Journal of International Money and Finance 30 (2011) 1034–1054

Contents lists available at ScienceDirect

Journal of International Money and Finance

journal homepage: www.elsevier.com/locate/jimf

Consolidation in banking and the lending channel of monetary transmission: Evidence from Asia and Latin America

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JEL classification:
E4
E5
G21

Keywords:
Banking consolidation
Bank lending channel
Monetary policy transmission

A B S T R A C T

This paper examines the relationship between increased consolidation in banking and monetary policy transmission in eighteen Asian and Latin American economies, using bank-level data from 1996 to 2006. Our results provide consistent evidence that as concentration in banking increases, the bank lending channel is weakened, leading the monetary policy transmission mechanism to be less effective. We also investigate how this relationship between concentration and the strength of the lending channel depends on bank-specific characteristics. Using bank-level balance sheet and income statement data allows us, first, to better identify the effects of banking consolidation on the *supply-side* bank lending channel from those of the *demand-side* interest rate channel, and second, to test for any systematic differences in the impact of consolidation on monetary policy transmission across banks of different size and financial strength. We also discuss potential explanations for and policy implications of the main findings of this paper.

1. Introduction

A significant increase in consolidation in the banking industry has been one of the important characteristics of financial development in emerging economies in recent years. For example, the five-

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doi:10.1016/j.jimonfin.2011.06.006

firm concentration ratio, defined as the share of total assets held by the five largest banks in the industry, increased from 0.42 in 1996 to 0.7 in 2006 in Brazil; from 0.61 to 0.76 in Chile; from 0.73 to 0.85 in Mexico; from 0.44 to 0.75 in Hong Kong; from 0.49 to 0.62 in Indonesia; and from 0.51 to 0.8 in Korea. We have seen this trend of increased banking consolidation hold true for the developed world as well. The recent 2007–9 financial crises in the United States and Europe have also been leading to important increases in banking consolidation.

A topic of special interest to researchers, bankers and policy makers has been whether this financial sector consolidation can affect the environment in which monetary policy decisions are made, and how its effects are transmitted to the rest of the economy (see "Report on Consolidation in the Financial Sector," Group of Ten, 2001). Despite the importance of this topic, little research has been done on the relationship between consolidation in banking and the sensitivity of bank lending to changes in monetary policy, especially at a global scale.

In this paper, we start filling this gap by studying the role played by increased consolidation in banking on the effectiveness of monetary policy. We focus on the bank lending channel as the monetary policy transmission mechanism. Our goal is to study whether consolidation in banking amplifies or reduces the impact of monetary policy shocks on bank lending. Moreover, we use bank-level data to study this issue at a global scale, with a specific focus on emerging and developing economies in Asia and Latin America. Using bank-level data allows us to contribute to the literature in two ways. First, we can better identify the effects of banking consolidation on lending of the *supply-side* bank lending channel from those of the *demand-side* interest rate channel. Second, we test for any systematic differences in the impact of consolidation in banking on monetary policy transmission across banks of different size and financial strength.

Banks play a special role in transmitting the effects of monetary policy through the bank lending channel. If after a monetary policy contraction banks cannot costlessly resort to non-deposit funding to offset the implied reduction in reserves, then they are forced to cut back their loan supply. They do so with a varying degree depending on financial strength of each individual bank (see Bernanke and Blinder (1988), Kashyap et al. (1993), Bernanke and Gertler (1995), and Kashyap and Stein (1995, 2000), among others). This reduced loan supply raises the cost of credit for bank-dependent firms, and negatively impacts real economic activity. Investment, employment and output are all negatively affected if borrowers are not able to resort to capital markets as an alternative. This bank lending channel of monetary policy transmission works on the supply side of the market for loans, amplifying the traditional demand-side interest rate channel.

There are several ways in which consolidation in the banking sector can have an impact on the effectiveness of the bank lending channel as a transmission mechanism of monetary policy.

First, consolidation raises the market share held by large banks. Lending by these banks is typically less sensitive to monetary policy shocks than lending by smaller institutions.[1] Therefore, consolidation can weaken the bank lending channel of monetary policy transmission.

Second, consolidation often leads to larger and potentially healthier banks. Larger banks often acquire smaller and weaker ones which do not have access to the same funding sources as larger banks. This consolidation process should improve access to alternative sources of funds for the banking sector as a whole, so that it is able to partially isolate the supply of credit from negative shocks to reserves.[2] Through this effect, consolidation can weaken monetary policy transmission through the bank lending channel.

Third, if increased consolidation reduces competition in the interbank market, some banks might try to exploit their larger market power or greater knowledge of liquidity conditions. This can in turn lead to higher costs of liquidity for other market participants. Higher costs of liquidity make it more difficult for

[1] It is well accepted that banks of different size respond differently to monetary shocks. This happens mainly for two reasons. First, small banks often have simpler capital structures and finance their loans mostly through transaction and savings deposits. When the money supply shrinks, these less liquid banks are not able to maintain their loan supply by resorting to alternative sources of funding for loans, such as cash or securities. Second, smaller banks have larger costs of dealing with the informational asymmetries involved in raising uninsured funds to finance their lending (see Peltzman (1969)).

[2] It is well accepted that less capitalized banks find it more difficult to obtain funding through capital markets to protect their loan portfolios (see Kashyap and Stein (1995, 2000), Favero et al. (1999) and Kishan and Opiela (2000), among others).

banks to isolate their supply of loans from the adverse shock to their reserves arising from a negative monetary shock. Therefore, this potential impact of consolidation on the cost of liquidity for non-consolidated banks can strengthen the bank lending channel.[3] Fourth, increased consolidation can result in larger banks with an informational monopoly over their customers' creditworthiness, and therefore, in higher switching costs for borrowers. Then, with firms finding it more costly to switch lenders, the excess demand left by small banks (those that are more severely affected by a contractionary monetary policy) cannot be picked up by large banks (those that are better able to protect their loan supply from the adverse shock). This could reinforce the effects of a given reduction in the supply of credit on economic activity, and strengthen the bank lending channel of monetary policy transmission.[4]

It is not clear which of these effects dominates. Therefore, consolidation in the banking industry could amplify or reduce the impact of a given change in the policy interest rate on economic activity. In short, consolidation could either strengthen or weaken the bank lending channel as the transmission mechanism of monetary policy. An empirical assessment of this impact is of particular interest at a time when the world financial crisis has been forcing significant consolidation in banking, while monetary policy is being heavily used for the bailout from financial turmoil and recessions around the world.

To examine the impact of consolidation on the monetary policy transmission mechanism, we use annual bank-level balance sheet and income statement data for banks in eighteen Asian and Latin American economies for the period 1996–2006.[5]

Our paper is closely related to Adams and Amel (2011) who study the role of market structure on small business lending in the United States, finding evidence that market concentration weakens the bank lending channel. There are two fundamental ways in which our work differs from Adams and Amel (2011). First, they use aggregate bank data on small business lending at the local market level, while we use bank-level data.[6] This allows us to contribute to the literature in the two ways mentioned above. Second, they focus on small business lending in the United States, while we seek evidence in a sample of Asian and Latin American countries. To our knowledge, very little research exists on this topic for these countries. It is especially relevant to study this issue in these countries since many of them have experienced significantly increased market concentration as well as other dramatic changes in the structure of their banking sectors, especially after the financial and banking crises of the last decade.[7] Also, after the crises some of these countries abandoned their currency pegs and moved to flexible exchange rate regimes, regaining monetary policy as a relevant tool for macroeconomic adjustments and control.[8]

Also related to our work is Cottarelli and Kourelis (1994) who study the relationship between market concentration in banking and the effects of monetary policy. However, they focus on the interest rate channel of monetary policy transmission as opposed to the bank lending channel that we study here.

Our results show that monetary policy becomes less effective as concentration in banking increases; that this concentration-lending channel link is robust across alternative banking consolidation

[3] See the Group of Ten (2001) report for a discussion of this argument.

[4] Klemperer (1995) summarizes the theoretical literature on switching costs, and Northcott (2004) discusses how the presence of switching costs affects market structure and contestability in the banking industry. Olivero and Yuan (2010) study the effects of switching costs in banking on the transmission of monetary policy. Also, Greenbaum et al. (1989) and Kim et al. (2003) provide theoretical models of switching costs in banking. Several empirical papers document the importance of switching costs in the banking industry (see Hubbard et al. (2002), Shy (2002), Santos and Winton (2008) and Hale and Santos (2009), among others). Santos and Winton (2008) use micro loan data and find that bank-dependent firms without accessibility to public debt markets pay significantly higher loan rates than those firms with the accessibility, implying that banks take advantage of their information monopoly.

[5] In these countries the banking sector is the most important actor in financial markets, as measured by the share of bank loans in the total liabilities of non-financial firms.

[6] A cost channel of monetary transmission, as another form of the supply-side effect of monetary policy, has also been identified to be important and time-varying at the macroeconomic level in the U.S. economy (see, for example, Tillmann (2009).).

[7] The most noteworthy among these changes are domestic mergers and acquisitions and changes in the structure of ownership along with increased foreign bank penetration and a shift from government to private control (see Wu et al. (2011)).

[8] Archer (2006) suggests that the broad credit channel plays an increasingly important role in emerging markets as the implementation of monetary policy in those countries has transitioned from direct intervention and regulation to the use of indirect monetary instruments.

measures and monetary policy targets; and that evidence on the link is consistent across Asia and Latin America. The adverse effects of banking consolidation on monetary policy transmission are shown to be the most conspicuous among banks of small size. From a policy perspective, our findings call for either a closer overseeing of consolidation efforts in the banking industry, or for measures that can offset the negative effects of further consolidation on the effectiveness of the monetary policy transmission mechanism.

The paper is organized as follows. Section 2 describes the data and discusses the empirical methodology. Section 3 presents the estimation results, reports various robustness test results, and discusses the implications of the main findings of this paper. Section 4 concludes. The appendix presents the data summary statistics.

2. The data and empirical methodology

2.1. Data description

In this paper we use annual bank-level data for a sample of eight Asian and ten Latin American countries.[9] The panel data contain unconsolidated balance sheet and income statement information for a total of 936 commercial banks from 1996 to 2006. The source of the bank-level panel data is *BankScope* provided by Bureau van Dijk and IBCA, a financial database that presents the information for banks in all countries in a standardized form.[10]

In the first step, we processed the data to remove negative values for assets, loans, deposits, interest income and expenses, and other expenses. In a second step, we cleaned the data following the criteria used in Arena et al. (2007). This implies deleting outliers from the sample, i.e. observations for which: 1) the growth rate of loans and/or deposits exceeds 300%; 2) the growth rate of assets exceeds 200%; and 3) the volume of loans represents more than 100 times that of deposits. Last, in a third step, we follow Favero et al. (1999) and delete two sets of banks falling in the following categories from our sample: First, the banks with only marginal lending activity, defined as those banks for which the ratio of loans to total assets is less than 10%. Second, the banks that have probably been involved in mergers or acquisitions, defined as those institutions for which total assets changed by more than 75% in one year. We do this to prevent the coefficients on the concentration measure from capturing other features of the banking industry such as institutional changes and the presence of institutions not focused on commercial banking activities. The appendix reports summary statistics on these data, as well as the number of banks for each country-year pair observations used in this paper.

We use consumer price indices and exchange rates for each country obtained from the *International Financial Statistics* to express all series in constant 2000 US dollars. Macroeconomic data on interest rates and GDP for all countries are also from the *International Financial Statistics*.

2.2. Methodology

Eq. (1) presents our empirical model. It relates bank loans (y) to the monetary policy measure (m) and an indicator of market concentration in the banking industry (c). To model the effects of

[9] The Asian economies are Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand. The Latin American countries are Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Paraguay, Peru, Uruguay, and Venezuela.

[10] In the literature the quality of *BankScope* data has been assessed as overall good. For example, using 1999 as a reference year, Cunningham (2001) observes that in 15 of 19 emerging market economies, *BankScope* data covers more than 90% of the total banking sector assets. The countries considered for the assessment are Argentina, Brazil, Chile, Colombia, Venezuela, Mexico, China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan, Thailand, the Czech Republic, Hungary, Poland, Russia and Turkey, many of which overlap with our country data set. Countries for which coverage is found to be less than 90% are China, Indonesia, the Czech Republic, and Russia. Ehrmann et al. (2002) find that the sample of European banks available in *BankScope* is biased toward large banks. They report that the biases are stronger for the beginning of the sample (1992-1999), and that the coverage of *BankScope* has improved markedly over the years. Our own study of *BankScope*'s coverage of commercial banks in Argentina and Korea using population data of all banks in these two countries shows a rate of coverage of 80–88% in terms of total assets for Argentina during the period 2002-2005. For Korea, all of the 14 (for the year of 2003) and 13 (2006) commercial banks are fully covered in *BankScope*.

consolidation on monetary policy transmission through the bank lending channel, we interact the banking concentration indicator with the monetary policy measure. We estimate the following relationship:

$$y_{i,c,t} = \alpha_i + \delta m_{c,t} + \theta c_{c,t} + \phi c_{c,t} * m_{c,t} + \beta x_{c,t} + \rho_1 z_{1i,c,t-1} + \rho_2 z_{2i,c,t-1} + \rho_3 z_{3i,c,t-1} + u_{i,c,t}, \quad (1)$$

where the subscript i indexes each individual bank, c indexes each country, and t denotes time. The constant α_i represents the bank-level fixed effects. Market size varies substantially across countries in our sample. Therefore, to avoid a given change in the monetary policy indicator having a larger impact on the volume of loans in larger markets, we use the percentage change in loans as the dependent variable instead of the volume of loans itself.

We follow Ashcraft (2006) and Adams and Amel (2011) in assuming that monetary policy shifts banks' marginal costs by affecting the interest rates they must pay for loanable funds. Therefore, for the measure of monetary policy (m) we use short-term interest rates. Following Arena et al. (2007) who study the lending channel of foreign banks in a cross-section of countries, we use the money market rate as the measure of monetary policy. When this rate is not available, the Treasury bill rate or the discount rate is used instead. Table A2 in the appendix shows the monetary policy indicator used for each country in our study. The coefficient on the monetary policy indicator, δ, measures the sensitivity of the growth rate of loans provided by bank i to monetary policy.

We use two alternative measures of concentration: 1) the five-firm concentration ratio (CR5) defined as the share of assets held by the five largest banks in the banking industry, and 2) the Herfindahl–Hirschman index (HHI), defined as the sum of squared market shares in the banking industry in terms of total assets.[11] The coefficients on the concentration measures capture the sensitivity of bank i's lending growth to the degree of banking market consolidation in its host country.

Using bank-level data allows us to control for different types and degrees of financial constraints faced by heterogeneous banks.[12] Here we use three bank-specific characteristics including size, liquidity and capitalization, as proxies for these heterogeneities in financial constraints or in the strength of banks' balance sheets. As it is standard practice in the banking literature, we proxy the financial strength of an individual bank using a liquidity measure (z_1) and a capitalization measure (z_2). The degree of liquidity for each bank is computed as the ratio of its liquid assets to total assets. The degree of capitalization is computed as the ratio of equity capital to total assets. The assumption is that banks with more liquid assets and better capitalization, which tend to pay a lower risk premium for uninsured debt, are better prepared to isolate their loans from unexpected monetary policy shocks to deposits. We also include the logarithm of total assets as a measure of bank size (z_3), which can capture elements unrelated to the strength of banks' balance sheets.[13] The argument is that bigger banks might find it easier to issue market instruments, which would make them better prepared to face a negative monetary shock.

The fact that Eq. (1) includes the z-variable controls for bank-level characteristics (liquidity, capitalization and size) should result in more efficient estimates of the coefficients on the monetary policy indicator variable and the interaction term. Also, introducing these controls allows us to address the concern that the effects of concentration on bank behavior could just be proxies for the effects of financial constraints, which has already been examined in previous research. This is not a problem in Adams and Amel (2011), since they show that the correlation coefficients between the market HHI and both levels and changes in bank size, liquidity and capitalization at the aggregate level are statistically significant, but in no case is their absolute value greater than 0.07. Still, we are better able to address

[11] The estimation results using the three-firm concentration ratio (CR3) are very similar and available upon request.

[12] See Peltzman (1969), Kashyap and Stein (1995, 2000), Cecchetti (1999), Favero et al. (1999), Kishan and Opiela (2000) and Ashcraft (2006), among others, for a detailed discussion on the need for these controls.

[13] Total assets are measured in the constant 2000 US dollar value. This absolute measure of bank size is useful to capture the heterogeneous role of bank size across all banks and countries in the bank lending channel. We also use a relative measure of bank size, calculated as the difference between the logarithm of total assets of a bank in a given period and the average of the logarithm of assets across all banks in a country for that same period. We find that our main findings are not significantly affected when using this alternative measure of bank size.

this issue by using bank-level data and explicitly controlling for these bank-level financial constraints in the estimation.

That said, there are some concerns on possible endogeneity associated with the z controls. First, bank size may be endogenous to loan growth. Second, it is not clear that better capitalized banks are indeed less financially constrained, because a bank may choose to raise more equity only because it faces a higher external finance premium at first. Third, bank liquidity can also be a biased measure of financial constraints if banks optimally choose to have a more liquid asset structure just to compensate for higher financing restrictions. To reduce a potential bias in the regression coefficients associated to these endogeneity concerns, we follow Arena et al. (2007) and use the one-year lagged values of these bank-level characteristics in Eq. (1).

The variable x denotes the growth rate of GDP. It is a standard practice in the literature to include this control to capture changes in loan demand and to isolate the effect of consolidation on the supply of bank loans. Doing this contributes to the identification of the *supply-side* bank lending channel from the alternative *demand-side* interest rate channel.[14]

Last, we introduce country dummies, year dummies and a financial crisis dummy into our model to control for the potential effects of cross-country institutional factors, year-specific factors, and the financial and banking crises experienced by these countries in different periods.

We expect an increase in the interest rate to reduce the growth rate of bank lending, so that the coefficient δ on the monetary policy indicator should be negative. Based on our discussion in the introduction, consolidation can either weaken or strengthen the monetary policy transmission mechanism through its impact on bank lending. Thus, the coefficient φ on the interaction term between monetary policy and banking concentration can be positive or negative, respectively. The positive coefficient of the interaction term indicates that the sensitivity of bank i's lending to monetary policy is expected to be smaller as banking consolidation increases. This implies the existence of a buffering effect of banking consolidation on monetary policy transmission.

3. Empirical results

We estimate Eq. (1) using bank-level fixed effects (FE) and robust standard errors. As a robustness test, and since the panel data combine a cross-section and a time-series dimension, we also estimate Eq. (1) using generalized least squares (GLS) to allow for autocorrelation within panels and heteroscedasticity across panels. We also adopt both CR5 and HHI as two alternative measures of market concentration in the banking industry in each country.

Table 1a reports the estimation results. First of all, the coefficient on monetary policy is negative and statistically significant. Moreover, as expected, the coefficient on the growth rate of GDP is positive, which shows the positive demand-side effect on loan growth. Therefore, after isolating the effect on the supply side of the market for bank loans, a negative and consistently significant coefficient on the monetary policy indicator serves as part of evidence for the bank lending channel of monetary policy operating in these economies. In other words, a negative monetary shock effectively induces banks in these economies to cut their loan supply, depending on the financial constraints faced by individual banks to be examined later.

The coefficients on the consolidation measures are statistically significant with a negative sign, suggesting that the supply of loans grows at a slower rate in more concentrated markets. Moreover, the obtained positive and statistically significant coefficient on the interaction term shows that increased consolidation in the banking industry makes monetary policy transmission weaker, reducing the impact of consolidation on the supply of bank loans. This confirms the existence of a buffering effect of consolidation on the monetary policy transmission mechanism in the banking sector of our sample economies.

The coefficients on the measures of bank liquidity (z_1) and capitalization (z_2) that serve as proxies for the strength of banks' balance sheets show that loan growth is faster in banks with a higher degree of liquidity and/or capitalization of their balance sheets. Although not statistically significant, the

[14] See also Ashcraft (2006) and Cetorelli and Goldberg (2008) for related work.

Table 1a
Consolidation in banking and the bank lending channel of monetary policy Dependent variable: Growth rate of real loans.

Variable	CR5		HHI	
	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)
mp	−2.186***	−2.283***	−0.660**	−0.948***
	(0.604)	(0.483)	(0.308)	(0.252)
consolidation	−44.71***	−41.91***	−60.33**	−71.08***
	(14.33)	(15.77)	(24.32)	(24.19)
mp*consolidation	3.110***	3.021***	3.795	5.089**
	(0.935)	(0.759)	(2.648)	(2.240)
Δln(real GDP)	1.814***	2.206***	1.829***	2.206***
	(0.225)	(0.184)	(0.224)	(0.184)
$size_{t-1}$	−0.144	0.0483	−0.165	0.0476
	(0.119)	(0.0602)	(0.130)	(0.0602)
$liquidity_{t-1}$	69.95***	34.07***	70.45***	34.04***
	(7.268)	(3.293)	(7.284)	(3.294)
$capitalization_{t-1}$	153.1***	75.58***	152.1***	75.52***
	(27.09)	(5.246)	(27.24)	(5.252)
dumcrisis	1.483	5.214*	1.817	5.386*
	(2.718)	(3.015)	(2.691)	(3.017)
Constant	−22.93**	5.526	−44.49***	−9.790
	(11.18)	(13.52)	(7.076)	(7.362)
Country dummies	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes
Observations	4305	4305	4305	4305
R-squared	0.191		0.188	
Number of bankid	844	844	844	844

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

coefficient on bank size (z_3) is mixed in sign, which indicates an ambiguous impact of size on loan growth.[15]

Using the estimation results reported in Table 1a, we next examine the overall effect of changes in monetary policy on bank lending. The overall effect is obtained as $\delta + \phi \cdot * c$. Table 1b shows the percentage change in bank lending as a result of a one percentage point increase in the monetary policy indicator, for several different levels of consolidation as measured by the CR5 ratio and HHI. For example, in economies where the concentration measure is at the 10th percentile of the CR5 distribution across countries, a one percentage point increase in the stance of monetary policy induces a 0.883% reduction in the supply of loans according to the fixed effects estimation. In economies with more consolidated banking sectors, for example in economies where the concentration measure is at the 25th and 50th percentile of the CR5 distribution, a policy shock of the same magnitude induces the supply of loans to fall by approximately 0.68% and 0.388%, respectively.[16] These results showing that the higher the CR5 ratio the lower loan growth rates, are consistent for both the FE and GLS estimations. Table 1a and b also show the results for the HHI as an alternative measure of banking consolidation. Estimation results are consistent with those obtained using the CR5 measure. Thus, our finding that increased consolidation in banking serves as a buffer in the transmission of monetary policy shocks to bank loans through the bank lending channel is robust to the alternative measures of banking industry concentration used.

To investigate whether there are significant differences in the effects of consolidation on the strength of monetary policy transmission across regions, we next split our entire sample into two

[15] We also use the relative measure of bank size, normalized by the average size of banks in each country. The estimation yields statistically significant and negative coefficients on the bank size variable, implying that larger banks exhibit a smaller loan growth.

[16] The total effects are calculated as $\delta + \phi *$ concentration measure, using the estimation results of Eq. (1).

Table 1b
Percentage change in lending after a one percentage point increase in the stance of monetary policy.

CR5			HHI		
	FE	GLS		FE	GLS
	(1)	(2)		(3)	(4)
CR5 = 0.5920 (sample mean)	−0.345	−0.495	HHI = 1066 (sample mean)	−0.660	−0.406
CR5 = 0.4191 (10th percentile)	−0.883	−1.017	HHI = 505 (10th percentile)	−0.660	−0.691
CR5 = 0.4842 (25th percentile)	−0.680	−0.820	HHI = 719 (25th percentile)	−0.660	−0.582
CR5 = 0.5782 (50th percentile)	−0.388	−0.536	HHI = 902 (50th percentile)	−0.660	−0.489

Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 1a.

subsamples of Latin American and Asian economies. As reported in Table 2a and Table 2b, the regression results for the two sets of countries are all consistent with those obtained using the entire sample with the only exception of the estimation for Asia when HHI is used as the consolidation measure. The estimation for the Asia-HHI case renders statistically insignificant coefficients on the monetary policy indicator and/or its interaction with consolidation. The results verify that overall banking market consolidation makes monetary policy transmission weaker in both Latin American and Asian markets.

In summary, our regression results show that monetary policy transmission becomes weaker in the economies where their banking industries are highly concentrated. These results are consistent across regions and robust to alternative measures of banking market concentration.

3.1. The impact of bank-specific characteristics on the consolidation-monetary transmission link

It is widely agreed that banks facing different degrees of financial constraints adjust their supply of credit to monetary shocks differently.[17] Therefore, next we want to examine whether the buffering effect of consolidation uncovered in our benchmark estimations works equally for banks of heterogeneous characteristics regarding the strength of their balance sheets. More specifically we want to answer the question of which types of banks in terms of bank size, liquidity and capitalization levels have the most conspicuous buffering effect of banking consolidation on monetary policy transmission. Our conjecture is that larger banks and banks with stronger capitalization and more liquid portfolios are less financially constrained, and therefore, are better able to isolate their loan supply from changes in monetary conditions. If this is true, the bank lending channel is expected to be more conspicuous among banks of small size, low liquidity and low capitalization.

With this goal in mind in this section we exploit the bank-level variation of our data and perform various subsample studies. We split the sample into subsamples according to the degree of financial constraints faced by banks as measured by their size, liquidity and capitalization, respectively. The estimation results are shown in Table 3a through Table 4b. The large (small) banks category contains banks with total assets above (below) the sample mean in each country. Similarly, the high (low) liquidity category contains those banks with a degree of liquidity above (below) the sample mean. The same criterion is used to define the capitalization categories.

While the coefficients on the interaction term are not significant at all for the subsample of large banks, they are positive and highly significant for the subsamples of small banks, and this is true for both measures of consolidation in banking (see the estimation results reported in Table 3b using CR5 and Table 4a using HHI as the measure of consolidation). These results allow us to conclude that the buffering effect of banking consolidation on monetary policy transmission works mostly through the response to monetary shocks by banks of small size. This bank size effect on monetary policy transmission is consistent with the results from Kashyap and Stein (1995) and Kishan and Opiela (2000). We provide evidence that the bank lending channel works more strongly among small banks than large

[17] See Peltzman (1969), Kashyap and Stein (1995, 2000), Cecchetti (1999), Favero et al. (1999), Kishan and Opiela (2000) and Ashcraft (2006), among others.

Table 2a
Consolidation in banking and the bank lending channel of monetary policy: Results by region, Asia and Latin America.

Dependent variable: Growth rate of real loans								
Variable	Asia				Latin America			
	CR5		HHI		CR5		HHI	
	FE	GLS	FE	GLS	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
mp	−3.294***	−3.109***	−0.802	−0.902**	−1.783**	−1.928***	−1.018***	−1.205***
	(1.071)	(0.796)	(0.520)	(0.378)	(0.707)	(0.642)	(0.384)	(0.356)
consolidation	−29.06	−42.43**	8.125	−4.583	−26.84	−24.64	−78.16	−91.72
	(19.97)	(20.84)	(26.69)	(27.46)	(22.96)	(27.11)	(61.05)	(67.62)
mp*consolidation	5.210***	4.294***	−4.035	−4.667	2.469**	2.532**	7.376**	8.126***
	(1.794)	(1.587)	(4.398)	(4.128)	(1.082)	(0.992)	(3.248)	(3.067)
Δln(real GDP)	1.768***	1.809***	2.046***	2.057***	2.072***	2.644***	2.038***	2.601***
	(0.335)	(0.273)	(0.332)	(0.267)	(0.332)	(0.272)	(0.332)	(0.272)
$size_{t-1}$	−0.333***	0.0541	−0.326***	0.0488	−0.812	−0.0931	−0.815	−0.0965
	(0.114)	(0.0517)	(0.108)	(0.0517)	(0.767)	(0.207)	(0.769)	(0.207)
$liquidity_{t-1}$	66.19***	46.83***	68.48***	47.45***	69.93***	27.19***	69.74***	27.12***
	(7.700)	(4.602)	(7.751)	(4.613)	(10.25)	(4.568)	(10.22)	(4.555)
$capitalization_{t-1}$	145.7**	74.27***	137.7**	71.96***	159.7***	74.05***	159.1***	74.08***
	(65.71)	(9.301)	(66.45)	(9.365)	(28.24)	(6.700)	(28.31)	(6.693)
dumcrisis	−11.36**	−10.89**	−3.946	−4.560	11.93***	16.05***	12.02***	16.20***
	(4.553)	(4.889)	(4.339)	(4.978)	(3.583)	(4.354)	(3.595)	(4.349)
Constant	−21.09	3.553	−36.22***	−22.62***	−43.08**	−19.35	−50.78***	−23.87**
	(15.34)	(16.65)	(9.617)	(7.166)	(18.26)	(18.30)	(12.20)	(9.476)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1838	1838	1838	1838	2467	2467	2467	2467
R-squared	0.281		0.274		0.180		0.179	
Number of banks	344	344	344	344	500	500	500	500

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

banks, but the strength of the bank lending channel will be weakened when banks are operating in a highly consolidated banking market.

The evidence is mixed regarding the liquidity subsamples. In some cases the largest response is among those banks with highly liquid portfolios, in some others it is among those that are less liquid. Regarding the subsamples based on degree of capitalization, the results are also mixed, although low capitalization banks show more consistent and statistically significant coefficients on the monetary policy indicator and the interaction term, implying the existence of a buffering effect of consolidation on monetary policy transmission.

To summarize, we find evidence that the buffering effects of banking consolidation on monetary policy transmission work through small banks, but do not find clear evidence regarding the relationship between banks' degree of liquidity or capitalization and the buffering effect of banking consolidation.

3.2. Robustness checks

We conduct several robustness tests to check whether the main findings of this paper are affected when our baseline estimation specification is modified by treating the bank size variable differently and by using alternative indicators of monetary policy.

First, we allow for the coefficient of bank size to vary across countries. This is because heterogeneity across countries is expected to affect banks' ability to have alternative sources of financing with which to respond to monetary policy tightening.[18] We re-estimate Eq. (1) by allowing for country-varying

[18] The authors appreciate this suggestion from a referee.

Table 2b
Percentage point change in lending after a one percentage point increase in the stance of monetary policy, results by region.

Asia						Latin America					
CR5			HHI			CR5			HHI		
	FE	GLS		FE	GLS		FE	GLS		FE	GLS
	(1)	(2)		(3)	(4)		(5)	(6)		(7)	(8)
CR5 = 0.6027 (sample mean)	−0.154	−0.521	HHI = 1197 (sample mean)	–	−0.902	CR5 = 0.5851 (sample mean)	−0.338	−0.447	HHI = 981 (sample mean)	−0.294	−0.408
CR5 = 0.4302 (10th percentile)	−1.053	−1.262	HHI = 623 (10th percentile)	–	−0.902	CR5 = 0.4191 (10th percentile)	−0.748	−0.867	HHI = 505 (10th percentile)	−0.646	−0.795
CR5 = 0.4885 (25th percentile)	−0.749	−1.011	HHI = 797 (25th percentile)	–	−0.902	CR5 = 0.4774 (25th percentile)	−0.604	−0.719	HHI = 673 (25th percentile)	−0.522	−0.658
CR5 = 0.6193 (50th percentile)	−0.067	−0.450	HHI = 962 (50th percentile)	–	−0.902	CR5 = 0.5543 (50th percentile)	−0.414	−0.525	HHI = 821 (50th percentile)	−0.412	−0.538

Values are calculated as $\delta + \phi * \text{concentration measure}$, using the regression results from Table 2a.

bank size controls. The estimation results are reported in Table 5a and Table 5b. The coefficients on the size variables are shown to vary in magnitude, sign and statistical significance. However, the results are consistent with those of the baseline specification reported in Table 1a and Table 1b, in the sense that contractionary monetary policy lowers loan growth and that this effect is reduced as consolidation in banking increases. Also, the growth rate of GDP, and liquidity and capitalization of banks' balance sheets all have a significantly positive effect on loan growth, and consolidation still negatively impacts loan growth.

Second, we examine whether the main results are robust to alternative measures of monetary policy across countries. Our baseline estimations use three different monetary policy indicators, namely money market rates, Treasury bill (TB) rates, and the discount rate (see Table A2). We re-estimate Eq. (1) by splitting the whole sample into three groups by type of monetary policy indicators. The estimation results shown in Table 6a and Table 6b confirm that for all three monetary policy indicators, tighter monetary policy reduces the growth rate of bank loans, and that this reduction in loan growth becomes smaller as banking consolidation increases. The main findings on the consolidation-monetary transmission link are robust to alternative measures of monetary policy. However, it is interesting to find that loan growth is most sensitive to monetary policy changes in the countries for which monetary policy is measured using the TB rate, followed by those where the discount rate and the money market rate are used. Also, the buffering effects of consolidation are not statistically significant among those countries for which the money market rate is used as a measure of the stance of monetary policy.[19]

Third, we conduct a robustness test to further explore the supply-side effects in bank loan markets by including additional interaction terms in Eq. (1). As suggested by Ashcraft (2006), we introduce an interaction of the bank-characteristics measuring the financial constraints faced by banks with the demand indicator *x*. The purpose of the interaction term is to capture potential differential changes in

[19] We also check the robustness of our results to the use of another alternative monetary policy indicator, which is the VAR-model based indicator of monetary policy. This measure is constructed as the residuals of the interest rate equation in a vector autoregressive (VAR) model. The idea is that the effects on short-term interest rates of other macroeconomic shocks are eliminated, and only the variation due to exogenous monetary shocks is kept (see, for example, Gunji et al. (2009)). For each country in our sample we build a 6-variable VAR system which consists of the short-term interest rate, the rate of exchange rate depreciation, and the logarithms of bank lending, the monetary base, the price level and aggregate output. The estimation results, not reported to save space, show that although the coefficients on monetary policy and the interaction term are not statistically significant, these results are still consistent in sign with those reported and discussed earlier. The estimation results are available upon request.

Table 3a
Consolidation in banking and the bank lending channel by bank-specific characteristics: Consolidation measure, CR5.

Dependent variable: Δln(real loans)	Bank size				Liquidity				Capitalization			
	Large banks		Small banks		High liquidity banks		Low liquidity banks		High capitalization banks		Low capitalization banks	
	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
mp	0.303	−0.235	−3.127***	−2.833***	−2.682**	−2.223**	−0.982	−1.477***	−1.188	−3.076**	−1.710***	−1.889***
	(0.685)	(0.588)	(0.754)	(0.627)	(1.212)	(0.903)	(0.631)	(0.552)	(1.402)	(1.247)	(0.583)	(0.449)
consolidation	15.32	−5.803	−67.65***	−49.78**	−21.84	−25.78	−28.53	−35.91*	−36.47	−25.43	−32.89**	−46.38***
	(21.52)	(16.47)	(20.23)	(21.55)	(24.22)	(27.59)	(17.83)	(18.89)	(33.94)	(39.17)	(14.82)	(14.88)
mp*consolidation	−0.445	0.280	4.459***	3.791***	3.368*	2.418*	1.216	1.823**	1.683	4.325**	2.508***	2.713***
	(1.024)	(0.917)	(1.177)	(0.987)	(1.878)	(1.454)	(0.941)	(0.863)	(2.198)	(1.956)	(0.898)	(0.704)
Δln(real GDP)	1.156***	1.831***	1.758***	2.343***	1.452***	1.431***	1.783***	2.543***	1.250**	2.248***	1.473***	1.935***
	(0.255)	(0.193)	(0.296)	(0.250)	(0.451)	(0.319)	(0.239)	(0.214)	(0.487)	(0.483)	(0.265)	(0.169)
$absolutesize_{t-1}$	−0.731*	−0.120**	−3.087**	−0.456	−0.484	0.120	−1.046**	−0.0126	0.0449	0.220	−0.363*	−0.00696
	(0.434)	(0.0489)	(1.474)	(0.540)	(0.422)	(0.0979)	(0.528)	(0.0725)	(0.177)	(0.225)	(0.215)	(0.0519)
$liquidity_{t-1}$	49.75***	22.83***	74.76***	40.16***	75.45***	68.64***	107.3***	72.53***	90.10***	56.74***	66.92***	28.36***
	(8.998)	(3.700)	(9.151)	(4.417)	(10.48)	(6.113)	(11.39)	(5.613)	(16.05)	(7.927)	(7.945)	(3.179)
$capitalization_{t-1}$	101.9***	52.88***	158.1***	82.12***	137.9*	55.86***	182.0***	88.59***	153.8***	130.5***	254.9***	181.9***
	(37.01)	(12.58)	(29.42)	(6.462)	(70.20)	(9.350)	(27.44)	(6.101)	(31.76)	(11.09)	(43.23)	(12.70)
dumcrisis	4.529	9.295***	−1.899	4.562	0.955	3.423	1.356	5.839*	−8.130	3.028	2.926	3.396
	(3.411)	(3.299)	(3.580)	(4.027)	(5.781)	(5.573)	(2.966)	(3.383)	(8.161)	(8.227)	(2.782)	(2.732)
Constant	−27.20*	8.195	−12.53	4.731	−43.61*	−23.37	−28.86**	−3.152	−58.22**	−53.03	−25.92**	6.638
	(14.16)	(14.11)	(15.71)	(18.71)	(22.76)	(23.47)	(12.87)	(16.23)	(24.82)	(34.01)	(11.66)	(12.75)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1317	1317	2988	2988	1746	1746	2557	2557	1170	1170	3134	3134
R-squared	0.168		0.210		0.210		0.300		0.244		0.204	
Number of banks	254	254	678	678	572	572	702	702	385	385	695	695

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3b
Percentage point change in lending after a one percentage point increase in the stance of monetary policy by bank-specific characteristics: Consolidation measure, CR5.

Consolidation measure: CR5	Bank size				Liquidity				Capitalization			
	Large banks		Small banks		High liquidity banks		Low liquidity banks		High capitalization banks		Low capitalization banks	
	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CR5 = 0.6222 (sample mean)	–	–	−0.487	−0.589	−0.688	−0.792	–	−0.398	–	−0.516	−0.225	−0.283
CR5 = 0.4284 (10th percentile)	–	–	−1.258	−1.244	−1.270	−1.210	–	−0.713	–	−1.263	−0.659	−0.752
CR5 = 0.4830 (25th percentile)	–	–	−0.968	−0.997	−1.051	−1.052	–	−0.594	–	−0.982	−0.496	−0.575
CR5 = 0.5993 (50th percentile)	–	–	−0.549	−0.641	−0.735	−0.825	–	−0.423	–	−0.575	−0.260	−0.320

Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 3a.

Table 4a
Consolidation in banking and the bank Lending channel by bank-specific characteristics: Consolidation measure, HHI.

Dependent variable: Δln(real loans)	Bank size				Liquidity				Capitalization			
	Large banks		Small banks		High liquidity banks		Low liquidity banks		High capitalization banks		Low capitalization banks	
	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
mp	0.412	0.0843	−1.122***	−1.269***	−1.013*	−1.088**	−0.254	−0.598**	0.377	−1.048	−0.590*	−0.694***
	(0.384)	(0.304)	(0.377)	(0.326)	(0.576)	(0.462)	(0.334)	(0.288)	(0.743)	(0.655)	(0.308)	(0.234)
consolidation	52.67	−1.761	−92.72***	−85.21***	14.18	−37.24	−39.07*	−65.26**	13.97	−35.37	−65.55**	−84.30***
	(45.05)	(27.98)	(32.58)	(31.80)	(43.79)	(46.73)	(20.91)	(26.79)	(45.68)	(55.65)	(27.45)	(23.85)
mp*consolidation	−3.651	−1.415	7.256**	7.470**	3.845	3.075	0.211	2.349	−5.294	6.378	4.102	4.510**
	(3.206)	(2.667)	(3.304)	(2.911)	(4.845)	(4.267)	(2.599)	(2.554)	(6.602)	(5.925)	(2.677)	(2.046)
Δln(real GDP)	1.160***	1.837***	1.785***	2.343***	1.433***	1.420***	1.791***	2.544***	1.316***	2.274***	1.477***	1.932***
	(0.254)	(0.193)	(0.296)	(0.250)	(0.448)	(0.320)	(0.239)	(0.214)	(0.481)	(0.484)	(0.264)	(0.170)
$absolutesize_{t-1}$	−0.750*	−0.119**	−3.536**	−0.487	−0.594	0.131	−1.072**	−0.0270	−0.0232	0.223	−0.350	−0.00354
	(0.432)	(0.0494)	(1.457)	(0.542)	(0.408)	(0.0992)	(0.522)	(0.0726)	(0.156)	(0.225)	(0.247)	(0.0520)
$liquidity_{t-1}$	49.32***	22.79***	75.52***	40.12***	76.54***	68.91***	107.6***	72.58***	90.72***	56.72***	67.23***	28.32***
	(9.063)	(3.694)	(9.171)	(4.419)	(10.49)	(6.112)	(11.37)	(5.608)	(16.02)	(7.941)	(7.982)	(3.178)
$capitalization_{t-1}$	104.5***	53.07***	156.4***	81.97***	136.1*	55.63***	181.8***	88.63***	150.2***	129.2***	253.9***	181.6***
	(36.13)	(12.57)	(29.71)	(6.473)	(69.72)	(9.368)	(27.27)	(6.101)	(31.49)	(11.11)	(43.11)	(12.70)
dumcrisis	4.553	9.352***	−1.591	4.632	1.057	3.646	1.410	5.943*	−7.836	3.328	3.312	3.577
	(3.382)	(3.291)	(3.555)	(4.033)	(5.813)	(5.615)	(2.914)	(3.370)	(8.015)	(8.215)	(2.767)	(2.734)
Constant	−23.50***	4.764	−44.46***	−13.66	−59.12***	−33.82**	−42.30***	−14.47*	−82.39***	−63.01***	−39.22***	−8.889
	(7.945)	(8.392)	(9.383)	(10.10)	(16.95)	(13.77)	(7.709)	(8.353)	(14.33)	(17.75)	(8.189)	(7.245)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	1317	1317	2988	2988	1746	1746	2557	2557	1170	1170	3134	3134
R-squared	0.170		0.206		0.207		0.300		0.244		0.202	
Number of banks	254	254	678	678	572	572	702	702	385	385	695	695

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4b
Percentage change in lending after a one percentage point increase in the stance of monetary policy by bank-specific characteristics Consolidation measure, HHI.

Consolidation measure: HHI	Bank size				Liquidity				Capitalization			
	Large banks		Small banks		High liquidity banks		Low liquidity banks		High capitalization banks		Low capitalization banks	
	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HHI = 1404 (sample mean)	–	–	−0.349	−0.473	−1.013	−1.088	–	−0.598	–	–	−0.590	−0.213
HHI = 529 (10th percentile)	–	–	−0.756	−0.892	−1.013	−1.088	–	−0.598	–	–	−0.590	−0.466
HHI = 688 (25th percentile)	–	–	−0.600	−0.732	−1.013	−1.088	–	−0.598	–	–	−0.590	−0.370
HHI = 961 (50th percentile)	–	–	−0.468	−0.595	−1.013	−1.088	–	−0.598	–	–	−0.590	−0.287

Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 4a.

Table 5a
Consolidation in banking and the bank lending channel of monetary policy, with country-varying size controls.

Dependent variable: Growth rate of real loans				
Variable	CR5		HHI	
	FE	GLS	FE	GLS
	(1)	(2)	(3)	(4)
mp	−1.757***	−2.313***	−0.413***	−0.615***
	(0.523)	(0.430)	(0.130)	(0.127)
consolidation	−30.63**	−40.74***	−14.73*	−23.34**
	(12.64)	(12.60)	(7.912)	(10.38)
mp*consolidation	2.370***	2.962***	1.164***	1.367***
	(0.776)	(0.656)	(0.375)	(0.521)
Δln(real GDP)	1.249***	1.513***	1.271***	1.543***
	(0.207)	(0.200)	(0.205)	(0.201)
$liquidity_{t-1}$	71.06***	41.70***	71.61***	41.84***
	(7.778)	(3.475)	(7.786)	(3.486)
$capitalization_{t-1}$	110.4***	78.96***	110.0***	78.37***
	(28.45)	(6.438)	(28.50)	(6.448)
dumcrisis	0.661	2.703	0.828	3.257
	(2.900)	(3.032)	(2.896)	(3.053)
$sizecountry1_{t-1}$	−18.17	2.711**	−18.58*	2.684**
	(11.07)	(1.353)	(11.11)	(1.355)
$sizecountry2_{t-1}$	−30.11***	1.154	−29.93***	1.318
	(9.214)	(1.365)	(9.375)	(1.366)
$sizecountry3_{t-1}$	7.432	0.774	10.60	0.975
	(9.363)	(1.735)	(8.756)	(1.736)
$sizecountry4_{t-1}$	−19.68***	2.973	−20.81***	2.993
	(6.161)	(2.789)	(5.382)	(2.793)
$sizecountry5_{t-1}$	−14.21***	7.079***	−14.61***	7.048***
	(5.089)	(2.122)	(5.100)	(2.125)
$sizecountry6_{t-1}$	−21.10**	0.911	−22.62**	0.815
	(8.817)	(1.306)	(8.839)	(1.309)
$sizecountry7_{t-1}$	−45.61	2.896	−45.98	2.766
	(29.51)	(2.311)	(30.08)	(2.315)
$sizecountry8_{t-1}$	−17.12	−2.033	−16.77	−1.984
	(15.21)	(2.748)	(15.54)	(2.752)
$sizecountry9_{t-1}$	−27.97***	3.986***	−28.65***	3.942***
	(8.493)	(1.217)	(8.470)	(1.219)
$sizecountry10_{t-1}$	−28.28	6.885	−27.16	6.952*
	(19.27)	(4.202)	(19.52)	(4.208)
$sizecountry11_{t-1}$	−41.26***	−2.620***	−39.66***	−2.584***
	(8.840)	(0.919)	(8.771)	(0.920)
$sizecountry12_{t-1}$	−11.77*	7.683***	−13.76**	7.620***
	(6.730)	(1.752)	(6.672)	(1.755)
$sizecountry13_{t-1}$	−27.12*	2.775	−28.53*	2.711
	(15.71)	(2.154)	(15.87)	(2.158)
$sizecountry14_{t-1}$	−5.905	−1.405	−7.356	−1.591
	(8.111)	(1.482)	(8.040)	(1.484)
$sizecountry15_{t-1}$	−8.138	−3.572	−8.614	−3.709
	(8.543)	(4.188)	(8.588)	(4.194)
$sizecountry16_{t-1}$	−20.29**	−1.139	−22.58***	−1.349
	(8.267)	(2.864)	(8.451)	(2.868)
$sizecountry17_{t-1}$	−13.61	6.906**	−11.30	6.919**
	(10.74)	(2.695)	(11.41)	(2.700)
$sizecountry18_{t-1}$	−25.29*	−2.844	−25.85*	−2.974
	(15.16)	(1.915)	(14.95)	(1.918)
Constant	148.2***	−22.23	128.7***	−47.30***
	(31.60)	(17.79)	(29.40)	(14.75)
Country dummies	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes
Observations	4291	4291	4291	4291
R-squared	0.224		0.222	
Number of banks	834	834	834	834

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5b
Percentage change in lending after a one percentage point increase in the stance of monetary policy, with country-varying size controls.

CR5			HHI		
	FE	GLS		FE	GLS
	(1)	(2)		(3)	(4)
CR5 = 0.6222 (sample mean)	−0.282	−0.470	HHI = 1404 (sample mean)	−0.250	−0.423
CR5 = 0.4284 (10th percentile)	−0.742	−1.044	HHI = 529 (10th percentile)	−0.351	−0.543
CR5 = 0.4830 (25th percentile)	−0.612	−0.882	HHI = 688 (25th percentile)	−0.333	−0.521
CR5 = 0.5993 (50th percentile)	−0.337	−0.538	HHI = 961 (50th percentile)	−0.301	−0.484

Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 5a.

Table 6a
Consolidation in banking and the bank lending channel of monetary policy, results by type of monetary policy interest rate indicators.

Dependent variable: Growth rate of real loans						
Variable	Money market rate		TB rate		Discount rate	
	CR5	HHI	CR5	HHI	CR5	HHI
	(1)	(2)	(3)	(4)	(5)	(6)
mp	−0.283	−0.859	−4.645***	−2.485***	−3.135***	−1.022**
	(1.225)	(0.580)	(1.280)	(0.754)	(0.685)	(0.407)
consolidation	11.63	−81.93	−67.30*	−63.99*	−55.49***	−149.8***
	(31.47)	(84.31)	(39.96)	(37.10)	(18.74)	(39.94)
mp*consolidation	0.252	6.035	4.135**	6.037	6.547***	15.34***
	(1.810)	(4.600)	(1.607)	(4.264)	(1.319)	(5.064)
Δ ln(real GDP)	3.081***	2.981***	1.030*	1.072*	2.234***	2.431***
	(0.308)	(0.308)	(0.556)	(0.551)	(0.255)	(0.247)
$size_{t-1}$	−0.017	−0.008	0.138*	0.141*	−0.212	−0.203
	(0.126)	(0.125)	(0.080)	(0.081)	(0.239)	(0.240)
$liquidity_{t-1}$	38.53***	38.27***	37.27***	36.06***	26.14***	26.25***
	(6.888)	(6.873)	(5.953)	(5.941)	(4.031)	(4.064)
$capitalization_{t-1}$	64.36***	64.87***	125.1***	125.8***	−2.348	−2.730
	(8.360)	(8.356)	(9.360)	(9.388)	(8.526)	(8.567)
dumcrisis	22.22***	22.42***	−12.04	−8.892	−13.64***	−15.10***
	(5.043)	(5.025)	(9.607)	(9.579)	(4.653)	(4.746)
Constant	−51.47**	−30.95*	13.55	−32.42**	15.36	−2.190
	(24.37)	(15.97)	(40.57)	(13.23)	(11.33)	(6.176)
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Observations	1241	1241	1760	1760	1304	1304
Number of banks	252	252	340	340	252	252

The estimation results are based on the GLS estimator. The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

loan demand across heterogeneous banks in response to any changes in aggregate output. Consistently across specifications, we find that the effects captured by these interaction terms are statistically insignificant, and the main findings of this paper on the consolidation-monetary transmission link remain the same.

Finally, we examine whether the buffering effect of banking consolidation on the response of loan growth to monetary policy shocks is also present when aggregate country-level data for bank lending are used for the empirical estimation.[20] In other words, we want to assess whether our main results are robust to the level of aggregation in the data. For this purpose, we re-estimate the loan growth equation using the asset-weighted country average of loan growth in each year as the dependent

[20] The authors appreciate this suggestion from a referee.

Table 6b
Percentage change in lending after a one percentage point increase in the stance of monetary policy, results by type of monetary policy interest rate indicators.

Consolidation measures: CR5/HHI	Money market rate		TB rate		Discount rate	
	CR5	HHI	CR5	HHI	CR5	HHI
	(1)	(2)	(3)	(4)	(5)	(6)
CR5 = 0.5920/HHI = 1066 (sample mean)	–	–	−1.790	−2.485	−0.543	−0.872
CR5 = 0.4191/HHI = 505 (10th percentile)	–	–	−2.383	−2.485	−1.375	−1.098
CR5 = 0.4842/HHI = 719 (25th percentile)	–	–	−2.216	−2.485	−1.140	−1.057
CR5 = 0.5782/HHI = 902 (50th percentile)	–	–	−1.860	−2.485	−0.641	−0.987

The mean and three percentile values for consolidation measures are estimated for the whole sample. Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 6a.

variable. We also modify the liquidity (z_1) and capitalization (z_2) controls to be asset-weighted averages for each country-year pair observation. Overall, we obtain consistent results when using the aggregate data, although the estimation reflects loan growth at the national level, rather than loan growth at the individual bank level with bank-specific characteristics controls applied (see Table 7a and Table 7b).

3.3. Consolidation as a moderating condition for the effectiveness of the bank lending channel

Our results indicate that increased consolidation in the banking industry provides sizable buffering effects on the bank lending channel, which dominate over its effects of strengthening the bank lending channel. As we discussed in the introduction, this finding implies that as banking consolidation increases, the factors affecting monetary transmission adversely (i.e. the resulting increase in the market share held by large banks and in the overall financial strength of the banking sector after consolidation) are stronger than the factors reinforcing monetary transmission (i.e. the costs of

Table 7a
Consolidation in Banking and the Bank Lending Channel – Country-level Aggregate Market Data.

Dependent variable: Δln (asset-weighted average real loans)	No balance sheet controls		With balance sheet controls	
	CR5	HHI	CR5	HHI
	(1)	(2)	(3)	(4)
mp	−11.62***	−3.860***	−10.56***	−3.164***
	(2.090)	(1.099)	(2.126)	(1.179)
consolidation	−97.43*	−146.7**	−85.95*	−128.1**
	(51.09)	(58.10)	(51.23)	(58.92)
mp*consolidation	15.70***	22.32**	14.49***	18.95**
	(3.121)	(8.872)	(3.138)	(9.268)
Δln(real GDP)	1.319	1.215	1.441	1.388
	(0.856)	(0.916)	(0.876)	(0.929)
asset-weighted average liquidity$_{t-1}$			82.32**	98.19**
			(36.98)	(39.48)
asset-weighted average capitalization$_{t-1}$			57.31	60.04
			(134.9)	(148.2)
dumcrisis	10.94	7.791	15.14	13.10
	(12.59)	(13.44)	(12.73)	(13.57)
Constant	137.2***	67.45***	73.78	0.0756
	(39.29)	(22.37)	(50.15)	(42.32)
Country dummies	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes
Observations	168	168	168	168
R-squared	0.345	0.251	0.369	0.286

The numbers in parentheses denote standard errors of the coefficients. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7b
Percentage change in lending after a one percentage point increase in the stance of monetary policy, using country-level aggregate market data.

Consolidation measures: CR5/HHI	No balance sheet controls		With balance sheet controls	
	CR5	HHI	CR5	HHI
	(1)	(2)	(3)	(4)
Concentration measure = 0.5920/1066 (sample mean)	−2.326	−1.481	−1.982	−1.144
Concentration measure = 0.4191/505 (10th percentile)	−5.040	−2.733	−4.487	−2.207
Concentration measure = 0.4842/719 (25th percentile)	−4.018	−2.255	−3.544	−1.801
Concentration measure = 0.5782/902 (50th percentile)	−2.542	−1.847	−2.182	−1.455

Values are calculated as $\delta + \phi *$ concentration measure, using the regression results from Table 7a.

information and liquidity effect and the switching costs effect). It is worth noting that this is only a conjecture, since in this paper we do not provide complete identifications of the relative size of specific contributing factors for the uncovered inverse relationship between consolidation in banking and the strength of the bank lending channel, which is beyond the scope of our paper.[21]

That said, our conjecture is supported by previous findings in the empirical literature in banking that documents how banks of different size and financial strength respond differently to monetary shocks (see Kashyap and Stein (1995, 2000), Favero et al. (1999) and Kishan and Opiela (2000) among others). Also, Cecchetti (1999) discusses how the bank lending channel can be expected to be relatively strong in countries with systems composed of a large network of small banks, and relatively weak in countries dominated by a small number of large banks. We provide evidence of an important moderating condition on the banking market structure for the bank lending channel to work effectively. We show that the bank lending channel is weakened significantly and consistently, even among small banks, when banks operate in highly concentrated banking markets.

4. Conclusions

In this paper, we examine the relationship between consolidation in banking and the effectiveness of monetary policy transmission. We focus on the bank lending channel, according to which banks are especially relevant to the transmission of monetary policy shocks. This topic is of particular interest at a time when the world financial crisis has been leading to significant consolidation in the banking sector, and when monetary policy is being heavily used to fight financial fallout as well as domestic and global recessions. However, little research has been done on this topic so far, especially using bank-level data for a cross-section of developing and emerging economies. Here we continue filling this gap. Using bank-level data in the empirical analysis we contribute to the literature by better identifying the effects of the *supply-side* bank lending channel on monetary transmission from the effects of the *demand-side* interest rate channel, and by testing for any systematic differences in the impact of consolidation on monetary policy across banks of different size and financial strength.

Using data for a sample of emerging and developing economies in Asia and Latin America from 1996 to 2006, we present evidence that an increase in banking sector consolidation weakens the bank lending channel of monetary policy transmission. We also show that these results are quite robust to alternative measures of consolidation, alternative measures of monetary policy, different specifications on bank size and the demand effects, different levels of aggregation, and different subsets of countries considered.

[21] To discern specific underlying reasons for this conjecture, we would need additional data including those on the impact of consolidation on financial strength, liquidity and switching costs.

Based on our estimations for subsamples of heterogeneous banks, the explanation we suggest for the result that consolidation weakens monetary policy transmission is that the recent consolidation in banking has raised the market share held by large banks for which the supply of loans is less responsive to changes in monetary policy conditions. We provide evidence that banking consolidation, which has been increasing in developing and emerging economies in Asia and Latin America in recent years, is a moderating factor to the effectiveness of monetary policy transmission. The bank lending channel is shown to be weakened significantly and consistently when banks operate in highly concentrated banking markets.

From a policy perspective, our results call for a closer overseeing of consolidation efforts in the banking industry and for measures that can offset the negative effects of further consolidation on the effectiveness of monetary policy transmission. We leave for another paper the study of the impact on monetary policy transmission of non-competitive pricing and market power in banking. Other related interesting areas for further research include the investigation of the effects of other market structure changes that typically happen together with increases in consolidation (Olivero et al., 2011). Changes in bank ownership, privatization efforts and increased participation of foreign banks, which are all related to banking consolidation, are considered to be the most important among these changes in the banking industries of developing and emerging economies.

Appendix A: Data appendix

Table A1
Number of bank observations by country and year, 1996–2006.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Argentina	56	45	57	59	44	56	50	48	40	37	35	471
Bolivia	5	3	9	8	11	11	12	11	10	9	8	92
Brazil	78	58	82	79	72	62	76	69	70	60	44	672
Chile	25	22	25	23	24	20	17	19	21	16	14	201
Colombia	18	16	25	24	21	25	26	29	27	17	12	222
Hong Kong	23	22	29	31	30	27	27	23	19	17	16	241
Indonesia	75	44	26	40	39	41	39	43	35	43	38	388
India	58	57	57	58	52	51	46	39	1	0	0	361
Korea	24	23	17	18	15	14	13	14	14	13	13	154
Mexico	27	21	26	27	30	23	22	20	18	17	12	216
Malaysia	35	33	33	28	24	19	20	20	15	14	13	219
Peru	17	15	21	17	13	12	12	12	12	10	8	132
Philippines	26	27	29	29	25	23	23	30	21	19	18	244
Paraguay	8	5	10	20	19	15	14	11	12	8	10	124
Singapore	13	13	10	8	10	8	7	6	4	5	3	74
Thailand	17	12	15	16	15	17	17	17	18	14	15	156
Uruguay	10	7	12	12	12	19	16	16	16	12	11	133
Venezuela	15	12	20	21	34	31	28	20	17	17	5	205
Total	530	435	503	518	490	474	465	447	370	328	275	4,305

BankScope from Bureau van Dijk and IBCA.

Table A2
Monetary policy indicators.

Country	Monetary policy indicator	Country	Monetary policy indicator
Argentina	money market rate	Hong Kong	Treasury bill rate
Bolivia	Treasury bill rate	India	discount rate
Brazil	Treasury bill rate	Indonesia	discount rate
Chile	discount rate	Korea	money market rate
Colombia	discount rate	Malaysia	Treasury bill rate
Mexico	Treasury bill rate	Philippines	Treasury bill rate
Paraguay	money market rate	Singapore	Treasury bill rate

Table A2 (*continued*)

Country	Monetary policy indicator	Country	Monetary policy indicator
Peru	discount rate	Thailand	money market rate
Uruguay	money market rate		
Venezuela	money market rate		

Table A3
Data summary statistics for the estimated concentration measures by economy, averages for the period 1996–2006.

Country	CR5	HHI
Latin American countries		
Argentina	0.5393	775.50
Bolivia	0.7494	1362.01
Brazil	0.4564	609.18
Chile	0.6899	1203.28
Colombia	0.5013	769.02
Mexico	0.7820	1614.75
Paraguay	0.6458	1084.84
Peru	0.7835	1709.05
Uruguay	0.7103	1601.85
Venezuela	0.6199	990.51
Asian countries		
Hong Kong	0.7554	2419.64
India	0.4179	648.27
Indonesia	0.6033	1009.46
Korea	0.5992	1009.51
Malaysia	0.5490	877.49
Philippines	0.5765	887.62
Singapore	0.9302	2460.05
Thailand	0.6981	1209.61

Table A4
Data summary statistics: Bank-specific characteristics by economy measured by balance sheet and financial strength indicators for the period 1996–2006.

Country	Size				Liquidity				Capitalization			
	Mean	Percentiles			Mean	Percentiles			Mean	Percentiles		
		25th	50th	75th		25th	50th	75th		25th	50th	75th
Latin American countries												
Argentina	1.58	0.11	0.35	1.08	0.39	0.24	0.35	0.50	0.22	0.09	0.13	0.27
Bolivia	0.40	0.17	0.32	0.63	0.13	0.07	0.11	0.17	0.14	0.07	0.10	0.14
Brazil	2.55	0.10	0.48	1.62	0.44	0.24	0.41	0.61	0.22	0.10	0.15	0.27
Chile	2.69	0.20	0.78	3.08	0.35	0.16	0.27	0.49	0.19	0.08	0.11	0.19
Colombia	1.17	0.30	0.82	1.65	0.33	0.17	0.27	0.42	0.13	0.09	0.12	0.14
Mexico	5.04	0.23	0.54	4.67	0.29	0.14	0.23	0.38	0.19	0.08	0.13	0.23
Paraguay	0.15	0.05	0.11	0.22	0.41	0.30	0.40	0.48	0.16	0.11	0.14	0.18
Peru	1.09	0.20	0.47	1.23	0.25	0.16	0.22	0.29	0.12	0.08	0.10	0.13
Uruguay	0.78	0.10	0.40	0.90	0.54	0.34	0.51	0.68	0.17	0.07	0.08	0.16
Venezuela	0.99	0.10	0.53	1.14	0.53	0.33	0.47	0.70	0.22	0.10	0.13	0.18
Asian economies												
Hong Kong	13.43	0.30	3.90	8.49	0.35	0.24	0.32	0.43	0.17	0.10	0.13	0.17
India	3.72	0.67	1.93	4.37	0.45	0.42	0.47	0.51	0.06	0.04	0.05	0.06
Indonesia	1.33	0.12	0.26	0.96	0.50	0.26	0.44	0.68	0.13	0.07	0.11	0.17
Korea	30.48	7.55	19.55	43.06	0.11	0.07	0.11	0.14	0.05	0.04	0.05	0.06
Malaysia	4.52	0.71	2.27	5.88	0.34	0.22	0.28	0.38	0.11	0.07	0.09	0.12
Philippines	1.82	0.26	0.85	2.56	0.28	0.19	0.25	0.34	0.17	0.11	0.14	0.19
Singapore	13.99	0.33	2.14	23.19	0.29	0.13	0.27	0.39	0.23	0.11	0.15	0.23
Thailand	8.99	1.44	5.42	15.61	0.23	0.11	0.19	0.30	0.10	0.05	0.07	0.10

Notes: Size is measured in billions of 2000 US dollars. The liquidity variable is measured as the ratio of liquid assets to total assets. The capitalization variable is measured as the ratio of equity to total assets.

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