The bank lending channel in Chile[1]

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1. Introduction

Modigliani and Miller (1958) undermined enthusiasm about the role of credit in the economy by suggesting that the capital structure of the firm was mostly irrelevant. Moreover, the strong and robust correlation between money and real variables found in the empirical literature of the 1960s provided strong support for the view that the main transmission mechanism for monetary policy operates through changes in the cost of capital and their impact on investment (the interest rate channel).[2] In that view, banks were important only because they created money. In the 1970s, however, the new field of the economics of information underscored the relevance of capital market imperfections and the uniqueness of bank loans against other forms of debt.[3] In this context, the "credit view" emerged as a new way of understanding the monetary policy transmission mechanism. This literature distinguishes between two subchannels, namely the broad credit channel and the bank lending channel, although more recent interpretations of the role that banks play in the transmission of monetary policy highlight the interaction between the two channels.[4]

This paper focuses on the bank lending channel, which emphasises the role played by banks in the transmission of monetary policy.[5] Thus, if the central bank follows a tight monetary policy, interbank lending is curtailed and the supply of funds for banks drops. Some banks might succeed in raising funds elsewhere, thus insulating their loan portfolios against monetary policy. Other banks, however, are forced to curtail their supply of credit, especially in the face of a strong negative monetary shock. Such a decrease in the bank loan supply is likely to be heterogeneous, as well, in the sense that heavily indebted households and small and medium-sized enterprises (SMEs), which are presumably bank-dependent, are crowded out of the market for bank loans and become severely financially constrained.[6] On the other hand, less binding adverse selection and moral hazard problems allow

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[2] See, for example, Friedman and Schwartz (1963).

[3] The seminal paper is Akerlof (1970). The author draws on the market for used cars to illustrate the problem caused by asymmetric information between dealers and buyers. Later references include Jaffee and Russell (1976), Townsend (1979), Stiglitz and Weiss (1981) and Diamond (1984), among many others.

[4] See, for example, Huang (2003).

[5] The broad credit channel (also known as the balance sheet channel) is related to the supply of credit by all financial intermediaries, emphasising the role of asymmetric information in the existence of an external financing premium. This premium is defined as the difference in the costs of external and internal financing. The external financing premium depends negatively on the net worth of a potential borrower and positively on the stance of monetary policy. Hence, it is a financial accelerator mechanism that amplifies the effects of monetary policy on investment and consumption decisions. See the Appendix for an overview of how both the broad credit channel and the bank lending channel are related to the whole set of monetary transmission mechanisms.

[6] Because of their comparative advantages in information collection and processing, as well as their capacity to establish long-term relationships with their customers, banks are the only intermediaries able to offer credit to certain types of borrowers. However, banks that serve customers without any other market alternative have to deal with an asymmetric information problem, since it is difficult for the market to value their loan portfolios. Those banks will therefore experience difficulties in substituting their financial sources. For example, Goldberg et al (2002), using a survey on small firms conducted by the Federal Reserve, find that larger banks rely on standard techniques based on financial statements to make their commercial loan decisions. Smaller banks tend to deviate from these criteria, supporting their decisions with a much more personalised assessment of the entrepreneurs (of SMEs). In other words, the role played by asymmetric

large enterprises to maintain, if not increase, their access to domestic bank loans and other domestic financial sources.[7] As a result, the bank lending channel exacerbates the impact of a negative monetary policy shock in aggregate spending.

In distinguishing between movements in the demand and supply of bank credit - a key issue for interpreting the evidence on the bank lending channel - we follow a strategy of identification through heterogeneity, by comparing economic agents that are more likely to be affected by financial frictions with economic agents that are less likely to be so affected. In the words of Gilchrist and Zakrajsek (1995): "By observing and measuring the differential behavior of economic agents under consideration, one can potentially attribute some, if not all, of the difference in behavior to frictions caused by credit markets".

Although we are well aware that the asymmetric nature of financial frictions also implies time-varying differences, that is, in and out of times of tight monetary policy, we concentrate on explaining cross-sectional differences by following a two-step approach. First, we follow a panel data approach to test how bank characteristics (size, liquidity and capitalisation) affect the response of loan supply after a change in monetary policy. Second, using the evidence gathered in the previous step regarding the main forces behind the bank lending channel, we construct an aggregate variable - the low-/high-quality ratio - aimed at capturing the availability of bank credit to households and SMEs vis-à-vis large enterprises. Using the low-/high-quality ratio, we test - within a vector autoregression (VAR) system - whether the bank lending channel exacerbates the effect of a monetary policy shock on macroeconomic activity.

Our panel data approach is closely related to Hernando and Martínez-Pagés (2001) and, to a lesser extent, to Kashyap and Stein (1995, 2000) and Kishan and Opiela (2000).[8] Our VAR approach is mainly related to Gilchrist and Zakrajsek (1995). Using this two-step approach, we conclude that the bank lending channel operated as a monetary policy transmission mechanism in Chile within the sample period, having a significant impact on macroeconomic activity.

The rest of the paper is organised as follows: Section 2 describes the data, Section 3 examines some methodological issues and presents the empirical results, and Section 4 concludes.

2. The data

The data used in this paper come mainly from financial statements of banks and publicly listed enterprises.[9] Our data set covers the period from the first quarter of 1990 to the second quarter of 2002. We also make use of several macroeconomic series, which are mostly taken from the Central Bank of Chile database.

When using bank statements, we consider only banks that are active participants in the credit market, excluding branches of foreign banks that are mainly engaged in cash and portfolio management activities.[10] This diminishes the problems associated with heterogeneous demand shocks, because

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information is twofold: it affects the capacity of some banks to raise funds in situations of low market liquidity, and it generates a set of captive customers among banks.

7 For example, if large firms are at the same time being directly affected by an external shock that is restricting their access to international financial markets, they will satisfy their financial needs domestically, thereby further crowding other agents out of financial markets. In addition to taking out bank loans, large Chilean enterprises have been actively issuing new domestic bonds in recent periods.

8 See Cavieres (2002) for a study about the bank lending channel in Chile that closely follows Kishan and Opiela (2000).

9 The bank statements are published in the statistical bulletin of the Superintendency of Banks and Financial Institutions (SBIF); the statements of publicly listed enterprises are taken from a data set assembled by the Santiago Stock Exchange containing all the information provided by the Fecu (ficha estadística codificada uniforme), a standardised statement that every listed company in Chile is required to file quarterly.

10 When estimating the panel data, the original data set is adjusted slightly to take into account mergers that occurred during the sample period. We follow the intermediate strategy proposed by Hernando and Martínez-Pagés (2001), generating a new bank when a merger of banks of similar size takes place. If the merger is between banks of significantly different sizes, the data of the merged bank is considered as data of the largest merging institution and no new bank appears.

the share of different types of loans in the banks' portfolios does not differ significantly (Table 1). Even after this adjustment, our data set is quite representative of the credit market, accounting for more than 90% of total loans at any point in time (Graph 1).

Table 1

Characteristics of the banking system[1]

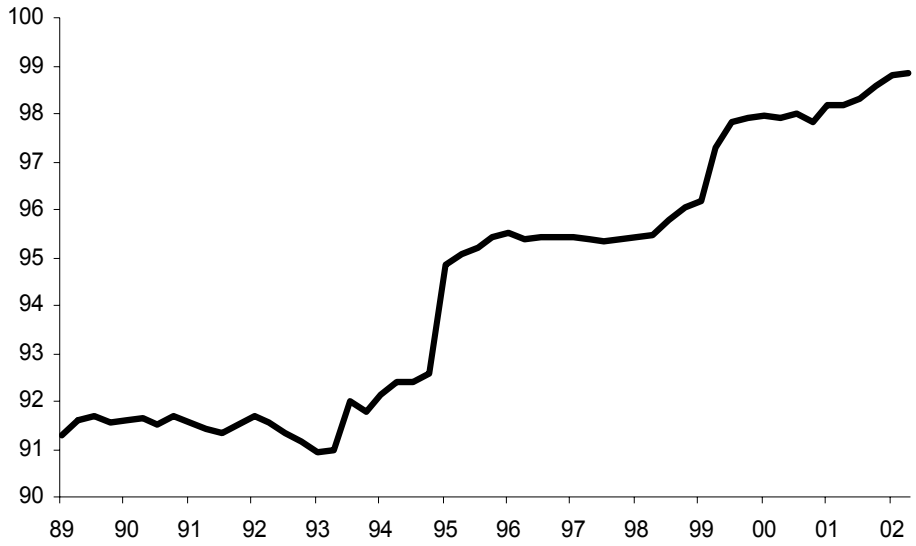
	Size				Capitalisation			
	<p25	**p25-50**	**p50-75**	**>p75**	**<p25**	**p25-50**	**p50-75**	**>p75**
Market share (%) of								
Total assets	3.9	10.0	23.1	63.0	29.5	40.0	22.8	7.7
Loans	1.1	4.5	20.5	73.9	36.6	46.2	16.5	0.8
Deposits	1.4	5.2	20.6	72.8	35.5	46.0	17.2	1.3
Size indicator								
Average number of bank branches	2.7	12.5	31.3	113.6	78.7	87.3	29.3	1.2
Average total assets[2]	12,134	32,117	71,944	205,512	122,428	180,964	97,110	34,403
Asset composition (%)	12.9	20.3	40.2	53.1	55.4	51.6	32.2	4.7
Loans	11.6	18.9	38.9	50.7	53.5	49.3	30.0	3.1
Commercial loans	44.3	44.7	57.4	57.0	59.4	58.9	53.4	48.3
Consumer loans	13.6	27.0	10.3	6.1	11.7	7.8	8.7	5.5
Mortgage loans	0.5	2.6	12.3	16.4	11.6	17.6	20.3	0.1
Other loans	41.7	25.7	19.9	20.5	17.3	15.8	17.6	46.1
Securities	6.8	7.8	9.6	14.7	8.8	12.8	10.6	4.6
Other assets	81.6	73.3	51.5	34.6	37.7	38.0	59.3	92.3
Liability composition (%)								
Deposits	51.2	68.4	63.9	62.5	66.3	64.3	61.1	52.0
Overnight deposits	7.5	4.8	8.6	14.1	11.4	12.7	13.4	7.2
Time deposits	43.8	63.6	55.3	48.4	54.9	51.6	47.7	44.8
Mortgage bonds	0.4	2.0	14.7	16.9	17.1	18.4	18.1	0.1
Foreign loans	8.0	9.5	6.7	7.7	4.6	4.2	5.7	2.8
Subordinate bonds	0.0	0.2	1.8	1.7	2.3	2.3	1.2	0.0
Stock of provisions	1.4	2.6	2.4	2.6	2.1	1.9	2.0	1.0
Capital and reserves	38.9	17.3	10.4	8.6	7.6	8.9	12.0	44.0

[1] This analysis is performed for the whole sample period (1990-2002). P*xx* refers to the corresponding percentile of the distribution of banks by asset size and capitalisation. The percentiles are calculated for each quarter separately. [2] In millions of pesos.

Sources: SBIF; authors' calculations.

Graph 1

Share of total loans for banks included in the sample, in per cent



Source: SBIF.

From these bank statements we collect total loans, consumer loans and commercial loans. The distinction between consumer loans and commercial loans also points towards a better identification of movements in the supply of credit.[11] Indeed, evidence indicates a differential behaviour of various types of loans during the business cycle (Graph 2), which suggests that diverse types of loans may be affected differently by demand shocks.

We also collect our proxies for bank characteristics - size, liquidity and capitalisation - which are based on how the existing empirical literature about the bank lending channel captures the potential problems associated with asymmetric information.[12] Size is defined as the bank's share of the total assets of the banking system; liquidity is defined as the ratio of liquid assets to total assets; and capitalisation is defined as the seasonally adjusted ratio of capital and reserves to total assets. Table 2 presents the main descriptive statistics on this set of bank characteristics.

Table 2

Descriptive statistics on bank characteristics[1]

	Mean	Standard error	Minimum	Maximum	p25	p50	p75
Size	4.21	4.01	0.03	19.04	0.87	3.24	5.92
Liquidity	20.69	9.01	4.48	53.92	13.41	19.58	27.26
Capitalisation	8.76	9.43	1.09	63.44	4.64	5.68	7.95

[1] P*xx* refers to the corresponding percentile of the distribution of banks by asset size, liquidity and capitalisation.

Source: Authors' calculations.

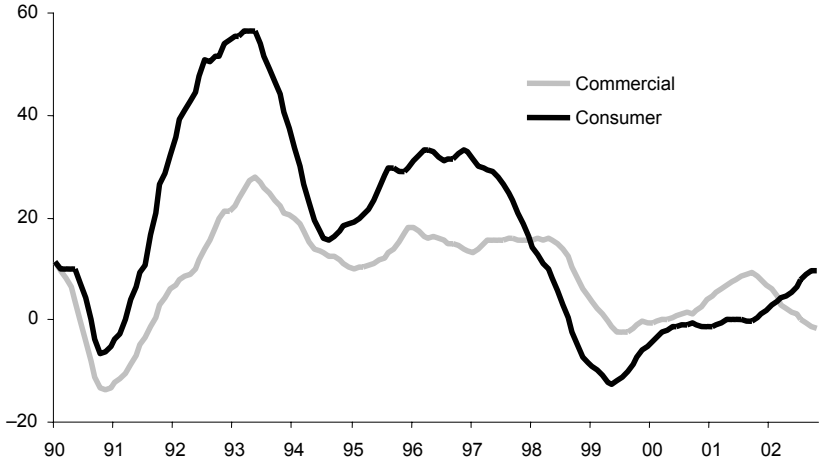
[11] As suggested by Hernando and Martínez-Pagés (2001).

[12] See, for example, Kashyap and Stein (1995, 2000) and Kishan and Opiela (2000).

Graph 2

Annual growth of consumer and commercial loans

All banks, moving average in per cent



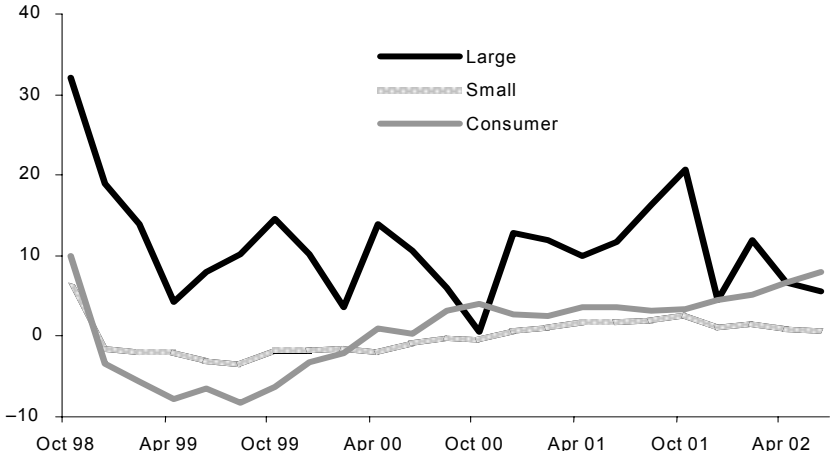
Source: SBIF.

From the statements of publicly listed enterprises, we take the total large corporate sector bank debt. Using this variable as the denominator and the consumer loans of the banking system as the numerator, we construct a variable that we call the low-/high-quality ratio, to capture the availability of bank credit to households and SMEs vis-à-vis large enterprises. Two features of this ratio deserve further explanation: the extent to which consumer loans capture not only household credit but also loans directed to SMEs; and the relation of this ratio to a flight to quality. With regard to the first feature, we could have measured credit to SMEs more directly using data that is available by loan size, but this series is only available as from 1996, and with less than quarterly frequency. However, when graphing the small business loans and consumer loans together (Graph 3), the two series follow a relatively similar path (the correlation is over 90%). Credit to SMEs is, in fact, known to usually take the form of a consumer credit in the Chilean banking industry, whereas credit to large enterprises follows a very different path.

Graph 3

Annual growth of small, large and consumer loans

In per cent



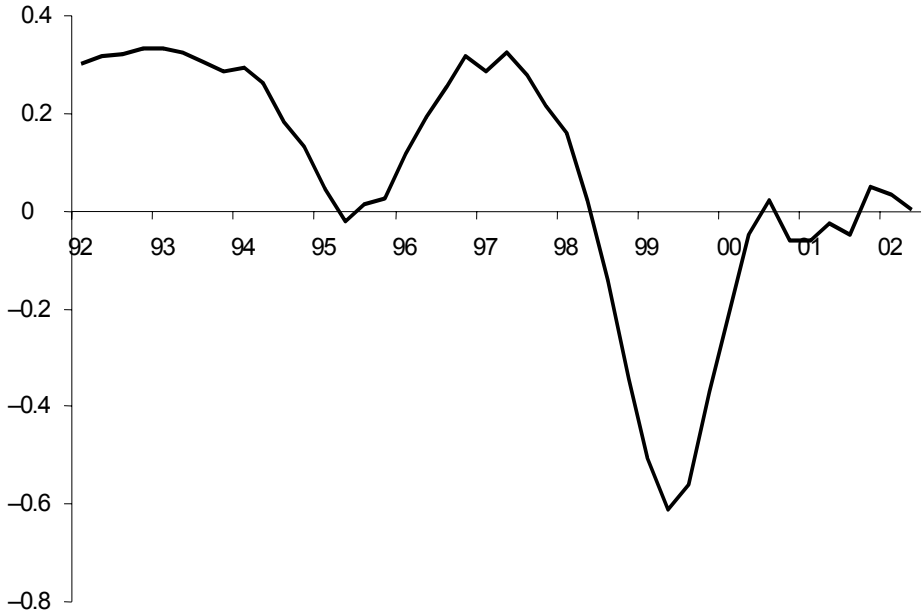
Source: SBIF.

With regard to the second feature, our low-/high-quality ratio is (inversely) related to the indicator of a flight to quality constructed by Caballero (2002) using precisely the share of large loans from the available data by loan size. Although our story is different from Caballero's, in the sense that we are trying to pin down the effect of a monetary policy shock instead of an external shock, the operative financial mechanism is basically the same: indebted consumers and especially SMEs are crowded out of the banking system by large firms, thus becoming severely financially constrained. Graph 4 shows a severe flight to quality effect in 1998-99, a period of extremely tight monetary policy.

Graph 4

Annual growth in low-/high-quality ratio

Moving average, in per cent



Sources: Central Bank of Chile; authors' calculations.

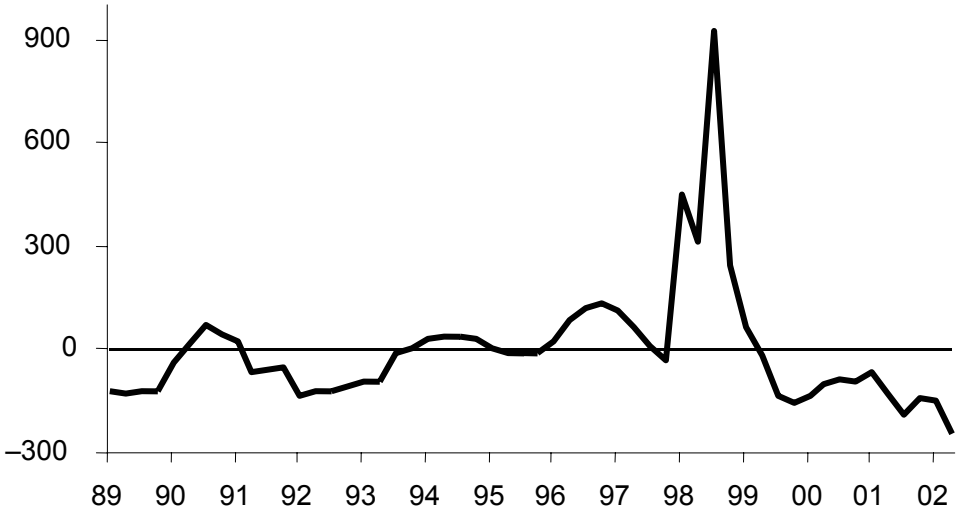
To identify the effect of a monetary policy shock on the supply of bank loans, we need an indicator that is closely tied to monetary policy. The international empirical literature offers several alternatives, but the set of choices in the case of Chile is limited by data availability. Within this limited choice set, we choose the term spread, defined as the difference between the monetary policy rate and the PRC8.[13] As explained in Gertler and Lown (2000), a positive movement in the term spread (so defined) simply reflects the fact that the monetary tightening is inducing a fall in long-term rates, because there are expectations of a drop in the short-term interest rate in the near future (Graph 5).

[13] The PRC8 are long-term indexed bonds issued by the Central Bank of Chile. See Estrella and Mishkin (1998) for a positive assessment of the predictive power of the term spread; see Gertler and Lown (2000) for an explanation of the close relationship between the term spread and monetary policy, particularly in periods of significant monetary tightening.

Graph 5

Term spread

In basis points



Source: Central Bank of Chile.

Finally, we use several macroeconomic series in the panel and the VAR system. Specifically, in the panel of banks we use the annual growth of real GDP to capture changes in income, and the annual depreciation of the real exchange rate to capture movements in relative prices. Both variables are intended to control for demand effects. In the VAR system, we use three additional endogenous variables (besides the low-/high-quality ratio and the term spread): namely, a proxy for macroeconomic activity (in logs and seasonally adjusted), the consumer price index (in logs and seasonally adjusted) and the real exchange rate (in logs). We use six different proxies for macroeconomic activity: real GDP, industrial production, business investment, durable goods consumption, unemployment rate and residential investment. In addition to these endogenous variables, every VAR model includes the following set of exogenous variables: terms of trade, inflation target, external output and a time trend.[14]

3. Methodological issues and empirical results

Our main goal in this section is to analyse whether the bank lending channel played any role as a transmission mechanism for monetary policy in the Chilean economy during the period 1990-2002 and, if so, whether this transmission mechanism plays any significant macroeconomic role. We follow a two-step approach. First, we use a panel of bank data to identify shifts in the loan supply curve in response to changes in monetary policy by exploiting the heterogeneity among banks. Such an exercise lets us gather evidence about where the bank lending channel has operated most strongly. Second, we use that knowledge to construct a variable that is likely to be a good proxy of how the

[14] This is justified on the grounds that Chile is a small open economy with an inflation target regime operating since the early 1990s. In particular, by including the terms of trade, we are controlling for external shocks. Hence, if we find that the low-/high-quality ratio influences economic activity following a monetary policy shock, we can interpret the flight to quality effect as being domestically driven.

bank lending channel exacerbates the monetary policy shock, thus having an independent and significant impact on aggregate spending. This variable is the low-/high-quality ratio, which captures the availability of bank credit to households and SMEs vis-à-vis large enterprises. Here again, we appeal to heterogeneity for identification purposes, this time among borrowers. Finally, we embed the low-/high-quality ratio within a VAR system to test whether the bank lending channel exacerbates the effect of a monetary policy shock on macroeconomic activity.

3.1 First step: a panel of bank data

As discussed in the introduction, a tight monetary policy reduces the amount of funds available to the banking system, and some banks are unable to offset the reduction in interbank funds owing to information problems. How do bank characteristics affect the response of loan supply following a monetary policy shock? To answer this question, we follow a panel data approach in which bank characteristics (size, liquidity and capitalisation) interact with the term spread (our indicator of monetary policy) to disentangle the differential behaviour of banks with regard to total loans, consumer loans and commercial loans.

In this panel model, the dynamic structure is adequately handled by introducing one lag for the endogenous variable and four lags for the term spread, the variables aimed at controlling for demand effects and the variables related to bank characteristics. Although including a lag of the dependent variable is trivial in the time-series context, the fixed-effects estimator is severely biased in a dynamic context. Instead of following the traditional approach to dealing with such a problem - namely, the Arellano and Bond generalised method of moments (GMM) procedure - we use the bias-corrected estimator proposed by Hahn and Kuersteiner (2002).[15]

The empirical specification within this panel data approach is the following:

$$y_{it} = \rho y_{it-1} + \sum_{j=0}^{4} x'_{it-j}\beta + z'_{it-1}\gamma + \sum_{j=1}^{4} x_{3it-j} z'_{it-1}\phi + \sum_{s=1}^{4} \sigma D_{st} + u_{it},$$

where y_{it} represents the annual growth of total loans, commercial loans and consumer loans, respectively; x_{it} is a vector of macroeconomic variables aimed at controlling demand side shocks (annual growth of GDP and annual depreciation of the real exchange rate) in addition to the monetary policy indicator (term spread); z_{it} denotes a vector of bank-specific variables (liquidity, size and capitalisation); D is a set of seasonal dummies; u_{it} is iid; $i = 1, ..., N$ represents the number of banks included in the data set; and $t = 1, ..., T$ is the time index from the first quarter of 1990 to the second quarter of 2002. Note that the bank-specific explanatory variables z_{it} are included with one lag to account for potential endogeneity.

We disentangle loan supply from loan demand effects by looking at cross-sectional differences in the response of bank loans to a monetary policy shock. Were these differences to be related to indicators of the degree of informational asymmetries (size, liquidity, or capitalisation), they would support the existence of the bank lending channel. More specifically, if the bank lending channel holds, we should expect a positive and significant cross-coefficient between the term spread and bank characteristics.

Table 3 shows the long-run coefficients for each of the explanatory variables. First, note that the long-run coefficient for the annual growth of real GDP, when statistically significant, is positive. Second, the long-run coefficient for annual real depreciation is always significant and negative. Third, the long-run coefficient of the term spread, which is positively related with a tighter monetary policy, is always significant and negative. Finally, regarding the interaction of bank characteristics with monetary policy, the results show that liquidity is always significant and positive, size is positive and significant only for total loans, and capitalisation is positive and significant only for consumer loans.

[15] The Arellano and Bond GMM procedure is subject to substantial finite sample bias, as shown by Alonso-Borrego and Arellano (1999) and Hahn et al (2002). For a more technical discussion of the methodological issues, see Brock and Franken (2003).

Table 3

Long-run coefficients and standard errors

Dependent variable	Coefficient	Standard error
1. Growth of total loans		
Real GDP growth	0.57*	0.19
Real exchange rate devaluation	–0.93*	0.11
Term spread	–4.31*	0.46
Bank characteristic and term spread:		
Liquidity	7.83*	1.56
Size	13.24*	2.83
Capitalisation	–1.43	3.85
2. Growth of consumer loans		
Real GDP growth	1.09*	0.19
Real exchange rate devaluation	–0.20**	0.10
Term spread	–2.65*	0.57
Bank characteristic and term spread:		
Liquidity	6.41*	1.66
Size	3.44	3.89
Capitalisation	5.39*	1.37
3. Growth of commercial loans		
Real GDP growth	–0.02	0.37
Real exchange rate devaluation	–1.71*	0.21
Term spread	–6.85*	0.99
Bank characteristic and term spread:		
Liquidity	13.59*	4.01
Size	2.22	4.21
Capitalisation	–3.94	6.28

Note: * 1% significance level; ** 5% significance level.

Table 4 shows the overall effects of a tight monetary policy in terms of the annual growth rate of total loans, consumer loans and commercial loans.[16] As can be seen from the table, tightening monetary policy results in a larger drop in the growth rate of total loans for small banks than for large banks.[17] In addition, the drop in the growth rate of all types of loans is larger for less liquid banks than for their

[16] The overall effects include the direct effect of monetary policy plus the interactive effects of bank characteristics with monetary policy. If the parameter is non-significant, it is computed as being equal to zero. Bank characteristics are evaluated at three representative levels for each category.

[17] A 1 percentage point increase in the term spread accounts for an annual reduction of 4.2% in total loans when the bank is small, but only 3.5% when the bank is large.

more liquid counterparts.[18] In the case of consumer loans, the bank lending channel operates through less capitalised banks.[19]

Table 4

Overall effect of a monetary policy shock on the rate of growth of loans[1]

	Size			Capitalisation			Liquidity		
	p25	**p50**	**p75**	**p25**	**p50**	**p75**	**p25**	**p50**	**p75**
Total	–4.2	–3.9	–3.5	–4.3	–4.3	–4.3	–3.3	–2.8	–2.2
Consumer	–2.6	–2.6	–2.6	–2.4	–2.3	–2.2	–1.8	–1.4	–0.9
Commercial	–6.9	–6.9	–6.9	–6.9	–6.9	–6.9	–5.0	–4.2	–3.1

[1] P*xx* refers to the corresponding percentile of the distribution of banks by asset size, capitalisation and liquidity.

Our preliminary results thus support the idea that the bank lending channel has operated in Chile. Furthermore, consumer loans seem to better capture the role played by informational asymmetries in the response of bank lending to monetary policy shocks. Indeed, both liquidity and capitalisation have played a restrictive role for consumer loans, while commercial loans have only been affected by liquidity. We argued above that consumer loans are a reasonably good proxy for bank credit directed to both households and SMEs. Hence, our results in this first step suggest that the decrease in banks' loan supply may have actually been heterogeneous, affecting more SMEs and, to a lesser extent, highly indebted households, than large enterprises. The next step concentrates on providing more solid evidence along these lines.

3.2 Second step: a VAR system including an aggregate proxy for the bank lending channel

The fact that banks' loan supply affects borrowers heterogeneously can be exploited to identify how the bank lending channel magnifies a monetary policy shock. We therefore construct the low-/high-quality ratio to capture the availability of bank credit to households and SMEs vis-à-vis large enterprises.[20] More specifically, we ask the following question regarding the impact of monetary policy on the real sector of the economy: does the bank lending channel play any significant macroeconomic role as a monetary transmission mechanism? To answer it, we analyse whether the low-/high-quality ratio has marginal predictive power over a set of macroeconomic variables.

We expect a negative monetary policy shock to reduce the low-/high-quality ratio (flight to quality), which would strongly affect bank-dependent households and SMEs by eliminating their only source of external funding.[21] For example, casual evidence for the Chilean economy shows that SMEs have

[18] A 1 percentage point increase in the term spread accounts for an annual reduction of 3.3% in total loans, 1.8% in consumer loans and 5.0% in commercial loans for a less liquid bank. On the other hand, a 1 percentage point increase in the term spread accounts for an annual reduction of only 2.2% in total loans, 0.9% in consumer loans and 3.1% in commercial loans for a highly liquid bank.

[19] A 1 percentage point increase in the term spread accounts for an annual reduction of 2.4% in consumer loans when the bank is less capitalised, but only 2.2% when the bank is more capitalised.

[20] See Section 2 for a more detailed explanation of this particular variable.

[21] See footnote 5.

quite limited access, if any, to bond-issuing or capital-raising on the stock market.[22] In other words, the decline in the low-high-quality ratio represents a decrease in the portion of banks' loan supply directed to those economic agents (households and SMEs) which bear the largest share of the costs associated with information problems. This may, in turn, have a significant effect on economic activity.[23]

The empirical approach used in this section consists in estimating a set of VAR models in levels, each of which includes the low-/high-quality ratio that accounts for the existence of the bank lending channel. Four endogenous variables are also included, namely the term spread as the indicator of the monetary policy stance, a proxy for macroeconomic activity (with six different alternatives), the real exchange rate and the price level. Finally, every model includes a set of exogenous variables: terms of trade, inflation target, external output and a time trend.[24]

To assess the macroeconomic importance of the bank lending channel, we test for the marginal predictive power of the credit variable (low-/high-quality ratio) by carrying out Granger causality tests and reporting the corresponding p-values. A rejection of the null hypothesis that the credit variable is irrelevant for predicting macroeconomic activity is one piece of evidence in favour of the bank lending channel. This evidence has to be complemented with two simultaneous conditions, however: rejection of the null hypothesis that the term spread is irrelevant for predicting the credit variable, and failure to reject the null hypothesis that the proxy for macroeconomic activity is useless in predicting the credit variable. In other words, the bank lending channel requires that lagged values of the term spread be significant in predicting the credit variable, which in turn must be significant in predicting either macroeconomic activity or other macroeconomic variables.

Table 5 shows the Granger causality test for each VAR model. The results support the hypothesis that the low-/high-quality ratio predicts macroeconomic variables in all cases. These results also indicate that the lags of the term spread are significant for predicting macroeconomic variables in just three out of six cases.[25] On the other hand, macroeconomic variables are not helpful for predicting the low-/high-quality ratio in each case, whereas the term spread is helpful for predicting the low-/high-quality ratio in all cases. The empirical evidence thus strongly supports a causality running from monetary policy to credit and from credit to macroeconomic activity.

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[22] This is consistent with the international empirical evidence, which shows that finding alternative sources of credit is quite difficult for SMEs.

[23] The drop in the supply of bank credit pushes SMEs to curtail their productive activities, which are usually labour-intensive. This has a strong impact in terms of job destruction, since the affected workers are generally unskilled and thus difficult to absorb into other sectors of the economy. Because increasing unemployment rates are strongly correlated with consumer confidence (in the United States and elsewhere), aggregate demand falls. Hancock and Wilcox (1998) find that small banks engage in "high power" credit activities, with a drop in their credit supply having a large impact on economic activity measured in terms of unemployment, real wages, GDP and number of bankruptcies.

[24] We use a two-step procedure to define the optimal lag structure (Johansen (1995)): the first step uses the Schwarz Bayesian criterion; the second step adds additional lags for eliminating any evidence of serial correlation detected by the multivariate LM test statistics for residual serial correlation.

[25] At the 5% level of significance.

Table 5

VAR pairwise Granger causality/block exogeneity Wald tests
p-values from exclusion tests

Models classified according to proxies for macroeconomic activity	Variables exclude from:			
	Macroeconomic activity equation	p-values	Low-/high-quality ratio equation	p-values
GDP[1]	Monetary policy shock Low-/high-quality ratio	95.6% 0.0%	GDP Monetary policy shock	73.6% 0.2%
Industrial production[1]	Monetary policy shock Low-/high-quality ratio	4.5% 0.5%	Industrial production Monetary policy shock	90.7% 0.6%
Business investment[1]	Monetary policy shock Low-/high-quality ratio	68.7% 0.0%	Business investment Monetary policy shock	66.5% 0.2%
Durable consumption[2]	Monetary policy shock Low-/high-quality ratio	0.2% 1.9%	Durable consumption Monetary policy shock	52.6% 3.3%
Unemployment rate[1]	Monetary policy shock Low-/high-quality ratio	44.7% 0.0%	Unemployment Monetary policy shock	95.6% 0.8%
Residential investment[2]	Monetary policy shock Low-/high-quality ratio	3.1% 1.9%	Residential investment Monetary policy shock	55.4% 2.5%

Note: This table shows the results obtained from six VAR models. Each one uses a different option for measuring macroeconomic activity: real GDP, industrial production, business investment, durable consumption, unemployment rate and residential investment, respectively. Each proxy is added one at a time to the base VAR. The base model is comprised of five variables: real GDP, CPI, term spread, low-/high-quality ratio and real exchange rate. The exogenous variables are terms of trade, inflation target, external output and a time trend.

The numbers in the table are the p-values for the null hypothesis that some variables do not contain information for the dependent variable. For each model, we pick the equations representing both the proxy for macroeconomic activity and the credit variable (low-/high-quality ratio). Then we perform the following tests:

(i) Term spread and the credit variable do not Granger cause macroeconomic activity; and

(ii) Macroeconomic activity and monetary policy do not Granger cause the credit variable.

If p-values are lower than 5% we can reject the null hypothesis.

[1] Endogenous variables two lags, exogenous variables two lags. [2] Endogenous variables three lags, exogenous variables two lags.

To study the dynamics of the bank lending channel, we estimate a structural vector autoregression (SVAR) and report impulse responses to a monetary policy shock. The set of identifying assumptions is borrowed from a vast list of authors who use this type of identification scheme in VAR models.[26] Variables are thus divided into three recursive sets: non-policy variables that are not contemporaneously affected by policy variables; policy variables; and non-policy variables that are contemporaneously affected by policy variables.[27] In other words, the central bank's feedback rule is identified by dividing the set of non-policy variables into variables that cause a policy reaction and variables that are affected by the policy reaction. For the policy variables, we assume the following sequence of events: the central bank first sets an inflation target, which is an exogenous variable, and then sets the monetary policy stance.[28] For the non-policy variables, we assume a recursive causal relationship ordered as follows: price level, output and the credit variable.[29] Our positioning of the variable used as a proxy for the bank lending channel (low-/high-quality ratio) in last place is based on the assumption that the central bank is able to affect it contemporaneously through the monetary policy stance, since capital markets tend to respond faster than goods and labour markets.[30]

Graph 6 displays the estimated impulse responses (black lines). The low-/high-quality ratio decreases following the monetary policy shock, a result that is consistent with a flight to quality effect as described above. GDP declines about two quarters after a tightening in monetary policy. The maximum decline occurs about a year after the shock, and the effect gradually dies out thereafter. We observe a similar pattern when GDP is replaced by industrial production or unemployment rate, although the effect seems to be more persistent in the latter case.

When both investment and durable consumption replace GDP, these two components of aggregate output decline during the first year and a half. This result differs from the international empirical evidence. For example, Bernanke and Gertler (1995) find evidence that in the United States the decline of durable consumption and residential investment precedes that of business fixed investment. Their interpretation is against the conventional monetary policy transmission mechanism that operates through an earlier decline in investment. In the Chilean case, however, the impulse responses indicate that durable consumption and both types of investment decrease at approximately the same time. We interpret this as evidence that both transmission mechanisms are relevant for Chile.

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[26] See, for example, Bernanke and Blinder (1992), Gertler and Gilchrist (1994), Eichenbaum and Evans (1995), Strogin (1995), Christiano et al (1996, 1997, 1999) and Bernanke and Mihov (1998). For the case of Chile, see Bravo and García (2002).

[27] In our particular case, we use an exactly identified VAR because additional identifying restrictions in the parameters do not change the results obtained in the impulse response functions.

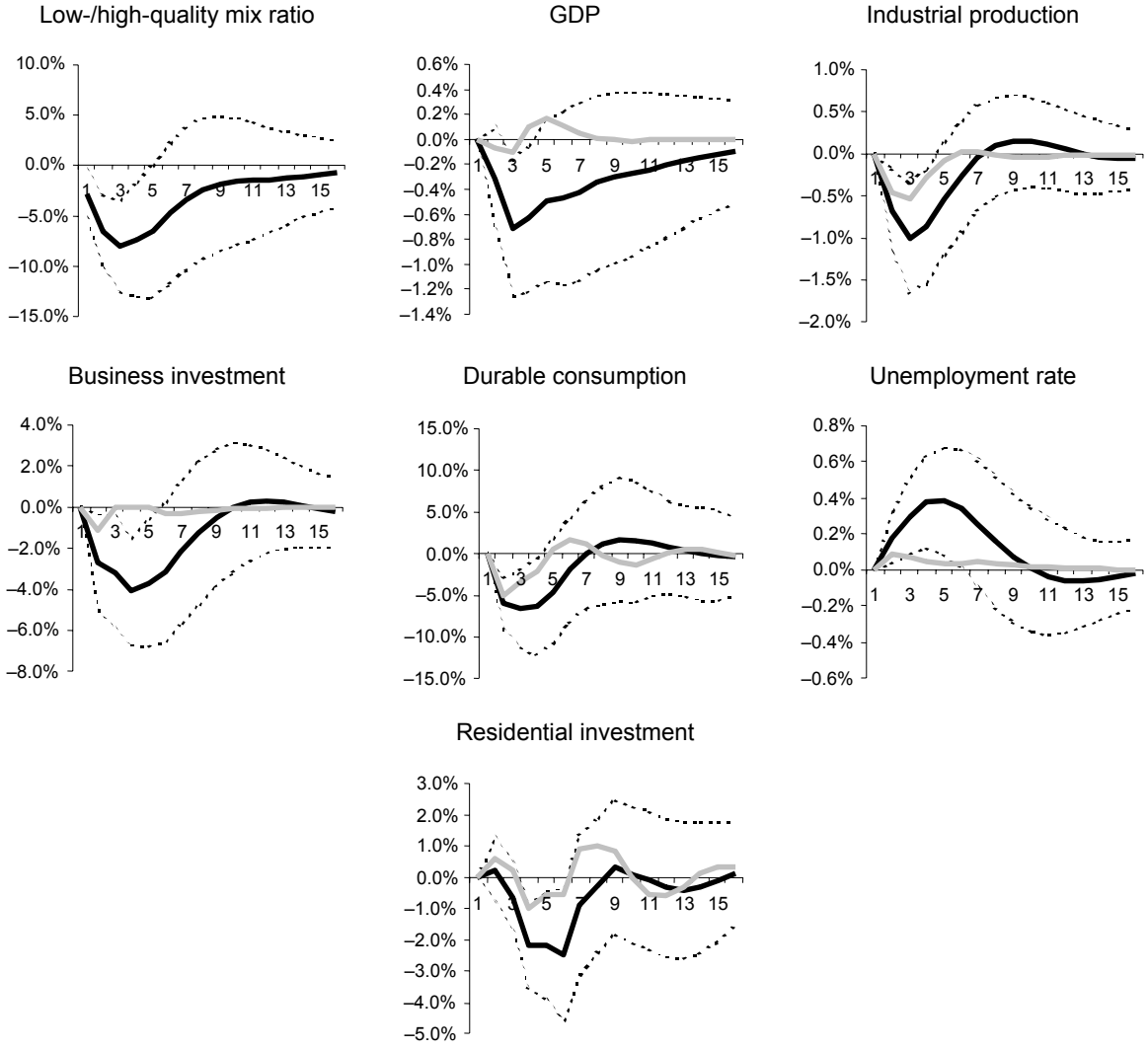
[28] This assumption is consistent with the fact that the monetary policy rate is used as a fine-tuning policy, given a known inflation target.

[29] The assumption behind this order is that the price level is stickier than output, a fact that is consistent with the high level of backward indexation in the Chilean economy (Jadresic (1996)).

[30] To illustrate the identifying assumptions described above, assume that the central bank contemporaneously knows the evolution of the inflation rate but is not able to affect it. If the economy faces an inflationary shock (an oil shock, for instance), the central bank could respond with a change in the monetary policy rate. This, in turn, would have an immediate impact on other variables, such as the low-/high-quality ratio and the exchange rate. Only then might monetary policy affect variables such as GDP, investment, consumption and inflation.

Graph 6

Responses to structural one SD innovations ± 2 SE on monetary policy shock[1,2,3]



[1] For VAR specification see Table 5. [2] Black lines for the bank lending channel (low-/high-quality ratio) being endogenous. [3] Grey lines for the bank lending channel (low-/high-quality ratio) being exogenous.

The empirical strategy described above allows us to compare the impulse responses to a monetary policy shock in two different systems, in which the variable used as a proxy for the bank lending channel (ie the low-/high-quality ratio) is first defined as endogenous (black lines) and then as exogenous (grey lines). Shutting down the bank lending channel effect on other macroeconomic variables following a monetary policy shock establishes a measure of the macroeconomic relevance of the bank lending channel: namely, the difference between the two impulse responses.[31] To determine whether this difference is statistically significant, we display the dashed lines that represent a 95% confidence interval for each impulse response function when the bank lending channel is endogenous.

[31] From the Granger causality tests, we already know that the empirical evidence strongly supports a causality running from monetary policy to credit and from credit to macroeconomic activity. What we are doing here, therefore, is determining whether the flight to quality effect occurs as a result of a monetary policy shock or is driven by other factors.

If the impulse response functions calculated under the assumption that the credit variable is exogenous fall outside this confidence interval, we interpret this as evidence in favour of the macroeconomic relevance of the bank lending channel.

What do we find? The bank lending channel is unambiguously relevant in terms of GDP, business investment and the unemployment rate, since the responses of these variables are definitely much weaker if the proxy for the bank lending channel is exogenously included in the system. The other results also support the macroeconomic relevance of the bank lending channel to a degree, since durable consumption, residential investment and industrial production are on the brink of being statistically different from the case of an endogenous bank lending channel.[32]

4. Concluding remarks and directions for future research

We conclude that the bank lending channel operated as a monetary policy transmission mechanism in Chile during the period 1990-2002, with an independent and significant effect in terms of macroeconomic activity. The way that the bank lending channel seems to have operated in Chile is consistent with the international empirical evidence: first, some banks - less liquid banks and, to a lesser extent, smaller and less capitalised banks - are forced to curtail their supply of credit following a monetary policy shock; second, the access of households and SMEs to external financing is severely restricted following the drop in the supply of bank credit; third, the uneven distribution of the drop in the supply of bank credit, which can be associated with a flight to quality effect, has a significant influence in terms of macroeconomic activity. By pushing towards a better understanding of the way in which the bank lending channel operates as a transmission mechanism of monetary policy in Chile, our paper contributes to an improvement in the monetary policy decision framework.

Our focus in this paper is on explaining cross-sectional differences among economic agents (banks, firms and, to a lesser extent, households). The evidence gathered in this paper therefore points towards a bank lending channel operating across the sample period, abstracting from the asymmetries related to tightening versus easing of monetary policy and from the evolution of certain features in the economy that may affect the strength of the bank lending channel. For example, information problems are likely to be less binding in periods of relatively loose monetary policy, rendering the bank lending channel much less relevant as a transmission mechanism in comparison with periods of a tighter monetary stance. In particular, the large monetary policy shock in 1998-99 probably represents the bank lending channel operating at its maximum strength, although the counterfactual exercise of what would have happened had the exchange rate been allowed to depreciate sharply points to the possibility of a financial accelerator mechanism as well, through larger balance sheet effects. Another example is the role played by the increase in the capital base of banks during the 1990s, as well as the more widespread use of credit scoring. Both trends have probably strengthened the capacity of banks to deal with informational asymmetries.

This study underscores at least four avenues for future research that may deepen our knowledge of the functioning of the credit channel, in general, and the bank lending channel, in particular, as transmission mechanisms for monetary policy in the Chilean economy: (i) improvements in measuring monetary policy shocks; (ii) improvements in measuring the costs for bank-dependent borrowers associated with a drop in banks' credit supply; (iii) improvements in incorporating the effects of policy changes and financial sector developments; and (iv) improvements in assembling more comprehensive data sets at the microeconomic level.

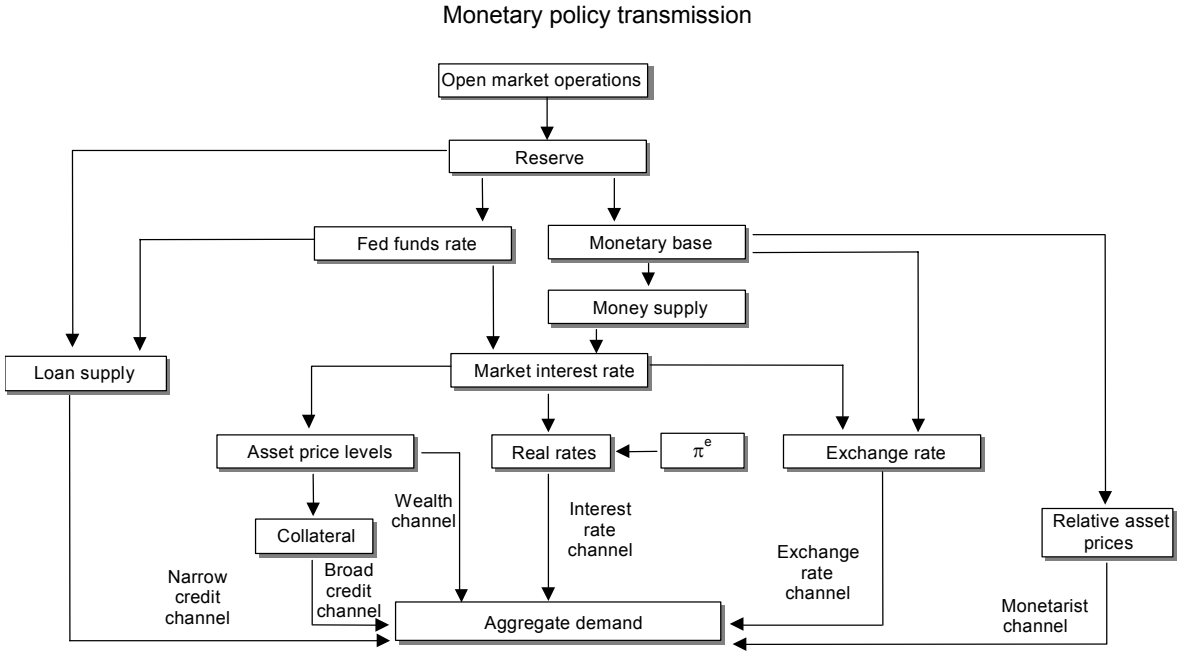
[32] We are using a relatively small data set given the relatively large set of variables included in the VAR system, meaning that we are dealing with large sampling uncertainty. The 95% confidence interval is thus a rather strict test. For instance, researchers tend to use ± 1 standard deviation when dealing with large sampling uncertainty, meaning that a 67% confidence interval for the true impulse response function is considered good enough for the purpose at hand (see, for example, Stock and Watson (2001)). If we use the latter benchmark, the macroeconomic relevance of the bank lending channel is unambiguously supported for all variables used as proxies for macroeconomic activity.

Appendix:
Subchannels of monetary transmission

The different transmission mechanisms of monetary policy can be illustrated by means of the diagram in Figure A1 (Kuttner and Mosser (2002)). The transmission mechanism process begins with the central bank's definition of a monetary policy rate. The interbank rate then converges to this objective through the regulation of the liquidity of the financial system. Once the liquidity is adjusted, different mechanisms start operating in the transmission channel. Four of these are activated by market interest rates moving in tandem with the interbank interest rate. These are the interest rate channel, in which an increase in the cost of capital reduces domestic aggregate demand through a fall in investment and in the consumption of durable goods; the exchange rate channel (in open economies), which operates through the effect of the uncovered interest rate parity on net imports; the asset price channel (stocks, bonds and real estate), which generates a wealth effect that has an impact on consumers' decisions; and the broad credit channel, which is also related to the market value of assets and which is described in the introduction. The transmission mechanism of monetary policy does not end there, however. It is possible to distinguish two additional channels; namely, the monetarist channel related to changes in relative asset prices and the bank lending channel, the main issue of our paper.

Figure A1

Channels of monetary policy transmission



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