EconomiX
http://economix.u-paris10.fr/

Document de Travail
Working Paper
2011-02

On the link between credit procyclicality and bank competitions

Vincent Bouvatier
Antonia-Lopez-Villavicencio
Valérie Mignon

UMR 7235

Université de Paris Ouest Nanterre La Défense
(bâtiments T et G)
200, Avenue de la République
92001 NANTERRE CEDEX

Tél et Fax : 33.(0)1.40.97.59.07
Email : nasam.zaroualete@u-paris10.fr

On the link between credit procyclicality and bank competition*

Vincent Bouvatier† Antonia López-Villavicencio‡ Valérie Mignon§

November 6, 2010

Abstract

This paper investigates the relationship between bank competition and credit procyclicality for 17 OECD countries on the 1986-2009 period. We account for heterogeneity among countries in terms of bank competition through the use of a hierarchical clustering methodology. We then estimate panel VAR models for the identified sub-groups of economies to investigate whether credit procyclicality is more important when the degree of bank competition is high. Our findings show that while credit significantly responds to shocks to GDP, the degree of bank competition is not essential in assessing the procyclicality of credit for OECD countries.

JEL Classification: C33, E32, E51, G21.
Keywords: Credit cycle, economic cycle, bank competition, financial stability, panel VAR.

*Corresponding author: Valérie Mignon, EconomiX-CNRS, University of Paris Ouest, 200 avenue de la République, 92001 Nanterre Cedex, France. E-mail: `valerie.mignon@u-paris10.fr`. Phone: +33 (0)1 40 97 58 60. Fax: +33 (0)1 40 97 77 84. We would like to thank Agnès Bénassy-Quéré and Gunther Capelle-Blancard for helpful remarks and suggestions, and Hong Liu for providing us with the Herfindahl-Hirschman index data.

†EconomiX-CNRS, University of Paris Ouest, France. E-mail: `vbouvatier@u-paris10.fr`

‡CEPN-CNRS, University of Paris North, France. E-mail: `lopezvillavicencio@univ-paris13.fr`

§EconomiX-CNRS, University of Paris Ouest and CEPII, Paris, France. E-mail: `valerie.mignon@u-paris10.fr`

1 Introduction

The link between bank competition and banking system stability has recently received renewed interest. Two approaches have emerged in this literature.[1] The first one is the "competition-fragility" approach according to which a rise in bank competition may destabilize the banking system. Indeed, due to the resulting decrease in their profitability, banks are encouraged to take excessive risks to increase returns and recover their margin profits. As noticed by Keeley (1990) in his pionnered paper, such banks' behavior may lead to a deterioration in the quality of the loan portfolio, leading to an increase in the bank fragility. This view has been followed by many authors such as Demsetz et al. (1996), Hellmann et al. (2000) or Jimenez et al. (2007).

The second, opposite approach, is the so-called "competition-stability" one according to which more competition between banks has positive effects on the banking system stability. The main explanation relies on the borrowers' behavior: the lower interest rates induced by bank competition tend to decrease moral hazard. Hence, the default risk is reduced. This view, supported by Boyd and De Nicolo (2005), has been investigated empirically in Boyd et al. (2006), De Nicolo and Loukoianova (2006) and Schaeck et al. (2006) among others.

From an empirical viewpoint, results are somewhat mitigated regarding the superiority of one approach to the other. This absence of clear-cut findings may be due to various factors. The first one may come from the absence of a unique measure of bank competition. This issue has been investigated by Berger et al. (2004) and Beck et al. (2006) among others, showing that concentration measures are not always suitable for assessing bank competition. Second, the link between bank competition and banking system stability may be polluted by endogeneity problems, in the sense that the degree of bank competition may itself depend on the stability of the banking system (see Berger et al. (2004) for an empirical investigation regarding this point).

In addition to these factors that have been investigated in the literature, we think that the measure retained for the stability of the banking system may also play a crucial role. Various measures have been used in previous works, mainly based on risk exposure indicators such as proxies for loan portfolio risk, proxies for firm's probability of failure, the level of bank's capitalization,[2] and—at a more macroeconomic level—the probability of failures in the banking sector and of generalized banking crises (Beck et al., 2006). In this paper, we propose to contribute to this literature by relying on credit procyclicality. The general concept of credit procyclicality refers to the relationship between private credit and GDP. Here, relying on a VAR-type framework, we propose a precise measure of credit procyclicality based on the impulse response function of credit to a shock in GDP. The underlying idea for considering the credit procyclicality as an indicator of the banking sector stability is quite simple. As argued by Goodhart and Hofmann (2004), the liberalization of the financial sector has contributed to increasing the procyclicality of financial systems through the development of procyclical lending practices of banks. The historical experience tends to attach some weight to this argument by showing that

[1] See Carletti and Hartmann (2003) and Berger et al. (2009) for a survey.

[2] See Boyd et al. (2006), Jimenez et al. (2007), and Berger et al. (2009). In particular, as noticed by Berger et al. (2009), an increase in the loan risk does not necessarily imply a rise in the overall bank risk, putting forward the importance of the choice of the risk measure in empirical analyses.

episodes of financial turbulences and crises have frequently been preceded by credit booming (Borio and Lowe, 2004; Detken and Smets, 2004; Adalid and Detken, 2007; Goodhart and Hofmann, 2008). Within this framework, our aim is to investigate the link between banking system stability—apprehended through the credit dynamics—and banks' market power. More specifically, we aim at studying whether credit procyclicality—i.e. the response of the credit market to a shock on GDP—is more important when the degree of banking competition is higher. This point has a direct implication for the design of banking regulation. Addressing procyclicality in bank behavior has become a priority for banking regulators since the 2007-2008 financial crisis. In particular, Basel III reform introduces a countercyclical capital buffer and promotes more forward-looking provisioning practices (BIS, 2009a). However, if factors related to the banking system structure—as the degree of competition—are also relevant to explain credit procyclicality, banking regulators should not focus only on prudential measures.

The relationship between credit procyclicality and bank competition is investigated on a sample of 17 OECD countries over the 1986-2009 period. We rely on the panel VAR (PVAR) modelling, allowing us to work in a multi-country framework, which is obviously relevant when analyzing the stability of banking system—which may be subject to contagion effects. We consider two estimation methods for the PVAR model to provide robust results regarding the interactions between credit and business cycles, and then derive the corresponding impulse-response functions to assess the credit response to a shock on the GDP. Given that our sample covers various economies, we account for its potential heterogeneity by estimating the PVAR on sub-groups of countries depending on their degree of bank competition. As previously mentioned, we pay a particular attention to this measure of bank competition, which we assess through the use of a hierarchical clustering approach.

Our paper contributes to the recent literature in several ways. First, by relying on credit procyclicality, we add to the discussion on how to measure the stability of the banking system. Second, we specifically account for heterogeneity among countries through the use of a hierarchical clustering methodology. This allows us (i) to provide an original measure of bank competition based on several indicators, and (ii) to classify the countries according to this degree of bank competition. Third, our paper also adds to the "competition-fragility" versus "competition-stability" debate concerning the link between bank competition and banking system stability. Finally, we contribute to the literature on the banking system regulation by investigating the determinants that are at play in the procyclical character of credit.

The rest of the paper is organized as follows. Section 2 describes the data and their transformations. Section 3 deals with the measure of bank competition through the use of a hierarchical clustering approach. In Section 4, we present the results of the PVAR estimation for the different clusters, together with the impulse-response functions. Section 5 provides some concluding remarks.

2 Data

We consider quarterly data over the 1986-2009 period for the following sample of 17 OECD countries: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and the

United States.[3] Note that, following Assenmacher-Wesche and Gerlach (2009), our sample starts in 1986 to avoid outliers observations due to the high-inflation period that ends in the mid 1980s.

Regarding the data, the following variables enter in our PVAR specification: credit cycle and business cycle—which are our main variables of interest—and three control variables, namely the inflation rate, the interest rate, and share prices. So, in addition to the inclusion of the first two control variables that are standard in the monetary policy literature, we also introduce share prices series in our analysis, because there is an obvious link between asset price dynamics and financial (in)stability: as recalled by Goodhart and Hofmann (2008) among others, booming asset prices episodes are frequently viewed as announcing future sharp correction of prices, generating instability of the financial and banking sector. In addition, regarding the interplay between financial constraints and entrepreneurship, both private credit and stock market capitalization can be seen as supplementary (or complementary) sources of financialisation.

The credit cycle variable is built on bank credit to the private non-financial sector taken from the International Financial Statistics (IFS) database of the IMF, except for Canada (source: Statistics Canada), and Norway for 2007Q1 to 2009Q4 (source: Norges Bank). These credit series exhibit important level shifts notably due to changes in definitions. We have adjusted the series for these level shifts following the methodology proposed by Stock and Watson (2003): the growth rate of the observation affected by the level shift is replaced by the median of the growth rate of the two periods before and after the occurence of the level shift (see also Goodhart and Hofmann, 2008).[4] Turning to the GDP series, they are extracted from the OECD database and are expressed in real terms. We derive credit cycle and business cycle variables by isolating the cyclical components of credit and GDP series using the usual Hodrick-Prescott (HP) filter. The credit cycle is therefore represented by the percentage credit gap, and the business cycle by the percentage output gap.[5]

Turning now to the control variables, we consider three series. The annual inflation rate is based on the consumer price index, which is extracted from the OECD database for all the countries of the sample. The interest rate is the money market rate taken from the OECD database, except for Japan (source: IFS), and Denmark and Finland for which some observations were missing for the year 1986 and have been complemented using IFS. Finally, share price series are taken from the OECD database ("all share" prices). Like for credit and GDP series, to isolate the cyclical component of interest rates and share prices, these two series

[3] This sample of countries—ensuring data availability—is also retained by Assenmacher-Wesche and Gerlach (2008, 2009) and Goodhart and Hofmann (2008).

[4] Following Goodhart and Hofmann (2008), we have corrected for the following level shifts: Australia in 1989Q1 and 2002Q1; Belgium in 1992Q4 and 1999Q1; Canada in 2001Q4; Denmark in 1987Q4, 1991Q1, and 2000Q3; Finland in 1999Q1; France in 1999Q1; Germany in 1990Q2 and 1999Q1; Italy in 1999Q1; Ireland in 1995Q1 and 1999Q1; Japan in 1997Q4 and 2001Q4; Netherlands in 1988Q4; Spain in 1986Q1 and 1999Q1; Sweden in 1996Q1; Switzerland in 1996Q4; UK in 1986Q2; and USA in 2001Q4.

[5] Note that, following Assenmacher-Wesche and Gerlach (2008, 2009) and Goodhart and Hofmann (2008) among others, credit is not expressed in real terms. However, to assess the robustness of our results, we have also considered specifications in which credit has been deflated using either the CPI or the GDP deflator. The conclusions remain globally similar to those presented in this paper, and detailed results are available upon request to the authors.

are considered in their HP filtered versions.[6] More precisely, our interest rate variable is the cyclical component deduced from the HP filter, and our share prices variable is the percentage gap obtained from a one-sided HP filter.[7] GDP, credit and share price series have been taken in logarithms, and all series—except interest rates and share prices—have been seasonally adjusted.

Finally, it should be noticed that all the filtered series are, by definition, stationary. We thus have to check the stationarity property only for the inflation rate variable. To this end, we have applied various panel unit root tests. All the tests point to the rejection of the null hypothesis of unit root, indicating that inflation rate is also a stationary series.[8]

3 Assessing the degree of bank competition

3.1 Preliminary analysis

Supply factors explaining procyclicality in credit might be noticeably different accross countries. These factors are related to the modification in bank behavior during the business cycle. Banks can have incentives to relax credit standards during economic upswings, which leads to a rapid growth in bank lending and then to excessive risk taking.[9] Several theories of bank behavior, such as disaster myopia (Guttentag and Herring, 1986) or herd behavior (Rajan, 1994), support this point and the "competition-fragility" approach suggests that these procyclical behaviors should be more important when bank competition is higher.

Within this context, an important question concerns the measure of bank competition and its effect on credit procyclicality. Different measures have been proposed in the literature (see Section 3.2), among which the most common ones are: (i) a concentration index given by the total market share of the three largest banks, (ii) the Herfindahl-Hirschman index (HHI), and (iii) the financial freedom index from the Heritage Foundation. As an illustration and to give a first insight regarding the importance of the choice of the bank competition proxy, Figure 1 shows the average of these three measures between 2004-2008 (2004-2007 in the case of

[6]The case of the interest rate deserves some comments. Indeed, various methods exist to estimate the "equilibrium" value of the interest rate (see Giammarioli and Valla (2004) for a survey). One may rely on univariate methods, such as (i) the calculation of averages (or moving averages) of observed interest rates, and (ii), as in the current paper, the use of filters—the underlying idea being that the equilibrium is proxied reasonably well by the trend. Another common method is to derive the equilibrium interest rate from the estimation of a Taylor-type monetary-policy rule, or from its time-varying extension based on the Kalman filter. Structural models, dynamic stochastic general equilibrium models may also be used, as well as the yield curve and asset pricing models to derive equilibrium interest rates. While these three last methods are clearly beyond the scope of our paper, the use of a Taylor-type rule may be viewed as a good candidate to estimate the equilibrium interest rate. However, we choose here the filtering methods which are the simplest ones, and which have the advantage of being not dependent on the choice of various parameters that enter in the monetary-policy rule such as the retained measure for the output gap, the choice of the inflation target, the choice of instruments if one relies on the Kalman methodology...

[7]The share prices trend is therefore estimated recursively, i.e. without future data.

[8]The Levin and Lin (1992, 1993), Maddala and Wu (1999), Breitung (2000), and Im, Pesaran and Shin (2003) tests all reject the null hypothesis at the 1% significance level. The detailed results are available upon request to the authors.

[9]See for example Keeton (1999) and Jiménez and Saurina (2006) about the relationship between rapid credit growth during the economic upswing and loan losses during the downturn.

the HHI) versus the average correlation between credit cycle and business cycle.[10] The main conclusion that emerges from this figure is that the classification of countries depends on the retained measure for bank competition. As an example, the correlation between credit and business cycles is high for Switzerland. This country is characterized by high concentration and HH indices—illustrating a weak degree of bank competition—and by a relatively important financial freedom index—suggesting some degree of bank competition. In other words, a country may appear more or less competitive in the banking sector, depending on the proxy used for bank competition. This illustrates the difficulty to draw general conclusions regarding the links between bank competition and credit procyclicality on the basis of only one measure of bank competition. As a consequence, it is crucial to rely on a more general approach, accounting for various measures of bank competition simultaneoulsy, in order to properly investigate the interactions between credit procyclicality and market power. This is the aim of the hierarchical clustering approach.

3.2 Hierarchical clustering

Our previous preliminary analysis outlines two important aspects. First, different measures of bank competition yield opposite predictions regarding the relationship between competition and credit procyclicality. In this sense, the alternative measures should be seen as complementary rather than substitutes. Second, there is important heterogeneity among countries, which cannot be captured by a single model for the whole panel. Therefore, to account for this potential heterogeneity and in order to assess whether the procyclicality of credit is different across countries with different levels of financial competition, we proceed by performing a hierarchical clustering. To this end, we consider many indicators and divide our original sample into three sub-samples according to the degree of bank competition in the considered countries.

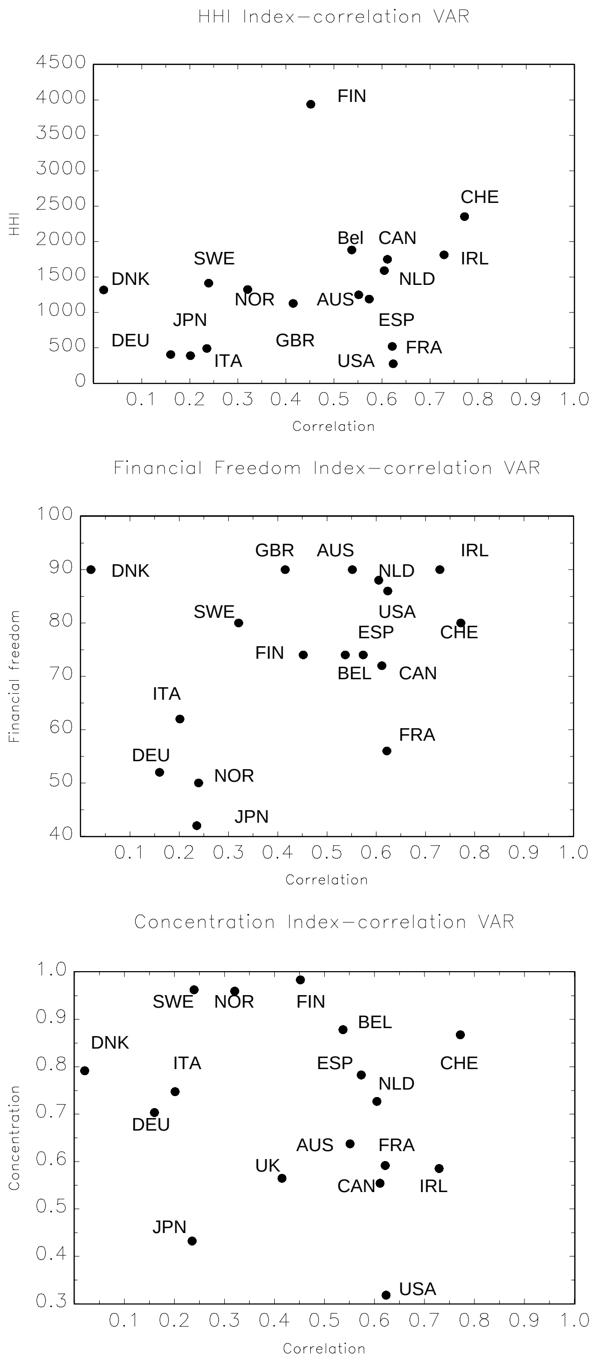
We retain 10 variables to make the hierarchical clustering:

- $C3$: a concentration index given by the assets of three largest banks as a share of assets of all commercial banks,
- HHI: the Herfindahl-Hirschman index, defined as the sum of squared market shares,
- $FREE$: the financial freedom index from the Heritage Foundation,
- $REST$: a measure of a bank's restrictions to engage in securities and insurance activities,
- $DEPTH$: the credit depth of information index from the Doing Business project,
- BC: total assets of commercial banks as a share of total assets of the banking system,[11]
- GVT: the fraction of the banking system loans in banks that are 50% or more government owned,

[10] These correlations are deduced from the estimation of bivariate VAR processes between credit and business cycles. More specifically, to explore the co-movements between the two variables, we used the approach based on the conditional correlation coefficients of VAR forecast errors (den Haan, 2000). Complete results are available upon request to the authors.

[11] The banking system is represented by "other monetary institutions", i.e. commercial banks + savings banks + cooperative banks + other miscellaneous monetary institutions.

Figure 1: **Mean correlation between credit and business cycle versus the HH, financial freedom and concentration indices**



- FOR: the fraction of the banking system loans in banks that are 50% or more foreign owned,
- $MARGIN$: bank's net interest income as a share of their interest-bearing assets,
- $CRED$: private credit to GDP ratio.

$C3$, $FREE$, $DEPTH$, BC, $MARGIN$ and $CRED$ are taken as averages over the 2004-2008 period. $C3$, $MARGIN$ and $CRED$ come from the World Bank database on financial development and structure, BC is computed from the OECD database, $FREE$ is taken from the Heritage Foundation database, and $DEPTH$ from the World Bank Doing Business database. HHI corresponds to an average over the 2004-2007 period and has been provided by Goddard et al. (2010). $REST$, GVT and FOR are extracted from the World Bank database on bank regulation and supervision which contains data for the yearend 2005.

The concentration index ($C3$) and the Herfindahl-Hirschman index (HHI) are widely used to measure bank competition and are based on the traditional approach that associate more firms with more competition. However, barriers to entry and more generally market contestability, which can represent an important aspect of competition, are not captured by these two indices. The financial freedom index ($FREE$), the measure of a bank restrictions ($REST$) and the credit depth of information index ($DEPTH$) allow to include, to a certain extent, this dimension in the hierarchical clustering.[12] The bank ownership structure could be also informative to characterize competition. We capture this aspect with the variables BC, GVT and FOR which measure respectively the importance of commercial banks, government owned banks and foreign owned banks. Finally, we include the net interest margin ($MARGIN$) as a partial measure of banks market power, and the credit-to-GDP ratio ($CRED$) to control for the size of the credit market in the economy.

The hierarchical agglomerative clustering (HAC) is performed on the principal components of a factorial analysis. We retain 5 factors which represent 85% of the variance in the dataset. We use the Euclidean distance as metric for calculating dissimilarities between countries and the Ward's method to build the hierarchy.[13] The clusters produced by the HAC are illustrated by the dendrogram displayed in Figure 4 in Appendix. We retain three clusters which are composed as follows:

- cluster 1: Australia, Canada, Ireland, Netherlands, UK and the USA,
- cluster 2: Belgium, Denmark, France, Finland, Norway, Spain, Sweden and Switzerland,
- cluster 3: Germany, Italy and Japan.

Table 1 reports descriptive statistics to highlight the main characteristics of each cluster. Mean tests are performed to evaluate if differences are significant. Cluster 1, composed mainly of

[12] The World Bank database on bank regulation and supervision contains data on the number of applications for commercial banking licenses received and denied from domestic and foreign entities over the period 2000-2005. However, this information is not useful for our sample of 17 counties. The ratio of denied entry applications to received entry applications is 0, except for Italy.

[13] The Ward's method minimizes the increase in variance for the cluster being merged.

English-speaking countries, is notably characterized by a high financial freedom index, a banking system principally owned by commercial banks and a high credit-to-GDP ratio. Compared to the whole sample, cluster 1 is also characterized by a lower concentration index, a higher credit depth of information index and lower bank's restrictions ($REST$), despite the non significance of the mean test at the 10% level for this last variable. Cluster 2 is composed of continental European countries and its characteristics are close to the ones obtained for the total sample, except for the concentration index which is higher, and the credit depth of information index which is lower. Finally, cluster 3 merges countries with a specific banking system structure. The low concentration and Herfindahl-Hirschman indices and the limited importance of commercial banks can be explained by the large number of cooperative banks in Germany, Italy and Japan.[14] Compared to the global sample, this cluster is also characterized by lower financial freedom index and credit to GDP ratio, and by few foreign owned banks.

On the whole, cluster 1 merges countries with the higher degree of competition in their banking system, while cluster 3 merges countries with the lower degree of competition. The degree of competition that we capture appears mainly through the freedom in financial activities and the importance of commercial banks in the banking system. Finally, it has to be noticed that according to the number of variables used to perform the HAC, some countries can move from one cluster to another. For example, if we consider a narrow set of variables composed only of the concentration, the Herfindahl-Hirschman and the financial freedom indexes, France joins cluster 3 and Denmark cluster 1. However, this kind of modification in the clustering methodology does not modify the core of cluster 1 composed of English-speaking countries and the core of cluster 3 made of Germany, Italy and Japan.

4 The PVAR analysis

According to the "competition-fragility" view—apprehended through the credit dynamics—we expect the two following propositions to be observed:

- Proposition 1: procyclicality in credit is higher in cluster 1. Banking systems in this cluster are more owned by commercial banks and benefit from more freedom. Banks could therefore be more encouraged to take excessive risks during an economic upswing.
- Proposition 2: procyclicality in credit is lower in cluster 3. With a lower importance of commercial banks and with lower freedom, we could expect that banks have less incentives and/or less possibilities to take excessive risks during an economic upswing.

To investigate the relevance of these two propositions, we proceed to the PVAR estimation at the cluster level.

4.1 Methodology

In order to assess the link between credit procyclicality and bank competition in our three sub-samples of countries, we consider the following PVAR model for each of the three clusters:

[14] Cooperative banks operating at the regional level can impact the concentration and the Herfindahl-Hirschman indexes. This specific banking structure can therefore reduce the accuracy of these indexes to measure the degree of competition when international comparisons are done.

$$Y_{i,t} = \alpha_i + A\left(L\right) Y_{i,t} + \varepsilon_{i,t} \tag{1}$$

where i denotes the country, $t = 1, ..., T$, $Y_{i,t}$ is the vector of endogenous variables, $\varepsilon_{i,t}$ is the vector of errors, α_i denotes the country-specific intercepts matrix, and $A(L)$ represents the matrix polynomial in the lag operator L—the number of lags being selected using the Akaike information criterion. The vector $Y_{i,t}$ is given by:

$$Y_{i,t} = (FCRED_{i,t}, FGDP_{i,t}, Fi_{i,t}, FSHA_{i,t}, \pi_{i,t})' \tag{2}$$

where $FCRED_{i,t}$ is the credit cycle (i.e. the filtered series for the credit), $FGDP_{i,t}$ the business cycle (i.e. the real GDP filtered series), $Fi_{i,t}$ the interest rate filtered series, $FSHAR$ the share prices filtered series, and $\pi_{i,t}$ denotes the inflation rate.

The interest of the PVAR approach is that it combines the traditional VAR framework—in which all the variables are endogenous—with the panel-data setup—in which unobserved individual heterogeneity is allowed. Turning to estimation issues, it is well known that the standard fixed-effect estimator is biased in dynamic panel specifications, due to the existence of correlation between the regressors and the fixed effects. To overcome this issue, we consider here two alternative estimation methods: the mean group (MG) and generalized method of moments (GMM) methodologies.

The MG methodology (see Pesaran and Smith, 1995) consists in estimating separate relationships for each country (or group) and then averaging the estimated parameters and their standard errors. Thus, denoting by $\hat{a}_i$ the estimated coefficients of interest, the mean group coefficients are compiled as:

$$\hat{a} = \frac{1}{N} \sum_{i=1}^{N} \hat{a}_i \tag{3}$$

and their standard errors ($\hat{s}$) are given by:

$$\hat{s} = \frac{1}{N} \sqrt{\sum_{i=1}^{N} \hat{s}_i^2} \tag{4}$$

As suggested by Kireyev (2000), since the MG estimator is a simple arithmetic average of time series estimates, the PVAR is given by the average of the function rather than the function of the average. This approach allows performing a VAR on a panel without losing consistency.

Alternatively, we use the GMM methodology. Since the fixed effects in Equation (1) are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. To avoid this problem, we use forward mean-differencing, also referred to as the "Helmert procedure" (see Arellano and Bover, 1995; Love and Zicchino, 2006). In this procedure, to remove the fixed effects, all variables in the model are transformed into deviations from forward means, then each observation is weighted to standardize the variance. This transformation preserves the orthogonality between transformed variables and lagged regressors, so we can use lagged regressors as instruments and estimate the coefficients by the GMM procedure. A special feature of the GMM estimation is that the number of moment conditions increases with T. Yet, there is convincing evidence that too many moment conditions introduce bias while increasing efficiency. To deal with this issue, it is suggested to use a subset of these moment conditions to take advantage of the trade-off between the reduction in bias and the loss in efficiency. Therefore, we restrict the moment conditions to a maximum of two lags on the dependent variable.[15]

Once the coefficients have been estimated using the MG and GMM procedures, we compute the impulse response functions (IRFs), together with their confidence intervals.[16]

4.2 Results

As mentioned before, in order to investigate the procyclical character of credit, we analyze the response of the credit variable to a shock on GDP for our three groups of countries. To this end, we rely on the Cholesky decomposition to identify the shocks. We consider the following ordering:[17] $\pi_{i,t}, FGDP_{i,t}, FCRED_{i,t}, Fi_{i,t}, FSHAR_{i,t}$. The ordering of the first two variables is standard in the monetary transmission literature (Christiano et al., 1999). We order share prices last in the system, given the fact that they are dependent on the discounted value of future earnings, i.e. on the interest rate. The ordering of credit—placed before the interest rate—may be seen as somewhat arbitrary. This choice—also made by Assenmacher-Wesche et al. (2008)—is based on the assumption that movements in the stock of credit may immediately influence interest rates, while credit is assumed to respond only gradually to interest rates movements.[18] Based on these hypotheses, Figure 2 displays the impulse response functions at the cluster level, together with their 5% error bands, obtained respectively with the MG and GMM estimators.[19] Despite some differences in terms of significance, the two methodologies give similar results concerning the values and the scale of the impulse response functions.[20]

Three main comments can be drawn from these figures. Firstly, Proposition 2 is confirmed. In cluster 3, the GDP shock does not have a significant effect on credit with the MG estimator. After two quarters, the impulse response of credit is significant during six periods with the GMM estimator, but the value of the response is quite low. The initial shock to GDP is 0.15,

[15]Note, however, that the results presented are robust to the number of instrumental variables used.

[16]Note that, in the case of the GMM estimation, we rely on boostrap methods to derive the IRFs' confidence intervals.

[17]Recall that the usual convention is to adopt a particular ordering and allocate any correlation between the residuals of any two elements to the variable that comes first in the ordering. The identifying assumption is that the variables that come earlier in the ordering affect the following variables contemporaneously, as well as with a lag, while the variables that come later affect the previous variables only with a lag.

[18]This hypothesis seems quite reasonable but, for robustness checks, we have also estimated the generalized impulse response functions (GIRF). The latter, introduced by Pesaran and Shin (1998) have the advantage to allow for the construction of an orthogonal set of innovations that does not depend on the VAR ordering. The results were very similar to those obtained using the Cholesky decomposition, and are thus not reported here to save space (they are available upon request to the authors).

[19]The corresponding response functions of GDP to a shock in GDP are given in Figure 3 in Appendix.

[20]Indeed, the main difference between the two methodologies is that confidence intervals are systemically higher with the MG estimator, a fact that may be explained by the tendency for GMM estimates to display less important standard errors. In addition, in the case of the MG estimator, standard errors are calculated from X samples of T observations, while only one sample of $X \times T$ observations is used in the case of the GMM estimator, where X denotes the number of countries in each cluster. As a consequence, the GMM estimator tends to be more precise than the MG one, explaining the lower corresponding standard errors.

while the impulse response of credit reaches its maximum at 0.05 during period 5. As a result, the procyclicality in credit is not or weakly observed in cluster 3 characterized by the lower level of bank competition.

Secondly, Proposition 1 is not confirmed. Indeed, the impulse response of credit does not seem different between cluster 1 and cluster 2. In the two sub-samples, the initial shock to GDP is around 0.15 and the impulse response of credit reaches its maximum during period 5 at 0.15 with the GMM estimator and 0.13 with the MG estimator. As a result, the higher degree of bank competition in "English-speaking" countries (cluster 1) does not lead to a stronger procyclicality in credit. To illustrate and confirm this finding, Figure 5 in Appendix reports the difference IRF between the two samples according to the MG estimation. The difference between the two impulse responses is not significant at the 5% level.

Thirdly, it is worth mentioning that the lower procyclicality observed in cluster 3 as compared to clusters 1 and 2 could lead to the wrong conclusion that the degree of competition explains the procyclicality in credit. However, recall that this group is formed only of three countries, namely Japan, Germany and Italy. Among them, only the first two present non-significant impulse response functions, illustrating the special situation of the Japanese and German banking systems. Turning to Italy, the response is rather close to the rest of the countries in the panel: positive and significant, with its two times standard error band intersecting the horizontal axis after 6 periods.

Figure 2: **Response functions of credit to a shock in GDP. Mean Group and GMM estimations**

Mean Group **GMM**

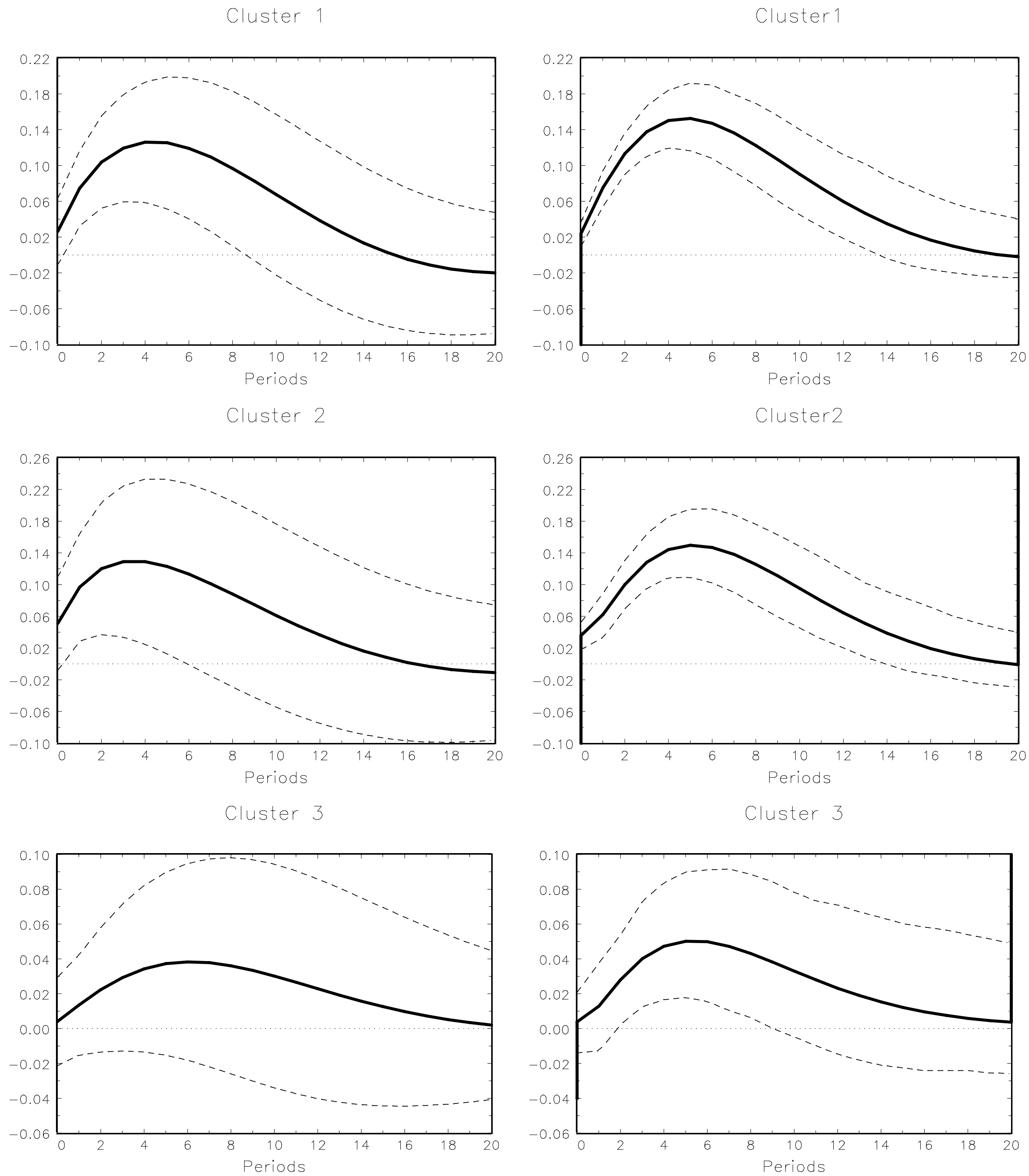


Table 1: General descriptive statistics: mean and standard deviation

		$C3$	HHI	$FREE$	$REST$	$DEPTH$	BC	GVT	FOR	$MARGIN$	$CRED$
Total	Mean	0.687	1353	73	2.176	5.078	0.833	0.051	0.178	0.021	1.302
	SE	0.209	898	15	0.727	0.829	0.175	0.115	0.161	0.007	0.393
Cluster 1	Mean	0.564	1299	86	1.833	5.667	0.936	0.009	0.180	0.022	1.606
	SE	0.136	571	7	0.983	0.516	0.831	0.020	0.202	0.010	0.286
	Mean test	4.1%	83.6%	0%	25.6%	1.1%	2.8%	16.4%	98%	92.2%	0%
Cluster 2	Mean	0.852	1741	72	2.375	4.375	0.810	0.033	0.219	0.021	1.190
	SE	0.129	1034	13	0.290	0.517	0.178	0.091	0.155	0.006	0.399
	Mean test	0%	10.6%	75.8%	64.6%	0%	62.8%	55.2%	32.7%	79.4%	28.6%
Cluster 3	Mean	0.492	426	52	2.333	5.778	0.686	0.252	0.067	0.022	0.990
	SE	0.188	55	10	0.517	0.384	0.226	0.213	0.051	0.005	0.081
	Mean test	12.1%	0%	1.1%	64.6%	2.1%	29%	35.7%	2.4%	81.8%	0%

5 Conclusion

The recent worldwide turmoil has highlighted significant weaknesses in the banking regulatory and supervisory system, opening a debate about the role that bank competition and access to finance play in causing and propagating the crisis. Our aim in this paper is to contribute to this debate by investigating to what extent competition in the banking sector can be beneficial to the banking system stability. While the previous literature mainly focuses on risk exposure indicators or on probability of bank failures, we add a new dimension to the analysis by measuring the banking system stability through the credit procyclicality.

Within this context, we aim at studying whether the credit procyclicality is more important when the degree of bank competition is high. This relationship between credit procyclicality and bank competition is investigated on a sample of 17 OECD countries over the 1986-2009 period. From a methodological viewpoint, we account for heterogeneity among economies through the use of a hierarchical clustering methodology, and estimate panel VAR models on the resulting sub-groups of countries. Our findings show that while credit significantly responds to shocks to GDP, the degree of bank competition is not essential in assessing the procyclicality of credit for our group of OECD countries.

Regarding the two main conflicting approaches, namely the "competition-fragility" and "competition-stability" views, our results do not support any of them. Indeed, a banking system with more freedom and mainly owned by commercial banks does not lead to stronger swings in credit during a business cycle, and the degree of competition appears rather not essential to assess the procyclicality in credit. Our findings rather suggest that in an attempt to reduce procyclicality in bank lending behavior, the focus should be placed on the micro and macro-prudential regulation. Modifications in capital requirements, in bank provisioning practices or the introduction of a systemic risk regulation to dampen credit procyclicality[21] do not need complementary measures on the banking system structure to supervise the degree of bank competition.

References

Adalid, R. and Detken, C. (2007), "Money's Role in Asset Price Booms", *ECB Working Paper* No. 732.

Arellano, M. and Bover, O. (1995), "Another Look at the Instrumental Variables Estimation of Error-components Models", *Journal of Econometrics* 68, 29-51.

Assenmacher-Wesche, K. and Gerlach, S. (2008), "Monetary policy, asset prices and macroeconomic conditions: a panel-VAR study", *Working Paper Research* 149, National Bank of Belgium.

Assenmacher-Wesche, K. and Gerlach, S. (2009), "Financial Structure and the Impact of Monetary Policy on Asset Prices", *Working Paper* 2008-16, Swiss National Bank.

[21]See for example the Geneva Report (2009), the Turner Review (2009), the Financial Stability Forum Report (2009), BIS (2009, 2010), Saurina (2009) or Repullo et al. (2009) about the different proposals to introduce countercyclicality into prudential regulation.

Beck, T., Demirguc-Kunt, A. and Levine, R. (2006), "Bank concentration, competition, and crises: first results", *Journal of Banking and Finance* 30, 1581-1603.

Berger, A.N., Demirguc-Kunt, A., Levine, R. and Haubrich, J. (2004), "Bank concentration and competition: An evolution in the making", *Journal of Money, Credit and Banking* 36, 433-451.

Berger, A.N., Klapper, L.F. and Turk-Ariss, R. (2009), "Bank competition and financial stability", *Journal of Financial Services Research* 35(2), 99-118.

Bank for International Settlements (BIS) (2009a), "Strengthening the resilience of the banking sector", Consultative Document, Basel, December.

BIS (2009b), "Risk and opportunities: towards a fail-safe financial system", 79th Annual Report, Basel, June.

BIS (2010), "Macroprudential policy and addressing procyclicality", 80th Annual Report, Basel, June.

Borio, C. and Lowe, P. (2004), "Securing Sustainable Price Stability: Should Credit Come Back from the Wilderness?", *BIS Working Paper* No. 157.

Boyd, J. and De Nicolo, G. (2005), "The Theory of Bank Risk Taking Revisited", *Journal of Finance* 60, 1329-1343.

Boyd, J., De Nicolo, G. and Jalal, A.M. (2006), "Bank risk taking and competition revisited: New Theory and Evidence", *IMF Working paper*, WP/06/297.

Breitung, J. (2000), "The local power of some unit root tests for panel data", in B. Baltagi (ed.), *Advances in Econometrics*, Vol. 15: Nonstationary Panels, Panel Cointegration, and Dynamic Panels, Amsterdam: JAI Press, 161-178.

Carletti, E. and Hartmann, P. (2003), "Competition and Financial Stability: What's Special about Banking?", In *Monetary History, Exchange Rates and Financial Markets: Essays in Honour of Charles Goodhart*, Vol. 2, edited by P. Mizen, Cheltenham, UK: Edward Elgar.

Christiano, L.J., Eichenbaum, M. and Evans, C.L. (1999), "Monetary Policy Shocks: What Have We Learned and To What End?", in: John B. Taylor and Michael Woodford (ed.), *Handbook of Macroeconomics*, Elsevier, Amsterdam, 65-148.

De Nicolo, G. and Loukoianova, E. (2006), "Bank Ownership, Market Structure, and Risk", Unpublished Working Paper, International Monetary Fund, Washington, D.C.

den Haan, W.J. (2000), "The comovement between output and prices", *Journal of Monetary Economics* 46, 3-30.

Demsetz, R., Saidenberg, M.R. and Strahan, P.E. (1996), "Banks with something to lose: The disciplinary role of franchise value", *Federal Reserve Bank of New York Economic Policy Review* 2(2), 1-14.

Detken, C. and Smets, F. (2004), "Asset Price Booms and Monetary Policy", *ECB Working Paper* No. 364.

Financial Stability Forum Report (2009), "Report of the Financial Stability Forum on Addressing Procyclicality in the Financial System", Basel, April 2009.

Geneva Report (2009), "The Fundamental Principles of Financial Regulation", Geneva Report 11, Centre for Economic Policy Research, London.

Giammarioli, N. and Valla, N. (2004), "The natural real interest rate and monetary policy: a review", *Journal of Policy Modeling* 26, 641-660.

Goddard, J., Liu, H., Molyneux, P. and Wilson, J. (2010), "The Persistence of Bank Profit", *Bangor Business School Working Paper* 10/002.

Goodhart, C. and Hofmann, B. (2004), "Deflation, Credit and Asset Prices", in R. Burdekin and P. Siklos (eds), *Deflation. Current and Historical Perspectives*, Cambridge, Cambridge University Press, 166-88.

Goodhart, C. and Hofmann, B. (2008), "House Prices, Money, Credit, and the Macroeconomy", *Oxford Review of Economic Policy* 24, 180-205.

Guttentag, J. M. and Herring, R.J. (1986), "Disaster Myopia in International Banking", Essays in International Finance, 164, International Finance Section, Princeton University.

Hellmann, T.F., Murdock, K. and Stiglitz, J. (2000), "Liberalization, moral hazard in banking and prudential regulation: are capital requirements enough?", *American Economic Review* 90, 147-165.

Im, K.S., Pesaran, M.H. and Shin, Y. (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics* 115, 53-74.

Jimenez, G., Lopez, J. and Saurina, J. (2007), "How does competition impact bank risk taking?", *Working Paper*, Banco de Espana.

Jimenez, G. and Saurina, J. (2006), "Credit Cycles, Credit Risk, and Prudential Regulation", *International Journal of Central Banking* 2(2), 65-98.

Keeley, M. (1990), "Deposit Insurance, Risk and Market Power in Banking", *American Economic Review*, 1183-1200.

Keeton, W. (1999), "Does faster loan growth lead to higher loan losses ?", *Federal Reserve Bank of Kansas City, Economic Review*, Second Quarter, 57-75.

Kireyev, A. (2000), "Comparative Macroeconomic Dynamics in the Arab World: A Panel VAR Approach", *IMF Working Paper* 54.

Levin, A. and Lin, C.F. (1992), "Unit root tests in panel data: Asymptotic and finite sample properties", *Discussion Paper* 56, Department of Economics, University of California at San Diego.

Levin, A. and Lin, C.F. (1993), "Unit root tests in panel data: new results", *Discussion Paper* 92-93, Department of Economics, University of California at San Diego.

Love, I. and Zicchino, L. (2006), "Financial development and dynamic investment behavior: Evidence from a panel VAR", *The Quarterly Review of Economics and Finance* 46, 190-210.

Maddala, G. and Wu, S. (1999), "A comparative study of unit root tests and a new simple test", *Oxford Bulletin of Economics and Statistics* 61, 631-652.

Pesaran, M.H. and Shin, Y. (1998), "Generalized impulse response analysis in linear multivariate models", *Economics Letters* 58(1), 17-29.

Pesaran, M. H. and Smith, R. (1995), “Estimating Long-Run Relationships from Dynamic Heterogeneous Panels”, *Journal of Econometrics* 68, 79-113.

Rajan, R. G. (1994), “Why credit policies fluctuate: A theory and some evidence”, *Quarterly Journal of Economics* 109, 399-442.

Repullo, R., Saurina, J. and Trucharte, C. (2009), “Mitigating the Procyclicality of Basel II”, in *Macroeconomic Stability and Financial regulation: Key Issues for the G20*, edited by M. Dewatripont, X. Freixas and R. Portes, RBWC/CEPR.

Saurina, J. (2009), “Loan loss provisions in Spain. A working macroprudential tool”, *Bank of Spain, Revista de Estabilidad Financiera*, 17, 11-26.

Schaeck, K., Cihak, M. and Wolfe, S. (2006), “Are More Competitive Banking Systems More Stable?”, Unpublished Working Paper No. 143, International Monetary Fund, Washington, D.C.

Stock, J., and Watson, M. (2003), “Forecasting Output and Inflation: The Role of Asset Prices”, *Journal of Economic Literature* 41, 788-829.

The Turner Review (2009), “A regulatory response to the global banking crisis”, March.

Appendix

Figure 3: **Response functions of GDP to a shock in GDP. Mean Group and GMM estimations**

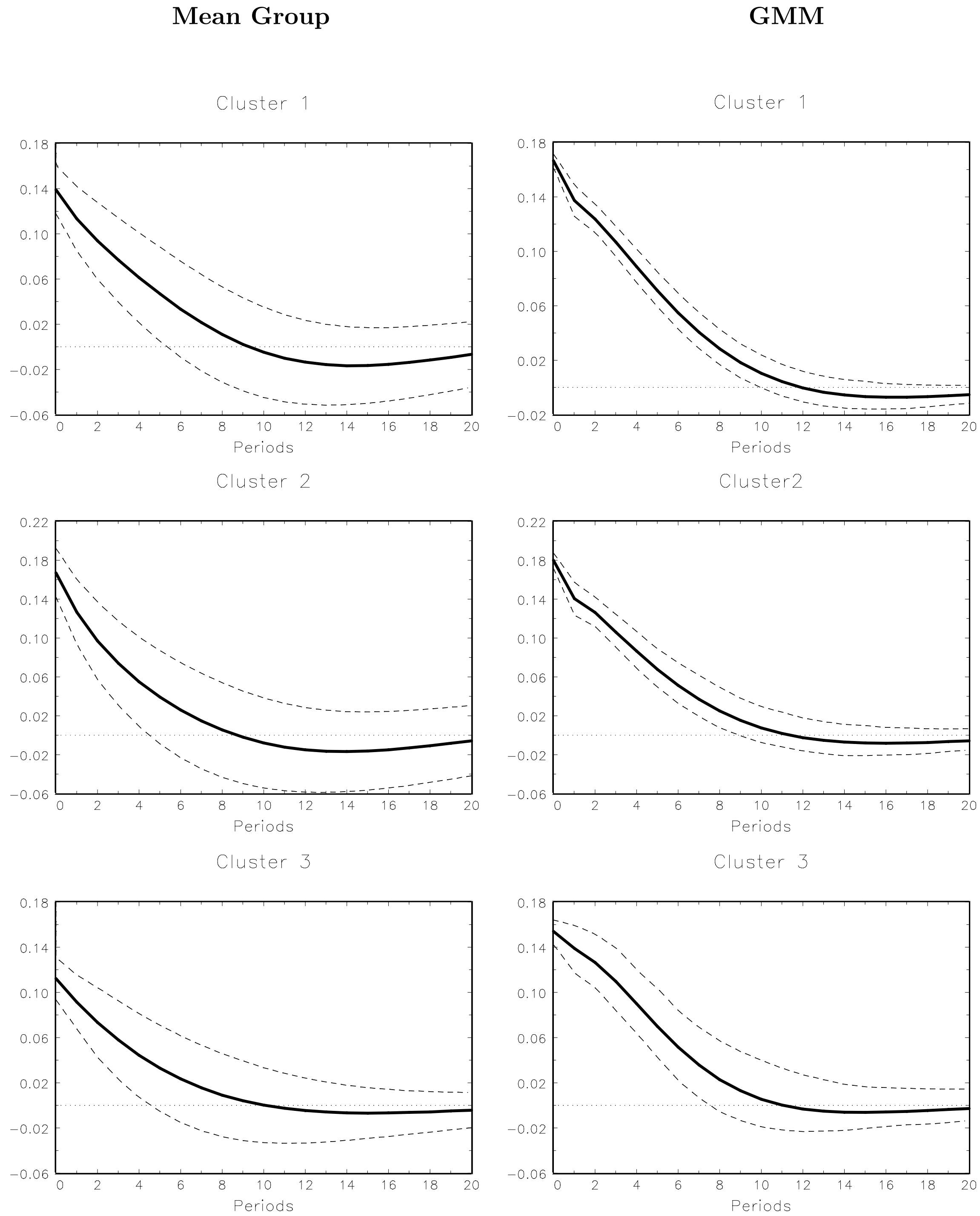


Figure 4: **Dendogram (hierarchical agglomerative clustering)**

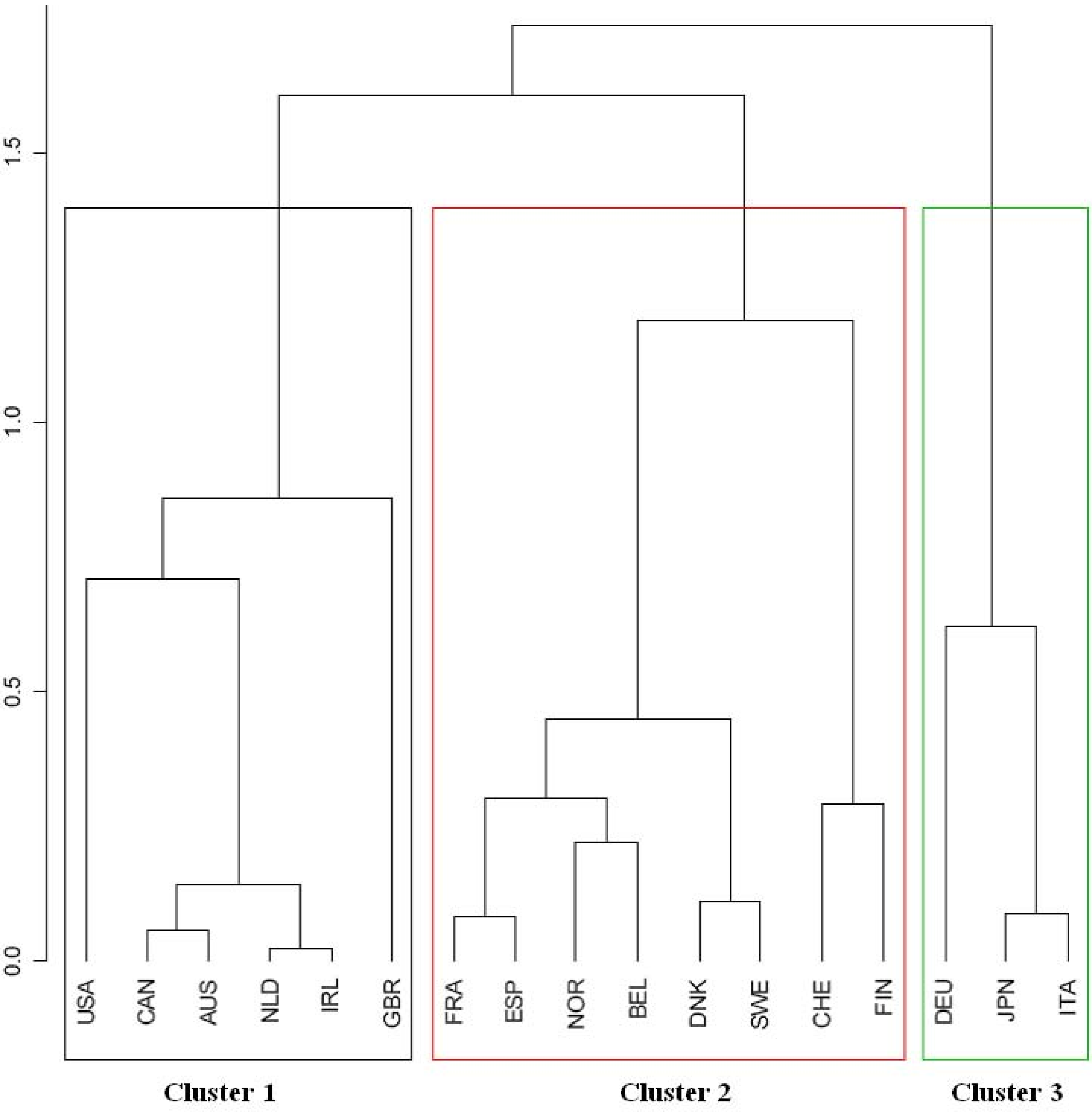


Figure 5: **Difference impulse response function cluster 1 and cluster 2**