Is full banking integration desirable?*

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June 22, 2017

Abstract

We analyze the links between banking integration and economic development for a sample of OECD countries. We measure banking integration considering indicators that merge not only openness but also connectedness with other banking systems. We plug these indicators into income regressions, also controlling for other relevant variables considered by the literature. In contrast to previous initiatives, this second stage explicitly takes 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. To this end, 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) overall is positive and significant. The quantile regression models used in the second stage show that the effects are stronger for the poorest economies.

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

JEL Classifications: C21, F15, F36, F62, F65.

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*The authors thank Mohamed Shaban and other participants in the IFABS 2016 Conference for their constructive comments. Suggestions by Erwin Diewert, Giorgio Fagiolo, Kevin Fox, Co-Pierre Georg, Paul Schreyer, Dan Sichel, Nigel Stapledon and Michael Arghyrou are also gratefully acknowledged. This paper is a result of the BBVA Foundation-Ivie Research Program. All authors acknowledge financial support from the Ministerio de Ciencia e Innovación (ECO2011-27227 and ECO2013-46550-R), the Generalitat Valenciana (ACOMP/2014/283, PROMETEOII/ 2014/046 and PROMETEOII/2014/054, ISIC/2012/021) and Universitat Jaume I (P1.1B2014-17). The usual disclaimer applies.

Is full banking integration desirable?

Abstract

We analyze the links between banking integration and economic development for a sample of OECD countries. We measure banking integration considering indicators that merge not only openness but also connectedness with other banking systems. We plug these indicators into income regressions, also controlling for other relevant variables considered by the literature. In contrast to previous initiatives, this second stage explicitly takes 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. To this end, 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) overall is positive and significant. The quantile regression models used in the second stage show that the effects are stronger for the poorest economies.

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1. Introduction

The broad consensus regarding the positive effects of enhanced financial integration came to a relatively abrupt halt with the start of the financial crisis in 2007. Today, there is a widespread view that financial globalization might have largely contributed to setting off the crisis. On this point, Lane (2012) has argued that financial globalization enabled the scaling-up of the US securitization boom that might have been the proximate trigger for the crisis. According to Yan et al. (2016), bank credit, portfolio flows and international trade is the main driver of crisis contagion. Therefore, countries with more integrated banking systems might have been most affected by the financial crisis.

Yet some voices had already warned about the limited benefits of deeper financial integration on growth, even before the start of the 2007–2008 international financial crisis. For instance, Gourinchas and Jeanne (2006) suggested that, despite standard theoretical arguments as to the positive effects of financial integration on macroeconomic convergence, the welfare gains might be limited. In contrast, Mishkin (2009) holds opposite views, arguing that "we shouldn't turn our backs on financial globalization" despite the vulnerabilities shown by the financial crisis, claiming that (financial) globalization is more an opportunity than a danger. Related to this, Kose et al. (2009) have considered that failing to find the expected positive effects of international financial integration (IFI) on growth (based on cross-country regressions) is not a failure but an opportunity—since it might suggest newer approaches, potentially more useful and convincing, should be used.

Therefore, it is now possible to obtain a more comprehensive evaluation of the financial globalization model, with a deeper understanding of the dangers associated with 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 started flourishing few years ago (Lane, 2012), with a branch of this literature focusing 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, there are fewer research initiatives so far, although Kleimeier et al. (2013a,b) provide some relevant empirical evidence on how the financial crisis affected 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, Schindler, 2009), fewer 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. This might actually be relevant in some particular contexts, however, as shown by Billio et al. (2012) in finance, in general, and particularly in the insurance sectors. More specifically, some contributions (see, for instance Fagiolo, 2006; Kali and Reyes, 2007; Kali et al., 2007; Fagiolo et al., 2010a) have proposed measuring integration by considering network analysis approaches in which countries are the network's nodes 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. One variant of these approaches focused on the particular case of financial integration would include, among others, McGuire and Tarashev (2006), von Peter (2007), Kali and Reyes (2010), Fagiolo et al. (2010b), Minoiu and Reyes (2013), and 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 (2011a), who modeled international *banking* integration also taking into account ideas from network analysis, in combination with the idea of *full* financial integration introduced by Stiglitz (2010b; 2010c) considering that the degree of banking integration advances via both openness and connectedness.

In this context, the paper attempts to make four main contributions. First, we focus on the specific impact of international *banking* integration on economic development, as opposed to other more general analyses considering broader measures of financial integration. In this regard, only Edison et al. (2002) have tentatively approached the issue. However, although they consider several measures of financial integration, they did not specifically measure *banking* integration, nor did they consider the relevance of connectedness. Second, we also attempt to provide new insights on the relationship between finance and income levels, especially after the financial and economic crisis that has reshaped the world economy. Specifically, we hypothesize that the impact of banking integration might vary at different levels of economic development—that is, the impact might differ for rich and poor 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 Stiglitz's (2010a) ideas on the desirability of *full* financial integration. Fourth, the selected period is 2003–2011, and therefore the analysis uses both pre-crisis and crisis data. 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 literature, banking integration positively, and significantly, affects the levels of per capita income in 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 these three issues are each factored in the analysis.

The article is structured as follows. After this introduction, Section 2 presents a review of the literature on financial development and economic performance. Section 3 introduces the indicators of bank integration and Section 4 describes the empirical framework, explaining the data, sources and models to be estimated. The methodology is presented in Section 5, and Section 6 is devoted to the results. Finally, Section 7 outlines some concluding remarks.

2. The links between banking integration and economic development

Few papers have explicitly dealt with the issue of banking integration and aggregate economic performance, although there is abundant literature on the links between financial development in a broader sense and economic growth/development. Most of the work over the last two decades builds on the seminal contribution by King and Levine (1993) in the early nineties, who, using data for 80 countries for the period 1960–1989, found robust ties between financial development and capital accumulation, physical capital efficiency and GDP growth. Shortly after, Levine and Zervos (1998) highlighted the role of the stock market in promoting growth and a series of studies, including Levine (1998) and Beck et al. (2000), underlined the importance of institutions and the financial system's regulatory framework for development processes. In a similar vein, Benhabib and Spiegel (2000) concluded that financial development is beneficial for both total factor productivity and investment, although the indicators differ for each case. They also suggested that financial development indicators might actually be capturing other broader country characteristics, since once fixed effects are included in the regressions, they lose significance.

Banking integration can be considered as a particular form of financial development. Therefore, although they can have their own particular implications for per capita income, most of the candidate channels through which more integrated banking systems might be positive for aggregate performance can be found in the finance-growth literature, which suggests a wide array of mechanisms. The main candidates include capital accumulation, savings and total factor productivity. Rajan and Zingales (1998) and Buera et al. (2011) noted the lower cost of financing for companies in highly developed financial systems. Romero-Ávila (2007) examined the particular case of the Single European Banking Market (SEM), concluding that the banking harmonization process in the EU was positive for growth, with efficiency in the intermediation being the main transmission channel. In particular, a more open and connected system raises competition and enhances the efficiency in resource allocation. More recently, considering a time span of 140 years and a sample of 21 OECD countries, Madsen and Ang (2016) concluded that financial development fosters growth via innovation, savings, investment and education.

Nevertheless, other authors are more skeptical about the nature of these links, and call for new insights on the issue. The debate, therefore, remains open. Al-Yousif (2002) found that the causal links between finance and growth remain unclear, suggesting a bidirectional relationship as the most likely scenario. Ram et al. (1999) argued that "(the results pertaining to the) finance-growth nexus are, at best, uncertain and ambiguous". More directly related with the particular topic of banking development, Levine (2002) provided several arguments based on banks' relationships with large firms for which a negative association with aggregate development is perfectly feasible. More recently, Shen and Lee's (2006) results suggested that while the development of the stock market is always positive for growth, this is not the case for banking development, for which negative effects are found. These effects are also heavily influenced by conditioning factors such as geography, currency crisis and institutional quality, with differing moderation effects for countries at different stages of development. According to these authors, a possible explanation is the existence of non-linearities in the relationship.

In response to these claims, another important strand of the literature has addressed, the likely existence of heterogeneous effects in that relationship for different stages of development. Deidda and Fattouh (2002) concluded that the positive relationship between financial development and growth holds only for high-income countries, whereas no significant effects are found for less developed nations. Aghion et al. (2005) argued that financial development is positive for convergence. Once an economy reaches a critical level of financial development, the catching up process with the most advanced economies is set in motion, which suggests that financial development would be especially beneficial for the poorest economies.

Differences are seen not only in the effects, but also in the transmission channels in developing and developed countries. In this line, Rioja and Valev (2004b) concluded that in more developed economies the positive effect of finance on growth is channeled via productivity, whereas in less developed economies the major transmission factor is capital accumulation. In contrast, Rioja and Valev (2004a) approached the finance-growth link by focusing on the level of development of the financial system. They found no significant effect in economies with underdeveloped financial systems, suggesting that the financial system must be a minimum size in order to generate the effects predicted by the literature. Shen and Lee (2006) concluded that the finance-growth link is non-linear. Similarly, but employing non-parametric procedures, Henderson et al.'s (2013) findings supported the argument of non-linear effects. More interestingly, they found evidence of parameter heterogeneity, with the effects increasing over time and larger for high-income countries, whereas no significant impacts were observed in less developed economies.

Theoretical models such as that by Dal Colle (2016) also show that growth is enhanced by financial development, since it fosters competition in the supply of loans. These models also reveal threshold effects. The positive effect of banking liberalization on growth in less developed countries is only seen when the fixed costs of banking activity in the liberalized economy are lower than in the domestic banking system. The more developed economies, however, benefit from liberalization more intensely, and in every setting.

3. Banking integration measures

3.1. Some previous initiatives to measure banking integration

As indicated in the preceding sections, the literature linking economic growth (or economic performance, in general) and financial integration has usually tended to analyze the causality with financial *development*, rather than financial *integration* (Ang, 2008; Madsen and Ang, 2016). Edison et al. (2002) are an exception, since they deal with the issue of how different measures of IFI might impact on growth. Specifically, after acknowledging the difficulties of measuring IFI, they do so 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, measures of both capital inflows and outflows, and Lane and Milesi-Ferretti's (2001; 2007) measure of accumulated stock of foreign assets referred to above.

Other authors have considered broader measures of IFI. These include the KOF index devised by Axel Dreher (2006), which is a more comprehensive index to measure different aspects of globalization—not only financial globalization. In contrast, other measures of IFI are more specific, focusing on particular types of integration such as banking globalization. Goldberg

(2009) has emphasized the importance of this type of financial globalization, which might be particularly relevant in economies where banks play a predominant role. However, in this case, the focus of our study, there are very few contributions. Some of them explicitly measure banking integration (Cabral et al., 2002; Manna, 2004; Pérez et al., 2005; Gropp and Kashyap, 2010; Arribas et al., 2011a), while others have broader research interests (Kleimeier et al., 2013a,b; Buch, 2005). However, all these contributions have generally disregarded the effects of banking integration on the real economy.

In contrast to most of the IFI measures proposed so far, several measures of *banking* integration have been based on quantities, instead of prices.[1] Some of these proposals have dealt with the concept of bank openness. However, more recent contributions argue that, when measuring integration, it is relevant not only to consider the concept of openness but also the idea of connectedness. In this regard, Fagiolo et al. (2010b), Kali and Reyes (2010) or Chinazzi et al. (2013) adopt approaches based on network analysis to model the World Trade Web (WTW) as well as its financial counterpart—i.e., the international financial network or, more specific to our goals, the global banking network (Minoiu and Reyes, 2013). The ideas on which they are based were partly inspired by the influential seminal work of Allen and Gale (2000), but these approaches to measure the integration of banking and financial markets have recently been gaining more importance (Chinazzi et al., 2013; Minoiu and Reyes, 2013; Elliott et al., 2014; Hautsch et al., 2014; Garratt et al., 2014; Minoiu et al., 2015; Caballero, 2015; Berardi and Tedeschi, 2017), together with approaches considering connectedness among financial institutions in general (Billio et al., 2012; Drehmann and Tarashev, 2013). Yet initiatives to analyze how they impact on economic performance are still in their infancy.

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

In general, the available international banking integration (IBI) indicators consider only information on the volume of cross-border asset holdings. However, their effects and scope might

[1] 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; we might therefore consider them to be closer to *de jure* than *de facto* measures of integration. Some of the measures of banking integration proposed in the literature that consider an axiomatic criterion include Cabral et al. (2002), Baele et al. (2004), Flood and Rose (2005), Kleimeier and Sander (2006) or Vajanne (2006). However, LOOP-compliant approaches encounter difficulties in measuring integration in the case of imperfect competition—a unique price only exists for homogeneous bank products. In addition, although we may expect convergence of interest rates in either government bond or interbank markets, this would not be the case in retail banking markets, which offer differentiated products for different investments and clients. As Gropp and Kashyap (2010) point out, while most observers conclude that money markets integrated rapidly soon after the euro was introduced, little is known about whether a similar process is taking place for retail banking.

also depend on the structure of current relations between banking markets—i.e., on the level of *connectedness* (Billio et al., 2012; Drehmann and Tarashev, 2013). 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 understand banking globalization as the highest possible level of IFI, corresponding to the scenario of no financial trade frictions, the flow from one country to another might only depend on their relative size because barriers to cross-border flows would be lifted and there would be no home bias effect. Considering this global scenario, a hypothetical benchmark can be defined that will not necessarily be reached if distance and other factors matter—in other words, what we might refer to as the *full potential* of banking integration. Therefore, in this hypothetical scenario the proportion of home and foreign assets held by domestic investors should be proportional to the relative sizes of each banking system. Being far from this scenario would be equivalent to the equity home bias effect (Lewis, 1999), where individuals hold too little of their wealth in foreign assets. These ideas underlie the indicators proposed by Arribas et al. (2009, 2011a), on which the subsections that follow are built on.

3.2.1. Degree of bank openness

In the first stage of our metric we characterize the *degree of bank openness*. We take into account the fact that, as documented by the literature on home equity bias, investors hold a proportion of domestic assets which is usually too big relative to the predictions of the standard portfolio theory (see Lewis, 1999). As suggested by this literature, investors should be able to exploit the benefits of international asset diversification, and not concentrate their investments in their home country assets (Cooper and Kaplanis, 1994; Coval and Moskowitz, 1999; Coeurdacier and Gourinchas, 2016).

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) 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, more usually referred to as asset trade, between countries i and j). Therefore, the *degree of banking openness* for a country $i \in N$ will be defined as $DBO_i = \sum_{j \in N \setminus i} DBO_{ij} = (\sum_{j \in N \setminus i} X_{ij})/\widehat{X}_i$, where a value of 1 indicates absence of home bias.

3.2.2. 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 is not geographically neutral. The latter instance would contribute to widen the gap between the current level of banking integration and the financially globalized world scenario. Thus, we define the *degree of bank connectedness* to measure the discrepancy between the cross-border banking flows when frictions to asset trade exist, and those corresponding to a frictionless globalized banking network.

In this network, the asset trade between country i and country j in terms of country i's total assets, 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 cross-border banking flows—the component ij of matrix A is α_{ij}. If the banking systems are *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's banking system when country i's banking system is excluded. 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 when no frictions to financial trade exist, with $\beta_{ii} = 0$, and $B = (\beta_{ij})$ the square matrix of degrees of openness in this frictionless global banking network.

Considering the matrices A and B defined above, we construct an indicator that measures the distance between the observed asset trade among the countries in our sample and the scenario with no frictions to cross-border financial flows. To this end, we consider the cosine of the angle of the vector of relative cross-border financial transactions with the vector of cross-border financial transactions in the frictionless world, i.e., the inner product of those vectors. We call this the *degree of bank connectedness* of country i, DBC_i, and it is defined as $DBC_i = \sum_{j \in N} \alpha_{ij}\beta_{ij} / \left(\sqrt{\sum_{j \in N} \alpha_{ij}^2} \sqrt{\sum_{j \in N} \beta_{ij}^2} \right)$. A country's DBC is equal to 1 if the distribution of its cross-border financial transactions between the remaining countries in the sample is proportional to the weight of their banking systems. A value lower than 1 indicates that countries with relatively small banking systems receive higher financial flows than those corresponding to their size, and that countries with large banking systems receive lower flows than their size would predict.[2]

3.2.3. Degree of bank integration

From the above concepts we define the *degree of banking integration*, which combines degrees of banking openness and banking connectedness, 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 $DBI_i = \sqrt{DBO_i \cdot DBC_i}$. This is the geometric average of its deviation from the balanced degree of banking openness and banking connectedness. Therefore, DBI_i depends on both the openness of the banking system and the balance in its flows with other banking systems. Moreover, and interestingly, the (hypothetical) scenario of completely globalized banking network would be achieved when $DBI = 1$ and, therefore, deviations from this value would be measuring how far we are from the scenario in which banking systems achieve their full potential for integration.[3]

Therefore, our proposal to measure different aspects of banking integration, although not free from limitations, has several advantages, briefly summarized as follows: (i) the measure of connectedness is related to the increasing number of initiatives that have attempted to model the global banking network and different issues related to the connectedness of banking systems (Anand et al., 2015), inspired by the seminal work of Allen and Gale (2000); (ii) our measure of openness also takes into account that *de jure* integration might not necessarily imply *de facto* integration, as suggested by (Bekaert et al., 2013; Kalemli-Ozcan et al., 2013); (iii) it is based on quantities and, therefore, could be considered as a quantity counterpart to the Law of One Price (LOOP); (iv) it considers the existence of both direct and indirect links, which in the case of financial and banking integration are quite relevant due to the contagious capacity of the international banking network (Bicu and Candelon, 2013); (v) the measure of openness

[2]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's (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. (2011b) for further details.

[3]We acknowledge, however, that there are other ways to combine the indicators of openness and connectedness in a single indicator of integration and that the geometric mean is partly *ad hoc*. In addition it is more difficult to interpret than either openness or connectedness, because it is constructed synthetically. Despite these limitations, we consider it is appealing to derive an indicator of banking integration that reflects the literature revised in this section.

also takes into account the likely existence of home equity bias (Coeurdacier and Gourinchas, 2016); (vi) since the measure is bilateral, we obtain country-specific indicators of openness and connectedness, and it is possible to measure how far we are from a (hypothetical) scenario of international asset trade without frictions (Anderson and van Wincoop, 2004); (vii) our specific measure is designed for banking data, which played a critical role during the 2007/08 financial crisis (Garratt et al., 2014).

4. Empirical framework

4.1. 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 evaluating. However, there are so many theories that authors such as Brock and Durlauf (2001) have referred to this circumstance as *theory-openendedness*, which implies that while one theory might explain economic growth, other theories might simultaneously predict growth as well, which complicates the choice of the final set of variables to include in the estimations.

One of the most accepted models in empirical 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 the contribution by Mankiw et al. (1992), 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 seminal 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 widespread 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.

Another point of debate in the literature concerns the choice of dependent variable, which can be considered as growth rates (variation of GDP per capita) or GDP per capita in levels. These two alternatives measure different concepts. Whereas growth rates capture cyclical variations of GDP per capita, differentiating between slow-growing and fast-growing economies, the variable in levels reflects disparities in the development level, that is, differences between poor and rich countries (Osborne, 2006). Given that one of our research questions is whether the effects of banking integration differ with the stage of development, we consider the model in levels to be a more appropriate alternative. There are several contributions in the literature that consider income levels instead of growth rates. For example, the seminal study by Mankiw et al. (1992) included regressions in both growth rates and income levels. More recent contributions based on models in levels are Dearmon and Grier (2009), Bjørnskov and Méon (2013) and Peiró-Palomino and Tortosa-Ausina (2013); the latter paper also implements quantile regression techniques.[4]

We set alternative models. The most comprehensive one includes the Solow variables, additional controls, time and geographic fixed effects, and the banking integration indicators. Regarding the geographical dummies we consider six different areas: i) Southern European countries (Spain, Italy, Greece, Portugal) and Ireland;[5] 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.

Thus, the model to be estimated obeys 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 (in logs), Z_i 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

[4]It might be argued that separate regressions in growth rates for different groups of income levels could be an alternative. However, we prefer to keep the dependent in levels and consider the entire sample in all cases because one of the advantages of quantile regressions, explained in detail the following section, is precisely that they allow researchers to estimate different impacts for the entire range of quantiles of the dependent variable, with no need for arbitrary splits.

[5]Although Ireland is not geographically close to the rest of the countries in this group, we include it here because the strength of the initial impact of the financial crisis was similar to the other countries in the group.

estimated and ϵ_{it} is the error term.

4.2. Variables and data sources

4.2.1. Banking integration indicators

The information necessary to construct 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 information on 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 inevitably led 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.

The information is publicly available from the Bank for International Settlements web page. Unfortunately, the information is very detailed and demanding (the flows are bilateral) and we were therefore only able to gather complete information for 23 countries for the period under analysis. For many others, we could not gather information on assets they held in other countries (because this information is disaggregated), or on countries' assets owned by foreign banks, or for several of the sample years.

Column three in Table 1 clearly shows that the U.S. financial system is far less dominated by banks 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 reveal 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 represent 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).[6]

4.2.2. 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 ($GDPPC$) in our model is the logarithm of the GDP per capita in real terms (in 2005 dollars). 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) [7] and the returns to education (Psacharopoulos, 1994). In addition, we include a composite measure of institutional quality ($INSTIT$) provided by the World Bank (`http://www.worldbank.org/`) and constructed by considering the following six 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 development processes, similar to other *soft assets* such as human capital.[8] Data on this variable are borrowed from Bjørnskov and Méon (2013), who provide data on trust for a large sample of countries.[9]

We further augment this baseline model with our financial integration variables, 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

[6] BIS provides data on 23 countries but we did not include Finland due to the lack of homogeneity in its banking system data collection.

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

[8] 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.

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

(DBI), which is a combination of the two above-mentioned variables (see Section 3.2.3). Table 2 reports summary statistics for all the variables of interest. All three indicators of banking integration range in the $[0, 1]$ interval, with 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 have thin tails in their distributions.

5. Econometric techniques

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 (upper quantiles) countries. We start our description of the estimation method with the quantile regression model (QR model) for cross-section data, as introduced by Koenker and Bassett (1978); we then describe its extension for panel data considering Koenker's (2004) proposal.

Endogeneity is a common problem in both cross-section and panel data regressions due to multiple factors (measurement error, sample selection or, more generally, to relevant omitted variables) and leads to inconsistencies in OLS or QR model estimates. However, while in the context of OLS a considerable number of contributions address the endogeneity issue, for QR models the alternatives are still comparatively scant. For cross-section data with endogenous independent variables, Chernozhukov and Hansen (2005, 2008) developed a robust inference procedure for an instrumental variables QR model. This approach is extended by Harding and Lamarche (2009) to estimate panel data models using instrumental variables.

5.1. Quantile regression

The quantile regression model (QR model), introduced by Koenker and Bassett (1978), allows us to model the quantiles of the dependent variable conditioned to a linear function of the independent variables. Consider a cross-section model $y_i = \mathbf{x}_i'\boldsymbol{\beta} + u_i$ where y_i is the country i's dependent variable, $\mathbf{x}_i$ is the vector of independent variables and $\boldsymbol{\beta}$ is the vector of parameters. Then, given a quantile τ, the parameter estimates of the QR model are obtained by solving the following minimization problem,

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

where $\rho_\tau(u) = (\tau - I(u \leq 0))u$ is the quantile regression loss function, and the vector of parameters $\boldsymbol{\beta}$ depends on τ.

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 increase the variance of the estimations of the covariates. One solution consists of allowing the impact of the covariates be quantile-dependent, whereas the fixed effects are not.

Let us consider the model,

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

where y_{it} is the dependent variable for country i at period t, $\mathbf{z}$ is the the vector of individual effects and $\boldsymbol{\alpha}$ the fixed effects' vector of parameters.

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

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

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 solved with an exact algorithm. Koenker and Bassett (1978) provide an asymptotic expression for the covariance matrix of the estimates.

5.2. Instrumental panel data quantile regression

For cross-section data, in the setting of endogenous independent variables Chernozhukov and Hansen (2005, 2008) develop a model with instrumental variables in the presence of endogeneity along with a robust inference approach to partial or weak identification. The instrumental QR estimates are then obtained in two steps and their covariance matrix has a standard sandwich formula representation (see Chernozhukov and Hansen (2008) for further details).

Harding and Lamarche (2009) merge the two above extensions of the QR model (from cross-section data to panel data, and from exogeneity to endogeneity) to estimate covariate effects in a model with fixed effects and instrumental variables. To this end, they start from 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.

Let us consider the following model,

$$y_{it} = \mathbf{d}_{it}'\delta + \mathbf{x}_{it}'\boldsymbol{\beta} + \mathbf{z}_{it}'\boldsymbol{\alpha} + u_{it}, \qquad i = 1, \ldots, n;\ t = 1, \ldots, T \tag{5}$$

where $\mathbf{d}$ is a vector of endogenous variables, which is related to a vector of instrumental variables $\mathbf{w}$; $\mathbf{x}$ is a vector of exogenous variables, $\mathbf{z}$ is the the vector of individual fixed effects and u is the error term. Given a quantile τ, the objective function is

$$R(\tau, \delta, \boldsymbol{\beta}, \gamma, \boldsymbol{\alpha}) = \sum_{t=1}^{T}\sum_{i=1}^{n} \rho_\tau(y_{it} - \mathbf{d}_{it}'\delta - \mathbf{x}_{it}'\boldsymbol{\beta} - \mathbf{z}_{it}'\boldsymbol{\alpha} - \widehat{\mathbf{d}}_i'\gamma) \tag{6}$$

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

As in Chernozhukov and Hansen (2008), the instrumental QR estimates are then obtained in two steps. In the first step the estimations of $\boldsymbol{\beta}$, γ and $\boldsymbol{\alpha}$ are obtained as a functions of τ and δ, i.e.,

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

The second step, allows us to find an estimation of δ as a function of τ by looking for the value of δ that makes the instrumental variables' coefficients as close to zero as possible, i.e.,

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

where $\mathbf{A}(\tau)$ is a positive-definite matrix.[10]

Then, the parameter estimates are $(\widehat{\delta}(\tau), \widehat{\boldsymbol{\beta}}(\tau, \widehat{\delta}(\tau)), \widehat{\gamma}(\tau, \widehat{\delta}(\tau)), \widehat{\boldsymbol{\alpha}}(\tau, \widehat{\delta}(\tau)))$, whose covariance matrix has a standard sandwich formula representation (see Harding and Lamarche (2009) for further details).

[10] Chernozhukov and Hansen (2008) indicate that it is convenient to set $\mathbf{A}(\tau)$ equal to the inverse of the asymptotic covariance matrix of $\sqrt{Tn}(\widehat{\gamma}(\tau, \delta) - \gamma(\tau, \delta))$.

6. Empirical results

6.1. Evolution of the banking integration measures

Table 3 reports results for the DBI, for years 2003, 2007 and 2011. Whereas in 2003 most advanced economies were expanding at high rates, by 2007 the crisis had begun and financial contagion spread across financial and banking systems. Year 2011 is relevant as well, not only because it is the last year for which information is available but also because the financial crisis was still affecting most Western economies. The last three rows in Table 3 provide summary statistics. The average evolution is shown in Figure 1, where the weighted average is computed using the GDP of the countries.

However, despite the context of international economic and financial crisis, most countries' levels of banking integration increased implying that, although the financial crisis was affecting many countries, banking integration actually grew for most of them. This result, despite being based on very different instruments, largely coincides with some of the findings of Kleimeier et al. (2013a,b), who show that financial crises have "significantly positive and often long-lasting effects on cross-border banking." In spite of these general trends, there are several discrepancies among countries. Focusing on the first three columns of Table 3, for most of the countries the degree of banking integration has an inverse U-shaped trend. 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; it is also the case for some non-European countries such as Australia, Japan and Mexico. The banking integration process in the U.S. and United Kingdom seems more immune to the crisis, exhibiting a steady increasing trend. For the former, the DBI increased from 33.99% in 2003 to 50.24% in 2011, whereas for the latter DBI increased from 45.85% to 57.05%.

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.

Individual results for the degree of bank openness for each country are provided in columns 4 to 6 of Table 3. It shows that the degrees of bank openness are quite heterogeneous across countries. This is not surprising and coincides with previous studies such as Lane and Milesi-Ferretti (2008), who found that the degree of financial integration is higher for advanced economies. 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 also have low values in some years (e.g. Denmark and, to a lesser degree, Austria in 2003), these are usually exceptions and the evolution is positive. 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.

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% in 2003 to 15.46% in 2011), highlighting 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 the 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 more modest and mainly occurred during the first year of the crisis. Figure 2 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.

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 fell sharply from 2003 to 2011. This pattern is more clearly shown in the right panel of Figure 1. Although there were some ups and downs previous to 2007, the decline has been sharp since the start of the financial crisis. 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 trends are parallel.

Figure 2 displays the violin plots of DBC. They reveal some patterns that the evolution of the average conceals: first, although the mean, both weighted and unweighted, declined over the 2003–2011 period, this behavior was 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 was partly anticipated by the summary statistics reported at the bottom of Table 3, which include the values corresponding to the standard deviation that, in general, show an increasing trend when comparing 2003 and 2011.

The Pearson's correlation between DBO and DBC, equal to 0.264, highlights that openness and connectedness are quite different and complementary measures of integration. On the other hand, by definition DBI is correlated with both DBO and DBC, and more so with the indicator that exhibits a higher variance, DBO in our sample (see Table 3). The relationships between DBI and both DBO and DBC are provided in Figure 3. The left panel displays the scatter plot between DBI and DBO, where its regression line has been plotted, and shows the high Pearson's correlation between these two indicators (0.945). The right panel is a scatter plot between DBI and DBC, which also reveals also a relatively high correlation between them (0.493). These results preclude the inclusion of DBI, jointly with DBO and DBC, as an interaction effect in regression models because it could generate multicollinearity issues and yield non-valid estimations of the effects of the indicators in the response variable, which is actually our main interest.[11]

6.2. Banking integration and economic development

In this section we provide results on the role of banking integration on economic performance. As noted throughout the paper, the models 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 can investigate whether banking integration has different implications according to the GDP per capita level.

6.2.1. OLS estimates

We consider different model specifications where the Solow variables, the additional controls and the banking integration indicators are included sequentially. Specifically, 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 add time effects and regional effects to Models 3 and 4. In addition, since the economic recession might

[11] A more detailed description of the trends of the three indicators of banking integration during the analyzed period is available from the authors upon request.

have significantly affected GDP per capita levels in most countries after 2007, we performed a separated analysis with different time periods. First, we ran the models 1–6 for the whole period of analysis (2003–2011). Second, we ran 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 allowed us to analyze 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 4.1, 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. Yet when additional controls are included in Models 4 and 6, the coefficient for DBC becomes significant, although 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 generally behave as expected, although some signs change 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 are incorporated in Models 5 and 6, 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 with 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 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, 2003–2007 and 2008–2011. Note that the second subperiod corresponds to the crisis years. The sample was split 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 can be easily compared. In light of the results, the crisis years had a remarkable effect on 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 last three 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, this second component is responsible for the significant effect of DBI in the second subperiod, reinforcing our views on the need for more sophisticated measures of banking integration.

6.2.2. Quantile estimates

Analogously to the case of OLS estimations, we provide quantile regression results for Models 1–6, reported in Tables 6 (for the entire period) and 7 (for 2003–2007 and 2008–2011).

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, it varies remarkably for the different quantiles: it is much stronger for the relatively poorer countries. In addition, the discrepancies between the two tails of the distribution are, in general, the result of a monotonically decreasing trend. 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. This can be linked with the idea that the effects of financial integration on GDP might be nonlinear, and yield a larger impact in the less developed economies. Once a country reaches higher development levels, the marginal effect of being financially integrated diminishes.

These results might seem controversial when compared to previous findings in the literature considering neoclassical models, suggesting that financial development is more beneficial for growth in rich countries. However, they are not directly comparable, since growth is a flow variable that might be capturing only a transitory stage. For example, a country can be experiencing high growth but still be relatively poor. In addition, following the neoclassical paradigm the richest economies are precisely those with lower growth potential. In contrast, by using income levels in our regressions we are able to capture a more permanent effect of banking integration on development, showing that banking integration effects are higher for low-income countries, for which the neoclassical theory predicts more favorable growth perspectives. In any case, the overall results for banking integration might be explained by the different behavior of its two components, namely openness and connectedness.

Analogously to the analysis undertaken via OLS, we also provide disaggregated results in 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.

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.[12] Although the finding of an overall positive and significant impact of banking integration on per capita income holds, there are several subtleties worth mentioning. Specifically, the higher impact of banking integration (Model 5) for poor countries holds for the pre-crisis and crisis periods, although the magnitude is slightly lower in the latter for countries below the quantile $\tau = .10$. For the rest, however, 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. As a general conclusion, these results suggest that banking integration is more an opportunity than a drawback during crisis.

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 throughout (at the 1% level), and the stronger impact for poorer countries is a common result for both indicators. However, the diminishing impact is much

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

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. But during the crisis period, although the impact of 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 as well as pointing to the overall impact of banking integration on per capita income, they also suggest that, in times of crisis, for some countries it is more important to be more connected than more open. Therefore, it is essential to decompose banking integration into openness and connectedness is essential to fully understand its effects on development, and it might explain, at least in part, why there is no consensus in the literature regarding these effects. The role of connectedness seems particularly relevant, but comparison with previous contributions is not possible because this dimension has historically been overlooked.

As Brock and Durlauf (2001) state, one problem in growth models is identifying which variables to include in the analysis, and that some of them are outcomes of the economy's development (reverse causation). In our framework, banking integration drives development and, at the same time, development leads banking integration, so that the banking integration indicators in Models 1 to 6 could be correlated with their error term. We use the Wu-Hausman test to examine the possible existence of endogeneity. A rejection of the null hypothesis indicates that the correlation between the (potential) endogenous variables and the error term is nonzero. For Models 5 and 6, the p-values of the tests are 0.479 and 0.078. Therefore, we do not reject the null hypothesis for Model 5 and conclude that DBI is an exogenous variable. However, in Model 6 the p-value is close to the rejection threshold (0.05), thus caution is called for with regard to the endogeneity issues, and in order to control for the possible existence of endogeneity we also ran an instrumental variable estimation, following the methods presented in Section 5. Yet, despite their advantages, we still must choose appropriate instruments. This choice is particularly difficult in our context, since we are dealing with composed indicators of banking integration (made up of different components), which considerably complicates an already challenging task. The problem of instrument selection in growth equations was already acknowledged by Temple (1999), who suggested that when there is no 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 Dufrenot et al., 2010) is the one we follow. The instruments are therefore the lagged (one year) observations of the corresponding bank integration indicator.

We test for weak instruments with the first-stage F-statistics. The instrumentation is very strong, as indicated by the *p*-values for the weak instrument hypothesis test, lower than 0.0001 for both indicators, DBO and DBC. The results for Model 6 for the entire period are reported in Table 8. Results for the instrumented model are fairly robust. This robustness holds, in general, for both integration indicators considered DBO and DBC, as well as the different quantiles of the conditional distribution. We find some differences in quantitative terms for bank openness and bank connectedness, although results remain, in general, qualitatively unaltered.

7. Conclusions

Over the last twenty years international financial integration (or, more succinctly, financial globalization) has received a remarkable amount of attention from a variety of points of view—not only from 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 its relevance, relatively few initiatives deal explicitly with the issue of how to measure international financial integration and, in our case, international banking integration. Therefore, when analyzing the issue of 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, there is a large body of literature analyzing the finance-growth nexus, i.e., whether more financially developed economies grow faster. A related literature has examined whether the existence of trade agreements (which might be considered a form of trade integration) affects economic growth. However, there are virtually no studies that attempt to evaluate how banking integration (which is a particular type of economic integration) impacts on growth or development. Our paper has attempted to bridge this gap.

Specifically, in an attempt to measure bank integration more precisely, 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 initiative is important, since the common view is that the financial crisis was highly contagious due to the strong connections between banks in different countries. There is also an expanding 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. To do 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. In this way we can test the hypothesis of 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 non-negligible role, since the degree of bank openness is not significant for the 2008-2011 period (on average). The quantile regressions indicate that the average impact is concealing some interesting trends, since the effect 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.

Our results have several implications, from a variety of points of view. First, they show how important it is to consider different aspects of integration. Whereas the literature that measures either financial or banking integration has usually considered axiomatic criteria such as the Law of One Price, approaches based on quantities, which measure the *de facto* degree of integration, are much less common and more appropriate for measuring banking integration. Our measures are based on quantities and, in addition, they explicitly take into account the degree of connectedness of the banking systems, which has been increasingly considered by the literature due to the contagion effects that existed during the crisis. Second, evaluating how the different indicators (which measure different things) impact on openness, connectedness and integration is also challenging, since the effects for richer and poorer countries might be remarkably different. Third, we address the potential effect of endogeneity issues by considering state-of-the-art methodologies that combine instrumental variables with quantile regression.

Although the study has some limitations because our measures are particularly demanding (requiring bilateral information on cross-border bank flows), and due to the relatively short period for which we had information on all the countries in the sample, the findings are robust: regardless of the type of indicator considered (openness, connectedness or integration), the country's wealth, or the periood considered, the impact of integration on per capita income is always positive. This would suggest that, from an academic point of view, more research is needed that considers larger samples, longer periods and, given the growing importance of connectedness in the global banking network, more indicatores of financial and banking integration. However, from a policy-makers' point of view, the findings can also be helpful when weighing in possible political decisions that can have an impact on the country's degree of financial and/or banking integration.

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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

Type of variable	Variable	# of observations	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Dependent	*GDPPC*	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 estimates, 2003–2011

	Dependent variable: $GDPPC(logs)$					
	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 estimates, Models 5 and 6, subperiods (2003–2011, 2003–2007 and 2008–2011)

	Dependent variable: $GDPPC(logs)$					
	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: Quantile regression estimates, (2003–2011)

		Dependent variable: $GDPPC(logs)$				
		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: Quantile regression estimates, Models 5 and 6, pre-crisis (2003–2007) and crisis (2008–2011) years

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

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$
All models include control variables and fixed effects

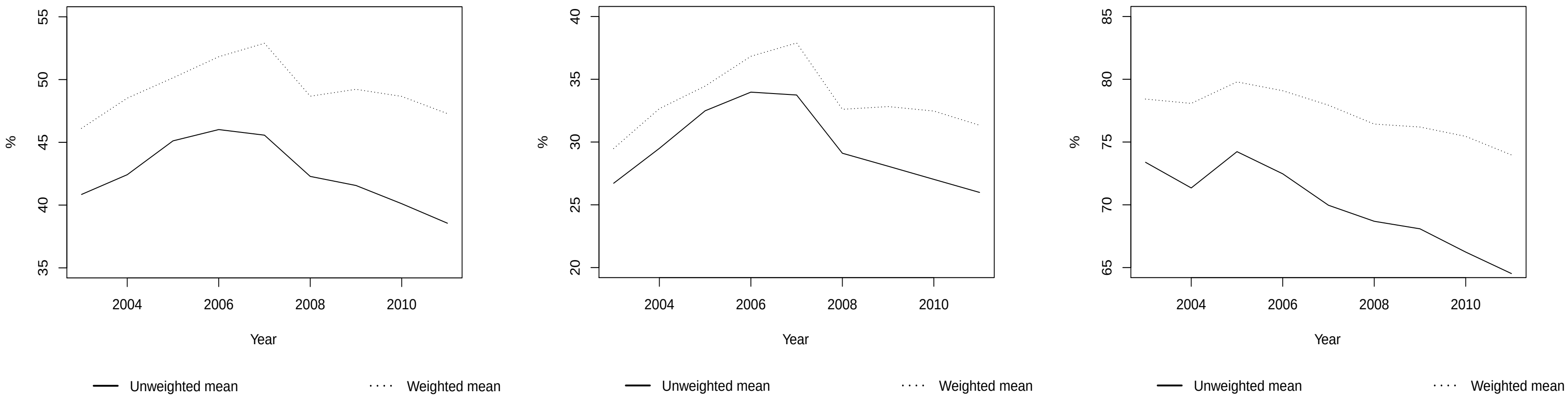
Table 8: Instrumental quantile regression estimates for Model 6, 2003–2011

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)

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

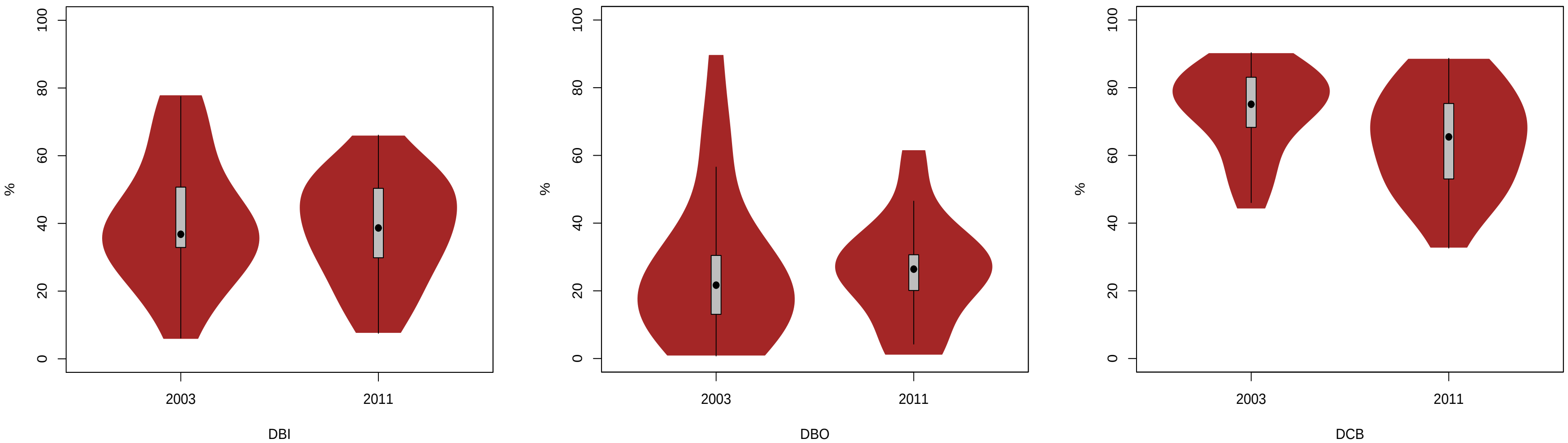
All models include control variables and fixed effects

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*

Figure 3: Degree of bank integration (DBI) vs. degree of bank openness (DBO) and degree of bank connectedness (DBC) (2003–2011)