Is full banking integration desirable?*

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Abstract

The aim of this paper is to analyze the links between banking integration and economic development for a sample of OECD countries. We measure banking integration considering state-of-the-art indicators which measure not only how open a banking system is but also its degree of connectedness with other banking systems. In a second stage, we plug in these indicators in a model of economic growth, controlling also for other relevant variables considered by that literature. In contrast to previous initiatives, this second stage takes explicitly into account the differing levels of economic development of the countries in our sample, since the benefits of enhanced banking integration might not be generalizable. For this, we implement quantile regression, also considering the presence of endogenous regressors. Results show that bank connectedness is more important for economic development than bank openness, but the combined effect (i.e., banking integration) is overall positive and significant. Quantile regression models in the second stage of the analysis show that the effects are stronger for the poorest economies.

Key words and phrases: banking, growth, integration, quantile regression

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1. Introduction

The debate as to the potential benefits of enhanced financial globalization stems indirectly from the long-lasting issue on the links between finance and economic performance. This debate emerged as far back as the beginning of the last century, and some of the most prominent advocates such as Schumpeter (1911) claimed that the benefits from enhanced financial development was related to the fact that financial intermediaries provide essential services for technological innovation and economic development, which enable to grow faster. Although by the end of last century some authors (Jayaratne and Strahan, 1996, among others) concluded that the debate on whether financial development played any causal role on economic growth was unresolved, the most extended view was that it exerted a significantly positive effect. This view was supported by relevant and compelling evidence (see, for instance Levine, 2005; Papaioannou, 2008; Aghion, 2008; Ang, 2008; Demirgüç-Kunt, 2010) and, although this literature was generally interested in the broad question of the impact of financial *development* on growth, some studies analyzed explicitly the links between international financial *integration* and economic performance.

However, while acknowledging the general benefits of both financial development and financial integration, some studies also stressed that the prospects might be not entirely positive. For instance, in a relevant survey, Ang (2008) reviewed the empirical literature focusing on either testing the role of financial development in stimulating economic growth or examining the direction of causality between the two variables. Despite admitting that the positive role of finance on growth had become a stylized fact, he also argued that some methodological reservations about the results from the empirical literature also existed.[1]

The broad consensus, with few exceptions, regarding the positive effects of enhanced financial integration came to a relatively abrupt halt with the start of the financial crisis in 2007. Some years later, the view that the financial globalization might have largely contributed to the origination of the crisis is very extended. This point has been done by, among others, Lane (2012), who argued that the financial globalization enabled the scaling-up of the US securitization boom that "was the proximate trigger for the crisis", and that "it is difficult to imagine that the growth in these credit markets would have been of similar magnitude with-

[1]From a more general perspective, extending the analysis to other aspects apart from growth, Agénor (2003) reviewed the benefits and costs of international financial integration, discussing the impact of financial openness and capital flows on consumption, investment and growth, together with the impact of foreign bank entry on the domestic financial system.

out the participation of foreign investors". However, even before the start of the 2007–2008 international financial crisis, some voices already warned about the limited benefits of deeper financial integration on growth.[2] Some of the most critical views even considered that it was a stylized fact that there is actually no correlation between long-run economic growth and financial globalization (Rodrik and Subramanian, 2009).[3]

In his most relatively recent contributions, Stiglitz (2010b,c) has also indicated that, despite integration of global financial markets "was supposed to lead to greater financial stability, as risks were spread around the world" (Stiglitz, 2010c, p.388), "the financial crisis has thrown doubt on this conclusion". He makes a comparison with the design of electric networks, where a failure in one part of the system can lead to system-wide failure; analogously, in the international financial network, a failure in one part of the global economic system might cause a global *meltdown*. However, other authors have argued that, despite the vulnerabilities shown by the financial crisis, "we shouldn't turn our backs on financial globalization" (Mishkin, 2009). Specifically, he admits that getting financial globalization to work is not an easy task, since it requires both policies that promote property rights, and also good-quality financial information in order to encourage effective prudential supervision and a stable macroeconomic environment. However, despite the dismal views on financial globalization by several relevant economists (not only Dani Rodrik or Joseph Stigltz, but also Jagdish Bhagwati[4] or even financiers such as George Soros[5]), Mishkin still considers that (financial) globalization is more an opportunity than a danger.[6]

In this global scenario, it is now possible to obtain a fuller evaluation of the financial global-

[2]For instance, Gourinchas and Jeanne (2006) indicated that, despite standard theoretical arguments as to the positive effects of financial integration on macroeconomic convergence, the welfare gains for the typical emerging market might be limited.

[3]For instance, in his comments on Lane's (2012) paper on financial globalization and the crisis, Dani Rodrik argued that some of the original arguments for the financial globalization claimed that it would equalize marginal returns to capital around the world, transfer saving from rich to poor countries, contributing to enhancing growth and convergence. It would also contributes to enhanced risk sharing and consumption smoothing across countries. According to this author, "these arguments have receded to the background, in large part because the accumulating evidence has not been kind to them" (Rodrik, 2012, p.33). Once the subprime financial crisis took place, many voices claimed that the benefits of financial globalization were even harder to find. Assuming that financial engineering was able to generate large gains (especially in terms of economic growth) might then sound less plausible than ever before. On this point, Rodrik and Subramanian have been particularly critic, arguing that the crisis has demonstrated that more is not necessarily better, and that "if you want to make an evidence-based case for financial globalization today, you are forced to resort to fairly indirect, speculative, and, in our view, ultimately unpersuasive arguments" (Rodrik and Subramanian, 2009, p.136).

[4]See Bhagwati (2004a,b).

[5]See Soros (2002).

[6]Other "gentle" views on financial globalization, in spite of the crisis, are offered by Kose et al. (2009). They consider that the failure of those research initiatives to find the expected positive effects of international financial integration on growth (based on cross-country regressions) is not a failure but an opportunity, since it points to newer approaches that are potentially more useful and convincing.

ization model, with a deeper understanding of the dangers associated to it for both developed and developing economies, due to the testing ground provided by the financial crisis. The research initiatives that have attempted to do this are blooming and, therefore, whatever the effort to provide an updated review will be unsuccessful because the crisis seems far to be over yet—at least in some countries. However, some recent contributions have made this attempt.[7] A branch of this literature has focused on the specific links between the financial crisis and cross-border *banking*. Confining the analysis to the case of bank activities is particularly relevant in the case of Europe and euro area countries, due to the euro effect on cross-border banking. In this specific case, the research initiatives conducted so far are comparatively minor, although the recent contributions by Kleimeier et al. (2013a,b) provide some relevant empirical evidence on how the financial crisis is affecting cross-border banking in Europe.

However, the literature cited above has not considered some of the complexities of the links between the different financial systems. Specifically, although many studies in this particular field have proposed measures of *de jure* financial openness (see, for instance, the recent proposal by Schindler, 2009), less initiatives have focused on *de facto* indicators. In addition, most of the previous studies have generally disregarded measuring the degree of *connectedness*, with few exceptions. However, this might be actually relevant in some particular contexts, as shown by Billio et al. (2012) in finance, in general, and in the insurance sectors, in particular. More specifically, some recent contributions (see, for instance Fagiolo, 2006; Kali and Reyes, 2007; Kali et al., 2007; Fagiolo et al., 2010a) have proposed measuring integration considering network analysis approaches in which countries are nodes of the network and the trade flows between them are the ties. Some of these authors consider they are modeling what could be referred to as the World Trade Web. A variant of these approaches focused on the particular case of financial integration which would include (among others McGuire and Tarashev, 2006; von Peter, 2007; Kali and Reyes, 2010; Fagiolo et al., 2010b; Minoiu and Reyes, 2013; Chinazzi et al., 2013). These types of approaches are implicitly measuring *de facto* financial (or banking) integration. In this line, we will follow the proposals by Arribas, Pérez and Tortosa-Ausina (2011b; 2011a), who modeled international *banking* integration taking also into account the network analysis approaches presented by Fagiolo et al. (2010b), Kali and Reyes (2010) or Chinazzi et al. (2013), in combination with the idea of *full* financial integration introduced by Stiglitz (2010b; 2010c) considering that the degree of banking integration advances via both

[7] An updated list of citations on the specific topic of financial globalization and financial crisis is provided by Lane (2012).

openness and connectedness.

Therefore, this study attempts to make a fourfold contribution. First, we focus on the specific impact of international *banking* integration on economic development and economic growth, as opposed to other more general analyses considering broader measures of financial integration. In this regard, only Edison et al. (2002) have analyzed the impact of financial integration on growth. However, although they consider several measures of financial integration, none of them measured specifically *banking* integration and, in addition, the relevance of connectedness was not considered either. Second, in order to explore this issue we hypothesize that the impact of banking integration might vary at different levels of economic development—i.e., the impact of international banking integration on economic performance can differ for richer and poorer economies. Third, our banking integration measures consider not only how open a given banking system is but also its degree of connectedness, in order to accommodate the ideas by Stiglitz (2010a) as to the desirability of *full* financial integration. Fourth, the analysis is performed using both pre-crisis and crisis data, being the selected period 2003–2011. Although this comes at the cost of having a smaller sample in terms of countries, it enables a better understanding on how the degree of banking integration has evolved during these turbulent years.

Our results can be explored from several angles but, in general, the overall finding is that, after controlling for the common control variables considered by the growth literature, banking integration affects positively, and significantly, the levels of per capita income of our sample of countries. In addition, it is also relevant to control for the different levels of economic development, for the decomposition of integration into openness and connectedness, and for the period of analysis (pre-crisis or crisis), since both the magnitude and significance of the effect remarkably vary when factoring in the analysis each of these three issues.

The paper is structured as follows. After this introduction, we present our indicators of bank integration in Section 2, whereas Section 3 is devoted to present the model of the impact of bank integration on economic development. Results are presented in two sections, namely Section 5, and 6 for the impact of bank integration on per capita income. Finally, Section 7 outlines some concluding remarks.

2. Banking integration indicators

2.1. Some previous initiatives to measure banking integration

The variety of issues covered by the literature on financial integration is now remarkable. Some of them have been explicitly concerned about its measurement, either directly or different aspects related to it. On this particular issue, the influential papers by Lane and Milesi-Ferretti (2001, 2007) provide compelling evidence on the specific question of the integration of world capital markets. They provide information on the construction of a database on the stocks of foreign assets and liabilities held by various countries—especially in the developing world. Other measures have been proposed by Baele et al. (2004) or Schindler (2009), among many others.

The measure by Chinn and Ito (2008) has also been widely used, partly due to its relative simplicity compared to others. Its most updated version provides information until 2011, although the initial year varies across countries. Their index measures the degree of capital account openness, and it is based on cross-border financial transactions reported in the IMF's *Annual Report on Exchange Rate Agreements and Exchange Restrictions*.

Some studies do actually acknowledge the variety of methodologies to measure financial integration. As indicated above, the literature linking economic growth and financial integration has usually leaned towards analyzing the causality with financial development, rather than financial integration. However, the paper cited above by Edison et al. (2002) does actually deal with the issue as to how different measures of financial integration might impact on growth. Specifically, after explicitly acknowledging how difficult it is to measure international financial integration, they do it using an extensive array of indicators such as the IMF-restriction measure and the Quinn (1997) measure of capital account restrictions, various measures of capital flows (FDI, portfolio, and total capital flows), measures of both capital inflows and outflows, or the measure of accumulated stock of foreign assets by Lane and Milesi-Ferretti (2001, 2007) referred to above.

Some other authors have considered broader measures of financial integration. This would include the KOF index by Axel Dreher (2006), who proposes a more encompassing index to measure different aspects of globalization—not only financial globalization. In contrast, other measures of financial integration are actually more specific, focusing on particular types of integration such as banking globalization. However, in this case the number of contributions is much scarcer. Goldberg (2009) has emphasized the importance of this type of financial

globalization, which might be particularly relevant in some economies where the role of banks is predominant. However, in this particular case data are more difficultly available, which partly explains the relatively low number of studies.

Even though, several research initiatives have been conducted in the specific field of banking integration. Some of them have been explicitly concerned with its measurement (Cabral et al., 2002; Manna, 2004; Pérez et al., 2005; Gropp and Kashyap, 2010; Arribas et al., 2011b,a) although, in other cases, the interests have been broader (Buch, 2005; Kleimeier et al., 2013a,b). However, the different contributions have generally disregarded the effects of banking integration on economic growth.

The measures of either financial or banking integration based on prices usually consider an axiomatic criterion, namely, the compliance with the law of one price (LOOP) in different geographical markets—therefore, we might consider they are closer to *de jure* rather than *de facto* measures of integration. Some of the measures of banking integration proposed in the literature consider an axiomatic criterion, among which we find Cabral et al. (2002), Baele et al. (2004), Flood and Rose (2005), Kleimeier and Sander (2006) or Vajanne (2006). However, LOOP-compliant approaches have difficulties to measure integration in case of imperfect competition—a unique price only exists for homogeneous bank products. Unless one controls for bank customers' life circumstances, preferences, risk characteristics and needs, which may differ strongly across countries, the LOOP will face difficulties for accurately measuring banking integration. In addition, although we may expect convergence of interest rates to take place in either government bonds' or interbank markets, this would not actually be the case in retail banking markets, which offer differentiated products for different investments and clients. As indicated by Gropp and Kashyap (2010), while most observers have concluded that money markets integrated rapidly soon after the euro was introduced, little is known as to whether a similar process is taking place for retail banking.

In contrast to most of the measures of financial integration proposed in the literature, several measures of *banking* integration have considered quantities, as opposed to prices. These would include Cabral et al. (2002), Manna (2004) or Pérez et al. (2005). Some of these proposals have been dealing with the concept of banking openness. However, recent contributions argue that, when measuring integration, it is relevant to consider the concept of connectedness as well. In this regard, Fagiolo et al. (2010b), Kali and Reyes (2010) or Chinazzi et al. (2013) have considered network analysis approaches to model the World Trade Web (WTW) and its financial counterpart—the World Financial Trade.

2.2. A new metric on banking integration: openness vs. connectedness

In general, the available international banking integration indicators consider only information on the amount of cross-border asset holdings. However, their effects and scope might also depend on the structure of current relations between banking markets—i.e., on the level of connectedness between banking systems (Billio et al., 2012). Relevant aspects of this structure include the number of asset trading partners, and whether the relationships are direct or indirect (i.e., whether cross-border asset holdings might involve more than two countries). In addition, the volume of cross-border banking activities between them is also important, as well as the proportionality of this activity to the size of the banking markets.

If we consider banking globalization as synonymous of the highest possible level of financial integration, corresponding to the scenario in which no frictions to financial trade exist, the flow from one country to another would only depend on their relative size because barriers to cross-border flows are lifted and there is no home bias effect. As suggested by the literature on home equity bias (Cooper and Kaplanis, 1994; Coval and Moskowitz, 1999), investors should be able to exploit the benefits of international asset diversification, and not concentrate their investments in the assets of their home country. Considering this global scenario, we will define the Standard Perfect Banking Integration (SPBI) as an extension of the concept of geographic neutrality (Krugman, 1996), and as a hypothetical benchmark that will not necessarily be reached if distance and other factors matter—in other words, the full potential of banking integration. Therefore, geographic neutrality implies that the proportion of home and foreign assets held by domestic investors should be proportional to the relative sizes of each banking system. The absence of geographic neutrality would be equivalent to the equity home bias effect (Lewis, 1999), where individuals hold too little of their wealth in foreign assets.

Arribas, Pérez and Tortosa-Ausina have proposed a related approach to measure the degree of trade integration (Arribas et al., 2009) as well as banking integration (Arribas et al., 2011a,b). Although their proposals share some of the underpinnings of other approaches based on network analysis, they have also a strong focus on providing a formal framework for the so-called *global village* (McLuhan and Fiore, 1968). For this, they considered ideas derived not only from network analysis approaches (similar to those considered by the papers cited in the previous paragraph) but also from the *geographic neutrality* concept introduced separately by Krugman (1996) and Kunimoto (1977).[8] According to this notion, each country's trade flows (or financial

[8]See also Iapadre (2006).

flows, depending of the type of economic integration under analysis) would be proportionate to each country's share in the World economy—and, therefore, this would be also related to the home bias literature in finance. In other words, the alternative they propose enables to measure *how far* the financial integration might be from its full potential (Stiglitz, 2010a). Given how encompassing they are, the indicators presented in this paper will build on these proposals.

2.2.1. Degree of bank openness

In the first stage of our metric we characterize the *degree of banking openness*. We will take into account that investors hold a proportion of domestic assets, and that its volume will vary depending on the size of each particular banking system.[9] Let N be our sample of countries (represented by each country's banking markets), and let i and j be typical members of this set. Let X_i be the size of the banking markets of country $i \in N$ (for example, in terms of total assets). In order to control for this home bias effect, we define $\widehat{X}_i$ as the foreign claims of country i (i.e., assets held abroad by banks of country i, in case we considered data on bank flows) taking into account the weight in the world banking system of the country under analysis, namely, $\widehat{X}_i = (1 - a_i)X_i$, where $a_i = X_i / \sum_j X_j$. We define the relative flow (cross-border banking assets or liabilities) or degree of banking openness between countries i and j as $DBO_{ij} = X_{ij}/\widehat{X}_i$ (X_{ij} is the cross-border banking activity between countries i and j). Then the *degree of banking openness* for a country $i \in N$ can be defined as $DBO_i = \sum_{j \in N \setminus i} DBO_{ij} = \frac{\sum_{j \in N \setminus i} X_{ij}}{\widehat{X}_i}$, where a value of 1 indicates a lack of home bias in the economy as expected under SPBI, and a value lower than one means that the economy is closed.

2.2.2. Degree of bank connectedness

In the second stage of our metric we analyze whether the connection of one banking system with others is proportional to the differing banking systems' sizes, or whether this connection does not show geographical neutrality. The latter instance would contribute to widen the gap between the current level of banking integration and the scenario corresponding to a financially globalized world. Thus, we define the *degree of bank connectedness* to measure the discrepancy between the cross-border banking flows in the real world and those corresponding to the theoretical full potential.

[9] As documented by the literature on home equity bias, the proportion of domestic assets held by domestic investors is too big relative to the predictions of the standard portfolio theory (see Lewis, 1999).

In this network, the relative flow from country i to country j in terms of the total banking flows of country i, α_{ij}, is given by $\alpha_{ij} = X_{ij}/\sum_{j\in N\setminus i} X_{ij}$, where $i \neq j$ and $\alpha_{ii} = 0$. Let $A = (\alpha_{ij})$ be the square matrix of relative flows (the component ij of matrix A is α_{ij}). If the world banking system is *completely* connected (i.e., the banking flows between two countries are proportional to the relative size of their banking systems), then the flow from country i to country j should be equal to $\beta_{ij}\widehat{X}_i$, where $\beta_{ij} = X_j/\sum_{k\in N\setminus i} X_k$ is the relative weight of country j in a world where country i is not considered. Note that $\sum_{j\in N\setminus i}\beta_{ij} = 1$ and that β_{ij} is the degree of banking openness between countries i and j in the perfectly connected world, with $\beta_{ii} = 0$. Let $B = (\beta_{ij})$ be the square matrix of degrees of openness in the perfectly balanced connected world.

Considering the previously defined matrices, A and B, we define an indicator that measures the distance between the real distribution of banking flows and that corresponding to a perfectly balanced connected world. We consider the cosine of the angle of the vector of relative flows with the vector of the flows in a perfectly connected world, i.e., the inner product of those vectors. We call it the *degree of bank connectedness* of country i, DBC_i, and it is defined as $DBC_i = \sum_{j\in N}\alpha_{ij}\beta_{ij}/\left(\sqrt{\sum_{j\in N}\alpha_{ij}^2}\sqrt{\sum_{j\in N}\beta_{ij}^2}\right)$. An economy's DBC is equal to 1 if the distribution of its financial flows between the rest of the economies is proportional to the weight of that economies, as expected under SPBI. A value lower than 1 indicates that small economies receive higher financial flows than correspond by its size, and that big economies get lower flows than their size predicts.[10]

2.3. Degree of bank integration

From the concepts above we define the *degree of banking integration*, which combines degrees of banking openness and banking regularity of connection, provided that both set limits to the banking integration level achieved. Therefore, for a given banking system $i \in N$ we define its degree of banking integration as $DBI_i = \sqrt{DBO_i \cdot DBC_i}$. It is the geometric average of its deviation from the balanced degree of banking openness and banking connectedness.

[10]The degree of banking connectedness has two possible extensions: considering also indirect links between economies and controlling for distance. The former takes into account that flows from country i to country j may cross third countries, and those indirect flows also contribute to integration. This issue may be especially severe if we take into account the existence of asset trade which is conducted through intermediaries in third countries such as the financial centers of the U.K. and the Caribbean. The latter considers Samuelson (1954) iceberg type transportation costs idea in order to compare economies that are not contiguous. If the banking markets of country j get as close to the banking markets of country i as possible, then j's size will be reduced, or as Samuelson (1954) stated, "only a fraction of ice exported reaches its destination as unmelted ice". See Arribas et al. (2011c) for further details.

Therefore, DBI_i depends on both the openness of the banking system and the balance in its flows with other banking systems. Moreover, if the banking system verifies SPBI properties, as referred to at the beginning of the section, then DBI will be equal 1.

3. On the impact of international banking integration on economic development

3.1. The Model

In the context of economic growth the literature has considered a variety of alternative models. The variables included in these models depend heavily on the theory or theories the analyst is interested in evaluate. However, the number of theories is so high that some authors such as Brock and Durlauf (2001) has referred to this fact as *theory-openendedness*, which implies that while one theory might explain economic growth, other theories might simultaneously predict growth as well.

One of the most accepted models in empirical growth studies is the neoclassical growth equation introduced by Solow (1957). In this model the dependent variable is a measure of aggregate economic performance, generally GDP per capita, and the list of regressors includes demographic factors (population growth) and rates of physical capital investment. The effect of human capital is also accounted for after Mankiw et al.'s (1992) contribution, who highlighted the importance of education as a growth predictor. Despite its apparent simplicity, the Solow model has demonstrated great explanatory power for predicting growth at both the country and the regional levels (see, for instance, the classical contributions by Barro, 1991; Sala-i-Martin, 1996, 1997).

Consequently, considering the Solow variables is a common starting point when analyzing the role of other theories on economic growth. In doing so, the most extended strategy consists of augmenting the Solow model with additional regressors which represent the theory being evaluated. Some recent examples can be found in Durlauf et al. (2008) and Henderson et al. (2012), who evaluated different growth theories such as demography, geography, institutions or ethnic fractionalization. Other studies have followed analogous strategies for evaluating the theory of social capital (see Peiró-Palomino and Tortosa-Ausina, 2013) and more directly related to our paper, the theory of financial development (see Henderson et al., 2013). Accordingly, we augment the Solow model with our indicators representing the theory of banking integration.

We consider different model specifications where the most comprehensive model to be

estimated includes the Solow variables, the additional controls, time and geographic fixed effects, and the banking integration indicators. Regarding the regional dummies we consider six different geographical areas: i) Southern European countries (Spain, Italy, Greece, Portugal) and Ireland;[11] ii) rest of Europe; iii) North America; iv) South America; v) Pacific; and vi) Turkey. A dummy variable for the Eurozone is included as well. In addition, since we have panel data the model includes time fixed effects.

Then, the model to be estimated obeys to the following expression:

$$Y_{it} = \beta_0 + \sum_j \beta_j Z_{jit} + \sum_k \beta_k P_{kit} + \sum_m \beta_m R_{mi} + \sum_s \beta_s V_{st} + \epsilon_{it}, \qquad i = 1, \ldots, N; t = 1, \ldots, T \quad (1)$$

where for each country i and period t, Y_{it} is GDP per capita, Z_{it} is a vector of Solow and control variables, P_i is a vector of banking integration variables, R_i is a vector of geographical dummies and V_t is a vector of time effects. β_0, β_j, β_k, β_m and β_s are the parameters to be estimated and ϵ_{it} is the error term.

3.2. Quantile regression estimation: panel data and endogeneity issues

Given that we are dealing with longitudinal data, Model (1) can be estimated by OLS techniques for panel data. In fact, our representation of the model corresponds to a fixed effects approach. Therefore, we are assuming that the parameters β, which measure the effect of the exogenous variables on GDP per capita, are constant and independent of any feature of the country. However, we consider that the conditional impact of the covariates on the dependent variable might vary across quantiles—i.e., that the effects may differ for poorer (lower quantiles) and richer countries (upper quantiles). Quantile regression model (QR model), introduced by Koenker and Bassett (1978), allows to model the quantiles of the dependent variable conditioned to a linear function of the independent variables. Given a quantile τ, the parameter estimates of the QR model are obtained by solving the following minimization problem,

$$\min_{\beta} \sum_{i=1}^{n} \rho_\tau (y_i - \mathbf{x}_i' \boldsymbol{\beta}), \quad (2)$$

where $\rho_\tau = u(\tau - I(u_i \leq 0))$ is the quantile regression loss function ($u_i = y_i - \mathbf{x}_i' \boldsymbol{\beta}$), y_i is the subject i's dependent variable, $\mathbf{x}_i$ is the vector of independent variables and $\boldsymbol{\beta}$ is the vector of parameters, which depends on τ.

[11] Although Ireland is not geographically close to the rest of countries in this group, we include it in this group because the initial impact of the financial crisis was as strong as the rest of its group peers.

The extension of the QR model for panel data with the introduction of fixed effects is straightforward. However, as Koenker (2004) notes, the introduction of a large number of fixed effects can increases the variance of the estimations of the covariates. A solution consists of allowing the impact of the covariates be quantile-dependent, whereas the fixed effects are not.

Let us consider the model,

$$y_{it} = \alpha_i + \mathbf{x}_{it}'\boldsymbol{\beta} + u_{it}, \qquad i = 1, \ldots, n; j = 1, \ldots, T \tag{3}$$

where y_{it} is the dependent variable for subject i at period t and α_i is subject i's fixed effect.

The minimizing problem to estimate Model (3) for a vector of quantiles $(\tau_1, \ldots, \tau_q)$, under Koenker's approach, is

$$\min_{\alpha,\beta} \sum_{k=1}^{q} \sum_{i=1}^{n} \sum_{t=1}^{T} w_k \rho_{\tau_k}(y_{it} - \alpha_i - \mathbf{x}_i'\boldsymbol{\beta}(\tau_k)) \tag{4}$$

where the weights w_k measure the relevance of quantile τ_k in the estimation of the parameters. The above minimization problem can be expressed as a linear programming problem and be solved with an exact algorithm. Koenker and Bassett (1978) provide an asymptotic expression for the covariance matrix of the estimates.

Endogeneity is a usual problem in cross-section or panel data regressions, making OLS or QR model estimates to be inconsistent. However, while in the context of OLS the number of contributions addressing this issue is notable, for QR models the alternatives are still comparatively scant. In this setting, we will consider the proposals by Chernozhukov and Hansen (2005, 2008), who develop a model with instrumental variables in the presence of endogeneity along with a robust inference approach to partial or weak identification.

Let us consider the following model,

$$y_i = \mathbf{d}_i'\boldsymbol{\delta} + \mathbf{x}_i'\boldsymbol{\beta} + u_i, \qquad i = 1, \ldots, n \tag{5}$$

where $\mathbf{d}_i$ is the subject i's vector of endogenous variables, which is related to a vector of instrumental variables $\mathbf{w}_i$. Given a quantile τ, the objective function is

$$R(\tau, \boldsymbol{\delta}, \boldsymbol{\beta}, \boldsymbol{\gamma}) = \sum_{i=1}^{n} \rho_\tau(y_i - \mathbf{d}_i'\boldsymbol{\delta} - \mathbf{x}_i'\boldsymbol{\beta} - \widehat{\mathbf{d}}_i'\boldsymbol{\gamma}) \tag{6}$$

where $\widehat{\mathbf{d}}$ is the OLS projection of the endogenous variables $\mathbf{d}$ on variables $\mathbf{w}$ and $\mathbf{x}$.

Then the instrumental QR estimates are obtained in two steps. In the first step the estimations of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are obtained as a functions of τ and $\boldsymbol{\delta}$, i.e.,

$$(\widehat{\boldsymbol{\beta}}(\tau,\boldsymbol{\delta}),\widehat{\boldsymbol{\gamma}}(\tau,\boldsymbol{\delta})) \in \arg\min_{\beta,\gamma} R(\tau,\boldsymbol{\delta},\boldsymbol{\beta},\boldsymbol{\gamma}) \tag{7}$$

The second step allows to find an estimation of $\boldsymbol{\delta}$ as a function of τ by looking for the value of δ that makes the instrumental variables' coefficients as close to zero as posible, i.e.,

$$\widehat{\boldsymbol{\delta}}(\tau) \in \arg\min_{\delta} \widehat{\boldsymbol{\gamma}}(\tau,\boldsymbol{\delta})'\mathbf{A}\widehat{\boldsymbol{\gamma}}(\tau,\boldsymbol{\delta}), \tag{8}$$

where $\mathbf{A}$ is a positive defined matrix. Then, the parameter estimates are $(\widehat{\boldsymbol{\delta}}(\tau),\widehat{\boldsymbol{\beta}}(\tau,\widehat{\boldsymbol{\delta}}))$.

Harding and Lamarche (2009) merge the two above extensions of the QR model to estimate covariate effects in a model with fixed effects and instrumental variables. To this end they take as starting point the instrumental QR approach by Chernozhukov and Hansen (2008) which is extended by allowing fixed effects as introduced by Koenker (2004), although in Harding and Lamarche's (2009) approach the fixed effects estimators are also τ-dependent.

4. Variables and data sources

4.1. Data on the banking integration indicators

The information necessary for the construction of the indicators is available through the Bank for International Settlements (BIS), which provides data on total assets held abroad by banks of a given country, and assets of a given country owned by foreign banks (i.e., the information provided contains bilateral bank assets). This institution issues quarterly the international claims of its reporting banks on individual countries, geographically broken down by nationality of the reporting banks.

The dataset contains information on most of the largest world economies, and also on some specific countries with large banking systems such as Switzerland, with a final sample size of 23 countries. The data on total assets are provided by the European Central Bank for European Union countries, and by the central bank of each country. Our sample is also crucially determined by the available information, which was incomplete in terms of both countries and years. Stretching the sample period in both dimensions led inevitably to incomplete data sets and difficulties for drawing conclusions on the dynamics of banking globalization. Furthermore, even if additional countries for which information was available for some years were

included in the sample, the gains in terms of total bank assets would not be substantial, as the constrained sample accounted for more than 90% of the enlarged sample.

As shown by column three in Table 1, it is quite apparent that the U.S. financial system is far less "bancarized" than large European countries such as Germany, Italy, France, or Spain. As of 2011, the share of the U.S. banking system was quite small (13.97%, see column two in Table 1), especially taking into account the size of the U.S. economy.

Cross-border claims also exhibit high heterogeneity between countries. This information is reported in columns four to six. As expected, in the Netherlands, Sweden, United Kingdom and, especially, Switzerland, foreign claims represents an important share of both GDP (column five), and total assists (column six). U.S and Japan foreign claims represent an small proportion of their total assets, perhaps due to a relevant home bias effect. Columns seven to nine report information on the representativeness of our sample, which varies depending on the country but is in general remarkably high.

After considering the above-mentioned data limitations, our final sample included 198 observations from twenty-two countries and nine years (2003–2011).[12]

4.2. Data on the control variables

The main source of data for our control variables is the Penn World Table 8.0. (`https://pwt.sas.upenn.edu/`), which provides a complete set of information for a wide sample of countries covering a long time span. The dependent variable in our model is GDP per capita in real terms (dollars of 2005), denoted by ($GDPPC$). The list of explanatory variables comprises the Solow variables, namely population growth ($POPG$), physical capital investment in real terms as a share of GDP (INV), and an index of human capital (HC), based on the total years of schooling (Barro and Lee, 2013) [13] and the returns to education (Psacharopoulos, 1994). In addition, we include a composed measure of institutional quality ($INSTIT$) provided by the World Bank (`http://www.worldbank.org/`) and constructed by considering the following six different components: i) voice and accountability; ii) political stability and absence of violence; iii) government effectiveness; iv) regulatory quality; v) rule of law; and vi) control of corruption. Finally, we include an indicator of social capital, namely social trust ($TRUST$). Following Knack and Keefer (1997) or, more recently, Bjørnskov and Méon (2013), social trust might play an important role in growth processes, similar to other *soft assets* such as human

[12] BIS provides data of 23 countries but we have discarded Finland due to the lack of homogeneity in its banking system data collection.

[13] See `http://www.barrolee.com/`.

capital.[14] Data on this variable are borrowed from Bjørnskov and Méon (2013), who provide data on trust for a large sample of countries.[15]

We further augment this baseline model with our variables of financial integration, namely degree of bank openness (DBO) and degree of bank connectedness (DBC). Alternatively, we also consider the composed indicator measuring the global degree of banking integration (DBI), which is a combination of the two mentioned variables (see Section 2.3). Table 2 reports summary statistics for all the variables of interest. All three indicators of banking integration range in the $]0, 1]$ interval, being the degree of bank openness (DBO) highly skewed to the right and the degree of bank connectedness (DBC) highly skewed to the left. The average degree of integration (DBI) is 0.4. Almost all the variables exhibit thin tails in their distributions.

5. Evolution of the indicators of banking integration

We provide a variety of results for our different indicators of banking integration. The presentation of the results is split between the three types of bank indicators—integration, openness, connectedness.

5.1. Degree of bank integration

Due to the way this indicator has been constructed, its evolution is completely explained by those of the degree of bank openness and the degree of bank connectedness. Its values for all countries and selected years are reported in the three first columns of Table 3, for years 2003, 2007 and 2011, which are relevant periods in terms of the financial crisis. Whereas in 2003 most advanced economies were expanding at remarkably high rates, by 2007 the crisis was starting and financial contagion was fast across the different financial and banking systems—especially for developed countries. Year 2011 is relevant as well, not only because of being the last year for which information is available but also because the financial crisis was still affecting most Western economies—which largely dominate our sample. The last three rows in Table 3 provide summary statistics—unweighted average, standard deviation and coefficient of variation. The average evolution along the period of analysis is shown in Figure 1, where the weighted average is computed using the GDP of the countries as weights for the summary

[14] Social trust is a particular indicator of the broader term social capital. An excellent discussion on social capital as a growth theory is provided, for instance, in Durlauf and Fafchamps (2005). Examples of empirical analysis are Bjørnskov (2012) and Peiró-Palomino and Tortosa-Ausina (2013), to name some of the most recent.

[15] See Bjørnskov and Méon (2013) for a complete description on how the variable is constructed and the primary sources, which are several social barometers.

statistic.

The patterns shown in the left panel of Figure 1 reveal a dual behavior. Before the start of the international financial crisis, in 2007, the pattern is increasing. Although the unweighted average starts to decline slightly a bit earlier (in 2006), in the case of the weighted average the change in the trend is blatant, and it takes part exactly in 2007. This slightly different behavior for the unweighted and weighted average can be partly explained because the countries more severely affected by the financial countries were, generally, countries with large banking systems. Because of this peculiar evolution, with two distinct periods, on average the degree of banking integration has similar values when comparing the initial year and final year only: the discrepancies between the 2003 and 2011 unweighted average is less than two percentage points. The dispersion indicator (standard deviation), reported at the bottom of Table 3 (three first columns), shows a similar pattern, since the values are not very different when comparing years 2003 and 2011.

Although violin plots, displayed in the left panel of Figure 2,[16] could provide with additional information to that conveyed by the mean (unweighted or weighted) and the standard deviation, in this cases the static analysis of 2003 vs. 2011 reveals slight differences. However, some of them were concealed by the evolution of the summary statistics reviewed (mean and standard deviation).

Specifically, most countries, despite the context of international economic and financial crisis, are actually increasing in their levels of bank integration when considering our integration indicator. This is shown by probability mass (i.e. more countries) shifting upwards in the violin plot of 2011 with respect to the violin plot of 2003, implying that despite the financial crisis was affecting many countries, banking integration actually grew for most of the them. This result, despite being based on very different instruments, large coincides with some of those obtained by Kleimeier et al. (2013a,b), who show that financial crises have "significantly positive and often long-lasting effects on cross-border banking."

However, despite the general tendencies, there are several discrepancies among countries. Focusing on the three first columns of Table 3, for most of the countries the degree of banking integration has an inverse U-shape tendency. This is the case for the European countries with the exception of United Kingdom and the two most severely affected by the crisis, Ireland and Greece; and also the case for some non European countries as Australia, Japan and Mexico.

[16] Violin plots combine box plots and densities (estimating via kernel smoothing). The box of the plot (representing the central 50% of the probability mass, or the interquartile range) is inside the violin, and a rotated kernel density plot is added to each side of the box plot. A black dot inside the box is also included to mark the median.

For the U.S. and United Kingdom the banking integration process seems more immune to the crisis, exhibiting a steadily growing increasing trend. For the former, the DBI increases from 33.99% in 2003 to 50.24% in 2011, whereas for the latter DBI increased from 45.85% to 57.05%. In contrast, for Ireland, Turkey and Switzerland the decline has been sharp, as their DBIs fell from 62.19%, 22.96% and 77.98% to 24.40%, 18.71% and 66.08%, respectively. There are particular countries for which results are more difficult to reconcile with those described in the paragraphs above. The degree of banking integration for Brazil, Chile and Greece fells from 2003 to 2007 and grows from 2007 to 2011. In the case of Chile, the DBI fell from 16.65% (2003) to 13.61% (2007) to recover and reach the value of 17.40% (2011). These figures for Greece are 39.53%, 18,69% and 29.44%.

Therefore, although the average (global) degree of banking integration is almost the same in 2003 and 2011, this is the result of two opposite country-specific behaviors: for half of the economies, the current degree of integration is higher than that corresponding to 2003, whereas for the other half it is actually lower.

5.2. Degree of bank openness

Regarding the degree of bank openness, individual results for each country are provided in columns 4 to 6 of Table 3. It reveals a variety of relevant features. The first one is that the degrees of bank openness are quite heterogeneous across countries. This is not surprising and coincides with previous findings such as those by Lane and Milesi-Ferretti (2008), who indicated that the degree of financial integration is higher for advanced economies—although the indicators they use differ from ours (see also Obstfeld, 2009). The degree of openness is particularly low for Brazil, Chile, Mexico and Turkey, compared with the rest of the countries in the sample. Although some rich countries have low values in some years as well (e.g. Denmark and, to a lesser degree, Austria in 2003), these constitute usually exceptions and the evolution is positive—at least comparing 2003 and 2007.

We also observe remarkable discrepancies in the evolution of the degree of bank openness across countries. Underlying these discrepancies one may probably find how the crisis (both economic and financial) is affecting the different sample countries. Specifically, in the case of the euro area countries, the degree of openness has decreased notably since the crisis started. With the exception of Greece, whose degree of openness actually increased between 2007 and 2011 (from 16.63% to 26.57%, as indicated in the fifth and sixth columns of Table 3) the degree of bank openness fell for *all* euro area countries.

However, despite this generalized tendency for all euro area countries, there are remarkable discrepancies among them. For some countries the decline has been abrupt between 2007 and 2011; this is especially apparent in the case of Belgium and the Netherlands, whose *DBO* fell from 75.11% to 21.02% and from 79.52% to 37.37%, respectively—representing a whopping 72% and 42% decline, respectively. The fall has been more moderate for other euro area countries such as Austria, France or Germany, whose *DBO* fell from 42.85%, 42.61% and 45.95% to 30.60%, 35.80% and 30.60%, respectively, representing more modest yet still remarkable declines between the same periods (29%, 16% and 33%). If we extend the analysis to a non-EU yet geographically close country such as Switzerland, the decline is also substantial (from 86.79% to 61.67%, representing a 29% deterioration). These countries have a common feature which might be explaining this trend, namely, all of them are net lenders. Although it remains an open question to ascertain the reasons of this decline—i.e. whether the economic crisis is affecting their closest neighbors or for prudential considerations—the fact is that these countries' banking systems are now much more closed.

In contrast, for the rest of euro area countries the tendencies are not exactly coincidental. Among these countries, we find some of the most severely affected by the international crisis, namely, Italy, Portugal and Spain, whose degree of bank openness remained virtually unaltered—they decreased from 25.63%, 21.95% and 29.65% to 24.50%, 19.80% and 29.57% between 2003 and 2007, representing declines of 4%, 10% and 0.3%. Therefore, in the particular case of Europe and, more specifically, euro area countries, although the general tendency has been to become *less* financially integrated, the degree of heterogeneity is remarkable, the borrower countries being those with most declining *DBO*. These differing tendencies are partly responsible for the the decline of the standard deviation, whose values for 2003 and 2007 are quite similar (22.61% and 23.94%, respectively), but then in 2011 it falls to 15.46%.

There are two particular countries for which results are more difficult to reconcile with those described in the paragraphs above. The first of these two cases is Greece, whose degree of bank openness is even higher than that of Belgium by 2011 (it has increased from 16.63% to 26.57%). The second case is Ireland, whose banking system particularities deserve a specific analysis. In this case, the decline has been from 38.89% to 12.19% between 2003 and 2011 (representing a 69% decline), being now, by and large, the most closed banking system of the euro area.

Regardless of the tendencies for each particular country or groups of countries, on average, as indicated at the bottom of Table 3, the degree of bank openness increased between 2003

and 2007 (from 26.72% to 33.75%) and then it fell to 25.98% by 2011. Therefore, we could tentatively conclude that between the beginning and the end of the period, on average, the world's largest banking systems are *less* open. However, the standard deviation did actually decrease by a remarkable amount (from 22.61% by 2003 to 15.46% by 2011), pointing out the asymmetries in the evolution of the degree of bank openness—i.e., despite its average decline, there is a notable convergence process among countries. Similarly to the DBI, we also provide graphical summaries in central panel of Figures 1 and 2. The former contains the evolution of the average, both unweighted and weighted. It is clearly apparent that, on average, banking integration has fallen to pre-crisis levels, yet for large financial systems the decline was been more modest and occurred mainly during the first year of the crisis. The latter displays violin plots. The lower left violin plot clearly indicates that, comparing 2003 and 2011, banking integration shows greater convergence—although the most highly banking integrated countries are now more closed, the bulk of probability is shifting upwards.

5.3. Degree of bank connectedness

Analogous results to those reported for the degree of integration and openness are reported for the degree of connectedness in the last three columns of Table 3. The average, displayed at the bottom of Table 3, shows that banking connectedness has been falling sharply from 2003 to 2011. This pattern is more clearly shown in the right panel of Figure 1. Despite previous to 2007 there were some ups and downs, since the financial crisis started the decline has been sharp. Some discrepancies between unweighted and weighted values also exist, with the weighted average higher (i.e. large banking systems are more highly connected), but the tendencies are paralleled.

Figure 2 display the violin plots of DBC. They reveal some patterns which the evolution of the average conceals: first, although the mean, both weighted and unweighted, has declined over the 2003–2011 period, this behavior has been largely caused by a high number of countries whose connectedness is much lower by 2011; second, the heterogeneity of the DBC across countries has increased. This behavior had been partly anticipated by the summary statistics reported at the bottom of Table 3, among which we find the values corresponding to the standard deviation which, in general, show an increasing tendency when comparing 2003 vs. 2011.

6. Banking integration and economic development

In this section we provide results on the role of banking integration on economic performance. As commented on along the paper, the models presented in Section 4.1 are estimated not only using OLS regressions but also quantile regressions. While the former only provide the average estimated coefficient, the latter permit a deeper analysis by providing estimates for the different quantiles of the dependent variable, namely GDP per capita. Therefore, we are able to investigate if banking integration has different implications according to the GDP per capita level.

6.1. OLS regressions

We consider different model specifications where the Solow variables, the additional controls and the banking integration indicators are included sequentially. In particular, Models 1 and 2 consider only an intercept and the banking integration indicators. Models 3 and 4 incorporate Solow and control variables to Models 1 and 2, respectively. Finally, Models 5 and 6 include time effects and regional effects to Models 3 and 4. In addition, since the economic recession might have importantly affected GDP per capita levels in most countries after 2007, we performed a separated analysis with different time periods. First, we run the models 1–6 for the whole period of analysis (2003–2011). Second, we run separate regressions for Models 5 and 6, the most comprehensive ones, after splitting the sample into two subperiods, namely 2003–2007 and 2008–2011. This strategy will enable analyzing whether the influence of banking integration on growth differs before the crisis started and during the crisis years.

Results for the OLS regressions for Models 1–6 and for the entire period (2003–2011) are provided in Table 4. The degree of banking integration (DBI) is, on average, positive and significant at both the 5% and 1% significance levels. As introduced in Section 3.1, Model 1 only incorporates the intercept and the DBI indicator. The results hold for Model 3, which includes a set of control variables and also for Model 5, which incorporates temporal and geographical fixed effects.

However, in order to better understand the effects of banking integration, we decompose the effect of bank integration in Models 2, 4 and 6, in which the DBI variable is substituted by its two components, namely, the degree of bank openness (DBO) and the degree of bank connectedness (DBC). In Model 2 (simple regression), the degree of bank openness is significant but the degree of bank connectedness is not. However, when additional controls are included

in Models 4 and 6, the coefficient for DBC becomes significant. However, the magnitude of the DBO coefficient decreases remarkably when other controls are included, and this holds for both Model 4 and Model 6, while for the degree of connectedness the effect increases.

The control variables behave generally as expected, although some signs suffer some changes after the inclusion of fixed effects in Models 5 and 6. Population growth ($GPOP$) is negative in Models 3 and 4 but, once time and geographical dummies in Models 5 and 6 are incorporated, the coefficient become positive. However, the variable is nonsignificant throughout. Physical capital investment (INV) is positive and significant in Models 3 and 4 but including fixed effects dramatically affects the consistency of the results, and significance is lost. The results associated to human capital (HC) are more robust, and its coefficient is positive and significant across all models. The coefficient on social trust ($TRUST$) behaves similarly to that for investment, the sign changes when fixed effects are incorporated and significance is lost in some cases. Finally, the quality of formal institutions ($INSTIT$) is positive and significant in all cases, empirically supporting the views on the importance of having healthy and reliable institutions for better economic performance.

In order to analyze whether the economic recession might have modified the link between banking integration and economic outcomes we split the temporal period in two shorter subperiods, namely 2003–2007 and 2008–2011. Note that the second subperiod corresponds to the crisis years. Splitting the sample is motivated because, as indicated throughout the article and also in recent contributions (Choudhry et al., 2014), with the advent of the global financial crisis there might be (worrying) signs of European financial and banking disintegration. For space reasons, these regressions are only performed for the most comprehensive models (Models 5 and 6).

Results are provided in Table 5, where the estimations for the three temporal periods might be easily compared. In light of the results, the crisis years have remarkably affected the role of banking integration. According to the degree of banking integration (DBI), the magnitude of the effect almost doubles during the crisis. However, the three last columns, where the degree of banking integration is decomposed, reveals that the degree of bank openness (DBO), although significant (5%) for the entire period, losses significance during the recession years. However, the degree of bank connectedness (DBC) is significant (at the 1% level) during the two subperiods. Therefore, it is this second component the responsible for the significant effect of DBI in the second subperiod, reinforcing our views on the need of more sophisticated measures of banking integration.

6.2. Quantile regressions

6.2.1. Results for the entire period

The results provided in the previous paragraph, although interesting, are based on the *average* impact of banking integration regardless of each countries' level of economic development. However, as indicated in the introduction, the effects might differ across the conditional distribution of the dependent variable (per capita income).

For this, we consider the proposals by Koenker and Bassett (1978) and Koenker (2001) and implement a quantile regression estimation. As a first step, we have estimated simple models where the dependent variable is $GDPPC$ and the explanatory variables are DBI, DBO and DBC (included separately) together with an intercept. Figure 6 shows scatterplots of the observed values and the different slopes for several quantiles as well as for the OLS regression. Note that there is a group of countries showing particularly low values of per capita income and bank integration (DBI), the latter indicator clearly driven by bank openness (DBO) levels. However, the degree of connectedness is more similar across countries, regardless the income level. Focusing on the fits, we notice that the application of quantile regression is appealing, since the average fit represented by OLS regression does simply not reflect how the indicators affect particular groups of countries.

The previous results, despite insightful, are based on simple regressions. The results for the more complete models including control variables are reported in Tables 6 (for the entire period) and 7 (for 2003–2007 and 2008–2011). Figure 7 provides the graphical counterparts for the estimated quantile coefficients for DBI (Model 5) and its components DBO and DBC (Model 6), considering the entire period (2003–2011).

Focusing on the degree of banking integration (DBI, Models 1, 3 and 5), as indicated in Table 6 the magnitude of its impact on per capita income is always positive and significant for all models. However, its magnitude varies remarkably for the different quantiles, being much stronger for the relatively poorer countries. In addition, the discrepancies between the two tails of the distribution is, in general, the result of a monotonically decreasing tendency. Therefore, these results would suggest that although, on average, the impact of banking integration on per capita income is strong, it is particularly beneficial for the relatively poorer countries in our sample.

Analogously to the analysis undertaken via OLS, we also provide results for models which decompose the effect of banking integration into openness and connectedness (Models 2, 4 and

6). Regarding the effect of openness (DBO), there are some differences across models, but the dominant view (Models 2 and 6) is that its effect on per capita income is also diminishing, to the point that its significance is completely lost for the richest countries. In the case of connectedness (DBC), the effect also varies across models, and the monotonically decreasing impact (i.e., stronger for the poorest) is virtually lost. However, according to our most comprehensive specification (Model 6), its effect on per capita income is significant (at the 1% level) across quantiles.

6.2.2. Results for the subperiods

We also report quantile regression results for both pre-crisis and crisis subperiods (Table 7). For space reasons the analysis is constrained to Models 5 and 6.[17] Although the finding of an overall positive and significant impact of banking integration on per capita income is preserved, there are several subtelties worth mentioning. Specifically, the higher impact of banking integration (Model 5) for poor countries holds for the pre-crisis period, but is slightly diluted for 2008–2011—although only for the lowest quantile. Actually, for the rest of the quantiles (25% and above) the magnitude of the coefficient is actually *higher*, indicating that the positive (and significant) influence of banking integration (DBI) on per capita income exacerbated during the crisis years.

The explanations for these findings are multiple, and some of them are related to the decomposition of DBI into DBO and DBC, as shown by the results for Model 6. For the pre-crisis period, both the degree of openness (DBO) and the degree of connectedness (DBC) are positive and significant throught (at the 1% level), and the stronger impact for poorer countries is a common result for both indicators. However, the diminishing impact is much faster for DBO, whose coefficient for the richest countries ($\tau = .90$) is close to zero. In contrast, the degree of connectedness shows a more stable, and stronger, pattern. However, during the crisis period, although the impact o f DBC is generally similar, the degree of bank openness is not only lower but also loses it significance for the lower quantiles. We consider these results are interesting because they would not only point out to the overall impact of banking integration on per capita income but also that, in crisis times, for some countries it is more important to be more connected than more open.

[17]The results for the rest of the models are available from the authors upon request.

6.2.3. Instrumental variable estimation

In order to control for the possible existence of endogeneity we have also run an instrumental variable estimation. In this case, the literature combining quantile regression with instruments is in a relatively preliminary stage. For this, we follow the approach by Harding and Lamarche (2009), that extends previous work by Chernozhukov and Hansen (2006), who implemented a robust inference approach for instrumental variables quantile regression, with the inclusion of fixed effects as introduced by Koenker (2004).[18]

However, the latest refinements on the estimation methods do not solve the problem of selecting appropriate instruments. This choice is particularly difficult in our context, since we are dealing with composed indicators of banking integration (made of different components), which remarkably complicates a task *per se* challenging. The problem of instruments selection in growth equations was already acknowledged by Temple (1999), who suggest that when there is not a set of instruments to choose from, lagged values of the potentially endogenous regressors can be used as instruments. This alternative, used in recent contributions (see, for instance Dufrénot et al., 2010) is the one we follow. Then, the instruments are the lagged (one year) observations of the corresponding bank integration indicator.

The results are reported in Tables 8 and 9 for Models 5 and 6, respectively, and for the entire period. The analysis shows that results, after including the instruments, are fairly robust. The robustness holds, in general, for the three integration indicators considered, as well as the different quantiles of the conditional distribution.

There are some small differences, especially for the degrees of bank integration and bank openness. In the case of the former, the declining tendency across quantiles is partly lost but, in contrast, the impact is generally higher (while holding significance). In the case of the degree of openness, significance is generally lower across quantiles. In contrast, for the degree of connectedness the impact is found to be even stronger (although for the poorest countries significance is lost), a tendency which underlies the results for DBI. These results would reinforce our views on the alleged positive and significant impact of banking integration on per capita income.

[18] Harding and Lamarche (2009) also provide code implemented in R language (www.r-project.org), which is available at http://gatton.uky.edu/Faculty/lamarche/software.html. We have taken this code as starting point and make some improvements allowing more than one fixed effect and testing the significance of the estimates.

7. Conclusions

Over the last twenty years international financial integration (or, more succinctly, financial globalization) has received a remarkable deal of attention from a variety of points of view—not only from the academia but also from policy makers and the media in general. It is part of the broader issue of international economic integration but the particular case of financial integration has become particularly important since 2007 due to its central role before and during the international financial crisis.

Despite the relevance of the issue, the number of initiatives dealing explicitly with the issue of how to measure international financial integration and, in the our case, international banking integration, is relatively low. Therefore, when dealing with the issue as to how financial (or banking) integration affects a given economic phenomenon we are confronted with the limitations of the measures proposed in the literature.

In the particular case of economic growth or development, the literature devoted to analyze the finance-growth nexus is large, i.e., whether more financially developed economies grow faster. A related literature has examined if the existence of trade agreements (which might be considered a form of trade integration) affects economic growth. However, initiatives attempting to evaluate how banking integration (which is a particular type of economic integration) impacts on growth or development are virtually nonexistent. Our paper does exactly that.

Specifically, in an attempt to measure bank integration with more precision, we consider some recently introduced indicators which take into account not only how open a banking system is but also how connected it is to the rest of banking systems. We consider this type of initiatives are important, since the shared view is that the financial crisis was highly contagious due to the strong connections between banks in different countries. There is also a growing literature taking into account the growing role of networks to explain economic phenomena.

Once the indicators are defined, we evaluate their impact on economic development. For this, instead of constraining the analysis to a methodology which focuses on the average impact for the average countries, we examine the differential effects for different parts of the distribution of per capita income—i.e., to different quantiles. This makes it possible to test the hypothesis as to whether the impact of banking integration on per capita income differs for poorer and richer countries.

Our results, obtained from a sample of developed countries, and specifying a variety of

models, can be explored in several ways. In general, the impact of our three indicators of banking globalization (integration, openness and connectedness) is positive and significant. However, the financial crisis has played a nonnegligible role, since the degree of bank openness is not significant for the 2008–2011 period (on average). The quantile regression indicate that the average impact is concealing some interesting trends, since the impact is much larger for the poorest countries, although being connected has a more homogeneous impact. Results also change during the crisis years when considering a separate analysis, but the significance and homogeneity of the degree of connectedness is preserved.

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Table 1: Data by country, 2011

Country	Bank assets			Consolidated foreign claims			Consolidated foreign claims of the sample countries		
	Total[a]	As % of total assets	As % of GDP	Total[a]	As % of GDP	As % of total assets	Total[a]	As % of total foreign claims	As % of total assets
	A	$A/\sum A$	A/GDP	B	B/GDP	B/A	C	C/B	C/A
Australia	2,938,124	3.31	214.19	658,990	48.04	22.43	106,898	16.22	3.64
Austria	1,509,089	1.70	360.61	453,869	108.46	30.08	144,030	31.73	9.54
Belgium	1,484,310	1.67	290.17	306,683	59.95	20.66	203,003	66.19	13.68
Brazil	2,748,802	3.10	110.99	88,709	3.58	3.23	55,277	62.31	2.01
Canada	3,930,837	4.43	226.42	985,647	56.78	25.07	742,582	75.34	18.89
Chile	143,131	0.16	57.58	6,595	2.65	4.61	5,012	76.00	3.50
Denmark	1,098,283	1.24	330.13	245,896	73.91	22.39	189,804	77.19	17.28
Finland	820,061	0.92	308.21	23,384	8.79	2.85	15,815	67.63	1.93
France	8,635,799	9.73	311.42	2,788,279	100.55	32.29	2,150,751	77.14	24.91
Germany	10,345,597	11.65	289.75	2,793,229	78.23	27.00	2,132,834	76.36	20.62
Greece	549,545	0.62	183.96	145,110	48.58	26.41	56,948	39.24	10.36
Ireland	1,543,584	1.74	710.43	184,927	85.11	11.98	170,011	91.93	11.01
Italy	3,615,713	4.07	164.74	849,326	38.70	23.49	558,863	65.80	15.46
Japan	10,950,917	12.34	186.65	2,941,347	50.13	26.86	1,971,948	67.04	18.01
Mexico	487,328	0.55	42.18	4,888	0.42	1.00	3,185	65.16	0.65
Netherlands, The	3,664,532	4.13	438.21	1,312,473	156.95	35.82	1,094,268	83.37	29.86
Portugal	663,357	0.75	279.28	130,335	54.87	19.65	88,548	67.94	13.35
Spain	5,065,981	5.71	339.81	1,411,690	94.69	27.87	1,250,755	88.60	24.69
Sweden	1,589,919	1.79	295.45	864,574	160.66	54.38	600,877	69.50	37.79
Switzerland	2,968,359	3.34	466.98	1,768,925	278.29	59.59	1,375,286	77.75	46.33
Turkey	553,604	0.62	71.61	25,336	3.28	4.58	19,667	77.62	3.55
United Kingdom	11,056,376	12.46	454.70	4,036,989	166.02	36.51	2,631,286	65.18	23.80
United States	12,403,492	13.97	82.17	3,932,891	20.09	24.45	2,084,624	68.73	16.81

[a] In millions of current $US.

Source: Comisión Nacional Bancaria y de Valores (2012), BIS (2012), Board of Governors of the Federal Reserve System (2012), European Central Bank (2012), Central Banks of Brazil, England, Denmark, Japan, Switzerland, Turkey (2012), Office of the Superintendent of Financial Institutions Canada (2012), Reserve Bank of Australia (2012), Central Banks of Brazil, Chile, England, Japan, Switzerland, Turkey (2012), Statistics Sweden (2012) and the World Bank (2012).

Table 2: Summary statistics, dependent and independent variables (JESÚS, NO FALTARIEN LES UNITATS? POTSER ES PODRIA FER UNA TAULA AMB LA DESCRIPCIÓ DE CADA VARIABLE, FONT ESTADÍSTICA I UNITAT DE MESURA)

Type of variable	Variable	# of observations	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Dependent	GDP/N	198	28,857.03	10,137.55	6,928.12	47,134.06	–0.69	–0.54
Independent	DBI	198	0.42	0.19	0.06	0.88	0.12	–0.45
	DBO	198	0.30	0.21	0.01	0.98	1.00	0.92
	DBC	198	0.70	0.14	0.21	0.93	–0.49	–0.31
	$POPG$	198	0.01	0.00	-0.00	0.02	0.36	–0.53
	INV	198	0.23	0.04	0.13	0.36	0.21	–0.21
	HC	198	2.96	0.33	2.16	3.62	–0.31	–0.28
	$TRUST$	198	34.42	16.09	5.80	68.10	0.26	–0.51
	$INSTIT$	198	1.16	0.59	–0.19	1.91	–1.02	–0.09

Table 3: Degree of bank integration (*DBI*), bank openness (*DBO*) and bank connectedness (*DBC*), percentage (%), 2003, 2007 and 2011

	DBI			*DBO*			*DBC*		
Country	2003	2007	2011	2003	2007	2011	2003	2007	2011
Australia	35.40	37.74	34.93	23.33	21.78	23.20	53.72	65.38	52.59
Austria	32.86	60.12	47.35	13.41	42.85	30.60	80.56	84.34	73.27
Belgium	68.76	76.93	38.47	64.23	75.11	21.02	73.60	78.80	70.41
Brazil	20.42	13.90	14.37	5.55	2.92	3.33	75.08	66.23	61.98
Canada	38.07	38.47	37.80	24.52	25.88	26.25	59.10	57.19	54.45
Chile	16.65	13.61	17.40	4.50	3.49	4.62	61.58	53.16	65.62
Denmark	24.40	42.48	31.08	7.92	31.06	22.67	75.14	58.10	42.60
France	51.91	61.72	54.40	29.83	42.61	35.80	90.34	89.39	82.66
Germany	57.85	64.51	51.58	38.10	45.95	30.60	87.84	90.56	86.93
Greece	39.53	18.69	29.44	18.65	16.63	26.57	83.78	21.02	32.63
Ireland	62.19	56.00	24.40	47.74	38.89	12.19	81.02	80.64	48.81
Italy	32.97	42.21	38.85	12.95	25.63	24.50	83.95	69.51	61.60
Japan	39.63	52.36	46.65	20.92	37.04	30.68	75.05	73.99	70.92
Mexico	5.77	8.79	7.54	0.75	1.36	1.01	44.19	56.59	56.32
Netherlands,The	75.02	84.86	56.41	66.46	79.52	37.37	84.69	90.55	85.15
Portugal	35.52	37.52	31.12	15.77	21.95	19.80	79.97	64.14	48.93
Spain	33.76	46.38	43.95	22.43	29.65	29.57	50.83	72.53	65.32
Sweden	47.12	56.87	50.40	30.60	53.39	55.38	72.56	60.58	45.86
Switzerland	77.98	77.96	66.08	89.80	86.79	61.67	67.71	70.02	70.80
Turkey	22.96	21.03	18.71	6.76	5.60	4.61	77.97	78.99	76.02
United Kingdom	45.85	50.85	57.05	30.03	36.07	41.76	70.00	71.70	77.93
United States	33.99	39.56	50.24	13.46	18.24	28.47	85.85	85.80	88.68
Unweighted average	40.85	45.57	38.56	26.72	33.75	25.98	73.39	69.96	64.52
Standard deviation	18.74	21.44	15.56	22.61	23.94	15.46	12.57	15.89	15.44
Coef. of variation	45.87	47.05	40.36	84.64	70.94	59.51	17.13	22.71	23.93

Table 4: OLS regressions, all period, 2003–2011

	Dependent variable: GDP/N					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
(Intercept)	9.397^{***}	9.624^{***}	7.711^{***}	7.464^{***}	8.517^{***}	8.242^{***}
	(0.057)	(0.129)	(0.171)	(0.198)	(0.147)	(0.139)
DBI	1.845^{***}		0.956^{***}		0.469^{***}	
	(0.123)		(0.102)		(0.079)	
DBO		1.370^{***}		0.451^{***}		0.156^{**}
		(0.128)		(0.092)		(0.053)
DBC		0.216		0.515^{***}		0.574^{***}
		(0.187)		(0.114)		(0.070)
$POPG$			-2.382	-4.875	3.021	3.422
			(3.211)	(3.361)	(2.169)	(1.972)
INV			1.049^{**}	1.268^{***}	-0.048	0.213
			(0.349)	(0.379)	(0.268)	(0.246)
HC			0.505^{***}	0.517^{***}	0.427^{***}	0.427^{***}
			(0.059)	(0.063)	(0.053)	(0.048)
$TRUST$			0.004^{**}	0.005^{**}	-0.002^{*}	-0.001
			(0.001)	(0.002)	(0.001)	(0.001)
$INSTIT$			0.173^{***}	0.236^{***}	0.350^{***}	0.355^{***}
			(0.045)	(0.047)	(0.032)	(0.029)
R^2	0.534	0.405	0.836	0.818	0.951	0.960
$\bar{R}^2$	0.531	0.398	0.831	0.811	0.945	0.955
# obs.	198	198	198	198	198	198
Fixed effects	No	No	No	No	Yes	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 5: OLS regressions, Models 5 and 6, subperiods (2003–2011, 2003–2007 and 2008–2011)

	Dependent variable: GDP/N					
	Model 5			Model 6		
	2003–2011	2003–2007	2008–2011	2003–2011	2003–2007	2008–2011
(Intercept)	8.517***	8.461***	8.729***	8.242***	8.029***	8.538***
	(0.147)	(0.219)	(0.220)	(0.139)	(0.203)	(0.221)
DBI	0.469***	0.403***	0.709***			
	(0.079)	(0.106)	(0.137)			
DBO				0.156**	0.151*	0.167
				(0.053)	(0.063)	(0.135)
DBC				0.574***	0.643***	0.591***
				(0.070)	(0.097)	(0.127)
$POPG$	3.021	3.356	5.344	3.422	4.957	3.083
	(2.169)	(3.072)	(3.230)	(1.972)	(2.675)	(3.166)
INV	−0.048	−0.020	−0.305	0.213	0.578	−0.006
	(0.268)	(0.462)	(0.343)	(0.246)	(0.416)	(0.349)
HC	0.427***	0.476***	0.331***	0.427***	0.471***	0.358***
	(0.053)	(0.076)	(0.076)	(0.048)	(0.066)	(0.074)
$TRUST$	−0.002*	−0.002	−0.001	−0.001	−0.002	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$INSTIT$	0.350***	0.327***	0.354***	0.355***	0.333***	0.375***
	(0.032)	(0.048)	(0.045)	(0.029)	(0.041)	(0.042)
R^2	0.951	0.950	0.959	0.960	0.963	0.961
$\bar{R}^2$	0.945	0.941	0.950	0.955	0.956	0.952
# obs.	198	110	88	198	110	88
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 6: Regression quantiles, all period (2003–2011)

		Dependent variable: GDP/N				
		Quantile (τ)				
		Poorest				Richest
Model	Indicator	.10	.25	.50	.75	.90
Model 1	*DBI*	2.133***	1.920***	1.563***	0.650***	0.729***
		(0.228)	(0.173)	(0.197)	(0.083)	(0.180)
Model 2	*DBO*	1.489***	1.613***	0.833***	0.402***	0.144**
		(0.209)	(0.232)	(0.186)	(0.101)	(0.052)
	DBC	−0.134	0.506	0.245	0.049	0.475***
		(0.181)	(0.300)	(0.151)	(0.161)	(0.091)
Model 3	*DBI*	0.944***	0.638***	0.547***	0.383***	0.504***
		(0.113)	(0.153)	(0.045)	(0.046)	(0.040)
Model 4	*DBO*	0.306**	0.193	0.265***	0.202***	0.276***
		(0.092)	(0.103)	(0.061)	(0.055)	(0.058)
	DBC	0.910***	0.551**	0.434***	0.133	0.359***
		(0.199)	(0.182)	(0.102)	(0.071)	(0.094)
Model 5	*DBI*	0.759**	0.812***	0.481***	0.365***	0.241*
		(0.233)	(0.099)	(0.068)	(0.078)	(0.097)
Model 6	*DBO*	0.515***	0.317***	0.174***	0.146***	0.100
		(0.083)	(0.075)	(0.050)	(0.021)	(0.072)
	DBC	0.577***	0.636***	0.690***	0.623***	0.548***
		(0.122)	(0.081)	(0.092)	(0.053)	(0.087)
# obs.		198	198	198	198	198

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.
Models 3,4,5 and 6 include control variables.
Models 5 and 6 include fixed effects.

Table 7: Regression quantiles, Models 5 and 6, pre-crisis (2003–2007) and crisis (2008–2011) years

			Dependent variable: GDP/N				
			Quantile (τ)				
			Poorest				Richest
Model	Period	Indicator	.10	.25	.50	.75	.90
Model 5	2003–2007	DBI	0.982^{***}	0.883^{***}	0.408^{***}	0.338^{***}	0.254^{***}
			(0.040)	(0.191)	(0.120)	(0.086)	(0.036)
	2008–2011	DBI	0.712^{***}	1.022^{***}	0.813^{***}	0.726^{***}	0.545^{***}
			(0.142)	(0.116)	(0.129)	(0.099)	(0.039)
Model 6	2003–2007	DBO	0.442^{***}	0.406^{***}	0.202^{***}	0.119^{***}	0.092^{**}
			(0.047)	(0.079)	(0.049)	(0.015)	(0.035)
		DBC	0.817^{***}	0.859^{***}	0.774^{***}	0.623^{***}	0.637^{***}
			(0.212)	(0.100)	(0.113)	(0.113)	(0.030)
	2008–2011	DBO	0.303	0.061	0.250^{***}	0.130^{*}	0.209^{**}
			(0.152)	(0.133)	(0.060)	(0.060)	(0.069)
		DBC	0.669^{**}	0.865^{***}	0.572^{***}	0.708^{***}	0.711^{***}
			(0.222)	(0.106)	(0.128)	(0.098)	(0.095)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

All models include control variables and fixed effects

Table 8: Instrumental variables regression for Model 5, 2003–2011

Without IV	OLS	$\tau = .10$	$\tau = .25$	$\tau = .50$	$\tau = .75$	$\tau = .90$
DBI	0.469^{***}	0.759^{**}	0.812^{***}	0.481^{***}	0.365^{***}	0.241^{*}
	(0.079)	(0.233)	(0.099)	(0.068)	(0.078)	(0.097)
With IV						
DBI	0.533^{***}	0.985^{***}	0.903^{***}	0.559^{***}	0.422^{***}	0.604^{***}
	(0.093)	(0.154)	(0.182)	(0.106)	(0.089)	(0.107)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

All models include control variables and fixed effects.

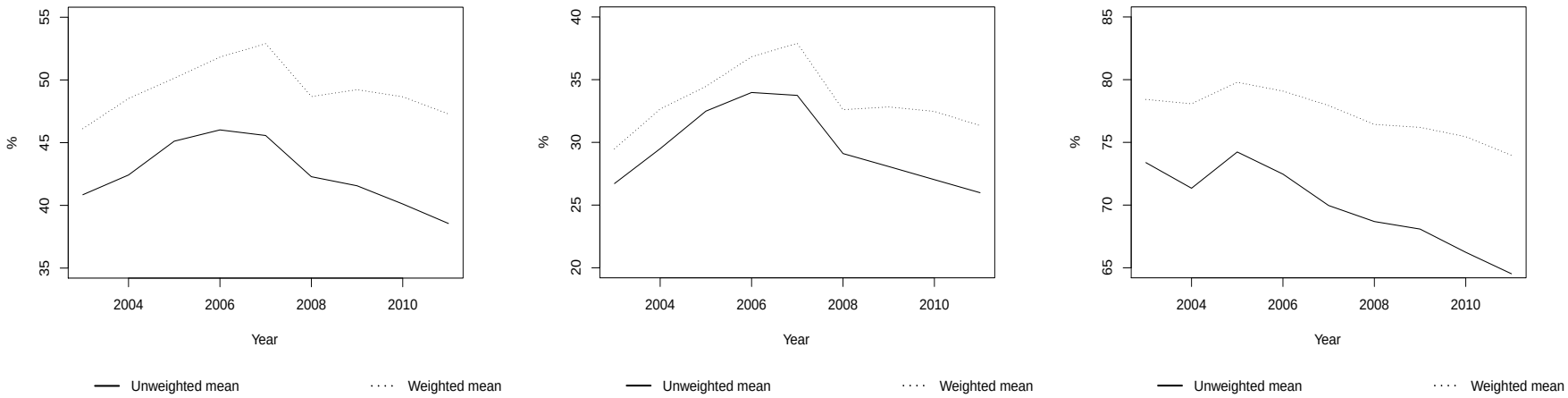
Table 9: Instrumental variables regression for Model 6, 2003–2011

Without IV	OLS	$\tau = .10$	$\tau = .25$	$\tau = .50$	$\tau = .75$	$\tau = .90$
DBO	0.156^{**}	0.515^{***}	0.317^{***}	0.174^{***}	0.146^{***}	0.100
	(0.053)	(0.083)	(0.075)	(0.050)	(0.021)	(0.072)
DBC	0.574^{***}	0.577^{***}	0.636^{***}	0.690^{***}	0.623^{***}	0.548^{***}
	(0.070)	(0.212)	(0.100)	(0.113)	(0.113)	(0.030)
With IV						
DBO	0.137^{*}	0.556^{*}	0.234^{**}	0.104^{*}	0.091	0.092
	(0.063)	(0.237)	(0.077)	(0.052)	(0.048)	(0.058)
DBC	0.710^{***}	0.542	0.992^{***}	1.003^{***}	0.770^{***}	0.728^{***}
	(0.090)	(0.465)	(0.273)	(0.178)	(0.099)	(0.143)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

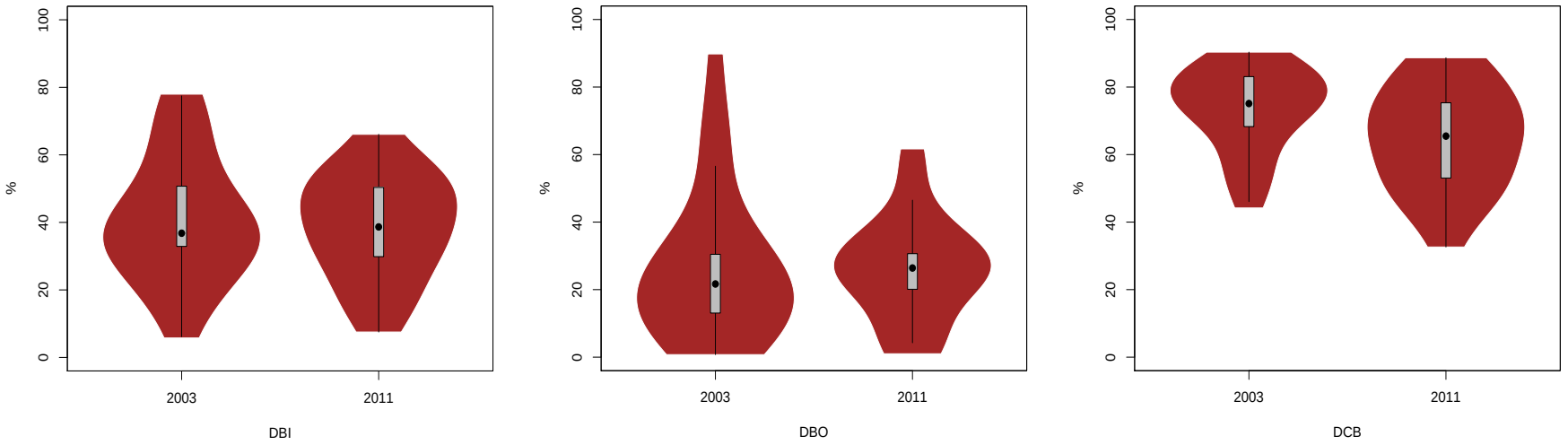
All models include control variables and fixed effects

Figure 1: Degree of bank integration (DBI), bank openness (DBO) and bank connectedness (DBC) (2003–2011)



DBI DBO DBC

Figure 2: Degree of bank integration (DBI), bank openness (DBO) and bank connectedness (DBC), violin plots (2003 and 2011)



DBI DBO DBC