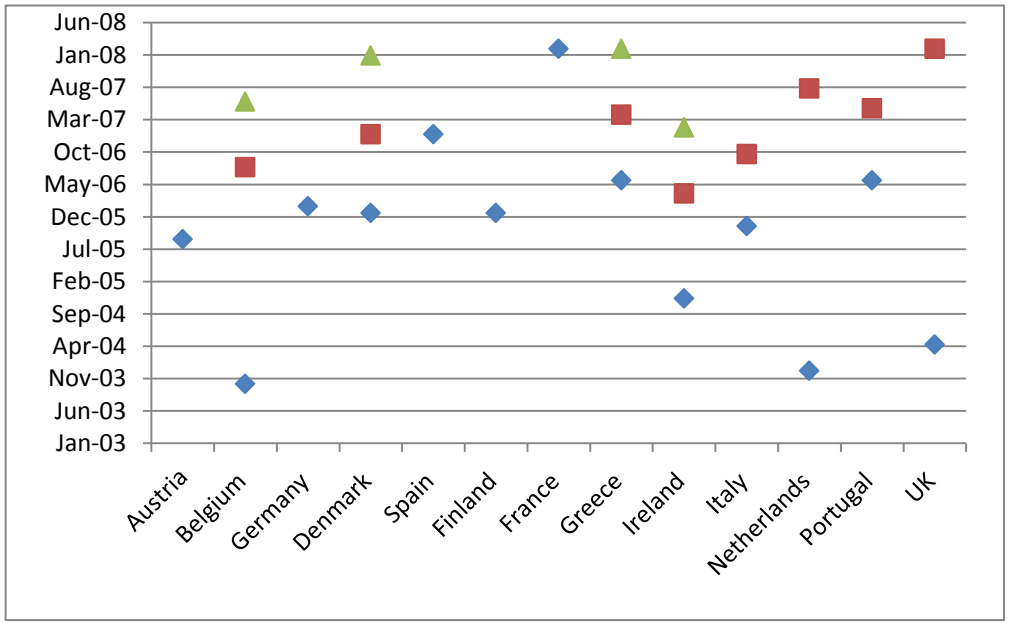


[49] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

[50] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.

Figure 19. Structural break dates for the over-2years' deposit spreads

to non-financial corporations for the period 2003-2008[51]



[51] ◆ Denotes the first break; ■ denotes the second break; and ▲ denotes the third break.