What Is the Role of Size in Latin American Banks' Performance in Response to External Shocks?

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Abstract

Are there differences in the performance of Latin American banks when facing external financial shocks? Could larger size be associated with a better performance? The main results of this empirical study reveal that an adverse external shock allows larger sized banks to avoid reductions in deposits and improve their profitability. The increase in profitability takes place despite a temporary loss in operating efficiency and a generalized reduction in lending, meaning that it is attributable to non-intermediation activities. Such gains seem to partly occur in response to a better leveraging of local currency depreciations in investment strategies. Nevertheless, the improved profitability of large banks does not translate into greater stability. The external shock also induces greater accumulation of liquid assets and a reallocation of resources toward mortgage credit for large banks. One possible interpretation of results points to the need of refocusing the policy debate on the role of bank intermediation and the arrangements for encouraging it.

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1. INTRODUCTION

In the wake of the subprime mortgage crisis, one topic of interest in the debate has been the vulnerability of advanced and emerging financial markets to external shocks. Significant falls in credit, leverage, and profitability have been identified as some of the triggers of systemic financial instability in those markets (Demirgüc-Kunt et al., 2006; Adrian and Shin, 2010; Duttagupta and Cashin, 2011). Moreover, the assumption that large banks are subject to problems of moral hazard that distort their adherence to market discipline have highlighted the importance of analyzing how bank size might determine their performance during crises. Although this discussion is not new, the theoretical and empirical results of the related research have not been fully conclusive.

There is a substantial amount of literature linking financial stability to bank size. Some papers review how high bank concentration, possibly generated by the appearance of large banks, encourages greater risk taking by borrowers given the high-interest rates that tend to prevail in less competitive markets (Boyd and De Nicoló, 2005). It has also been argued that lower competition in banking markets leads to more bank defaults as a result of the reduced diversification in their portfolios, making those banks more vulnerable to market shocks (Anginer et al., 2014). In other cases, given the incentives that large banks face in regulatory and bailout frameworks due to the moral hazard issues, it is assumed that these banks make riskier investing decisions (Siegert and Willinson, 2015).[1]

[1] However, the literature does not completely dismiss the potential advantages associated with the coexistence of a few banks with large participations. It is possible to mention the arguments of Beck (2008) in favor of improved supervision and more diversified portfolios in markets where such entities predominate.

Another important part of the analysis has focused on the link between size and efficiency. A large proportion of the empirical evidence in this regard mentions the presence of economies of scale in large banks that reduce operating costs as the size of the business increases (Carvallo and Kasman, 2005; Wheelock and Wilson, 2012; Laeven et al., 2014). For Latin America, the recent work of Tabak et al. (2013) also establishes that size is important in explaining the efficiency and profitability of local banks. This viewpoint generally implies that large banks, by displaying greater operating efficiency, can therefore exhibit improved profitability (Berger et al., 1993) and lower credit risk by having better technologies available to monitor and control lending activities (Berger and DeYoung, 1997; Fiordelisi et al., 2011).

In Latin America, since the financial liberalization of the 1990s and the resulting appearance of larger and more complex entities (IMF, 2001), the debate on bank size has become particularly relevant. Our qualitative analysis of banks in the region shows how, in the last decade, large banks have on average been more efficient (with lower operating costs and intermediation margins), but have paradoxically allocated fewer resources to traditional intermediation, i. e., the proportion of assets allocated to loans is significantly lower in large banks then in midsize and small ones.[2]

More recent literature has studied banks' business models, paying particular attention to the type of revenues they receive or the type of funding they use. Demirgüc-Kunt and Huizinga (2010) assert that banks whose earnings rely on activities other than intermediation or on non-deposit funding exhibit greater instability. For Köhler (2015), specialization in non-traditional activities is also important for explaining instability, suggesting that investment banks' operations (such as brokerage and securitization activities that do not generate interest

[2] Details of the qualitative analysis can be found in the following section.

income) are the ones that make financial institutions become insolvent. Moreover, DeYoung and Torna (2013) proved that banks whose income mainly came from securities trading or handling high-risk assets had a higher probability of default during the mortgage crisis. Nevertheless, after the financial deregulation of the 1990s, these transactions have precisely been the ones that have allowed diversification in large banks with a broad customer portfolio (DeYoung and Rice, 2004). In this regard, Laeven et al. (2014) state that large banks tend to have less capital, less stable sources of funding and more market-based income. Those authors and Brunnermeier et al. (2012) add that the presence of large-sized banks can unleash greater systemic risk because their earnings are more exposed to financial asset price fluctuations.

Although the latter discussion has revolved around the debate on the role of large banks in explaining instability or systemic risk, little is known about how such banks respond in times of stress. That is, up to now there has been a fundamentally static view of how size is directly or indirectly related to certain variables of interest such as concentration or competition, efficiency, default probability and stability. This paper aims to fill this gap in the literature by asking, firstly in general terms, whether bank size differentiates bank performance during sudden changes in the external environment. In particular, we attempt to determine if larger size generates advantages in the dynamic performance of banks that allow for establishing macroprudential policy implications. Although the current state of the discussion appears to be still deliberating the pros and cons of the different findings associated with size, the presentation of empirical evidence on the dynamic dimension of adjustments to shocks offers another important perspective.

To properly answer the questions set forth, the empirical strategy consists of assessing different facets of bank performance in the region, among them stability, during common external shocks. In this way, we not only seek to define the adverse financial conditions that are important in the regional

environment, but also to obtain financial responses that have a common trigger and that are, therefore, not related to countries' conditions. Methodologically this allows us to focus on the analysis of the responses of financial entities according to size.

The most outstanding findings of the paper are that larger institutions manage to maintain their deposits and even increase their profitability, over a horizon of one year after the shock. Moreover, larger size does not prevent contractions in lending, as stylized facts on crisis describe. Given this increased profitability, the reduction in operating efficiency and the low sensitivity of interest margins to the external shock, large banks' higher earnings after the crisis do not seem to stem from intermediation. However, these larger profits do not translate into greater stability. In terms of their assets, the adverse external shock encourages large banks to increase their positions in liquid assets and mortgage loans.

The paper estimates a factor-augmented vector autoregression (FAVAR) model that combines US economic performance with macroeconomic and micro financial data from a significant part of Latin America. Based on said data, financial performance indicators were also constructed by banks' groups: *large*, *midsize* and *small banks*. Identification of the external shock captures the fact that during the mortgage crisis two related events were produced simultaneously: an increase in financial uncertainty and a generalized fall in commodities prices. The shock was identified using the sign restrictions approach developed by Canova and De Nicoló (2002) and Uhlig (2005). The model is structured in two blocks: the first is associated with the US macroeconomic dynamics; and the second relates to the evolution of regional financial systems. Both blocks are estimated simultaneously and attempt to reflect the strong endogeneity between the US economy, the variables defining the shock and Latin American variables.

The rest of the paper is structured as follows: Section 2 presents some descriptive considerations about regional banks according to their size. Section 3 justifies the definition of the

external shock and describes the model estimated. The data employed and some details of the estimation are outlined in Section 4. Section 5 analyzes the results obtained through impulse responses. A panel data estimation is performed in Section 6 to establish the impact of size on bank profitability. Finally, conclusions and some policy considerations are given in Section 7.

2. QUALITATIVE ANALYSIS OF THE REGION'S BANKS

This regional study considers a total of 72 banks belonging to different countries with available monthly data: Argentina, Colombia, Ecuador, Mexico, Peru and Venezuela.[3] On average, selected banks accounted for around 90% of national assets at year-end 2012 and privately owned banks, operating under the figure of commercial banks or multipurpose/universal banks, predominate (only three institutions are publicly owned).[4] The analyzed variables were constructed based on the balance sheet and financial statements published by said institutions, trying as far as possible to homogenize the definitions or items employed.

Selected banks are categorized according to size, based on the share each institution's average assets represent (in millions of United States dollars) of the region's total assets (given by the sum of average assets of all the banks included in the sample). The accumulated frequency distribution of the

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[3] Two important countries of the region, Brazil and Chile, were not included in the sample because their bank data is only available as of 2008 and 2009, respectively. Inclusion of these countries would mean reducing the time span of all the variables and leave 2005-2008 out of the sample. This is because calculation of principal components is carried out with complete time series. Moreover, given that the external shock is defined in line with what happened in 2008, reducing the sample size to include more countries does not seem appropriate.

[4] These banks, besides intermediation, offer other types of services that can include capital market activities, broking services, currency operations, among others.

Table 1

LATIN AMERICA: BANK SAMPLE CLASSIFICATION BY COUNTRY, 2005-2012

Number of entities and percentages

	Size			
Country	*Small*	*Midsize*	*Large*	*Total*
Argentina	7 (18)	6 (26)	1 (9)	14
Colombia	6 (16)	5 (22)	2 (18)	13
Ecuador	12 (32)	1 (4)	–	13
Mexico	1 (3)	4 (17)	7 (64)	12
Peru	4 (11)	3 (13)	1 (9)	8
Venezuela	8 (21)	4 (17)	–	12
Total	38 (100)	23 (100)	11 (100)	72

Note: Figures in parentheses correspond to percentage participation.

size variable was used to qualitatively establish the inflection points that determined the reference sizes for creating the three groups. Thus, a bank was classified as large if its assets account for above 2% of regional assets, midsize if equal to or above 0.55% and below 2%, and small if below 0.55 percent.[5]

A brief review of the sample (Table 1) shows that most selected countries add a very similar number of banks to the regional sample (between 12 and 14 banks), but the classification by size reveals an unequal structure across countries. Within large banks, which account for 67% of the region's assets, Mexico has 7 out of 11 institutions (64% of regional assets). Furthermore, within the 38 small banks, which account for 10% of

[5] The use of other grouping techniques, such as cluster analysis, provided unsatisfactory segmentations that only distinguished between the four largest banks and the other banks. Thus, the methodology used allowed for greater distinctions among smaller banks and for one category grouping the 11 largest banks .

regional assets, 20 are in Ecuador and Venezuela.[6] As for the origin of capital, 65% of the sample (47 out of 72 banks) are domestically owned.

What are the values of the main performance indicators by group? Did the 2008 crisis affect those indicators? The first approach to this information, summarized in Table 2, is that large banks in Latin America have exhibited significant differences from the rest of the institutions, both before and after the crisis, in terms of most of the selected variables. In particular, on average, large banks clearly have a lower interest margin than smaller ones, particularly after the crisis. The operating costs of large banks are also below those of other banks during both periods (approximately 3.5% of their assets). According to some authors, low costs and interest margins can be interpreted as indirect evidence for the advantages large banks possess for intermediation. That is, the combination of greater operating efficiency with a lower rate of return (margin) per intermediated unit allows them to be potentially more competitive in intermediation.[7] In terms of net income (ROA), no significant differences are observed compared to the other institutions.

Regarding the composition of assets, large banks tend to allocate less resources to intermediation through credit, while they allocate a significant portion to purchasing securities, especially before the crisis. Even after the crisis when this allocation became statistically more diffuse, these banks maintained a qualitatively similar asset structure. After the crisis, the marginal increase in the share of assets allocated to credit in detriment of securities, seems to have taken place through greater mortgage funding, which is statistically higher. Contrarily, although large banks seem to have increased their capitalization in years following the crisis (from 10.7% to 12.3%),

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[6] Although the composition of groups is not homogenous across countries, the model controls for the responses associated with specific countries and banks by using regional factors. In this way, the response of groups to external shocks is exclusively related to comovements among regional variables.

[7] Demirgüc-Kunt and Huizinga (1999).

Table 2

LATIN AMERICA: MAIN INDICATORS FOR AVERAGE BANK PERFORMANCE BY SIZE[1]

Period	*Stratum*	*Capital*	*Credit*	*Securities*	*Mortgage credit*[2]	*Net result*	*Financial margin*[3]	*Operating costs*
2005-2008	Small (%)	10.9	52.6	19.7	11.3	2.9	6.1	5.7
	Midsize (%)	9.4	51.1	22.3	9.3	2.0	6.1	5.5
	Large (%)	10.7	43.6	28.6	15.5	2.2	4.6	3.5
2009-2012	Small (%)	10.9	52.6	17.8	11.0	2.4	6.1	5.5
	Midsize (%)	10.0	55.0	18.5	13.1	2.8	7.6	5.7
	Large (%)	12.3	49.0	24.5	18.1	2.0	4.5	3.4
Comparison of means[4]	2005-2008	0.45	0.11[c]	0.11[c]	0.25	0.26	0.25	0.04[a]
	2009-2012	0.36	0.40	0.22	0.09[b]	0.47	0.05[a]	0.13[c]

[1] All indicators are calculated as a proportion of banks' assets, except for mortgage credit. [2] As a proportion of total credit. [3] The difference between financial income and disbursements. [4] Bonferroni corrected *p* values (H_0: no difference in means across groups). [a] 5%; [b] 10%; [c] 15 percent.

this difference is not confirmed statistically, which might indicate greater dispersion among sample results. Finally, in bank stability and liquidity terms, results for large banks are not statistically different from the averages exhibited by other banks before or after the crisis (Table A.1, Annex 1).

It is possible to extract two interpretations from the above characterization. On the one hand, smaller financial margins and lower costs in large banks could reflect greater efficiency and the presence of economies of scale in the intermediation of local banks, even during the years after the crisis. These economies of scale can be produced even though large banks tend to hold a major part of their assets in items other than credit. On the other hand, given that profitability is similar for all banks, higher intermediation margins attributable to midsize and small banks seem to be channeled to funding their higher operating costs. This characterization is in line with the recent work of Tabak et al. (2013), who establish that large banks have greater operating efficiency. However, this possible advantage for intermediation does not translate into higher average levels of profitability.

One important question is whether the differences that emerge in large banks could be associated with the origin of capital. Of the 11 large banks in the sample, 5 (45%) are foreign owned, while out of the 38 small banks, 12 (32%) are foreign owned, i. e., the share of foreign banks is higher among large ones, but the distribution between domestic and foreign tends to be equal among large banks. When distinguishing for domestic and foreign banks in the total sample, it is not possible to identify any significant statistical or qualitative differences between the averages of the different performance indicators analyzed above (see Table A.2, Annex 1). Nevertheless, when the same classification is used (domestic compared to foreign) for large and small banks some characteristics do stand out. This information is shown in Table 3.

Table 3

LATIN AMERICA: MAIN PERFORMANCE VARIABLES OF LARGE AND SMALL BANKS BY ORIGIN OF CAPITAL
Averages 2005-2012, in terms of assets

Stratum	*Origen*	*Capital*	*Credit*	*Securities*	*Mortgages*[1]	*Net income*	*Financial margin*	*Operating costs*	*Liquidity*[3]	*Stability*[4]
Large (%)	Domestic	12.5	50.8	23.8	13.0	2.1	4.5	3.7	6.1	38.9
	Foreign	10.4	40.8	29.9	19.1	2.1	4.6	3.2	3.1	37.0
Small (%)	Domestic	10.7	52.0	17.9	11.7	2.8	5.8	5.8	6.8	38.3
	Foreign	11.3	53.9	20.6	9.8	2.3	6.5	5.3	5.8	36.4
Comparison of means[2]	Large	0.41	0.19	0.36	0.43	0.92	0.92	0.51	0.36	0.84
	Small	0.75	0.66	0.53	0.62	0.53	0.31	0.58	0.70	0.75

[1] As a proportion of total credit. [2] Bonferroni corrected *p* values (H_0: no difference in means across groups). [3] Liquid reserves/deposits.
[4] Distance to default measured based on the Z-score.

Statistically, it continues to be true that none of the differences between group averages are significant, i. e., these indicators do not distinguish domestic from foreign banks or large banks from small banks. This result is probably influenced by the small sample size. However, there are greater qualitative differences between the two large bank groups than between the two small bank groups. In particular, it can be seen that among large banks foreign ones tend to have lower capitalization, allocate a smaller portion of assets to credit, a larger portion of assets to securities and a higher portion of lending to the real estate market. Such differences are compatible with the assertion that foreign banks' business management is different from that of domestic banks, just as suggested by Arena et al. (2007) and Claessens and Van Horen (2014). Furthermore, as these foreign banks are mostly represented in the stratum of large banks, it is possible that some of the latter's behavior is influenced by the presence of foreign banks. Nevertheless, this is a hypothesis for which we do not seek additional evidence.

The statistical measures described in this section are simple averages across banks and do not allow for distinguishing the causes of the adjustments observed in the indicators or their temporality. Below we perform the analysis based on a dynamic structural model. This model allow us to disentangle the temporary adjustment of banking indicators by size in response to common external shocks and to properly define the characteristics of the structural shock.

3. STRATEGY FOR IDENTIFYING THE EXTERNAL FINANCIAL SHOCK AND MODEL SPECIFICATION

To assess the different aspects of the performance of regional banks in response to common external shocks (not related to the local conditions in each country), it is necessary to start by defining the characteristics of such shock in the context of the model.

The definition of the external financial shock is based on two factors: one, the movements observed in variables associated

with the subprime crisis and, two, the findings in Pagliacci (2014). During the mortgage crisis, there was a sudden increase in the Chicago Board Options Exchange Market Volatility Index (VIX), widely considered in the literature as an appropriate proxy variable for financial uncertainty, that affected financial decisions worldwide (Bloom, 2009; Hakkio and Keeton, 2009; Jurado et al., 2015; Bekaert et al., 2013). Adler and Tovar (2014) suggest that the rise in financial uncertainty is associated with the sharp fall in commodities prices that affected the external trade of countries in the region. In more general terms, Pagliacci (2014) shows that US contractionary financial shocks, defined as a simultaneous increase in the VIX and a reduction in share prices, explain a significant part of long-lasting commodities price movements. Moreover, idiosyncratic commodities prices movements significantly affect regional (net) capital flows that can potentially have important repercussions on financial systems. These results point to considerable endogeneity (or double causality) between US stock market volatility and commodities prices and open the possibility for characterizing the external financial shock to the region as a simultaneous movement in those variables. This paper defines a contractionary external shock as the simultaneous occurrence of an increase in US financial volatility and a fall in commodities prices. Theoretically, the explanations for this endogeneity are found in the growing financialization of commodity future markets, as pointed out in Fatttouh, Kilian and Mahadeva (2013), which probably also ends up affecting the behavior of the spot market.

The above contractionary shock is defined within the context of a factor-augmented vector autoregression (FAVAR) model and is identified by imposing sign restrictions. The model is composed of two blocks that are estimated simultaneously using seemingly unrelated regressions (SUR). The first block can be characterized as a structural vector autoregressive (SVAR) model that describes US macroeconomic performance. The second block refers to a dynamic factor model (DFM) that allows for

describing the behavior of Latin American financial systems using a broad set of financial and macroeconomic variables. The shock is identified within the first block and is transmitted to the emerging block through the correlation of residuals and the specification of the model itself, which is explained below.

The variables describing the path over time of the US economy are represented by Z^{US} through a *VAR(q)*, rewritten as a *VAR(1)*:

$$Z_t^{US} = A^{US} Z_{t-1}^{US} + B^{US} Y_{t-1}^{RW} + e_t^{US}, \quad (1)$$

where $Z^{US} = \left[Y^{US} \quad P^{US} \quad MP^{US} \quad STK^{US} \quad VIX \quad PCM \right]'$ contains the variables for US real economic activity growth, US inflation, monetary stance indicator, S&P500 index growth, stock market volatility, and commodity prices growth (*PCM*).[8] The system includes economic activity from the rest of the world (Y^{RW}) as a control. A^{US} represents the coefficients of the system, and e^{US} the reduced form residuals, distributed normal and correlated. The second block describes a similar (approximated) factor model to that proposed by Forni et al. (2009), and Forni and Gambetti (2010) for characterizing a data vector X^{LA}, which is an $N \to \infty$ dimensional vector corresponding to macroeconomic and financial variables for the region. For each $t = 1, 2..., T$, variables contained in X^{LA} are expressed as a function of g latent factors F ($N >> g$) as follows:

$$X_t^{LA} = \Lambda F_t + \zeta_t, \quad (2)$$

$$F_t = A^{LA} F_{t-1} + C Z_{t-1}^{US} + B^{LA} Y_{t-1}^{RW} + e_t^{LA}, \quad (3)$$

being Λ the loading matrix ($N \times g$) that relates X^{LA} with F, and ζ are the idiosyncratic errors orthogonal to common components ΛF, which are weakly correlated. The dynamic process of factors in 3 is represented by a *VAR(1)*, incorporating two groups

[8] As Pagliacci (2014) states, the importance of US performance in the global economy justifies the endogeneity between commodities prices and the variables in Z^{US}.

of lagged variables: one proxy variable of economic activity from the rest of the world (Y^{RW}), and vector Z^{US}. The residuals from this block are represented in vector e^{LA}, which are distributed normal and are correlated. Both blocks are rewritten as one FAVAR type system:

$$Z_t = AZ_{t-1} + BY_{t-1}^{RW} + e_t, \quad (4)$$

where $Z = [(Z^{US} \quad F)]'$, A is a matrix that combines information A^{US}, A^{LA}, C, and several zero-restrictions;[9] B combines B^{US} and B^{LA}, and $e = [e^{US} e^{LA}]'$ is the vector of all reduced form residuals, distributed normally with variance Σ. Thus, all system residuals are potentially correlated.

This reduced form system can be associated with the structural model:

$$\Psi^{-1} Z_t = \Gamma Z_{t-1} + DY_{t-1}^{RW} + u_t, \quad (5)$$

where u refers to structural shocks of the system $A = \Psi\Gamma$, $B = \Psi D$ and $e = \Psi u$. Estimation of 4 is carried out in two steps. First, we estimate factors F through principal components of X^{LA}, according to the model in 2. Then we estimate system 4, assuming that factors are observable. Given the presence of zero restrictions in coefficients matrix A, we apply generalized least squares. Identification of structural shocks u is carried out using the sign restrictions technique proposed in Canova and De Nicoló (2002), and Uhlig (2005). Details on how to perform this identification are provided in Annex 2.

[9] The structure of matrix A considers that US variables only respond to their own behavior and not to that of regional variables, being $A = \begin{bmatrix} A^{US} & 0 \\ C & A^{LA} \end{bmatrix}$.

4. DATA AND ESTIMATION

Data for the US block were obtained using statistics from the Federal Reserve, while commodities prices come from the statistical compendium of the IMF. As in Pagliacci (2014), a synthetic measure of the stance of US monetary policy was included and obtained from the first principal component between the federal fund rate (conventional measure), assets purchased by the Federal Reserve as a proportion of the quantity of money in the economy (M2) (heterodox measure) and real liquidity growth (M2).[10] Similarly, the proxy variable for activity linked to the rest of the world was computed as the first principal component of the annual growth rate of industrial production indexes for a group of 31 advanced and emerging countries, excluding the US and members of the region.

The sample employed includes data for the period 2005-2012, a time frame chosen in terms of the availability of the series (T= 96). The matrix of regional data (X^{LA}) was constructed by including macroeconomic and micro financial variables. The combination of macroeconomic and financial data for calculating the factors is justified by the strong endogeneity between both types of variables. Moreover, the fact that these factors capture the comovement of both types of variables at regional level means that the common external shock can be methodologically interpreted as part of the explanation for such comovement. The use of regional factors tends to control for country specific and bank specific effects because they capture the total variance of the region's variables. In contrast, the idiosyncratic errors of Equation 2 tend to capture all the movements in variables associated with the specific conditions of a

[10] Although there are other ways to measure the US monetary policy stance, the composite variable used is not crucial for identifying the external shock. It is employed in an attempt to include important data on the US economy regarding its monetary policy to avoid the appearance of estimation bias due to the omission of important information.

country or a bank. Once the comovement of the region's variables (financial and macroeconomic) has been found through factors, we can determine what part of this comovement depends on the defined (common) external shock.

Macroeconomic variables include information from each country in the sample: real activity index, consumer price index, imports, exports, exchange rate, international reserves, interest rates, monetary aggregates and fiscal variables, obtained from central bank publications and expressed in annual log differences. With respect to financial information, data from 20 indicators commonly employed in bank analysis were considered for each bank in the sample (72 banks). This data includes: growth rates of main balance sheet items (total assets, liquid assets, credit and its components, securities, deposits, and capital); ratios of main variables in the income statement (implicit interest rates of the assets and liabilities, operating costs, global profitability); and the stability indicator (z-score) by bank. These variables were calculated for each bank included in the sample, making use of data from their financial statements, provided by the application SAIF. Moreover, in order to include measures that typify the behavior of institutions in the region by size, bank data is broadened with: *1)* the means of each variable for all banks, and *2)* the means by variable for each group of banks (large, midsize and small). As a result, matrix X^{LA} had column dimension N = 1,583.

Based on the structure of matrix X^{LA}, since $N > T$, the common factors in the Latin American block (F) were approximated as the g first principal components of the matrix, as stated in Bai and Ng (2002). The number of factors g was qualitatively chosen to ensure a selection of components that would produce stable impulse responses and reduce the volatility associated with the addition of new factors. Under these criteria, $g = 10$ was selected as the most appropriate dimension for the common components, which explain around 83% of the variance

in X^{LA}.[11] Once these factors had been selected, estimation of 4 was carried out using generalized least squares.

Sign restrictions for identifying the external shock were imposed for six consecutive months in order to guarantee that the identified shock had a sufficiently persistent impact on variables.

5. STRUCTURAL FAVAR RESULTS AND ANALYSIS

In this section, we show the main results of the paper. Impulse responses were generated using Equation 6 of Annex 2 for relevant financial variables (means by banks' groups). The rotation matrices that satisfy the restrictions imposed on the external shock (117 matrices out of the 2,000,000 *Qs* evaluated) were used to calculate the median path and upper and lower bands of impulse responses (50, 16 and 84 percentiles of accumulated responses).[12] These functions were computed for a 24-month horizon.

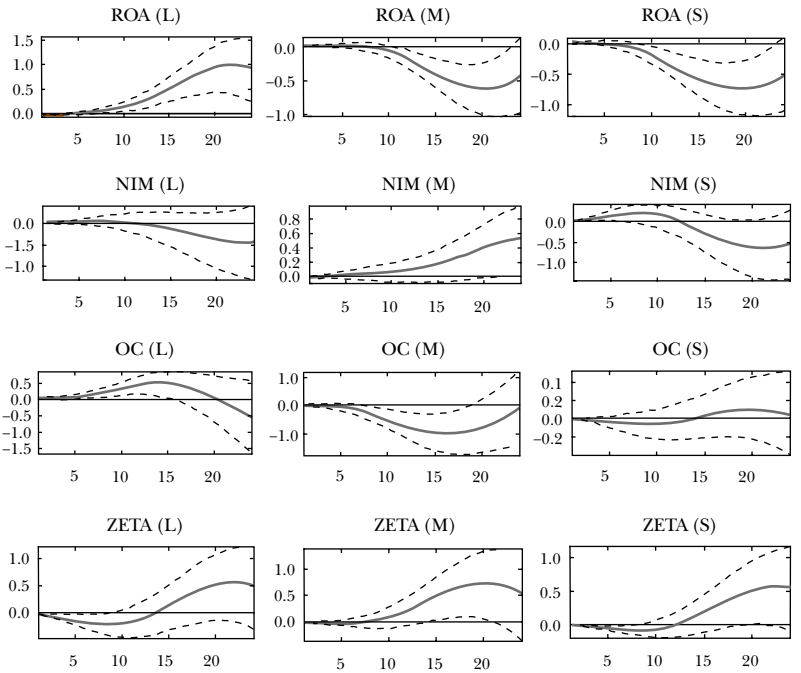
When evaluating results by size (Figure 1), it stands out that for several months after the contractionary external shock, the profitability (ROA) of large banks increases, while that of other banks declines. However, there are no significant increases

[11] A total of 7 to 12 X^{LA} factors were evaluated (between 77% and 85% of data variance). Considering a number less than 10 significantly altered the findings obtained, showing that a reduction in the components would lead to a substantial loss of information. Choosing 12 factors added negligible information that generated qualitatively similar responses with greater variance and, thereby, less significance.

[12] These bands capture uncertainty on different possible structural parameterizations that are consistent with reduced-form estimates of the model and that satisfy sign restrictions in the structural impulse responses. Following Bernanke et al. (2005), this uncertainty surrounding estimated factors is considered insignificant (given that $N > T$), and it is not included in these intervals. The size of the bands is also in line with available empirical works that identify shocks with sign restrictions.

Figure 1

BANKING IN LATIN AMERICA: CUMULATIVE IMPULSE RESPONSES TO A CONTRACTIVE EXTERNAL SHOCK BY SIZE (PROFITABILITY AND STABILITY)[1]



[1] The size of the shock corresponds to a standard deviation. The responses are expressed in the standardized units, where the dotted lines represent the lower and upper bands. Large banks: (L); medium banks: (M); small banks: (S). ROA: net result / asset; NIM = interest margin, defined as the difference between income and financial outlays as a proportion of assets; OC: operating expenses / assets; ZETA: z-score stability indicator, defined as the sum of ROA and capitalization, standardized by the changing volatility of ROA.

in the interest margin (NIM) of large banks, or reductions in their operating costs, which, on the contrary, temporarily increase. By construction, the growth in profitability can be broken down as follows: $\Delta ROA = \Delta NIM - \Delta OC + \Delta OtherNetIncome$, meaning that the increase in profitability of large banks seems to stem from an increase in other net inflows. That is, the higher revenues of large banks seem to have been obtained from activities not directly related to intermediation such as, for

instance, charging higher commissions for services or earnings associated with the purchase and sale of different types of assets. Due to limitations in the data, it is not possible to distinguish the source of these earnings. Nevertheless, it is clear that their importance becomes apparent after the episode of external stress.

For the other banks, profitability tends to decline during the year following the contractionary external shock. In the case of midsize banks, this reduction in profitability takes place despite marginally improved profits from intermediation (NIM) and lower operating costs (OC). That is, despite the efforts of these banks to increase their unitary profits and become more efficient, the decrease in profitability could not be prevented. This also implies that other net incomes of midsize banks must have fallen significantly, the opposite to what happened to large banks. For small banks, net income from intermediation (margin) seems to have risen slightly during several months after the shock, while operating costs do not appear to have changed. Thus, just like midsize banks, small banks also experienced lower profits in activities different from intermediation.

In terms of financial stability (ZETA), it can be seen that different patterns of profitability responses (ROA) do not have a direct influence on the behavior of stability. For large banks, the increase in ROA does not generate stability gains, while for the other banks the decrease does not have a negative impact on stability. In contrast, midsize and small banks can marginally increase their stability in periods of lower profitability. This implies that stability is highly determined by capitalization strategies, which will be assessed later in this section.

Figure 2 presents the overall results for banks' balance sheets. The first outstanding result is that, in the presence of the adverse external shock, credit (LOAN) granted by all banks' groups decreases considerably. This is in line with the idea that the external shock during the subprime mortgage crisis led to a substantial fall in lending, possibly as a result of the decline

in aggregate demand that took place in several countries of the region. However, this reduction in lending only translates into a decrease in assets (ASSET) in midsize and small banks. The counterpart to the reduction in assets is the decrease in deposits, particularly for small banks. Large banks, on the other hand, seem to increase their assets and deposits at the margin. This probably indicates that, after the crisis, rather than a reduction in countries' aggregate deposits, a reallocation of deposits from small banks to large ones could have occurred.

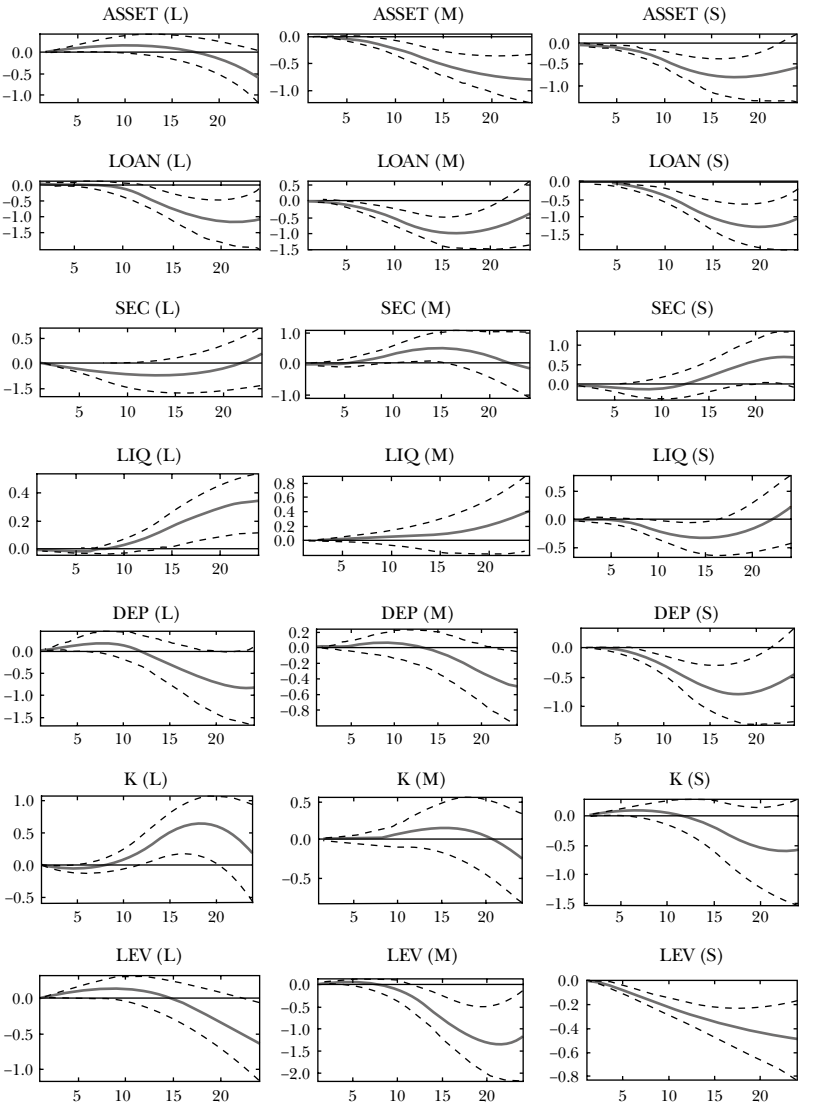
Comparing the behavior of credit with that of total assets, the reduction in midsize and small banks' lending is partly offset only by an increase in the holding of securities (SEC). However, in larger banks, the fall in lending is accompanied by a reduction in the holding of securities (SEC) and a significant accumulation of liquid assets (growth of LIQ).

The descriptive analysis in the previous section showed that before 2008 large banks tended to hold a greater portion of their assets in securities, approximately 10% more than the other banks. This difference declines after the crisis, even though large banks continue to hold a substantial part of their assets in securities. One possible hypothesis regarding the generation of earnings different from intermediation is assuming that large banks' profits were associated with a partial settlement of the securities portfolio, which is also observed in the reduction of SEC (Figure 2). These profits could have originated from two types of price movements: sovereign bond prices and relative prices of local currencies. On the one hand, after the initial fall of commodities prices in August 2008, starting in March 2009, government bond prices probably recovered sharply and along with them regional governments' funding conditions.[13]

[13] This statement is related to research that has found that terms of trade are negatively related to sovereign spreads, indicating that potential gains in countries' export tend to be coupled with increases in sovereign bond prices and consequently, spreads' reductions. Examples of this literature are Hilsher and Nosbusch (2010), and Acosta et al. (2015).

Figure 2

CUMULATIVE IMPULSE RESPONSES TO A CONTRACTIVE EXTERNAL SHOCK (BALANCE SHEET)[1]



[1] The size of the shock corresponds to a standard deviation. The responses are expressed in the standardized units, where the dotted lines represent the lower and upper bands. Large banks: (L); medium banks: (M); small banks: (S). ASSET: annual change in assets; LOAN: annual variation of credit; SEC: annual variation of securities; LIQ: reserves/deposits; DEP: annual variations of deposits; K: annual variation of capital; LEV: assets/capital.

Thus, the sale of securities in advantageous conditions could have contributed to the generation of these other net earnings. On the other hand, the depreciation of local currencies in the region, also after the external shock, could have encouraged the settlement of assets denominated in foreign currency to make profits in domestic currency. In this case, the explanation of earnings not related to intermediation would require assuming that large banks possess a greater amount of foreign currency denominated securities in their portfolios than the other banks. This is a hypothesis we cannot directly test due to a lack of information on the composition of assets according to their denomination. Nevertheless, Section 6 attempts to perform an indirect test of this hypothesis.

In both cases, the distribution of large banks' assets previous to the shock (less inclined towards credit and more dependent on securities) might have led to earnings not associated with intermediation.

As for the behavior of large banks' liquidity, this clearly differs from the performance of liquidity in other banks. Its growth is in line with the liquidity hoarding that tends to occur during periods of crisis or financial uncertainty, just as it is generally pointed out in banking literature. However, given that large banks potentially have a greater impact on domestic interbank markets, it can be assumed that this accumulation of liquidity could have explained redistributive tensions among banks during the external shock.[14] Attributing large banks' liquidity accumulation to the growth in deposits observed after the crisis it is another way to rationalize this phenomenon.

For the region, the general reduction in interest rates that took place after the external shock probably prevented the excessive liquidity accumulation of large banks from generating systemic repercussions. Nevertheless, it is possible that

[14] Acharya and Merrouche (2012) find that there were significant increases in interbank rates in the UK during the initial periods of the subprime crisis.

smaller banks' access to liquidity could have been compromised to some extent, although we do not have statistical data to prove this suspicion.

With respect to bank leverage (LEV), midsize and small banks are the ones that mostly reduce it after the contractionary external shock. This deleveraging is mainly explained by the reduction in assets that, in the case of small banks, seems to be caused by the fall in their deposits. This behavior of leverage, when accompanied by slower economic growth, is compatible with the financial procyclicality described by Adrian and Shin (2010). In the case of large banks, on the other hand, leverage initially rises slightly in response to the increase in their assets. Only after two years does a modest deleveraging take place, explained in this case by a significant expansion of capital.

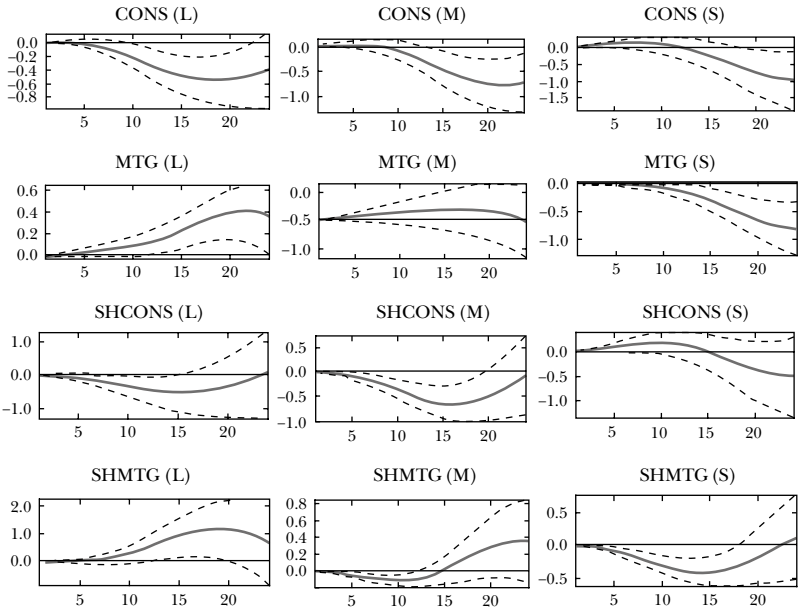
Large banks' capital accumulation one year after the shock can be understood in the context of the higher profits they obtain from activities other than intermediation.[15] Nevertheless, the fact that large banks tend to accumulate more capital than other banks can also be interpreted as indirect evidence for large banks' low capital holdings during normal times, as stated in Laeven et al. (2014) and Kasman et al. (2015). These low capitalization levels, which could be understood as capital levels very close to regulatory limits or as minimum buffers, must be compensated for at times of financial stress, making greater accumulation necessary during recessionary phases of the economic cycle.

As for the role of capitalization (the opposite of LEV) in the behavior of stability (ZETA), it would seem that higher capitalization ratios explain increased stability for midsize and small banks after two years. This rise in capitalization appears to originate from a reduction in balance sheet assets (ASSET) and not from a direct capital growth (K). For large banks, the decrease

[15] Cohen and Scatigna (2016) show that banks in emerging economies have used large portions of their higher earnings to build capital during periods following the crisis.

Figure 3

CUMULATIVE IMPULSE RESPONSES TO CONTRACTIVE EXTERNAL SHOCK (CREDIT COMPOSITION)[1]



[1] The size of the shock corresponds to a standard deviation.The responses are expressed in the standardized units, where the dotted lines represent the lower and upper bands. Large banks: (L); medium banks: (M); small banks: (S). CONS: annual variation of consumer credit; MTG: annual variation of mortgages; HSCONS: consumer credit/total credit; SHMTG: mortgages/total credit.

in capitalization during several months after the shock might also explain the decline in stability. Such behavior of stability could also originate from the increased volatility of bank earnings implied by higher ROA. The later recovery of stability in large banks appears to be associated with the capital accumulation in line with their higher profit margins.

Although we have pointed out that the fall in credit occurs for all three types of banks, its composition appears to differ according to size (Figure 3). While large banks raise their

mortgage credit position (MTG) and decrease their consumer loans (CONS), small banks show the opposite behavior. Considering that the macroeconomic environment in the region during 2009 and 2010 was characterized by slump in real activity, depreciations in domestic currencies and slack monetary policy, just as described by Pagliacci (2014), the increase in large banks' mortgage loans (MTG) can be understood as a result of these changes. In particular, loose monetary conditions, caused by reductions in policy rates, could have contributed to rising house prices. Moreover, adverse external conditions, such as the depreciation of domestic currencies, might have favored the increase in property prices, especially in dollarized market segments, as pointed out by Carvallo and Pagliacci (2016) for Venezuela. Such upward adjustments in regional house prices, clearly in the opposite direction to the change that took place in USA, could have foster a reallocation of resources towards the property market. In empirical terms, this phenomenon would be compatible with the increase in mortgage loans as a proportion of total lending (SHMTG), for large banks.

In sum, the above results allow us to deduce two lessons from the response of large banks to the contractionary external shock.

On the one hand, considering the adjustments in profitability, financial margin and operating costs, it can be concluded that the external shock induced higher profits from non-intermediation activities for large banks. This suggests that those banks have a business model oriented towards other activities rather than intermediation, just as suggested by recent literature. This potential specialization also helps explain why, in an environment of generalized credit contraction, only large institutions were able to turn changes in asset prices into profits.

However, the literature tends to point out that a nonconventional model for obtaining profits may encourage the appearance of additional risk factors during episodes of systemic instability. Thus, DeYoung and Rice (2004) state that banks

depending to a great extent on nontraditional income (such as investment or brokerage activities) increase the volatility of their earnings. Laeven et al. (2014) and Brunnermeier et al., (2012) show that greater exposure to fluctuations in the market value of the assets of these institutions possibly increase their default probabilities during the crisis, which would lead to greater systemic risk. For Latin America, we find that this potential specialization could have explained the use of strategies for generating profits after 2008 external crisis but, in fact, it also led to a slight decline in stability, measured with ZETA.

The other piece of empirical evidence this paper provides are the differences observed in the leverage and distribution of large banks' assets. After the crisis, only large banks did not clearly deleverage. This is partly connected with the reallocation of deposits towards those banks. Moreover, large banks tended to reduce security holdings, increase liquidity and reallocate lending towards the mortgage market, probably as part of a differentiated asset management strategy. There are no comparable studies on the distribution of different types of assets. However, some conjectures and their potential consequences could be extracted. On the one hand, the reallocation towards mortgage credit implies a greater exposure of large banks to fluctuations in real estate market prices. It is, therefore, reasonable to say that the latent risk associated with this market increases as the losses that could materialize during sudden falls in prices grow. This reallocation could also trigger more recessive macroeconomic conditions and more unstable financial systems, as shown in Jordá et al. (2016) in its historical understanding of the crisis and the role of mortgage credit. On the other hand, the accumulation of liquidity during times of stress can also lead to additional risks in domestic interbank markets, through interest rate premiums or frictions in the distribution of liquidity among agents.

6. A PANEL MODEL: HOW DOES SIZE AFFECT PROFITABILITY?

The previous section shows that a key variable in the performance of banks is profitability (ROA). Another way to compare the differentiated impact (according to bank size) of certain variables on profitability is by using a panel data regression. The model to be estimated is as follows:

$$ROA_{it} = \rho \sum_{k=1}^{3} ROA_{it-k} + \alpha \sum_{k=1}^{3} X_{it-k} + \beta M_{jt-l} + (\delta + \gamma * size) Z_{jt-l} + \varphi_i + \varepsilon_{it}, \quad (6)$$

where the level of current profitability is affected by past profitability. X represents the variables for bank i in period $t-k$ that affect profitability: the net interest margin (NIM) and operating costs (OC). The inclusion of these two variables aims to take into account the main components of profitability whose behavior was described in the previous section. Note that the part of profitability that is not explained by past ROA, NIM or OC attempts to register the part of profitability not related with intermediation activities. Some estimations consider the possibility that X also includes securities as a share of total assets (SHSEC) held by bank i in period $t-k$. M refers to j country variables that can influence profitability such as the real annual growth of economic activity (GDP) or inflation (PI), as stated by Albertazzi and Gambacorta (2009). Terms φ_i refer to banks' fixed effects and ε_{it} are regression errors related to different banks at each time-period. Z contains variables that are assumed to behave differently by bank type, i. e., Z coefficients allow for a nonlinear behavior with respect to size (SIZE). In particular, Z contains external variables, such as the level of volatility of the S&P500 index (VIX) and the annual growth rate of commodities prices (PCM), as well as the annual depreciation (DEP) of countries' currencies. The inclusion of depreciation rates tries to identify to what extent the behavior of non-interest earnings could be related to foreign currency assets' portfolio management for the largest banks.

Given that variables in *X*, *M* and DEP can be considered endogenous with respect to ROA, all these variables are included with lags. Moreover, a two-step estimation that uses instruments in the first step is carried out.[16] PCM and VIX variables are also used with lags, but serve as instruments for the other variables. Given that sufficient lags are included for bank variables, it is assumed that regression residuals can be correlated across banks, but do not exhibit serial correlation (cross section SUR). This implies that in the second step of the estimation we use generalized least squares to include the structure of residuals in the estimation of parameter values. This is equivalent to carrying out estimations using generalized method of moments. A total of three variations of model 6 are estimated. Results from estimations are shown in Annex 3.

Main results of the estimations of regression model 6 can be summarized as follows:

- There are differentiated effects of size on the portion of profitability that is not related to intermediation. These effects are summarized in Table 4.
- Higher real economic growth in countries tends to generate greater profitability, while higher inflation tends to produce a lower profitability.
- An increase in interest margin tends to raise profitability, while an increase in operating costs tends to reduce it. A settlement of securities that leads to a decrease in their proportion of total assets generates an increase in profitability.

As for non-linear effects (by size) on profitability, Table 4 shows intervals that reflect the variability (according to the three models estimated in Annex 3) of average effects different variables have on profitability. This Table illustrates that large banks are see their profitability reduced in response to an increasing volatility in the US stock market. A contraction in commodities prices also implies larger losses in profitability for

[16] The use of instruments also attempts to deal with the potential endogeneity of the lagged dependent variable that emerges in panel structured data. However, this problem is more obvious in panels with many individuals and few temporary observations.

Table 4

AVERAGE PROFITABILITY RESPONSES TO VARIATIONS IN VARIABLES BY BANK TYPE

	Large banks	*Midsize banks*	*Small banks*
Increase of one VIX unit	(–9.1E–05; –1.8E–04)	(2.1E–05; 3.4E–05)	(3.7E–05; 6.7E–05)
Annual growth of 100% of the PCM	(0.023; 0.053)	(0.003; 0.005)	(–0.0004; 0.0005)
Annual depreciation of 100%	(0.09; 0.17)	(0; 0.02)	(–0.02; 0.01)

larger banks. The greater sensitivity of large banks to changes in external variables (VIX and PCM) could be associated with the larger connections such banks typically have with international markets.[17] Viewed separately, these two results suggest that changes in the external environment would affect large banks more adversely than other banks.

However, large banks' potential losses, which are directly attributable to the international environment, are offset by earnings associated with domestic currency depreciations. Thus, although all banks might earn income from depreciations, large banks obtain much more earnings per percentage point of depreciation than their domestic peers. With this evidence, the hypothesis that large banks' earnings not related to intermediation could be linked to the sale of foreign currency assets becomes more relevant. In this case, the origin of earnings would be specifically connected to initial greater availability of foreign currency securities or to a greater leverage of domestic currency depreciation rates. However, in general terms, this description might also suggest a possible advantage or specialization of large banks in investment strategies.

[17] These connections can also originate from a greater share of foreign capital in large banks, as highlighted in Section 2.

7. CONCLUSIONS AND POLICY CONSIDERATIONS

Two important results are obtained from the construction of an econometric model that assesses the response of the region's banks to a negative external shock. First, large banks exhibit higher profitability after the external shock, possibly as a result of greater specialization in activities other than intermediation. In particular, such activities appear to be related to the application of better investment strategies that take advantage of domestic currency depreciations . These profitability gains did not, however, translate into stability gains. Second, the shock and the resulting macroeconomic conditions led to a reallocation of large banks' assets towards liquid assets and mortgage credit.

The potential consequences of such asset reallocation appear to be contingent, depending on the future occurrence of significant falls in domestic housing markets or interbank liquidity shortages. Nevertheless, the ability shown by large banks to obtain higher earnings that are not strictly related to intermediation could be interpreted in two ways.

On the one hand, the generation of greater profits in times of external stress could be interpreted as evidence for a greater adaptability of large banks. Nevertheless, we do not strictly know if the results obtained are tied to the particular mix of asset price changes resulting from the external shock or if they can be extrapolated to other situations of external stress. On the other hand, the fact that large banks have not translated higher profitability into greater stability shows that higher profitability could be the expression of increased volatility in earnings, which works against financial stability over the long term, as suggested by DeYoung and Rice (2004).

Thus, strictly based on the evidence above, it is very difficult to reach a definitive conclusion about the contribution of large banks to systemic financial risk. It is also hard to justify the need for imposing macroprudential regulations explicitly aimed at limiting the size of institutions.

One aspect, however, that is implicit in the considerations about the empirical evidence is the possible specialization of large banks in other activities rather than intermediation. Moreover, the qualitative evidence described at the beginning of the paper appears to suggest that credit intermediation is relatively smaller in larger banks. Thus, as suggested by Stiglitz (2015), one possible policy consideration would revolve around discussing the importance of credit for the real economy and the guidelines required to encourage it.

In contrast to this idea, the discussion and application of financial markets regulatory frameworks in the US and Europe have been carried out in terms of limiting the scope of securities trading inside traditional banks.[18] These arrangements have mainly been based on controlling activities exposed to market risk (such as the Vicken proposal), avoiding bank overspecialization in investment activities or preventing their migration to unregulated market segments (such as the cross-subsidization of Liikanen).[19] Nevertheless, application of this type of regulation in Latin America is not necessarily appropriate, especially if the considerable heterogeneity of the region in financial development and complexity is taken into account.

It is therefore important to continue seeking more specific answers for the region with respect to the precise nature of the operations large banks carry out, and which institutional or domestic factors ultimately discourage the development of more vigorous intermediation. Although the business of intermediation depends on the booms and busts of the economic cycle, it is also possible to think about arrangements that make it more resilient to these ups and downs, and thereby transform intermediation into a true buffer that minimizes short-term fluctuations in real economic activity.

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[18] In particular, the benchmarks of the regulation are summarized in the US Financial Systems Modernization Act 2010 (the Volcker rule); the proposals of the UK Independent Commission on Banking 2013 (Vickers report); and the 2012 Liikanen proposal for the European Union.

[19] A comparison of such regulatory reforms can be found in Gambacorta and Van Rixtel (2013).

Annex 1

Table A.1

LATIN AMERICA: PERFORMANCE VARIABLES FOR BANKS BY SIZE
Averages, in terms of assets

Period	Stratum	Liquidity[1]	Stability[2]
2005-2008	Small	6.9%	29.1
	Medium	7.3%	33.0
	Large	4.4%	30.9
2009-2012	Small	6.1%	46.4
	Medium	9.2%	43.9
	Large	5.0%	45.2
Comparison of means[3]	2005-2008	0.62	0.59
	2009-2012	0.22	0.93

[1] Liquid reserves/deposits in percent. [2] Measured by Z-score. [3] Bonferroni corrected *p* values (H_0: no difference in means across groups).

Table A.2

LATIN AMERICA: PERFORMANCE VARIABLES FOR BANKS BY ORIGIN OF CAPITAL
Average in terms of assets

Period	*Stratum*	*Capital*	*Credit*	*Securities*	*Mortgages*[1]	*Net income*	*Interest margin*	*Operating costs*	*Liquidity*[3]	*Stability*[4]
2005-2008	National (%)	10.3	49.9	21.9	11.0	2.7	5.9	5.5	6.4	31.8
	Foreign (%)	10.6	52.3	21.8	13.0	2.1	5.7	4.8	7.0	28.3
2009-2012	National (%)	10.8	52.9	18.7	11.7	2.4	6.4	5.5	6.2	44.8
	Foreign (%)	10.9	52.5	19.8	15.6	2.6	6.2	4.9	8.4	46.5
Comparison of means[2]	2005-2008	0.81	0.46	0.97	0.47	0.20	0.67	0.25	0.77	0.33
	2009-2012	0.89	0.89	0.70	0.15	0.74	0.83	0.46	0.25	0.78

[1]As a proportion of total loans. [2] Bonferroni corrected *p* values (H_0: i no difference in means across groups). [3] Liquid reserves / deposits.
[4]Measured by Z-score.

Annex 2

Identification of Shocks Using Sign Restrictions

The process of identifying shocks using the specification in 4 starts with the orthogonalization of residuals e_t, which involves finding a matrix $\hat{V}$ that decomposes its covariance matrix (Σ) such that $\hat{\Sigma} = \hat{V}\hat{V}'$. This matrix is obtained using the Cholesky decomposition of Σ. With this information, it possible to find orthogonal errors through $\hat{\varepsilon}_t = \hat{V}^{-1} e_t$, being ε a vector of non-structural orthogonal residuals, without interpretation. If it is also assumed that these orthogonal residuals are linked to structural errors by the rotation matrix Q (that satisfies $QQ' = I$ and $Q'Q = I$) and $\varepsilon_t = Q u_t$, the responses of variables Z to shocks u for horizon h is given by:

A1
$$I\hat{R}Z(h) = \hat{A}^{h-1}\hat{V}Q\,.$$

Producing equivalents $e_t = \hat{V}Q\,u_t$ and $\Psi = \hat{V}Q$. This representation A1 allows orthogonal shocks to be identified based on the expected effects on observable variables in Z, in particular PCM and VIX. Thus, sign restriction identification involves selecting the matrices Q that satisfy the expected signs in the IR of Z variables for structural shocks.[20] Since Z contains factors, the reactions of Latin American financial variables are given by:

A2
$$I\hat{R}X^{LA}(h) = \Lambda IRF(h)\,,$$

where Λ is the matrix of loads, which transmit movements of the *g principal* components F to X^{LA}.

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[20] According to Rubio, Waggoner and Zha (2001), the Q matrices can be obtained from applying the QR decomposition to a uniform random matrix. Moreover, to ensure that the identification of the external shock only employs information coming from the first block of the model, we impose that rotation matrices comply to the form $Q = \begin{bmatrix} Q_1 & 0 \\ 0 & Q_2 \end{bmatrix}$, where Q_1 and Q_2 are square matrices with dimension equal to the rank of Z^{US} and F respectively, that satisfy $Q_1'Q_1 = I$, $Q_2'Q_2 = I$.

Annex 3

Data Panel Regressions for Profitability (ROA)

Dependent variable Variable: ROA.

Representative samples: 72
Periods: 92
Total observations: 6,624

Representative sample SUR (PCSE) standard errors and covariance (corrected d.f.)

	Model 1		*Model 2*		*Model 3*	
Instruments	d(X) size VIX PCM		d(X) size VIX PCM		d(X) size VIX PCM	
	Coefficient		Coefficient		Coefficient	
C	0.000		0.003	*	0.008	*
ROA(–1)	0.700	*	0.735	*	0.734	*
ROA(–2)	0.060	*	0.060	*	0.046	*
ROA(–3)	0.004		0.005		–0.003	
MRG(–1)	–0.050	*	–0.063	*	–0.003	
MRG(–2)	0.050	*	0.044	*	0.052	*
MRG(–3)	0.053	*	0.048	*	0.060	*
Oc(–1)	0.032	*	0.028	*	0.004	
OC(–2)	–0.005		0.004		0.004	
OC(–3)	–0.036	*	–0.042	*	–0.059	*
SHSEC(–1)			–0.007	*	–0.012	*
SHSEC(–2)			0.006	*	0.005	*
SHSEC(–3)			–0.008	*	–0.007	*
VIX(–2)	0.000	*	0.000	*	0.000	*
SIZE*VIX(–2)	–0.002	*	–0.002	*	–0.004	*
PCOM(–3)	–0.001		–0.001		–0.007	*
SIZE*PCOM(–3)	0.563	*	0.448	*	1.021	*
DEP(–3)	0.006	*	0.008	*	–0.029	*
SIZE*DEP(–3)	1.782	*	1.395	*	3.295	*
GDP(–3)	0.021	*	0.027	*		
PI(–3)					–0.051	*

Fixed effects by bank (fictitious variables)

	Weighted statistical measures		
R squared	0.991725	0.988643	0.987208
Adjusted R squared	0.991615	0.988486	0.987032
Standard error of the regression	1.0491	1.020035	1.009836
Durbin-Watson statistic	1.757717	1.888866	1.931095
Instrument range	89	92	92
J statistic	0.028785	0.053543	0.069769
Prob (statistical measure of J)	0.865276	0.817009	0.791674
	Unweighted statistical measures		
R squared	0.889838	0.893083	0.865687
Durbin-Watson statistic	1.660277	1.759149	1.472502

* Coefficients with *p* values below 0.05.

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