Banco Central de Chile
Documentos de Trabajo

Central Bank of Chile
Working Papers

N° 436

Diciembre 2007

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MACROECONOMIC FLUCTUATIONS AND BANK BEHAVIOR IN CHILE

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Resumen

El propósito de este estudio es analizar el comportamiento de los balances contables e indicadores de los bancos en Chile en el corto y largo plazo, así como frente a shocks macroeconómicos. Para esto, se utiliza la evolución de los agregados bancarios, con datos trimestrales, para el período comprendido entre 1989 y 2006. Con el fin de establecer patrones de comportamiento históricos, se aplican técnicas utilizadas en la literatura de ciclos reales. Se utilizan varios tipos de filtros como una forma de comprobar la robustez de los resultados. Los efectos de shocks macroeconómicos son analizados mediante un caso de estudio y mediante funciones de impulso respuesta obtenidos con la estimación de VAR. Los resultados muestran que el crédito se rezaga al ciclo y los depósitos a la vista lo anteceden, aunque ambas variables son procíclicas. En cambio, el índice de adecuación de capital muestra ser contracíclico. Por otro lado, un shock de tasas de interés reduce los créditos (totales, comerciales y de consumo) y aumenta las colocaciones vencidas y el índice de adecuación de capital. Finalmente, un shock al crecimiento del PIB tiene efectos positivos sobre las colocaciones y el retorno sobre el capital, y un impacto negativo sobre las colocaciones vencidas y el índice de adecuación del capital.

Abstract

The purpose of this study is to analyze bank behavior in Chile over time, exploring how their balance sheets and performance move in both the short and the long run, and their reaction to macroeconomic shocks. The evolution of banking aggregates over an 18-year period (1989-2006), using quarterly data is examined. Techniques common in the real business cycle literature are applied to establish empirical patterns. Robustness tests using several filters are performed. The effects of macro shocks on banking variables are analyzed, both by means of an event study, and by estimating impulse responses with VARs. The results show that credit lags the cycle, demand deposits lead it, both being procyclical, while the capital adequacy ratio (CAR) is countercyclical. In addition, a shock to interest rates reduces loans (total, commercial, consumption), and increases non-performing loans (NPL) and the capital adequacy ratio (CAR). A shock to GDP growth has a positive effect on loans and ROE, and a negative impact on NPL and CAR.

We thank Kevin Cowan, Pablo García, Alejandro Jara, José Matus, Luis Opazo, Sergio Rodríguez, Rodrigo Valdés, participants in the Central Bank of Chile's in-house seminars, and an anonymous referee for comments to an earlier version. The opinions expressed in this article are the exclusive responsibility of the authors and do not necessarily represent the opinions of the Central Bank of Chile, its Board, or the International Monetary Fund. Email: abarajas@imf.org; lluna@bcentral.cl; jrestrepo@bcentral.cl.

1. Introduction

The purpose of this study is to analyze bank behavior in Chile over time, looking at how their balance sheets and performance move both in the short and long run, and how they react to macroeconomic shocks. We base our analysis on quarterly banking data provided by the Superintendency of Banks and Financial Institutions (SBIF) covering the 1989-2006 period. In addition to examining behavior for the banking system as a whole, we also disaggregate by bank type: private vs. total banks; large versus small banks; local versus foreign banks; and traditional, corporate, investment, and retail banks.[2]/ This makes it possible to determine whether there are groups of banks that perform differently throughout the cycle and in response to shocks.
It is worth noting that a detailed understanding of the behavior of banks helps to improve our knowledge of the monetary policy transmission mechanisms, which is of critical importance to the Central Bank. Our conclusions are also likely to shed light on issues of financial stability.[3]/ We describe our basic analytical exercises below.

First, we examine the evolution of various banking aggregates over the 18 year period. We calculate the long run trend for various bank balance sheet items (scaled by GDP) and for several key income statement indicators. We then compare their behavior to what has been found in other countries to get an idea of financial development in Chile relative to other economies.

Secondly, we use techniques commonly seen in the real business cycle literature to establish empirical relationships between banking and macroeconomic cycles. We calculate cross-correlations between the GDP cycle and a set of deflated, seasonally adjusted, and detrended banking variables. Specifically, we compare the cycle of each banking variable to the business cycle to see if these variables lead, coincide with or lag GDP.[4]/

This analysis also permits us to determine if certain banking variables are particularly good leading indicators for growth in Chile. In their well-known study of the credit channel in the U.S., Bernanke and Blinder (1988) argue that banking credit rather than traditional monetary aggregates performs well as a leading indicator in the U.S., given that money demand shocks are substantial. We carry out an exercise for the Chilean case, to determine whether credit also serves as a leading indicator for GDP growth. We also compare the volatility of other banking variables relative to that of GDP, and we calculate the size of the fluctuations by computing standard deviations and maximum percentage deviations from trend.[5]/ In this way we assess how large these fluctuations are, and how asset and liability composition and quality, profitability,

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[2]/ Private Banks exclude BancoEstado. The remaining categories are subdivisions of private banks. Large banks are those whose total assets are greater than 6% of the system for more than one year. Retail banks allocate more than 50% of their loans to consumer credit. Foreign banks are at least 50% owned by nonresidents. Corporate banks have a high share of commercial and foreign trade loans. Investment banks hold assets that are principally composed of financial investments and derivative instruments. The category of traditional banks basically includes whatever is leftover, namely, banks that focus on the more traditional banking business: multi-business lines and a diversified portfolio.

[3]/ It could also shed light on the current credit cycle stance.

[4]/ In most of the cases in which leads or lags with respect to GDP are significant, we find that Granger causality tests support causality running in the expected direction.

[5]/ We also calculate the cross-correlations between bank interest rates and the monetary policy rate.

and capital adequacy move over the business cycle. Therefore, our conclusions are also relevant for monitoring financial stability.

In order to test the robustness of the results we check the use of the Hodrick-Prescott filter with a growing sample, which mimics the analysis in real time. We also compute and compare the entire cross correlations using several alternative filters.

Thirdly, we analyze the effect of macro shocks on banking variables, both by means of an event study which follows a set of variables after the significant changes occurred in the economy in 1998, and by estimating impulse response functions from VAR analysis of banking variables, real GDP, and interest rates.

We further analyze the results by taking two possible hypotheses regarding credit behavior into account: if bank loans are used to smooth consumption and production, their behavior should be countercyclical, or at least acyclical, whereas if they behave in accordance with the credit channel and financial accelerator theory, they should fluctuate procyclically. Indeed, credit channel theorists essentially argue that financing fluctuates along with agents' net wealth, which is used as a guarantee. Thus, while lending grows in a period of expansion, during recessions banks hold liquid assets, and access to financing becomes stricter for individuals and small businesses, since they have less equity (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989).[6]/ Furthermore, Chami and Cosimano (2001), Kashyap y Stein (2004**),** Barajas, A. R. Chami y T. Cosimano (2005) argue and/or show evidence that, due to widespread implementation of Basel-type minimum capital requirements throughout the world, a "capital channel" of monetary policy may be operating such that, after a monetary policy interest rate hike, it is the less capitalized banks that are more prone to reduce their lending supply.

Between the early nineties and 2006, lending by Chilean banks as a share of GDP in increased substantially, particularly in mortgages and consumption lending, thus resulting in a level of financial depth that greatly surpasses that of most Latin American and other emerging economies. Our results show that total credit is strongly procyclical with a high correlation with GDP, and that the timing is such that most credit aggregates tend to lag business cycles by around two quarters. Furthermore, credit tends to be 1.6 times as volatile than GDP. Regarding timing, consumption lending appears to be an exception, roughly coinciding with the business cycle. In contrast, on the liability side, demand deposits as well as the nonperforming loan ratio (NPL) are also markedly procyclical, but do tend to lead the cycle.

The capital adequacy ratio (Basel index) and financial investments are countercyclical. In a recession, when credit risk is higher and capital more scarce, banks change the composition of their assets, substituting credit for more liquid (and presumably, safer) financial assets. In fact, from the standpoint of compliance with the regulatory minimum, there appears to be an overshooting, since capital adequacy actually *improves*. We show that these results are robust to

[6]/ Similarly, this perspective claims that the availability of credit can accentuate cycles, and that financing can be a better key indicator of economic activity than money, because the demand for lending is more stable than the demand for money. See Alfaro et al. (2004) for a study of the bank credit channel in Chile.

the choice of filter used to detrend the variables. In addition, the event study shows that macro developments affect banks balance sheets but the effects depend on the type of bank considered. Finally, the VAR estimation sheds light on the way monetary policy is transmitted to the economy and shows that interest rates and GDP shocks affect significantly bank balance sheets.

The following section characterizes the levels of banking aggregates. The third section provides a detailed summary of the main cyclical patterns found in the banking industry. The fourth section presents the effects of macroeconomic shocks on some selected variables. The last (fifth) section contains the conclusions.

2. Overview of banking variables in Chile

An examination of banking aggregates shows that credit is by far the most important component on the asset side of Chilean banks, amounting to about 70% of total assets. It has also been growing rapidly as a proportion of GDP since the early 1990s, from about 51 to 68% (Table 1).[7] Within this upward trend, evidence of a steady process of financial deepening, we also see that growth has been particularly strong in consumption credit (to households) and mortgage finance. On the other hand, financial investments have been reducing their share of banking assets in the last 18 years.

Table 1
Size and Composition and Banking Assets

	Loans to Firms	Personal Loans	Mortgage Loans	Other Loans *	Foreing Currency* *	Total Loans	Financial Inverstments	Total Loans
	(% Loans)					(% Assets)		(% Nom. GDP)
1989	46.9	3.3	9.4	40.5	23.1	58.4	26.2	52.2
89-06	53.9	9.0	16.8	20.4	15.2	70.5	17.3	60.2
89-96	52.4	6.9	12.4	28.4	19.9	66.8	20.6	50.8
97-06	54.2	9.5	17.8	18.5	14.1	71.5	16.4	67.2
2006	49.2	11.3	20.7	18.8	13.0	73.5	10.6	68.2

Source: Authors' calculations, based on data from the SBIF.
*: includes interbank, public sector, external sector loans.
**: includes firms and personal loans in foreign currency.

On the liability side, the share of time deposits has grown from just under 30% in the 1989 to over 46% in 2006, and are now by far the largest component of liabilities. Further evidence of significant financial deepening during the 18 year period, total liabilities plus capital have also grown rapidly, by about 15 percentage points of GDP (Table 2).

[7]/ Table 1 also shows that the ratio of banking assets to GDP has increased even more rapidly when calculated in real terms, as a result of the CPI (used to deflate assets) having grown less rapidly than the GDP deflator.

Table 2
Size and composition of Bank Liabilities

	Demand Deposits	Time Deposits	Fixed Income Debt*	External Debt	Loan Loss Provisions	Capital	Others	Total Liabilities
				(% Liabilities)				(% Nom.GDP)
1989	9.0	29.6	7.1	15.6	2.7	7.7	28.5	84.7
89-06	11.2	42.7	14.0	6.7	1.5	7.7	16.2	87.0
89-96	10.6	37.3	10.8	10.2	1.7	7.9	21.5	77.7
97-06	11.3	44.1	16.5	3.9	1.5	7.7	15.0	93.9
2006	12.0	46.5	12.2	4.9	1.1	7.1	16.2	92.8

*: includes letters of credit, senior and subordinated bonds.
Source: Authors' calculations, based on data from the SBIF.

Looking at bank revenues, net interest income is the main component, amounting to about four times fees, while operational costs are about three times that of provisions (Table 3). There has been a noticeable drop in return on equity from 13.2 percent from the 1989-96 period, to 9.9 percent in the more recent 1997-06 period. However, in 2006 bank profitability appeared to recover to the previous level, reaching 13%.

Table 3
Breakdown of Bank Revenues and Expenses

	Net Interest	Fees and others	Loan loss Provisions	Operating expenditures	Taxes and others *	Return over equity
			(% Capital)			
1989	43.2	11.2	-10.1	-21.6	-7.5	15.2
89-06	31.5	9.0	-7.3	-22.2	-0.3	10.6
89-96	39.1	7.9	-6.5	-26.3	-0.9	13.2
97-06	29.4	9.3	-7.6	-21.2	-0.1	9.9
2006	32.4	8.5	-7.1	-20.4	-0.4	13.0

*: includes changes in market prices.
Source: Authors' calculations, based on data from the SBIF.

We also disaggregated the banking system into different ownership and activity classifications: private banks; large versus small banks; local versus foreign banks; and traditional, corporate, investment, and retail banks.[8]/ As Table 4 illustrates, the share of local and corporate banks in the system has fallen since 1989, while that of large and traditional banks has increased, and there has been substantial foreign entry into the system since the early nineties, with the share of these institutions more than doubling.

[8]/ See footnote 2 for the definitions of the types of banks.

Table 4

Disaggregating the Chilean Banking System

	Number of Banks			Assets			Loans			Capital		
Clasification	Jan-89	Sep-99	Sep-06	Jan-89	Sep-99	Sep-06	Jan-89	Sep-99	Sep-06	Jan-89	Sep-99	Sep-06
	(Percent share in the aggregate)											
System	39	32	30	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Public	1	1	1	20.0	14.3	15.2	17.3	12.6	13.5	17.1	10.6	9.4
Private	38	31	29	80.0	85.7	84.8	82.7	87.4	86.5	82.9	89.4	90.6
Large	3	5	4	35.8	52.7	57.7	33.6	55.3	60.7	31.1	47.3	48.5
Small and Medium	35	26	25	44.2	33.0	27.0	49.1	32.1	25.8	51.8	42.1	42.1
Local	17	14	15	64.4	59.2	44.5	68.6	63.4	48.1	53.1	52.0	43.1
Foreign	21	17	14	15.5	26.5	40.3	14.1	24.0	38.5	29.8	37.4	47.5
Traditional	12	12	12	63.0	75.6	76.5	64.9	78.6	80.7	56.3	71.9	75.0
Corporate	20	13	10	14.1	6.2	5.1	15.0	5.6	4.1	22.1	11.8	8.4
Investment	2	2	3	1.3	1.2	1.8	1.1	0.1	0.1	2.6	2.7	5.2
Retail	4	4	4	1.5	2.8	1.3	1.8	3.1	1.6	1.9	2.9	2.0

Source: Authors' calculations, based on data from the SBIF.

Chile has achieved a level of financial deepening much greater than is the norm for Latin American or other emerging economies. We compared the Chilean banking system to a subsample of emerging economies and two industrial countries in the year 2003. We see from Table 5 that the overall size of the banking system, as measured by the credit-GDP ratio, is substantially greater in Chile than in (post-crisis) Argentina, Brazil, and Colombia, but falls short of the levels obtained in Australia, New Zealand, and Spain. Interestingly, its size is roughly similar to that of the U.S., although it should be pointed out that lending by institutions different from banks is more important in the U.S. Time deposits, the main source of funding for Chilean banks, are also large relative to other countries; as a percentage of GDP they are over twice that of the other two Latin American countries, and even surpass the levels of Spain and the U.S. However, Australia and particularly New Zealand have a higher stock of time deposits. Finally, bank capital as a percentage of GDP in Chile is considerably larger than in Argentina and Colombia, and is comparable to that of the U.S., but is significantly smaller than in the rest of the countries shown in Table 5.

Table 5

International Comparison Banking System 2003

COUNTRY NAME	Argentina	Australia	Brazil	Chile	Colombia	New Zealand	Spain	United States
Domestic Credit / GDP	10.6	98.6	27.9	64.6	19.3	117.3	117.0	64.1
Demand Deposits / GDP	4.3	24.7	4.2	7.0	5.5	13.7	24.4	5.8
Time Deposits / GDP	18.7	46.3	18.3	39.2	17.5	74.1	24.4	11.6
Capital / GDP	5.6	9.7	14.6	8.7	3.6	12.8	15.6	8.4

Source: Authors' calculations, based on data from FMI IFS, and the Central Bank of Chile.

3. Aggregate cyclical behavior

In this section, we look at the cyclical behavior of a broad set of banking sector indicators in Chile, to get a sense of how banks adjust their balance sheets and how their activities are affected by changing conditions in the macroeconomy. In addition to the full sample analysis, we are also interested in examining whether there was a structural break in banking behavior after 1998 as a result of key changes in the macroeconomic framework. In fact, after the Asian crises, which had an adverse effect on capital flows to Chile, there were significant changes in macroeconomic policy: a shift in the exchange rate regime from a pre-announced band to a float in 1999, the opening of the capital account, the full implementation of inflation targeting, as well as the implementation of an explicit fiscal rule. We label the 1989-1998 as the "pre-float" period, and 1999-2006 as the "floating" period.

Another issue of concern was that of appropriate banking sector leading indicators. As we discussed in the introduction, Bernanke y Blinder (1989) show that one may expect a GDP to be more closely related to credit than to other monetary aggregates, particularly in countries such as the U.S. where money demand shocks tend to be more prevalent than credit demand shocks. Therefore, one can make the case that credit, rather than monetary aggregates, would perform better as a leading indicator for economic activity and thus as a signal for possible monetary policy actions. In this section we examine whether this might be the case in Chile as well.

We calculate cross-correlations between the GDP cycle and a broad set of variables taken from banks' financial statements, using quarterly information from the SBIF for the period 1989–2006. The variables we included were the main asset and liability items, as well as solvency, liquidity, profitability, and efficiency indicators. Nominal stocks were deflated, all variables were seasonally adjusted and then detrended using a Hodrick-Prescott filter, as is common in this type of literature.[9]/ As mentioned earlier, we also divided the sample into two subperiods to reflect the crisis and the shift in exchange rate and monetary policy regimes in 1999.[10]/

We now describe the most salient features of the cyclical behavior of banks in Chile. In addition to calculating the cross correlations, we also computed absolute and relative volatilities, and the amplitude of cyclical fluctuations to get an idea of the severity of banking cycles.

The H-P detrending procedure identified four periods of above-trend GDP: 1989–1990, 1993–1994, 1996–1998, and 2004–2006; and four periods of recession, in 1988, 1990–1991, 1994–1995, and 1999–2004 (see Figure 1).[11]/ The GDP cycle lasts around 4.6 years, and the maximum deviations from trend are 5%, both negative and positive.

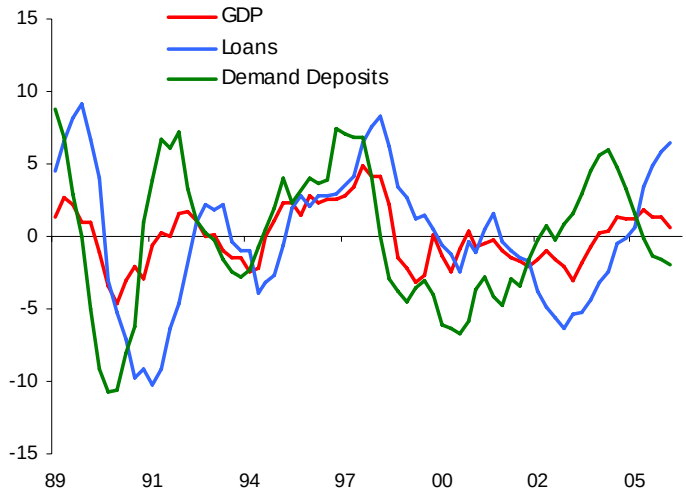
[9]/ The long moving average generates trends and cycles that are very similar to those obtained with other filters (band-pass), such as the one used in Baxter and King (1999).

[10]/ The first subperiod begins in the first quarter of 1989 and ends in the second quarter of 1998. The second subperiod runs from the third quarter of 1999 to the third quarter of 2006. We excluded the extreme market turbulence period from the third quarter of 1998 to the second quarter of 1999. We included these observations, however, when considering the sample as a whole.

[11]/ An analysis of the Chilean economy's empirical patterns can be found in Restrepo and Soto (2006).

Figure 1

Cycles of output, loans, and demand deposits, 1989–2006
(percent, deviation from trend)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Comparing the cyclical components of GDP, credit, and demand deposits reveals that while loans (credit) lag output cycles, demand deposits lead it. Moreover, the latter two series have larger fluctuations than GDP (see Figure 1).

For each of the banking variables, we define its cross-correlation in quarter $t+i$ and GDP in t, where the value of i ranges from –8 to 8 quarters. For example, if the highest correlation of the variable with GDP occurs in t+2 (t-2), then the variable is said to lag (lead) the output cycle by two quarters. We consider a correlation with GDP higher than one standard deviation to be considered significant.[12]/ In turn, we consider a lead or lag relative to GDP to be significant if the difference between the correlation in $t+i$ and the correlation in t (i=0) is statistically different from zero, with the same confidence level (equal to or higher than one standard deviation). The dotted lines in the figures correspond to the confidence intervals constructed from the standard deviations for the two subperiods.

3.1 Bank assets

Total loans are highly correlated with GDP, and they significantly lag the GDP cycle by two quarters (Figures 2 and 3, and Table 6). Loan cycles last approximately 4.3 years, and the size of positive and negative deviations is very similar, at 2.1 and 2.2 years, respectively. The deviations from trend in percentage terms were calculated as a measure of the size of the cycle. The maximum positive deviation found was 9%, while the maximum negative deviation was –10%. In other words, total loans can fluctuate nearly 20% during the course of one cycle (see Table 6).

[12]/ Given that the sample is relatively small, we use a one-standard-deviation confidence interval to determine the statistical significance of the correlations, as is common in the literature. In the Chilean case, this value is 0.12 for the full period, 0.16 for the 1989–1998 period, and 0.19 for the 1999–2006 period.

Consequently, their standard deviation (volatility) is 2.3 times that of GDP for the whole sample. A Granger causality test confirms that GDP is more likely to precede loans[13]:

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
Total LOANS does not Granger Cause GDP	0.01	0.06
GDP does not Granger Cause Total LOANS_	0.00	0.02

We interpret the high volatility of loans (relative to that of GDP) as a supply-side phenomenon caused by banks' decisions, since changes in *demand* for credit are likely to be more closely related to fluctuations in GDP.

Looking at different types of bank loans, the behavior of commercial loans across the cycle is very similar to the behavior of total loans, in terms of duration and the lag with the GDP cycle. Nevertheless, the size of the cycle is greater than that of total loans. The maximum deviation, both positive and negative, is 14%, (see Figure 4 and Table 7). The lagging behavior of commercial loans is consistent with the results of Granger causality tests:

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
COM_LOAN does not Granger Cause GDP	0.06	0.40
GDP does not Granger Cause COM _LOAN	0.00	0.01

Consumer loans, on the other hand, have a distinct behavior relative to other types. First, they fluctuate much more widely, with a maximum positive deviation is 20%, and negative one of 22%; in other words, they could fluctuate as much as 40% during the cycle. This is also reflected in their standard deviation, which is 5.2 times that of GDP.[14]/. They also lag GDP by one quarter, but not significantly so (see Figures 2 and 3). Thus, consumer loans appear to lead total loans. Furthermore, Granger causality tests show that there is no clear precedence between these loans and GDP:

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
CONS LOAN does not Granger Cause GDP	0.00	0.028
GDP does not Granger Cause CONS LOAN	0.00	0.047

Mortgage loans also showed a markedly lagged correlation with the GDP, which could be interpreted as evidence of acyclicality. This may be because the mortgage loan cycle is the longest of all types of loans, lasting approximately 7.7 years. The maximum value of positive

[13]/ The differences in the results between the granger causality test and cross correlations are due to the different methodologies that they involve. On one hand, cross correlations show leads or lags at the highest correlation; on the other, the granger causality test shows precedence whenever in a regression the lags of one variable are significant to explain another. So, while the first test only shows correlation, the second one shows statistical precedence. Neither test shows economic precedence. The Granger Causality test is significant at say 5%, when the probability associated with the test is lower than 5%, the same argument operates for the 10% and 1%.

[14]/ The relative volatility of these loans was 5.4 in the first period and then dropped to 5.2 in the second. However, this change is not significant.

percentage deviations is 11%, while negative deviations reach 14%. Moreover, disaggregating mortgage loans by type of bank reveals that local banks behave cyclically, with a correlation to GDP of 0.74 and a significant lag of two quarters. In contrast, mortgage loans given by foreign banks are fairly acyclical.

In general, there is little evidence of a significant structural break in lending behavior between the pre-float and the floating subperiods in Chile. The volatility and correlation with GDP of total loans and its components was roughly similar across periods, and the lag/lead behavior did not change significantly either.

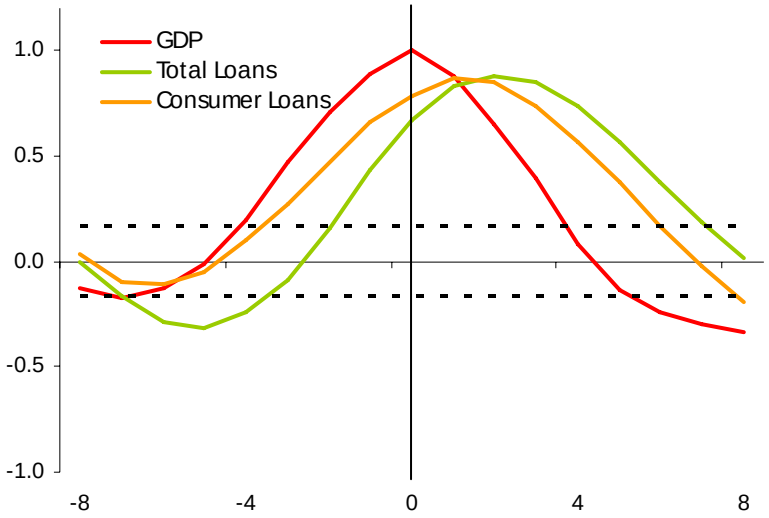
Finally, financial investments by banks are decidedly countercyclical and with a significant of lag of three quarters, a behavior confirmed by the Granger causality test below. Countercyclicality is consistent with the credit channel in the sense that when economic activity slows down and credit risk increases, banks restrict their lending and shift to safer assets such as financial investments. Also, in contrast to loans, the behavior of financial investments appear to have changed across periods. In the floating period, the countercyclicality was accentuated, with the negative correlation with GDP increasing from –0.52 to –0.67, and the lag declining. The maximum percentage deviations with respect to trend are 13% and –20%, which show a certain degree of asymmetry, whereby financial investments are more likely to increase during a recession than they are to fall during an upturn in economic activity. The standard deviation with respect to GDP, another indicator of volatility, calculated for the full sample, is 3.6, although in the floating period it rose to 5.1 (see Table 7).[15]/ Large banks lead the system with a maximum correlation of only a one-quarter lag, although their correlation is slightly lower (0.49 versus 0.57).

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
FIN_INV. does not Granger Cause GDP	0.06	0.42
GDP does not Granger Cause FIN_INV.	0.00	0.00

[15]/ The cycle of banks' liquid assets is similar to that of financial investments, but it is even more variable.

Figure 2

Correlation between total banking system loans and GDP: Pre-float Period
(percentages, 1989-1998)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile

Table 6

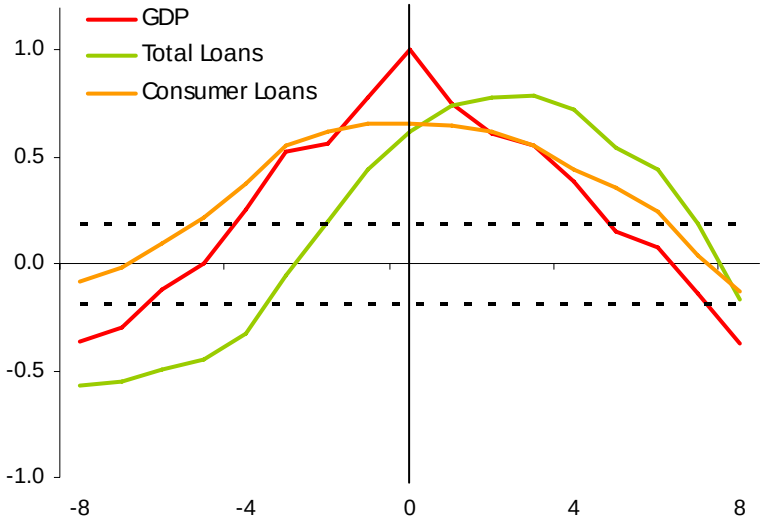
Cyclical behavior of total and consumption loans

	Period	Max. Correl. n	Max. Correl. Value	Relative Std.Dev.	Cycle Length	Max.(+) Dev.	Max.(-) Dev.
					(years)	(porcentaje)	
Total System Loans	89-06	2 *	0.81 *	2.4	4.3	9.2	10.2
Total System Loans	89-98	2 *	0.88 *	2.3			
Total System Loans	99-06	3	0.79 *	2.4			
System's Consumer Loans	89-06	1	0.82 *	5.2	5.9	20.4	22.0
System's Consumer Loans	89-98	1	0.87 *	5.4			
System's Consumer Loans	99-06	0	0.66 *	5.2			

Note: Cross-correlations are calculated relative to GDP. The * shows a significant difference in the lead or lag of the variable relative to the GDP in column "n", or the significance of the level of the correlation.
Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile

Figure 3

Correlation between total banking system loans and GDP: Floating period
(percentages, 1999-2006)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile

Table 7

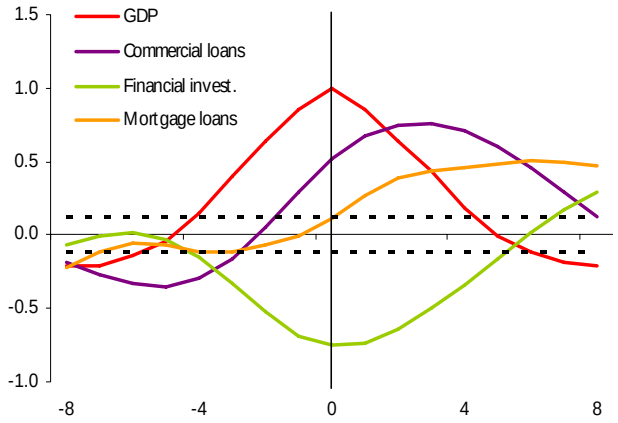
Cyclical behavior of total commercial and mortgage loans, and financial investments

	Period	Max. Correl.		Relative	Cycle	Max.(+)	Max.(-)
		n	Value	Std.Dev.	Length	Dev.	Dev.
					(years)	(porcentaje)	
System's Commercial Loans	89-06	3 *	0.76 *	2.8	4.4	13.9	13.7
System's Mortgage Loans	89-06	6 *	0.51 *	2.6	7.8	11.0	13.9
System's Mortgage Loans	89-98	7 *	0.60 *	2.6			
System's Mortgage Loans	99-06	1	0.58 *	3.2			
- local banks	89-06	2 *	0.74 *	5.3	7.6	31.7	17.7
System's Financial investments	89-06	3 *	-0.57 *	3.5	5.4	12.5	19.5
- large banks	89-06	1 *	-0.49 *	5.7	5.2	26.1	22.7

Note: Cross-correlations are calculated relative to GDP. The * shows a significant difference in the lead or lag of the variable relative to the GDP in column "n", or the significance of the level of the correlation.
Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile

Figure 4

Correlation between commercial, mortgage loans, and financial investments, and GDP
(Percentages, 1989-2006)

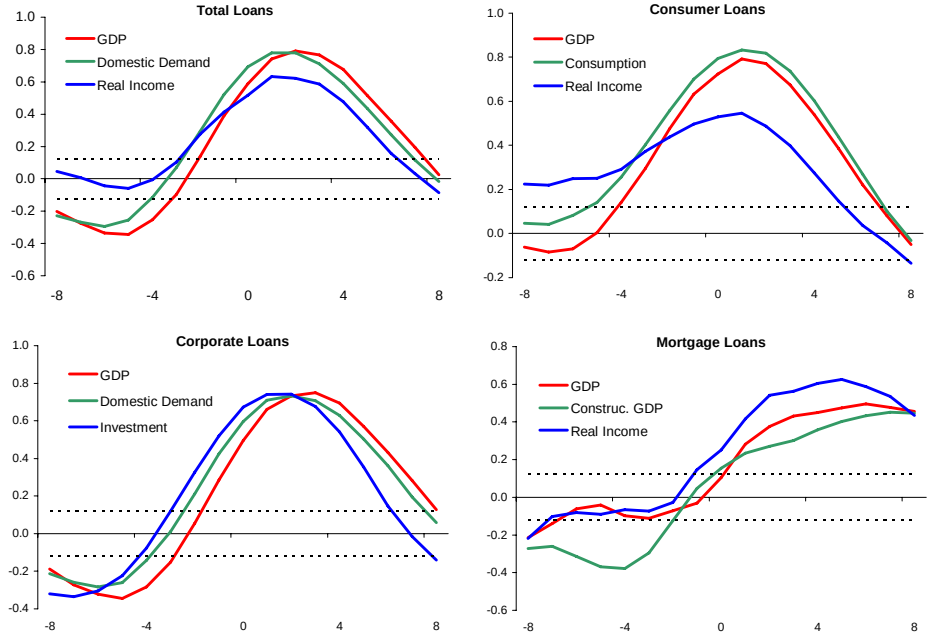


Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile.

In order to test the robustness of correlations with GDP, we computed cross correlations with other macroeconomic variables which could also be driving the different types of loans. Thus, we obtained cross correlations of each loan aggregate with total consumption, internal demand, investment, and real income. The results were roughly similar to those reported earlier, with one noteworthy exception: mortgages have a significantly larger correlation with real income than with GDP. Therefore, using GDP as benchmark for total, and consumer loans generates similar results as with domestic demand or aggregate consumption, respectively (Figure 5).

Figure 5

Correlation between loans, and GDP, consumption, real income (1989-2006)

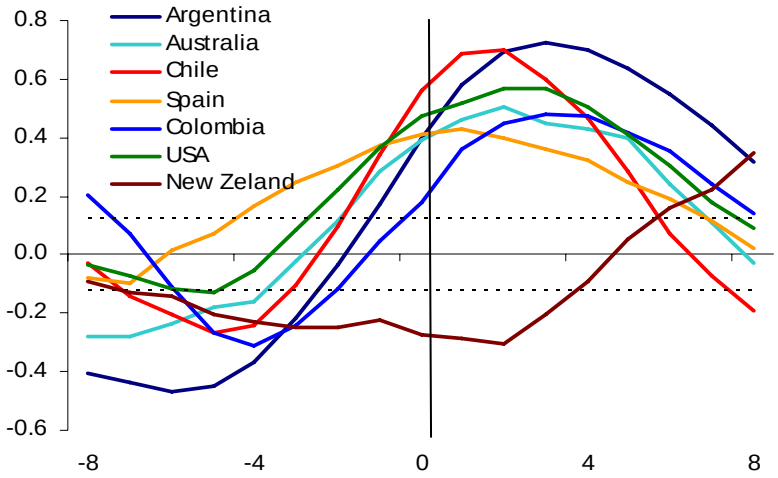


Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile.

As an international comparison, we computed the cross correlations between real aggregate bank credit, and real GDP for a sample of countries, including Chile.[16] For most of the countries, credit exhibits a similar behavior, largely procyclical (positive correlation with GDP) and lagging the business cycle by 2 to 5 quarters. One outlier emerges, however: New Zealand, where credit appears to be mainly countercyclical and lagging the cycle by two quarters. Chile's credit behaves in a rather typical fashion for this group; procyclical and lagging the GDP cycle by 2-3 quarters. Furthermore, along with Argentina, Chilean bank loans exhibit the highest maximum correlation with GDP (Figure 6), at around 0.70.

Figure 6

Cross-correlation of real bank credit and GDP, 1990-2003



Source: Authors' calculations, based on data from IMF's International Financial Statistics.

3.2 Bank Liabilities

Within the group of variables analyzed from the liability accounts, we focus here on demand deposits, time deposits, and subordinated bonds.

Demand deposits, whose evolution is heavily associated with the demand for money, have a statistically significant lead of two quarters relative to GDP (see Table 8 and Figure 7). This leading behavior is confirmed by the Granger causality tests below:

Null Hypothesis:	Probability (2 lags)	Probability (4 lags)
Checking ACC. does not Granger Cause GDP	0.00	0.00
GDP does not Granger Cause Checking ACC.	0.00	0.07

The demand deposit cycle is as long as the GDP cycle, but it is more volatile. Its maximum positive percentage deviation from trend is 24%, and the negative is 14%. This asymmetry could have to do with the existence of a nonlinear relation between money and interest rates, as

[16]/ We explain the procedure in greater detail in Section 3. The sample of countries includes: Argentina, Australia, Chile, Colombia, New Zealand, Spain, United Kingdom, and the U.S.

documented in Restrepo (2002)[17]/. The behavior of demand deposits is very similar in all types of banks (Table 8 and Figure 7).

Table 8

Cyclical Description of Liability Accounts

	Period	Max. Correl. n	Max. Correl. Value	Relative Std.Dev.	Cycle Length	Max.(+) Dev.	Max.(-) Dev.
System's Demand Deposits	89-06	-2 *	0.64 *	3.3	4.1	23.6	14.0
System's Demand Deposits	89-98	-2	0.69 *	3.3			
System's Demand Deposits	99-06	-6 *	0.56 *	3.7			
System's Time Deposits	89-06	3 *	0.50 *	2.3	6.0	8.0	11.8
- local banks	89-06	2 *	0.85 *	3.9			
System's Subordinated Bonds	89-06	5 *	0.52 *	7.3	4.1	29.0	37.6
- local banks	89-06	5 *	0.61 *	9.3	4.0	51.4	31.9

Note: Cross-correlations are calculated relative to GDP. The * shows a significant difference in the lead or lag of the variable relative to the GDP in column "n", or the significance of the level of the correlation.

Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile.

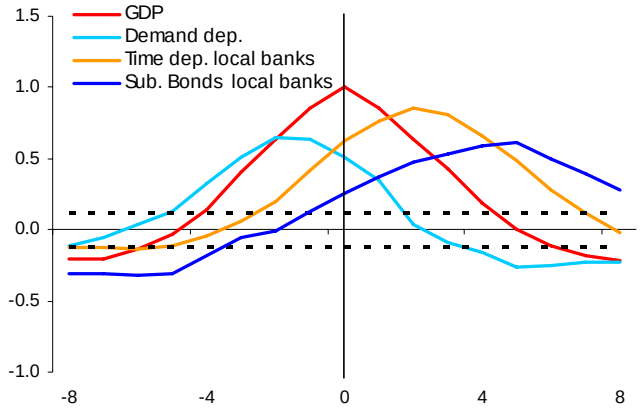
The banking system's time deposits, the largest component of bank liabilities, are also procyclical, with a lag of three quarters relative to GDP. In particular, those of local banks are highly correlated with GDP, with a coefficient of 0.85 with a lag of two quarters, as compared to 0.53 for traditional banks and 0.50 the system as a whole. The volatility of the system's time deposits is 2.3 times GDP, very similar to the volatility of total credit, while the volatility of local banks' deposits is 3.9 times higher than GDP (Table 8). However, the Granger causality tests are inconclusive, suggesting that neither time deposits nor GDP have clear precedence. Finally, it is interesting to note that time deposits of corporate and foreign banks behave relatively acyclically, quite the opposite of the system as a whole.

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
Time_DEP. does not Granger Cause GDP	0.10	0.41
GDP does not Granger Cause Time_DEP.	0.08	0.85

[17]/ That study shows that as interest rates drop, the elasticity of money demand rises, which could fully offset the reduction of real balances associated with a slowdown in economic growth. The opposite effect happens with interest rate hikes, which reduce elasticity.

Figure 7

Correlation between selected liability accounts and output, 1989–2006



Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile.

Another critical component of bank liabilities is subordinated bonds, which appear to be positively and highly correlated with GDP, especially in the case of local banks, but with a five-quarter lag. The lag may have to do partly with capital requirements and with the time it takes to issue this type of instrument. Following a recession, once it becomes possible to raise additional funds – and increase regulatory capital – through subordinated bonds, loans may then increase. Thus, both loans and subordinated bonds would tend to lag GDP, and would both exhibit a high degree of volatility.

Contrary to our analysis of loans, on the liability side there are some indications of appreciable changes occurred across subperiods, particularly concerning demand deposits. Relative to the pre-float period, these became more volatile, their correlation with GDP fell, and the lead increased from two to six quarters in the floating period.

3.3 Solvency, risk, and performance indicators

This section includes some indicators frequently used to analyze the soundness and performance of a financial institution.

One key indicator of credit risk or loan quality is the ratio of total nonperforming loans to total loans (NPL). As one would expect, the total NPL ratio is countercyclical and coincides with the GDP cycle. The degree to which banks account for this credit risk is proxied by two measures, the ratio of provisions to total loans, and to total assets. These two measures also exhibit countercyclical behavior, but their correlations with GDP are not as large nor as significant as that of NPL (see figure 8 and Table 9).[18]/ The Granger causality tests indicate that NPL leads

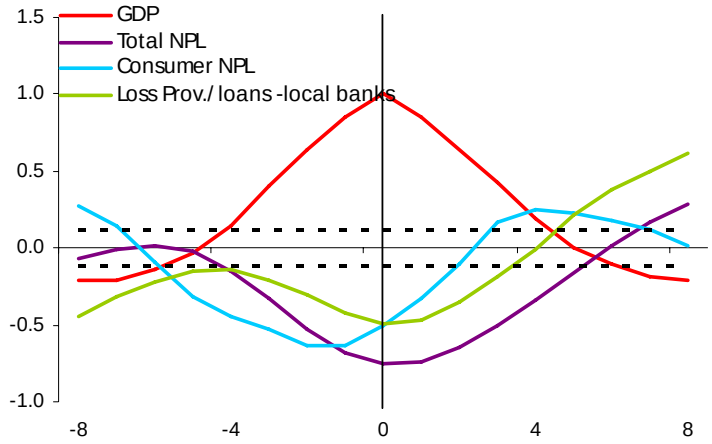
[18]/ Retail banks' loan loss provisions (not shown) have a low correlation with GDP.

GDP given that the hypothesis that NPL does not cause GDP is rejected. This result might be a consequence of the few number of time observations available for NPL:

Null Hypothesis:	Probability (2 lags)	Probability (4 lags)
NPL does not Granger Cause GDP	0.00	0.02
GDP does not Granger Cause NPL	0.13	0.40

Figure 8

Correlation between portfolio quality indicators and output, 1989–2006



Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile

The volatility of the NPL ratio is 7.5 times greater than that of GDP and three times greater than loan volatility. The maximum positive deviation from trend reached 30.2% during the recession, while the negative deviation reached –29.7% during an upswing in economic activity (see Table 9).

The consumer NPL ratio is also countercyclical, but it tends to lead the GDP cycle slightly. This is particularly the case with local and retail banks, which lead GDP by four quarters, thus suggesting that they could be good leading indicators of portfolio quality and economic activity in general (see Table 9).Interestingly, consumer NPL ratio deviations from trend are asymmetric. rising by 34% in recessions and drop by 17% during upswings. This implies that retail banking is indeed riskier than the more diversified wholesale banking activity, so normally these banks would have to compensate greater volatility with higher income and provisions. Moreover, retail banks might have to take into account that in recessions, losses coming from their retail business could surpass estimates based on the simple historical average or on a recent period of economic growth (see table 9). According to the Granger causality test, the consumer NPL ratio for the system as a whole does not lead nor lag GDP significantly:

Null Hypothesis:	Probability (2 lags)	Probability (4 lags)
CONS NPL does not Granger Cause GDP	0.05	0.22
GDP does not Granger Cause CONS NPL	0.08	0.10

Table 9

Cyclical Description of Solvency, Risk and Performance Indicators

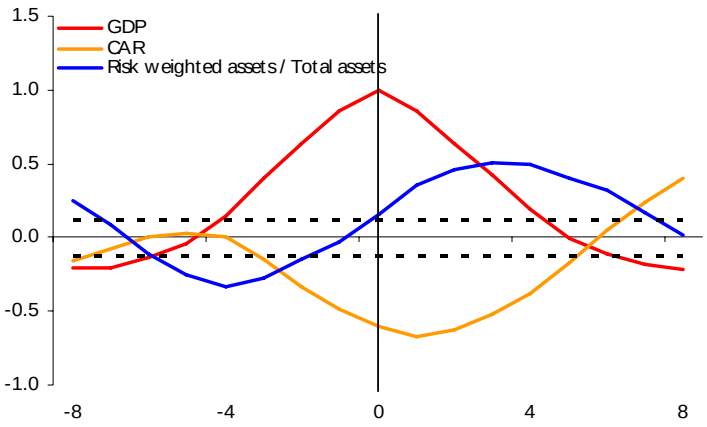
	Period	Max. Correl. n	Max. Correl. Value	Relative Std.Dev.	Cycle Length	Max.(+) Dev.	Max.(-) Dev.
System's non performing loans ratio (NPL)	89-06	0	-0.75 *	7.5	6.0	30.2	29.7
- retail banks	89-06	-4 *	-0.38 *	14.1	3.4	147.4	58.4
System's consumer NPL	89-06	-1	-0.64 **	5.5	2.8	34.2	17.1
- local banks	89-06	-4 *	-0.53 *	6.1	2.8	50.6	20.8
- retail banks	89-06	-4 *	-0.43 *	18.1	4.5	146.8	71.0
System's provisions / loans	89-06	0	-0.68 *	7.4	9.8	24.4	26.7
System's loan loss provisions /assets	89-06	0	-0.44 *	7.6	4.4	34.2	32.4
Capital adequacy ratio (CAR)	89-06	1	-0.67 *	2.3	4.1	9.7	8.0
Gross operating income (GOI) / assets	89-06	0	-0.58 *	2.3	3.3	10.7	13.5
- private banks	89-06	-1	-0.50 *	2.5	2.6	12.3	15.6
Net interest margin (NIM) / assets	89-06	-3 *	-0.33 *	4.0	3.2	18.0	30.2
Net interest margin (NIM) / assets	89-98	-1	-0.50 *	2.5			
Net interest margin (NIM) / assets	99-06	-4 *	-0.66 *	8.2			
Overhead expenses / assets	89-06	2	-0.30 *	1.3	3.3	6.5	7.2
Demand deposits over liquid assets	89-06	1	0.51 *	6.5	6.4	55.9	29.5

Note: Cross-correlations are calculated relative to GDP. The * shows a significant difference in the lead or lag of the variable relative to the GDP in column "n", or the significance of the level of the correlation.
Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile

The main measure of solvency is the capital adequacy ratio (CAR), or Basel index, which consists of regulatory capital divided by risk-weighted assets. This indicator displays a significantly countercyclical behavior (see figure 9),[19]/ driven to a large degree by movements in the denominator, of which bank loans are a key component. The correlation of CAR with GDP is similar in almost all types of banks, with the exception of foreign banks, whose ratio once again has an acyclical behavior (see Table 9).[20]

Figure 9

Correlation between solvency and risk indicators and output, 1989–2006



Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile

[19]/ It behaves the same way as the capital-to-total-assets ratio.
[20]/ Although a one-quarter lag can be seen in this figure, it is not significant.

Risk-weighted assets, as a ratio of total assets, grow a good deal during GDP's growth phase. They are positively correlated with GDP and lag the cycle. This happens because during the upswing the banks' appetite for risk increases (see figure 9).

The Granger causality test performed with two lags indicates that CAR lags GDP along the cycle. When the same test includes four lags the result says that none of them leads the other:

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
CAR does not Granger Cause GDP	0.62	0.74
GDP does not Granger Cause CAR	0.01	0.13

A common indicator of the profitability of financial intermediation is given by the ratio of net interest margin (NIM) to assets and the ratio of gross operating income (GOI) to assets. Both behave countercyclically, with NIM leading GDP by three quarters, and GOI coinciding with the GDP cycle. Thus, NIM seems to act to stabilize banking revenue throughout the cycle. A larger margin during recessions could reflect that banks are getting remunerated for taking larger risks, while procyclical operational costs are decreasing.

The cycle length for both variables is approximately 3.3 years, which is shorter than the loan and GDP cycles. Also, financial income is twice as volatile as gross operating income. In fact, the maximum positive and negative deviations of NIM to assets are 8% and –30%, respectively, while in the case of GOI to assets, the deviations are 11% and 14%. This means that nonfinancial income also seems to contribute to cushioning the fluctuations of financial income (see figure 9).

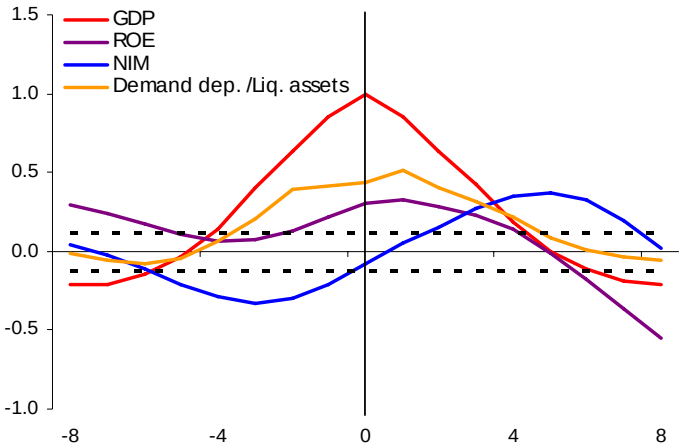
Turning our attention to indicators of return on assets (ROA) and return on equity (ROE), we see that both have a relatively low and lagged correlation with GDP, i.e., they are nearly acyclical (figure 10). Thus, even though the revenue component directly related to financial intermediation, NIM, is highly volatile, offsetting movements in nonfinancial revenue effectively serve to stabilize overall bank profitability throughout the cycle. This acyclicality is consistent with the results of Granger causality tests showing that neither ROE nor GDP clearly leads the other:

Null Hypothesis:	**Probability (2 lags)**	**Probability (4 lags)**
ROE does not Granger Cause GDP	0.89	0.74
GDP does not Granger Cause ROE	0.44	0.35

Overhead expenses are used to analyze bank efficiency. This expense is procyclical and lags the GDP cycle. However, when observing overhead expenses as a proportion of assets, it turns out these are countercyclical. This happens because loans increase much more with economic expansion. These expenses, although more volatile than GDP (1.4 times more), are less volatile than most of the variables considered in this study (see Table 9).

Figure 10

Correlation between earnings and performance indicators and output, 1989–2006



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

The demand deposits over liquid assets ratio is used as a measure of liquidity; an increase shows a liquidity reduction in the system. This indicator shows that the proportion of volatile liabilities to liquid assets increases in an economic expansion. This happens because during the expansion banks lend more moving towards a riskier asset composition while in downturns banks keep more financial assets dropping loans. Contrary to what we saw when analyzing demand deposits, this indicator does not lead the cycle, but rather is statistically coincident.

Comparing behavior across subperiods, we see that NIM to assets increases its lead from one quarter to four quarters in the floating period (see figure 10). These movements are practically the same for all types of banks.[21]/

3.4 Interest rates

We examined the behavior of a set of representative real lending and deposit rates in the economy. They all exhibited proyclicality, and different rates behave very similarly along the cycle. They tend to lag the GDP cycle by three to four quarters, and coincide with the real monetary policy rate (MPR) (see Table 10). In general, the correlation with the MPR is quite high, which is particularly true for the real 90- to 360-day loan rate. This high correlation points out that monetary policy is transmitted directly to other, longer term interest rates in the economy. After an interest rate hike by the Central Bank, banks are not able to substitute funds easily so they increase interest rates on both deposits and loans, and contract their loan supply.

[21]/ A Granger test with four lags demonstrates causality in both directions for net interest margin, gross operating income, and overhead expenses. In contrast, causality is not seen in either direction for demand deposits with four lags, but it is seen in both directions with eight lags.

Another consideration is that the interest rates analyzed here are much more volatile than GDP, but less so than the real monetary policy rate. For example, the maximum positive and negative percentage deviations from the BCU5 trend are 35 and 26%, respectively, and its volatility is half that of the MPR.[22]/ One exception is the real 90- to 360-day deposit interest rate; whose volatility is 50% greater than that of the MPR (see Table 10).

Table 10

Cyclical Description of Interest Rates

	Period	Max. Correl.		Relative	Cycle	Max.(+)	Max.(-)
		n	Value	Std.Dev.	Length	Dev.	Dev.
Real lending rate 90-360 days	89-06	0	0.91 *	0.7	3.5	57.0	48.7
Real deposit rate 90-360 days	89-06	0	0.77 *	1.5	5.5	94.4	183.3
Loans up to 500UF	89-06	0	0.68 *	0.5	6.5	16.6	44.3
Loans over 5000UF	89-06	0	0.73 *	0.9	7.0	48.1	48.1
BCU 5	89-06	0	0.77 *	0.5	5.6	34.9	26.1

Note: Cross-correlations are calculated relative to GDP. The * shows a significant difference in the lead or lag of the variable relative to the GDP in column "n", or the significance of the level of the correlation.

Source: Authors' calculations, based on data from the SBIF and Central Bank of Chile.

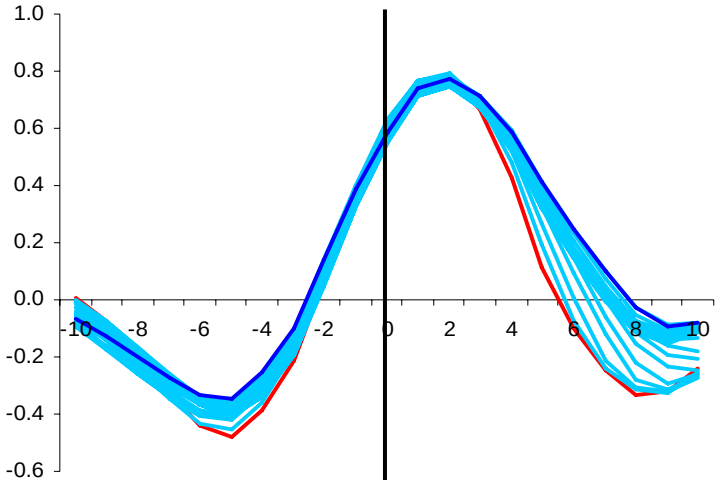
4. Robustness analysis

In order to test the robustness of the above results we followed several strategies. First, we checked the results of the Hodrick-Prescott filter with a growing sample, which mimics how the analysis in actually performed in real time. We began with an initial sample ending in 1999Q4 to compute the cross correlations between total loans and GDP, then repeated the computation adding one quarter at a time. The behavior of total loans over the cycle did not change appreciably (Figure 11). Note that the red line was generated with the shortest sample (1989:1-1999:4) while the dark blue line is the result of using data over the entire period (1989:1 2006:4).

[22]/ The volatility of the MPR is influenced by the major fluctuation observed from 1998 to 1999.

Figure 11

Real time Hodrick-Prescott filter, 1999Q4-2006Q4
(Percent, total loans deviations from trend)

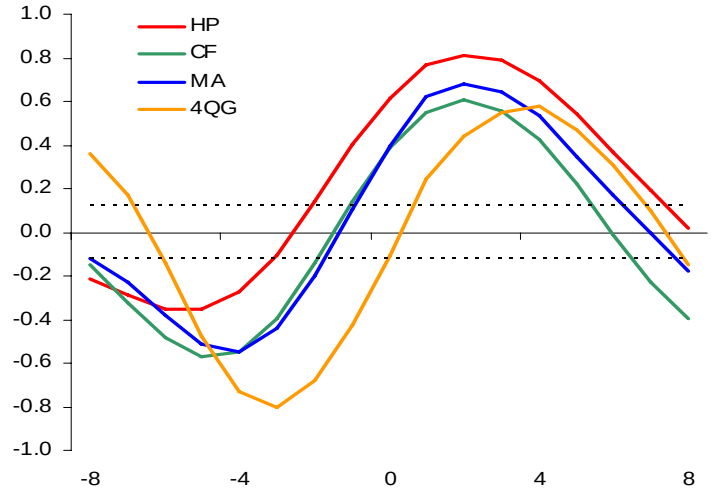


Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Second, we analyzed to what extent the election of the H-P filter mattered in the previous section. We compared the results shown above to those obtained with three alternative filters, the Christiano-Fitzgerald (2003), a three-year centered moving average, and the annual growth of every variable. Cross correlations of total loans with GDP obtained with the four filters reveal that annual growth detrending generates a larger lag with respect to GDP over the cycle (Figure 12 and Table 11).

Figure 12

Robustness analysis of the correlation of total loans, 1989-2006
(Percent, deviation from trend)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

We used these filters to find the period when each variable reaches its highest correlation with GDP and compute the difference with respect to the result obtained using H-P. For instance, if it is found that consumer loans lag GDP 2 periods using H-P while 3 periods using C-F, it is said that there is a one period difference.

Table 11

Total loans cross-correlation with GDP with alternative filters

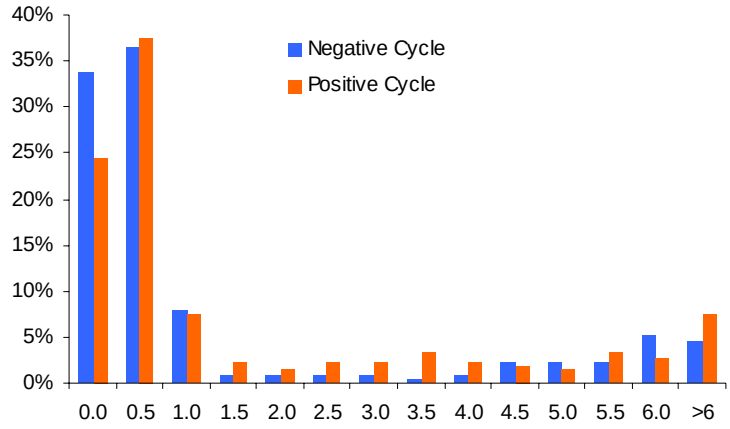
Filter	Max Correlation	Min Correlation	Lead/Lag at max.	Lead/Lag at min.
HP	0.81	-0.35	2	-5
CF	0.60	-0.57	2	-5
MA	0.68	-0.55	2	-4
4QG	0.58	-0.81	4	-3

Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Figure 13 shows the frequency of the differences among the first three filters in terms of numbers of period's standard deviation of the period of highest correlation with GDP. Over two thirds of the differences (positive or negative) are clustered around the 0 and 0.5 interval (periods), which means that the three filters generate virtually the same cyclical behavior (lead or lag with respect to GDP), with few exceptions.

Figure 13

Robustness analysis of the filters, 1989-1997
(Percent, deviation from trend)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

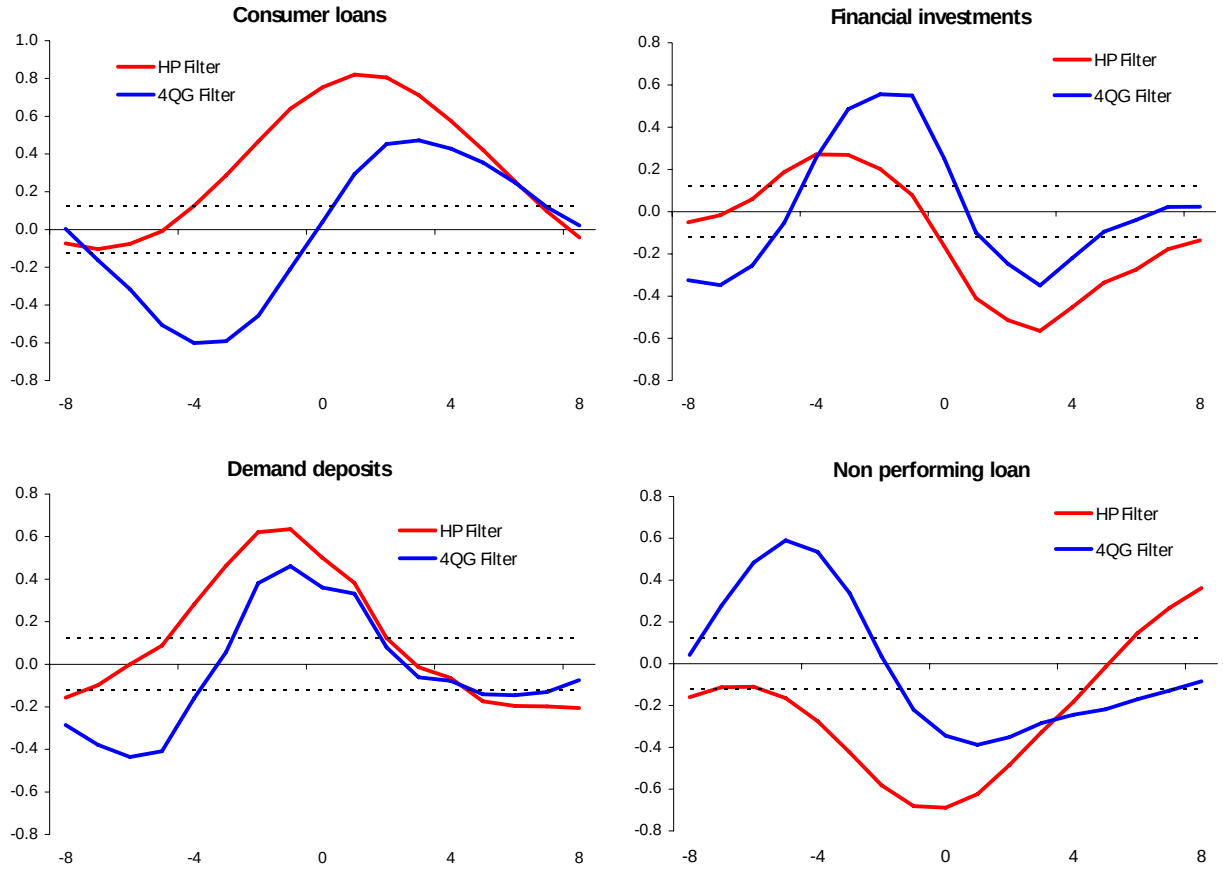
Furthermore, when the deviations are large, the cycles tend to coincide across the filters used, but differences in the tails generate differences when finding the maximum correlations. When looking at deviations throughout the cycle, we find that the H-P has a downward bias (toward

lower correlation) in the leads, but an upward bias in the lags. However, the use of the first three alternative filters does not change our basic results regarding the behavior over the cycle.

Finally, the cross correlations obtained using the fourth filter (variable's annual growth), are in many cases similar to those obtained with the H-P but tend to be lagged by two periods with respect to those obtained when using the H-P filter[23]. This last finding is important if the results showed here are used for the day-to-day analysis of the banking sector and/or monetary policy. Figure 14 shows cross-correlations obtained using the annual growth of the aggregate banking variables and GDP's and compares them to the correlations obtained from the H-P filtered variables.[24]/

Figure 14

Correlation between the annual growth of selected variables with GDP, 1989–2006



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

[23]/ The correlation of the variables' quarterly growth is very unstable for almost all the variables analyzed and does not have any relationship with the others filters examined.

[24]/ Detrending a series by annual differencing implies that shocks are given mostly to the trend and generates a less important cyclical component than applying a Hodrick-Prescott filter.

5. Effects of macroeconomic shocks on banking

5.1 Event study: contagion from the Asian crisis in 1998

In this section we describe the results of an event study in which we examined banking behavior during a window of 12 months following the policy changes enacted in 1998, in particular during the third quarter. As mentioned earlier, the Asian crisis impacted Chile's economy through a sharp fall of commodity prices and a sudden stop in capital flows, as a shift occurred toward presumably safer markets in the developed world. Both shocks created tremendous pressure on the exchange rate, which had been managed inside a band at the time. In response to this pressure, policymakers introduced a substantial interest rate hike (600 basis points) following a decrease in GDP growth and a sizable current account reversal. Important institutional reforms followed, including a shift to a free float, the opening of the capital account, the adoption of a fully fledged inflation targeting framework, along with a fiscal rule.[25]/ The event study considers the effects of such 1998 crisis on the bank balance sheets and was done not only for the aggregate banking system but for the different groups of banks as well.

In order to identify statistically significant changes in the variables (at a 95% level), we normalized them by their standard deviation, and thus defined changes in the normalized variables to be significant whenever their absolute value was greater than 1.64. Likewise, a change equal to 1 implies that the non-normalized variable increased by one standard deviation which, while not significant according to our definition, is still considerable.

For most subgroups of banks, loans declined significantly following the contagion (exchange rate band attack, interest rate hike, current account reversal) shock (see table 12). In particular, domestic banks contracted their lending activities the most, by over 31% (3 standard deviations). In contrast, foreign banks actually increased lending following the shock, by more than 100% two and four quarters later (4.7 standard deviations two quarters later to 3.8 four quarters after). Thus, loans of the total banking system declined in every quarter up to one year following the shock, when it increased but not significantly so. Looking at types of loans, consumption loans declined more strongly than did total loans, although again foreign banks increased their lending, particularly 2 and 4 quarters after the shock occurred.[26]/

On the deposit side, demand deposits seemed to exhibit some increase for the system, with a particularly strong growth for foreign banks in the third and fourth quarters following the shock (more than 120%), while for domestic banks there was a decline roughly one year after the shock. This behavior may reflect depositors' perception of greater stability of foreign banking institutions, a type of flight to quality effect during crises. Time deposits, on the other hand, declined significantly for domestic banks following the shock, thus showing their greater substitutability with other interest-bearing securities both within and outside the economy.

[25]/ This episode also served as a criterion to divide the sample in the cyclical characterization of the behavior of banks. It is worth noting that MPR increased only by 380 b.p. on quarterly basis and GDP annual growth decreased from 7.7% to a -2.2%.

[26]/ The share of foreign currency loans did not decline significantly.

Domestic banks were not able to increase their time deposits in all quarters while, interestingly, foreign banks were (see Table 12). This is consistent with the cyclical regularities found above where loan and time deposits are positively correlated with GDP.

Table 12

Variables' change after the 1998 contagion shock

Bank type	% Change	Total Loans	Consumer Loans	Demand Deposits.	Time Deposits	Loss Provisions	Total NPL	CAR	ROE
	in 2 quarters	-31.9***	-39.8***	-9.1	-28.2***	53.2***	42.6**	-5.6	-51.2
Domestic	in 4 quarters	-30.6***	-41**	-14.7	-28***	42.4*	45.9*	-2.5	-73.5
	in 2 quarters	108.9***	88.5**	129.6***	120.6***	39.9	47.4*	-4.3	-26.9
Foreign	in 4 quarters	112.6***	87.3*	111.3***	126.8***	63.5	44	-10	-5.6
	in 2 quarters	-0.5	-9.7	22.8	6.4	42.5**	45.1**	4.7	-49.7**
Private	in 4 quarters	1.3	-10.9	14.3	8	46.5**	45.3*	2.9	-54*
	in 2 quarters	3	3.5	2.2	-0.6	24.7	-14	39.9***	186.6***
Public	in 4 quarters	5.8	4.7	21.3	11.4	13.8	-25.4	57.5***	196.7***
	in 2 quarters	-0.3	-6.3	20.1	5.9	47.7**	56.4**	3.4	-19.4
Large	in 4 quarters	1.8	-7.5	11.8	9.5	52.1*	56.4**	2.6	-19.3
Small and	in 2 quarters	0.1	-11.3	16.4	5.1	35.4*	15.8	13.6*	-74.6
Medium	in 4 quarters	2	-12.2	21	7.2	36.3	11.8	13.4	-83.7
	in 2 quarters	2.5	-7.5	30.5	15.9	55.7	33.1	3	37.8
Corporate	in 4 quarters	5.5	-2.4	8	4	51	31.5	-0.5	77.7
	in 2 quarters	-33.2*	-33.4*	0	-28.2	8.2	-23.3	44.9***	-149.8
Retail	in 4 quarters	-53.6**	-50.9**	0	-44.9	26.7	-41.5	41.6**	-229**
	in 2 quarters	0.8	0.7	20.4	6.3	61.1***	45.9**	2.5	-25.4
Traditional	in 4 quarters	3.3	6.7	14.6	9.6	69.8**	45.7*	2	-28.2
	in 2 quarters	-0.1	-9.1*	18.5	5.5	40.4**	33*	7.9	-40.9*
System	in 4 quarters	1.9	-10.1	15.7	8.4	42.7*	30.7	7.4	-44.7*

(*): 90%, (**): 95%, (***): 99% change significance.

Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Partly as a result of the decline in lending activities, the banking system as a whole registered an increase in capital adequacy (measured as the ratio of capital to risk-weighted assets) following the shock, by 8% (1 standard deviation) in the third quarter. This result may have been driven to some extent by one prominent bank, the BancoEstado, which increased its capital adequacy substantially, by over 50% (4 standard deviations) one year after the shock (see table 12).

In general, profitability was not affected directly, at least in the short run but loan quality was. The operational margin did not register significant reductions overall, although some subgroups of banks showed a significant increase in the first quarter. On the other hand, the nonperforming loan ratio showed a widespread increase across different groups of banks, and for the system as a whole it increased more than 30% (1.5 standard deviations) two quarters after the shock. Consequently, provisions also increased, especially for large (48% or 2.4 standard deviations) and domestic banks (53% or 2.6 standard deviations) (see table 12).

In summary, the event study shows that the particular shape that contagion from the Asian crisis took place in Chile (exchange rate band attack, interest rate hike, current account reversal, etc) had a significant impact on bank balance sheets. The results showed here are consistent with the findings of the cyclical regularities since, for instance, a hike in the interest rates is followed by a

decrease in GDP. Consistently, after contagion took place, we observed a decrease in most types of credit and deposits and an increase in the risk indicators. Again we observed that the behavior of foreign and public banks is different from the others.

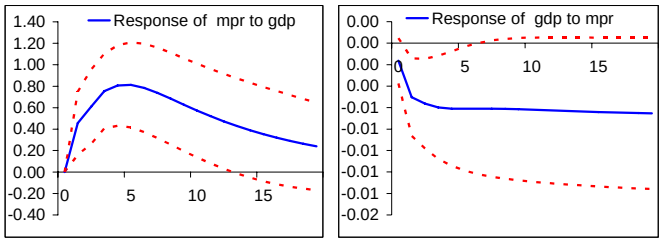
5.2 Time series analysis (VAR)

The event study shows the evolution of bank balance sheets after the external shock took place in 1998. However, it does not allow isolating the effects on the economy of a pure interest rate shock. In order to do that a Vector Autorregressions (VAR) is required. In this section we estimated, using a VAR, the effect of exogenous movements of the real interest rate and GDP on several bank variables including different types of loans, NPL, ROE and capital adequacy ratio. The main purpose is to obtain the elasticity of the variables and indicators to macro shocks.

The estimations were performed with quarterly data for the period 1989-2006. The variables are deflated and were seasonally adjusted but not detrended as before. The lags used in the estimations were chosen in order to get the more parsimonious model with white noise residuals. In the VAR estimation we used differences for GDP, real capital and loans (total, consumer, and mortgages) but levels for the interest rate, the NPL ratio, ROE and CAR.

We obtained impulse-response functions in order to compute elasticities. In all cases we found a significant negative effect of an interest-rate exogenous shock on GDP and a positive impact of an exogenous shock to GDP growth on the interest rate (figure 15). Therefore, we consider that a simple recursive (Choleski) identification strategy for the VAR: $[r, \Delta y, x]'$, with the monetary policy interest rate (mpr) placed as the most exogenous variable, followed by GDP growth (Δy) and the respective banking variable (x), generates sensible results.[27]/ The presentation of the results is focused on the effects of interest rates and GDP on each one of the selected variables.[28]/

Figure 15
General effects over interest rates and GDP



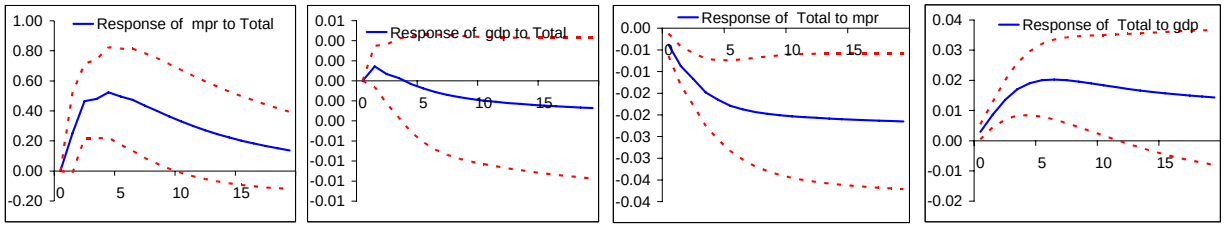
Source: Authors' calculations

[27]/ The confidence intervals were built here with 1.5 standard deviations. Bernanke and Blinder (1992) and Bernanke and Mihov (1996) use VARs to identify monetary policy. Monetary policy identification for Chile is found in Valdés (1998).

[28]/ The response of the interest rate and GDP to a shock given to several variables and indicators is not considered. The block exogeneity tests with the indicators (ROE, CAR, NPL) shows that these macro variables are not affected by them.

The first VAR measures the effect of shocks to both macro variables (r,GDP) on total loans through the estimation of the following vector: [r, Δy, Δcol]'. It is important to reiterate that an exogenous hike in interest rate engineers a reduction of GDP, while a positive exogenous shock to GDP growth produces a simultaneous increase of GDP and loans. In addition, while a shock to loans has no effect on economic growth it actually affects interest rates (see figure 16). When we include commercial loans, instead of total loans, in the estimation, the results are very similar; however we do not report them here.[29]/

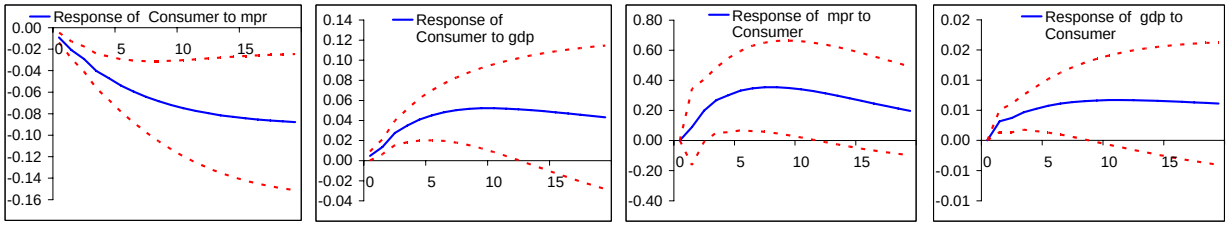
Figure 16
Effects of interest rates and GDP on total loans



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

The estimation of a VAR with consumption loans shows that this type of lending is more sensitive to interest rates and GDP. It is worth noting that, contrary to what happens with total loans, in this case GDP reacts positively to an exogenous increase in consumption lending (see Figure 17).

Figure 17
Effects of interest rates and GDP on consumer loans



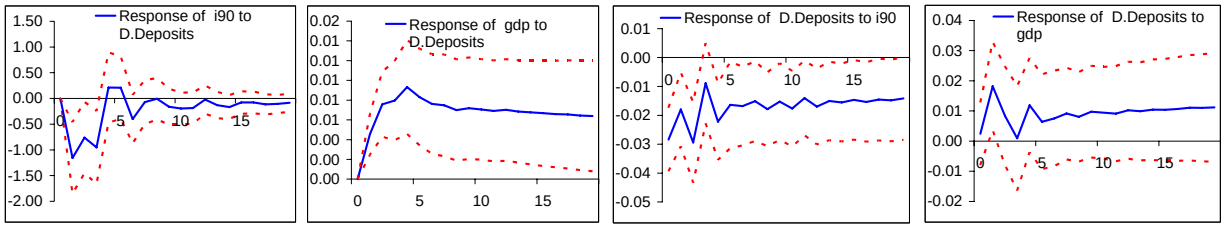
Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

This results show how monetary policy is transmitted: after a monetary policy rate hike, banks are not able to perfectly substitute their funds, increasing the interest rates they pay and charge, and reducing loans.

[29]/ On the other hand, we also run a VAR with mortgage loans (not reported) but they are not affected by either interest rates or GDP. In this case, disposable income might be a more appropriate scale variable to be included in the VAR.

Another VAR was estimated with the nominal interest rate, GDP and demand deposits. The results tell us that this type of deposits is very sensitive to interest rates but not to GDP (see figure 18). On the other hand, the results point to a small but significant effect of a shock to demand deposits on the interest rates and GDP.

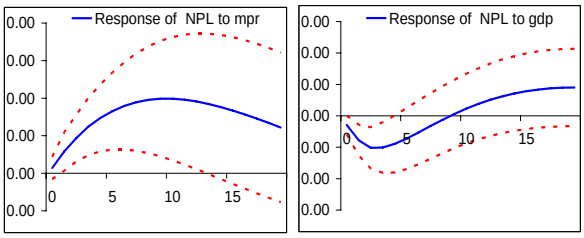
Figure 18
Effects of interest rates and GDP on Demand Deposits



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.
(4 lags and 90-360 days nominal interest rates)

The next VAR estimated includes NPL, in addition to interest rates and GDP growth. The impulse-responses obtained are as expected in most cases (see figure 19). NPL increases with an interest rate hike, and decreases with a positive shock to GDP growth. Surprisingly, an NPL increase generates a marginally significant drop of the interest rate as well as GDP. This last finding does not mean that the NPL generates a decrease in GDP, but it reflects a change in the economic environment with more uncertainty or higher risk. This is also consistent with the above finding NPL leading GDP.

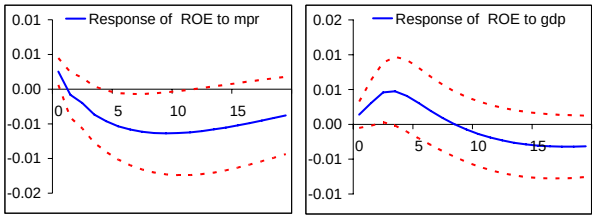
Figure 19
Effects of interest rates and GDP on NPL



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

The results of the following VAR estimated, which includes ROE, show, in the short run, a marginally significant positive effect on ROE of both macro variables interest rate and GDP. In the case of the interest rate the effect becomes negative after 5 quarters and not significantly different from zero later on (see figure 20). ROE does not have any impact on interest rates or GDP growth.

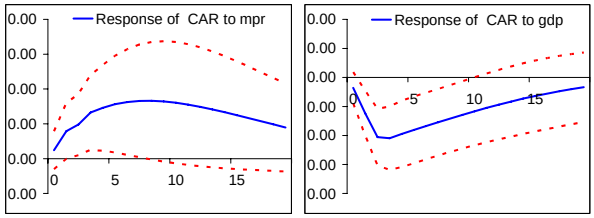
Figure 20
Effects of interest rates and GDP on ROE



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Finally, we estimated a VAR including the capital adequacy ratio (CAR) or Basel Index. Again, the results are coherent with the cross-correlations obtained above. An interest rate hike results in a higher CAR, while a positive shock to GDP growth has a negative impact on this ratio (see figure 21). Indeed, we had found before that CAR moved countercyclically, because banks move their portfolio towards riskier assets when economic growth accelerates (see figure 9).[30]/

Figure 21
Effects of interest rates and GDP on the CAR (Bassel Index)



Source: Authors' calculations, based on data from the SBIF and the Central Bank of Chile.

Summarizing the results from our VAR analysis, consumer loans are much more sensitive (its elasticity is higher) to interest rates and GDP than other types of loans (Table 13).[31]/ Second, demand deposits are very sensitive to interest rates but not to GDP (Table 12). On the other hand, NPL ratio is less sensitive than other indicators increasing with an interest rate hike, and falling with a positive shock to GDP growth. ROE shows a positive and strong reaction to GDP while its reaction to interest rates is negative and smaller. Finally, the results regarding CAR or Basel Index are coherent with the cross-correlations obtained above. An interest rate hike results in a higher CAR, while a positive shock to GDP growth has a negative impact on this ratio. Indeed, we had found before that the cross-correlations of CAR with GDP moved countercyclically, because banks move their portfolio towards riskier assets when economic growth accelerates.

We conclude that consumer loans are by far the most sensitive variable either to the interest rate or GDP (table 13). The elasticity of total loans is less than half of what was found for consumer

[30]/ We also run a VAR including real basic capital.
[31] / It is worth noting that differently to what happens with total loans, in this case GDP reacts positively to an exogenous increase in consumption lending.

loans. The non performing loan ratio as well as the capital adequacy ratio respond more to GDP (counter cyclically) than to interest rates. ROE grows strongly with a positive shock to GDP and falls with an interest rate hike.

Table 13

Elasticities and Semi-elasticities of selected variables

	Consumer Loans	Total Loans	Demand Deposits	NPL	ROE	CAR
Semi-elasticity to MPR*	-2.55	-0.99	-0.51	0.09	-0.25	0.22
Elasticity to GDP*	3.21	1.48	0.10	-0.14	1.22	-0.53

* measured based on annual changes.

6. Summary and conclusions

The data for aggregate bank's balance sheet in Chile show that between the early nineties and 2006, lending as a share of GDP has increased, particularly in mortgages and lending for consumption purposes, which reflect financial deepening. Indeed, bank loans and capital as a percentage of GDP in Chile are considerably larger than in Argentina, Brasil and Colombia, and is comparable to that of the U.S., but it is significantly smaller than in the rest of the OECD countries included in our sample. Cross correlations between real aggregate bank credit and real GDP for a sample of 10 countries, including Chile, show that Chile's credit behaves in a typical way, being procyclical and lagging the business cycle by 2-5 quarters.

Our examination of banks' total portfolio shows that it is markedly procyclical, and has a very high correlation with GDP, although it is more volatile. Also, loans generally lag the GDP cycle. Demand (and checking accounts) deposits are procyclical and lead the cycle. This result is different to what was found for the US (Bernanke and Blinder, 1988). However, here bank deposits were also found to be more volatile than loans. The nonperforming loan ratio of consumer loans from local and retail banks also leads the cycle, but in this case its behavior is markedly countercyclical. Thus, when the nonperforming loan ratio starts to rise, output growth begins to slow down.

The capital adequacy ratio (Basel index), banks' liquid assets and financial investments are countercyclical, which shows that in a recession, when risk increases, banks probably restrict the supply of loans and maintain financial investments. This first evidence, although descriptive in nature, tends to support the existence of a credit channel, which is important in terms of magnitude, considering that loan fluctuations can represent up to 14% of GDP. In fact, loans correspond to approximately 70% of GDP, and they had a maximum positive deviation from trend of 9% and negative deviation of 10% in the period analyzed. Loans can thus contribute to accentuating the GDP cycle, as this approach sustains.

Compared to the banking system as a whole, foreign banks, as well as BancoEstado (a public institution) have generally behaved differently along the cycle, in the case of many variables (ie acyclically). In particular, during recessions they have been able to attract deposits and continue lending, which could reflect that people perceive those banks as safer.

The event study shows that the particular shape that contagion from the Asian crisis took place in Chile (exchange rate band attack, interest rate hike, current account reversal, etc) had a significant impact on bank balance sheets, reducing profitability and loan quality across all subgroups of banks, and creating a general decline in consumer loans. However the effect varied across types of banks. As a result of a sizable in shift in deposits away from domestic and towards foreign banks, the latter were able to increase their lending activities considerably, even as their profitability and loan quality declined. Of course, this occurred at the expense of domestic banks.

Finally, VAR estimation shows that an interest rate shock has a significant impact on many variables and indicators of the aggregate banking system: after an exogenous interest rate shock GDP falls as well as total loans. Consumer loans fall even more, while ROE, NPL and CAR increase. In addition, a positive shock to GDP growth affects positively the interest rate, loans, and ROE. On the contrary, when this type of shock hits the economy, NPL and CAR decrease.

The empirical regularities presented here are part of a broad agenda to study the banking system, which should help monetary policy making and banking supervision as well.

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