Monetary Policy at the Zero Lower Bound: The Chilean Experience

Luis F. Céspedes
Universidad Adolfo Ibáñez

Javier García-Cicco
Central Bank of Chile
Universidad Católica Argentina

Diego Saravia
Central Bank of Chile

The global financial crisis that started in 2008 dramatically changed the analysis and implementation of monetary policy worldwide. Central banks were at the center of the stage during that time, implementing both conventional and unconventional policies. Not only were monetary policy rates drastically reduced, but also diverse policy measures were implemented: purchases of a wide range of financial assets, lending to financial institutions, intervening exchange rate markets and paying interest on reserves.[1] Given that these policies challenged the conventional view embedded in the predominant monetary policy model, within which central banks control only a short-term interest rate, it is most important to understand how these policies have worked, and to what extent they were successful.

We thank Carlos Salazar for research assistance and Matías Bernier and José Matus for helping us with the data and valuable discussions. We also thank Pablo García for his comments and suggestions. The views and conclusions presented in this paper are exclusively those of the authors and do not necessarily reflect the position of the Central Bank of Chile or its Board members.

1. See, for instance, Cespedes et al. (2011a) for a description of different policies implemented in central banks under an inflation-targeting framework.

Macroeconomic and Financial Stability: Challenges for Monetary Policy, edited by Sofía Bauducco, Lawrence Christiano and Claudio Raddatz. Santiago, Chile.

The purpose of this paper is to analyze the role that monetary policy actions played in the Chilean economy during the 2008-2010 period, particularly those implemented to deal with the zero-lower-bound situation. Responding to the global financial crisis, the Central Bank implemented a variety of policies; including, programs to provide domestic liquidity at the onset of the Lehman collapse, changes in the eligible collaterals used in operations with the Central Bank, a dramatic drop of 775 basis points in the policy rate reaching its lower bound at 50 basis points, and most notably the introduction of term liquidity facilities (the FLAP) as a way of committing to maintain the policy rate at the lower bound for an extended period of time. This last policy is the object of interest in this study.

In this paper, we describe the policy actions taken by the Central Bank and analyze the effects that they had on financial variables around the date when the FLAP was announced. We also study the effects of FLAP usage on banking lending activities. The focus on the FLAP is guaranteed, because it was the Central Bank's utmost effort to show its commitment to the provision of enough funds that would be available for a long enough period of time to let the economy cope with the financial crisis.

Accordingly, after describing the macroeconomic outlook for Chile in 2008, we pursue our analysis in two parts. In the first one, we analyze whether or not the market perceived the announcement that the policy interest rate would be maintained at its lowest level for a long period of time, which was the main goal behind the implementation of the FLAP, as credible. To do this, we study the way the announcements related to the FLAP program affected nominal and real interest rates, as well as other financial variables. In particular, we analyze the observed change in these variables around the date of the announcement, and contrast these observed values with impulse responses following monetary policy announcement (estimated using daily dates up to 2008). The results seem to indicate that the announcement had the effect of flattening the nominal yield curve, with the maximum effect being a decrease of between 30 and 50 basis points in medium term yields.

In the second part of the study we use panel regressions to understand how the use of the FLAP funds affected bank lending. For this, we construct a unique dataset consisting in a monthly panel combining banks' balance-sheet data and information about their FLAP usage. The results indicate that banks that borrowed from this facility increased commercial and consumer loans; the effect on mortgage credit was negligible.

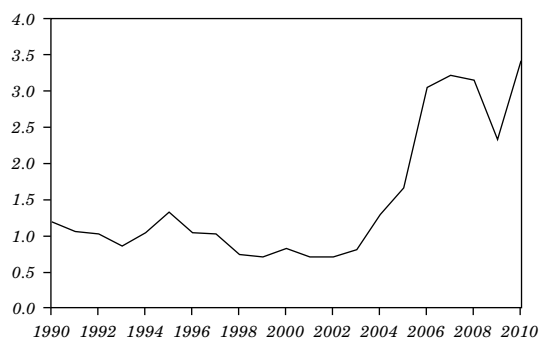
The rest of the paper is organized as follows: Section 1 presents a description of the events in Chile during 2008, as well as a description of the policies implemented. Section 2 discusses the conceptual framework that motivates our empirical work. In section 3, we analyze the effects of the FLAP announcement on interest rates and other financial assets. Section 4 presents the analysis based on bank level data. Finally, section 5 concludes.

1. Chile and the Global Financial Crisis

Chile's terms of trade started to increase significantly in the second half of the 2000s, led by especially high copper prices (figure 1). Despite suffering a negative shock due to higher energy prices, the economy was exhibiting a solid growth path. In the period 2005-2007, GDP grew at an annual average rate of 5.7 percent (figure 2). This strong GDP growth was the result of favorable international conditions and expansionary domestic macroeconomic policies.

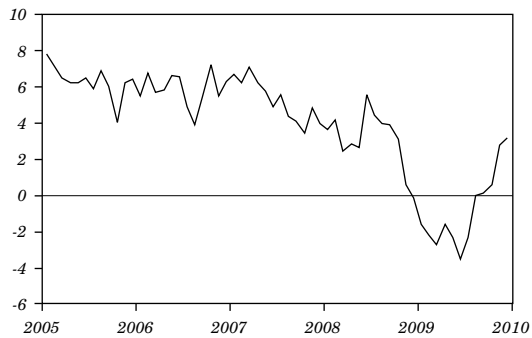
The significant increase in terms of trade did not produce a strong appreciation of the real exchange rate as would have been expected, based on previous terms of trade cycles. One explanation for this outcome was the implementation of a fiscal rule, which led to saving a significant fraction of the additional resources the government was collecting, due to the high price of copper.

Figure 1. Copper Prices
US$ per pound



Source: Central Bank of Chile.

Figure 2. Monthly Index of Economic Activity
Imacec, 12-month % change



Source: Central Bank of Chile.

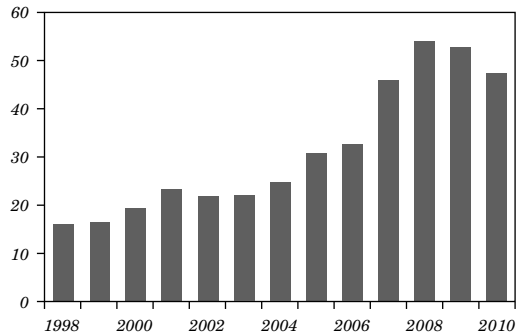
Figure 3. Nominal Exchange Rate
Ch$ per US$

Source: Central Bank of Chile.

But by the end of 2007, in the context of more expansionary monetary policy in the U.S., the nominal exchange rate began to appreciate significantly (figure 3). This led Central Bank to intervene in the foreign exchange market, starting the dollars purchase program in April 2008. Three months after the intervention was announced, the exchange rate had depreciated more than 12 percent.

During 2007 headline CPI inflation started to pick up due to increases in international food prices, and higher energy prices.

Figure 4. Energy Price- Central Grid Electricity Generation Cost
Average regulated price Ch$/Kwh



Source: National Bureau of Statistics.

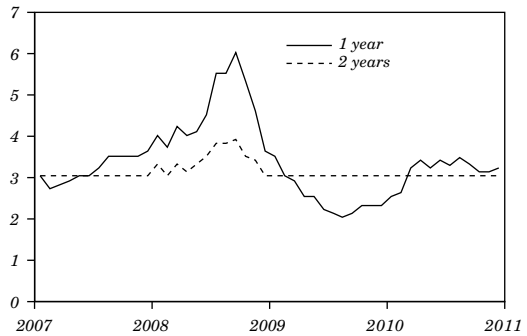
Nonetheless, core inflation measures remained below the inflation target of 3 percent at that time. Part of the higher energy prices were explained by the reduction in natural gas imports from Argentina, which caused electricity generation to shift towards more expensive sources. This, added to a reduction of rain, caused a significant increase in electricity prices (figure 4), which resulted in a lower rate of growth of output during the second half of 2007.

The combination of high oil prices and a more depreciated nominal exchange rate, since the intervention of the exchange rate market, started to generate pressures on tradable goods inflation. In this context, inflation expectations in the monetary policy horizon (2 years) started to deviate significantly from the inflation target (figure 5).

The Central Bank faced a difficult task: to increase the policy rate just enough to avoid second round effects, in order to control inflationary expectations and avoid an exchange rate appreciation. The monetary policy rate was raised by 100 basis points in the course of 2007. Between January and June 2008, the monetary policy rate was kept unchanged. In the same period, annual inflation rate went from 7.5 to 9.5%. The deterioration in inflation expectations, discussed before, led the Central Bank to increase its monetary policy rate rapidly. From June to September 2008, the Central Bank raised the interest rate from 6.25 to 8.25%.

The bankruptcy of Lehman Brothers in late September 2008 started an unprecedented period of monetary policy activism, not

Figure 5. Inflation Expectations, in 1 and 4 Years
12-month change



Source: Central Bank of Chile.

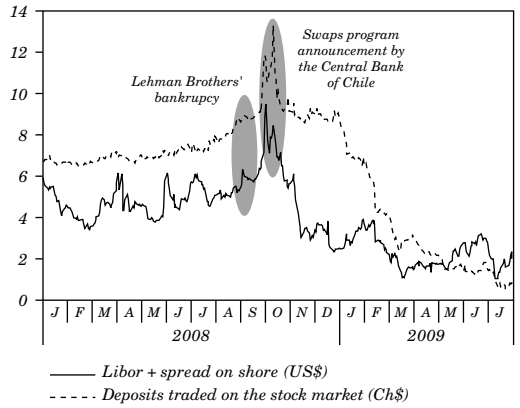
only in terms of the monetary stimulus itself, but also in terms of the different types of instruments implemented. In a first response after this event, the demand for liquidity intensified significantly, which led central banks around the world to either introduce or intensify existing liquidity provision measures.

In the case of Chile, the uncertainty regarding the effects of the U.S. financial crisis on the global economy triggered a significant increase in the demand for international and domestic liquidity. This situation translated into a significant increase in domestic interest rates. Deposit rates in domestic and foreign currency increased significantly (figure 6).

With a solid position in terms of international liquidity and a flexible exchange rate regime in full operation, the Central Bank of Chile announced a program of repos and swaps at the end of September 2008 with the objective of providing domestic and foreign liquidity to domestic financial intermediaries. This liquidity provision significantly reduced the deposit interest rates in domestic markets, which allowed the deposit interest rate in domestic currency to align itself with the monetary policy rate.

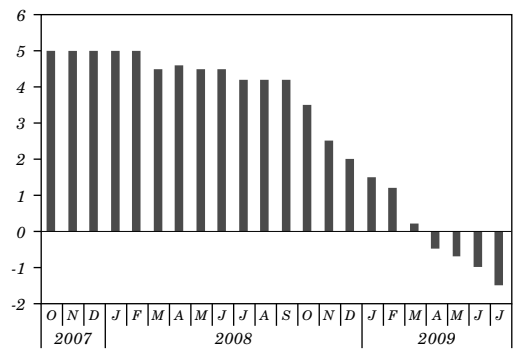
The severity of the financial crises generated a significant adjustment in macroeconomic expectations. Chile was not an exemption. In the case of economic activity, the less favorable external scenario during the first half of 2008 led to a relatively mild adjustment in GDP growth expectations for 2009. The situation was dramatically

Figure 6. Deposit Rates: Local US$ and Ch$ 90 Day Rates



Source: Central Bank of Chile.

Figure 7. GDP Growth Expectations
Annual percentage change

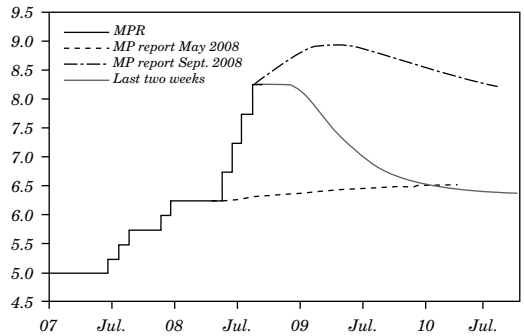


Source: Central Bank of Chile.

intensified in the last quarter of 2008 and throughout the first half of 2009. By December 2008, GDP growth expectation for 2009 was less than half the expected rate in September 2008 (figure 7).

It is interesting to notice that, despite falling from a level of 3.9 percent in September 2008 to 3.5 percent in October 2008, 24-month inflation expectations returned to the 3 percent inflation target in December 2008 (figure 5).

Figure 8. Expected Monetary Policy Rate on November 2008



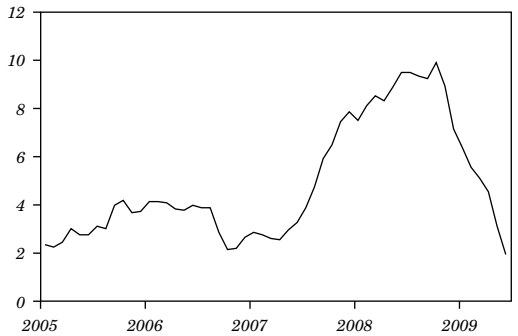
Source: Central Bank of Chile.

Despite keeping interest rate unchanged during the last quarter of 2008, monetary policy shifted from a restricted stance towards a mode consistent with the external scenario faced by the Chilean economy. In effect, in the monetary policy meeting September 4th 2008, the Central Bank had indicated that additional increases in the monetary policy rate were considered in the most likely scenario. In contrast, after the monetary policy meeting on October 9th 2008, the Central Bank indicated that given the drastic change in the external scenario, a new, full evaluation of the factors that determine the path of the monetary policy interest rate (MPR) consistent with achieving the inflation objective was required.[2]

The re-evaluation of the macroeconomic scenario facing the Chilean economy was part of the material considered by the Board at the monetary policy meeting on November 13th 2008. In comparison with the macroeconomic scenario presented in September of that year, the Central Bank considered significantly lower terms of trade and lower trade partners GDP growth. Regarding the MPR path, the Central Bank considered, in this new scenario, a path similar to that derived from the different measures of private sector expectations. That path implied that the MPR would remain unchanged until the end of the year, and then it would experience a gradual reduction along 2009 to a level of around 6 percent (figure 8).

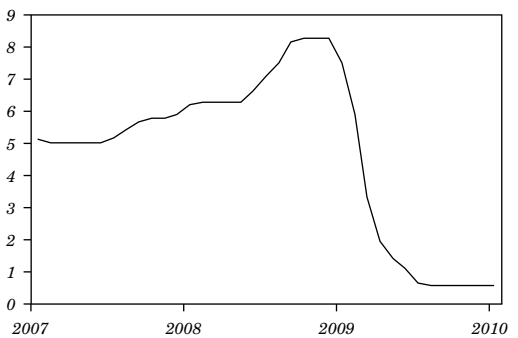
2. In normal times such evaluation occurred in May, September and January.

Figure 9. CPI Inflation
Percent



Source: Central Bank of Chile and National Bureau of Statistics.

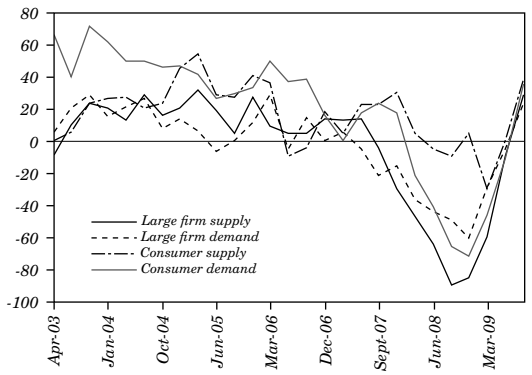
Figure 10. Monetary Policy Rate
Percent



Source: Central Bank of Chile.

By the end of 2008, it was clear that the contraction in the world's economic activity was well beyond the initial projections. At that point, the Central Bank of Chile started to implement a significant reduction in the monetary policy rate. Inflation, which had reached almost 10 percent in October 2008 due to high food and energy prices, experienced a rapid drop as commodity prices reverted from record highs in 2008 (figure 9). In the context of this fall in inflation, and a more negative external scenario than previously expected, the monetary policy rate was rapidly reduced (figure 10).

Figure 11. Bank Lending Conditions Survey
Net percent of survey responses[a]



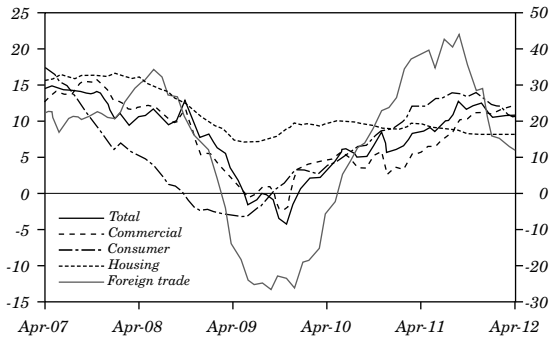
Source: Central Bank of Chile.
a. Negative values indicate a weaker perceotion of demand and less flexible supply conditions.

During all this period, financial conditions in the Chilean economy deteriorated markedly. The combination of high uncertainty, lower growth prospects (and commodity prices) and the deterioration in international financial conditions gave rise to very restrictive credit conditions (figure 11). Lending spreads increased significantly, and credit to firms became quite scarce. In this scenario, the possibility of disruptions in the monetary policy transmission channel could not be ruled out. In this context, the Central Bank announced a program that expanded the list of eligible collateral in its operations.

The deterioration of financial conditions resulted in a significant contraction in new loans. Commercial loans started to decrease rapidly in November 2008; the same was true for foreign trade credit and housing loans. Consumer loans had been falling since before September 2008, but its contraction was amplified since the bankruptcy of Lehman Brothers (figure 12).

As the economy was losing traction and inflation expectations continued falling (figure 5), the Central Bank reduced the policy rate to 75 basis points in June 2009 and added one additional statement in its monetary policy communiqué: "The Board considers that, in the most likely scenario, it will be necessary to maintain the monetary stimulus for a longer period than the one implicit in financial asset prices. This permits projected inflation to stand at 3% over the policy horizon." This statement reflected the intension of the Central Bank

Figure 12. Bank Loans
Real annual change, percent



Source: Central Bank of Chile.

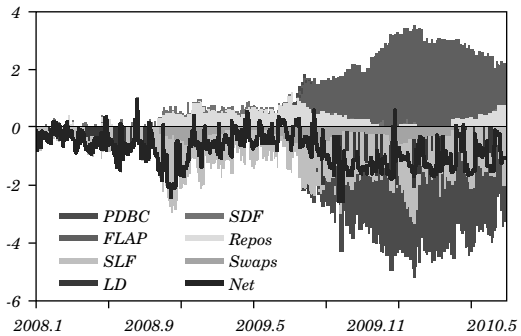
to signal a more expansionary path for the monetary policy rate than what was contemplated by private agents.

In the July meeting, the Board of the Central Bank of Chile decided to reduce the monetary policy interest rate by 25 basis points, to 0.50% annual (the words "minimum level" were added to indicate that no additional cuts in the monetary policy rate would be implemented), and to adopt complementary monetary policy measures to strengthen the effects of this decision. In the Central Bank's communiqué from the July 2009 monetary policy meeting, it was indicated that, "For projected inflation to reach 3% over the policy horizon within a context of a foreseen widening of the output gap and reduced imported cost pressures, it is necessary to increase the monetary stimulus. Therefore, the monetary policy rate will be held at this minimum level for a prolonged period of time."

Additionally, in order to reinforce this decision and align financial asset prices with the path of monetary policy, the Central Bank of Chile implemented complementary monetary policy measures:

— Established a term liquidity facility (*Facilidad de Liquidez a Plazo*, *FLAP*) for banking institutions, granting 90- and 180-day liquidity at the prevailing level of the monetary policy rate.
— Adjusted the program of Central Bank note issuance at maturities below one year, consistent with the aforementioned decision.
— Suspended, for the rest of 2009, the issuance of debt instruments maturing in one year or more, corresponding to two-year Central Bank peso-denominated bonds (BCP-2) and one-year Central Bank promissory notes (PDBC-360).

Figure 13. Monetary Operations of the Central Bank of Chile[a]
(Ch$ billions)



Source: Financial Stability Report 1st Semester 2010, Central Bank of Chile.
a. SLF: Standing liquidity facility; LD: Liquid deposits; SDF: Standing deposit facility, and FLAP: Short-term liquidity facility. PDBCs only consider the increase in the stock since the announcement of the FLAP. Source: Financial

Eligible collateral for the FLAP included Central Bank instruments, time deposits, and bank mortgage bills. The FLAP was widely used by local banks, peaking at Ch$3.284 trillion (close to US$6.5 billion) in mid-January 2010, or 40% of the banking system's capital and reserves. To neutralize the injection of resources associated with the FLAP, the Central Bank made significant PDBC issues, with a maximum of Ch$3.0 trillion (near US$6 billion) in February (figure 14).

In every monetary policy meeting since November 2009, the Central Bank extended the facility for loans up to six additional months. In the November meeting the FLAP was not further extended, implying that banks were able to borrow from the facility only until May 2010.

We conclude this section with some descriptive statistics on the FLAP usage. During the period in which the facility was available, 13 banks borrowed at least once from the facility, with nearly 60% of the total amount borrowed by two banks. The facility offered credit both in pesos and in UFs (indexation unit), with almost 60% of the total in UFs. Around 50% of the total was 180-day credit, while 30% had a 90-day maturity (the rest was mainly 30-day loans). Finally, July and November 2009 were the months in which the facility was

more heavily used (almost 1 trillion pesos in July, and nearly 1.2 trillion in November).

2. Unconventional Monetary Policy: A Conceptual Framework

A justification for the implementation of unconventional monetary policy is that the usual monetary instrument, the control of the overnight interest rate in the interbank market, may have reached its lower bound, and the economy needs additional monetary stimulus. This was the scenario faced by the Central Bank of Chile in 2009.

The FLAP was implemented in order to reinforce the decision of the Central Bank of Chile to keep the interest rate in its lower bound for a prolonged period of time. Therefore, the first place it can be analyzed is within the credibility channel. In general terms, if a central bank can commit in advance to future settings of the policy rate that will be lower than they would have been otherwise; the zero lower bound would not be a constraint to provide additional stimulus if required. By generating inflation expectations, the central bank can reduce the real interest rate. Nevertheless, the key conjecture is that such promises may not be credible. Credibility has been emphasized as a crucial constraint in this situation, starting with Krugman (1998).

Eggertsson and Woodford (2003) have argued that shifts in the central bank's portfolio could be of some value in making the central bank's commitment to a particular kind of future policy credible to the private sector. Jeanne and Svensson (2007) argue that the commitment problem may be solved if the central bank cares enough about its capital position. In particular, by shifting the composition of its portfolio (increasing foreign exchange reserves), it generates a currency mismatch. If the central bank deviates from a promise of high inflation, the concomitant currency appreciation would, via the fall in the value of the central bank's foreign reserves, result in a capital loss. This would deter the central bank from reneging on a promise of high inflation, if the central bank is assumed to care about its capital. In a similar vein, Céspedes, Chang, and García-Cicco (2011) show that by shifting the maturity of its debt (selling short term bonds and holding long term bonds), a central bank can ensure the credibility of an inflationary policy.

The term liquidity facility (FLAP) for banking institutions can be easily related to this brand of literature. By providing up to 180-day loans at the prevailing level of the monetary policy rate to commercial banks, the Central Bank of Chile reinforced its commitment to keeping its monetary policy interest rate at the lower bound for a prolonged period of time. Had the Central Bank decided to increase its monetary policy interest rate in anticipation, it would have suffered capital losses. In this way, in the first part of our analysis, we empirically assess how the FLAP affected interest rates and other assets prices. Our goal is to establish how effective was the FLAP in changing market expectations regarding future monetary policy.

A second branch of the literature under which the FLAP can be placed corresponds to the recent works on financial frictions and financial intermediation. As discussed by Woodford (2010), if intermediaries face costs to originate and service loans, or to manage their portfolios, in a competitive equilibrium, the interest rate at which they are willing to lend will exceed their cost of funds by a spread that reflects the marginal cost of lending. This marginal cost may be increasing in the volume of lending by the intermediary if the production function for loans involve diminishing returns to increases in the variable factors, owing to the fixed nature of some factors (such as specialized expertise or facilities that cannot be expanded quickly). In this context, and in similar setups, the leverage of financial intermediaries may be limited by their capital.

In particular, recent literature has emphasized that the supply of loans by financial intermediaries may be constrained by the size of the losses that the intermediary would be subject to in bad states of the world, relative to its capital as in Adrian and Shin (2010), and by the value of their available collateral as in Garleanu and Pedersen (2009) and Ashcraft, Garleanu and Pedersen (2010). By relaxing the financial constraint that capital-constrained banks face, or by reducing the cost of financing of these banks, some unconventional policies may stimulate the economy. Related to this, Céspedes, Chang, and Velasco (2011) show that in the context of a model with financial intermediaries subject to financial constraint, direct lending by the central bank to these intermediaries relaxes the constraint that they face, and therefore has a positive effect on the supply of loans by the financial sector.

In this context, if the term "liquidity facility," implemented by the Central Bank of Chile, helped to relax the financial constraint

of financial intermediaries, it may have affected the supply of loans of these institutions. This facility may be interpreted as a substitute for deposits or loans to banks at zero lower bound interest rates.

In line with this channel, in the second part of our empirical analysis we focus on the behavior of banks in response to the FLAP. We exploit a unique dataset that describes the use of the term liquidity facilities (FLAP) by each bank in the Chilean financial system.

3. The Effect of the FLAP Announcement on Asset Prices

In this section, we analyze the impact of policy announcements regarding the policy rate and the FLAP facility on both nominal and real interest yield, corresponding to instruments from the Central Bank of Chile, sovereign and corporate spreads, and the nominal exchange rate. As we argued before, one of the key transmission mechanisms for unconventional policies at the zero bound entails convincing the public that the Central Bank is going to implement expansionary polices for an extended period of time. Thus, we would expect these announcements to lower the long part of the nominal yield curve. In addition, comparing the response of nominal and real rates would allow us to gauge the effect of the announcement on inflation expectations and/or inflation premium. In addition, we want to explore if the FLAP announcement affected other relevant financial variables.

Event studies have been the common tool used in the literature to assess the effect of unconventional policy announcement in other countries. For instance, Cagnon et al. (2011) identify 23 events corresponding to announcements made by the Federal Reserve Board in the U.S. related to different asset-purchase programs implemented in 2008 and 2009. The case of the U.K.'s quantitative easing program is analyzed in Joyce et al. (2010). However, an event-based study is not feasible in our case because we do not have many events for the Chilean case.

Given this limitation, our approach exploits the fact that, at the same time the FLAP was announced, a reduction of 25 basis points in the policy rate was implemented. Suppose that we can characterize what is the usual reaction (in normal times) of financial variables to a 25 basis point cut in the policy rate. Then, if the market reaction was

significantly different from the usual response to the announcement of drop in the policy rate, we could attribute the difference to another announcement in that same meeting (i.e. the FLAP). Therefore, our identification strategy relies on estimating the normal time response of the financial variables to changes in the policy rate, its associated uncertainty, and attributing any significant difference to the FLAP announcement. We do this by implementing the strategy proposed by Rigobon (2003), known as "identification through heteroskedasticity," which we discuss in detail below.

We use daily data on 12 variables. In terms of nominal yields, we use the monetary policy rate (MPR) and the yield on the Central Bank of Chile's nominal promissory notes and bonds (PDBC and BCP) of 1, 2, 3, 6, 12 and 24 months of maturity. In terms of real rates, we use the yield on indexed bonds (BCU) of 1 and 2 years of maturity. All these rates were transformed so that they represent the different time periods between them. In that way, we will have, for instance, the 1 month rate, the 1-month-in-1 month rate, the 1-month-in-2 month rate, etc.[3] We choose to set the data in this way because otherwise, for instance, the response of the 2 months rate will in part be due to the response of the 1 month rate, and we want to separate these two effects.

In terms of spreads, we use the JP Morgan EMBI spread from Chile, and the LVA measure of AAA corporate bond spread.[4] Finally, the nominal exchange rate (NER) is the rate in the interbank market. Our sample ranges from September 13th, 2002, to December 30th, 2008, which we consider the normal-time period,[5] adding to 1572 daily observations.[6]

In the remainder of this section we first describe the identification strategy implemented to characterize the usual response of different financial variables to monetary policy announcements, and then used them to identify the differential effect attributed to the FLAP announcement.

3. These were constructed using the expectations hypothesis.

4. This spread is constructed considering AAA indexed corporate bonds of more than 8 years to maturity, relative to indexed bond from the Central Bank with the same maturity.

5. The first decrease in the policy rate after the Lehman Brothers collapse was in January 2009. Results are robust with using data only up to August 2008, i.e. before the Lehman Brothers collapse.

6. The data on yields of instruments from the Central Bank are from Risk America, and the other variables are taken from Bloomberg.

3.1 Identification of Normal-Time Responses

To estimate the response of financial variables to monetary policy announcements using daily data, we follow a strategy known as "identification through heteroskedasticity." This approach was proposed by Rigobon (2003), and it has been applied to identify monetary policy shocks by, for instance, Rigobon and Sack (2004), and Wright (2011), using U.S. data. An application of the methodology with Chilean data is in Chaumont and García-Cicco (2013).[7] The basic idea behind this procedure is to exploit the increase in the volatility of financial variables observed on the dates of policy announcements.

Consider the vector Y_t collecting the n variables of interest, and assume its evolution can be represented by a vector auto-regression,

$$Y_t = B(L)Y_{t-1} + u_t,$$

where $B(L)$ is a matrix of lag coefficients and the reduced-form errors u_t are assumed to be i.i.d. with mean zero and variance-covariance matrix Ω. The reduced-form errors are linked with the structural errors through the relationship,

$$u_t = \sum_{j=1}^{n} R_j e_{j,t} \,,$$

where R_j indicates how the structural error $e_{j,t}$ affects the reduced form errors. The goal is to identify R_M, i.e. the vector associated with the effect of monetary policy shocks.[8] The key identifying assumption is that the monetary policy shock has a variance σ_A^2 on announcement days and variance σ_{NA}^2 on all other dates, with $\sigma_A^2 \neq \sigma_{NA}^2$, while the variance of all other shocks does not change on those announcement dates.[9]

Let Ω_A and Ω_{NA} denote, respectively, the variance matrices of the reduced-form residuals on announcement and non-announcement

7. We refer to that paper for robustness checks of the results presented in this subsection.

8. Notice that the ordering of the shocks is irrelevant for this identification strategy.

9. The other structural shocks may display this kind of heteroskedasticity in different days. However, as we are only interested on identifying the monetary policy shocks, there is no need to specify the behavior of the other shocks.

dates. Given the assumed relationship between the reduced form and the structural error terms, we have

$$\Omega_A - \Omega_{NA} = R_M R_M' \sigma_A^2 - R_M R_M' \sigma_{NA}^2 = R_M R_M' (\sigma_A^2 - \sigma_{NA}^2).$$

This condition allows identifying R_M. Furthermore, assume without loss of generality that $(\sigma_A^2 - \sigma_{NA}^2) = 1$, as $(\sigma_A^2 - \sigma_{NA}^2)$ and R_M are not separately identified. Therefore, we can estimate R_M as the argument that solves the following minimum distance problem,

$$\min \left[vech(\hat{\Omega}_A - \hat{\Omega}_{NA}) - vech(R_M R_M') \right]' \left[\hat{V}_A - \hat{V}_{NA} \right]^{-1}$$

$$\left[vech(\hat{\Omega}_A - \hat{\Omega}_{NA}) - vech(R_M R_M') \right],$$

where $\hat{\Omega}_A$, $\hat{\Omega}_{NA}$ are constructed using the OLS reduced form errors, and $\hat{V}_A$, $\hat{V}_{NA}$ are the variances associated with the OLS estimators of $vech(\hat{\Omega}_A)$, $vech(\hat{\Omega}_{NA})$.[10] Once R_M is obtained, impulse responses can be computed with the usual techniques.[11]

Figure 14 displays the impulse responses,[12] normalizing the shock to represent a drop of 50 basis points of the monetary policy rate, for a 50-day horizon, using data up to December 30th, 2008. While the most important results in terms of our analysis in the next subsection are the obtained confidence bands, we provide here a brief discussion of the obtained responses.[13]

The identified shock produces a significant drop in the nominal rates up to a year of around 20 annualized basis points (a.b.p.). However, the nominal rate for 1 year in 1 year does not significantly move. The real rate also experiences a reduction: in the 1-year horizon, almost 30 a.b.p. in 50 days, while the minimum value for

10. The operator *vech()* represents the vectorization of the unique elements of a symmetric matrix.

11. In Chaumont and García-Cicco (2013) we present several tests for the hypothesis that Ω_A and Ω_{NA} are significantly different, which is the key moment condition that allows identification.

12. The reported 95% confidence bands (the gray areas) were constructed using the stationary bootstrap method proposed by Politis and Romano (1994) to resample blocks of residuals of expected length of 15 days. This is done to preserve some of the volatility clustering that is expected to be present in a daily dataset. Throughout the figures, all yields and spreads are expressed in annualized basis points, while the nominal exchange rate is expressed 100* log of pesos per dollar.

13. See Chaumont and García-Cicco (2013) for further discussion.

the 1-year in 1-year rate is around 15 a.b.p. This result implies a minor increase in inflation expectations (computed using the Fischer equation) up to two years, although the response of this implied expectation is not significant. In terms of spreads, the EMBI for Chile tends to decrease somehow after the announcement, while the corporate spread does no significantly move. Finally, the nominal exchange rate does not display a significant response either.

3.2 The Effects of the FLAP Announcement

Having described the usual response to monetary policy announcements, estimated using data up to 2008, we are interested in comparing these responses with the behavior of the variables after two announcement dates. The first one corresponds to the meeting on June 16th, 2009. At that meeting, the policy rate was lowered from 125 to 75 basis points. While in previous meetings the Central Bank had aggressively decreased the policy rate (700 basis points from January to May 2009), and in previous press releases, even hinted that further reductions were to be expected; the June meeting was the first time that the Board communicated that "in the most likely scenario, it will be necessary to maintain the monetary stimulus for a longer period than the one implicit in financial asset prices." This can be regarded as a first attempt to communicate that the policy rate was to be maintained at low values for an extended period of time. Under perfect credibility, such announcement would have been enough to stimulate the economy.

The second date we considered was the July meeting (on the 9th), when the policy rate was further decreased to 50 basis points and the FLAP was announced. It was also stated that "today's decision places the monetary policy rate in its minimum level" and that "the monetary policy rate will be held at this minimum level for a prolonged period of time."

Figure 15 displays, in solid black, the evolution of the variables 5 days before and 15 days after the June meeting (the zero corresponds to the day after the meeting).[14] We also report in dashed line the estimated response (and their 95% confidence bands in gray) that the estimated model (using data up to 2008) would have predicted given

14. It is important to highlight that in Chile monetary policy announcements are made after the markets close, and therefore they should have an impact in the day following the policy meeting.

Figure 14. Responses to the Monetary Policy Shocks in Normal Times

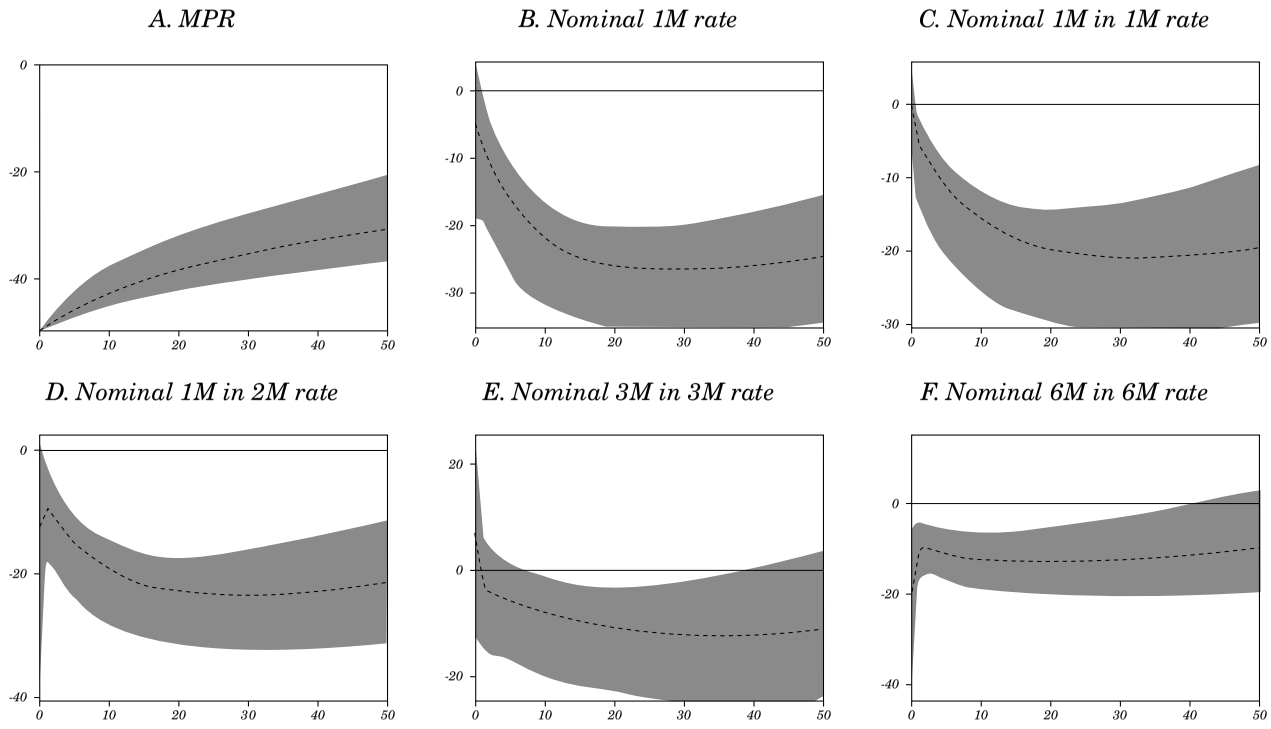
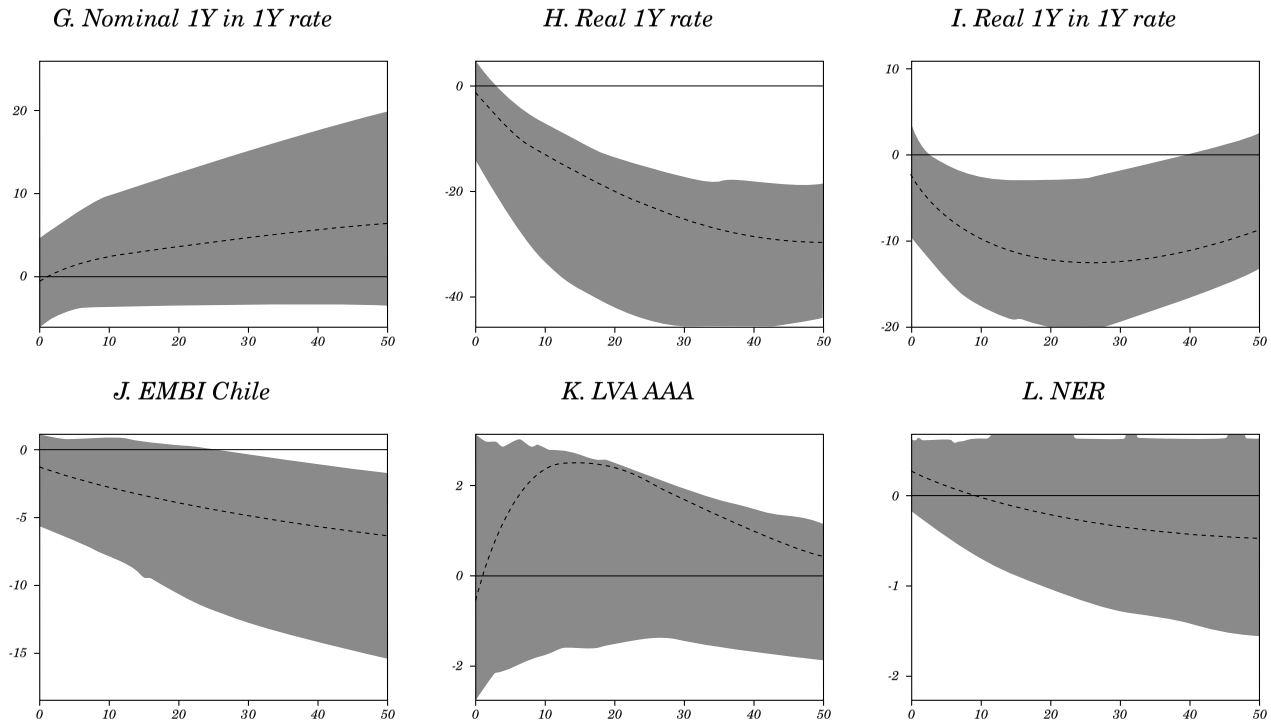


Figure 14. (continued)



Source: Authors' calculations.

Figure 15. Interest Rates and the Nominal Exchange Rate after the June Meeting

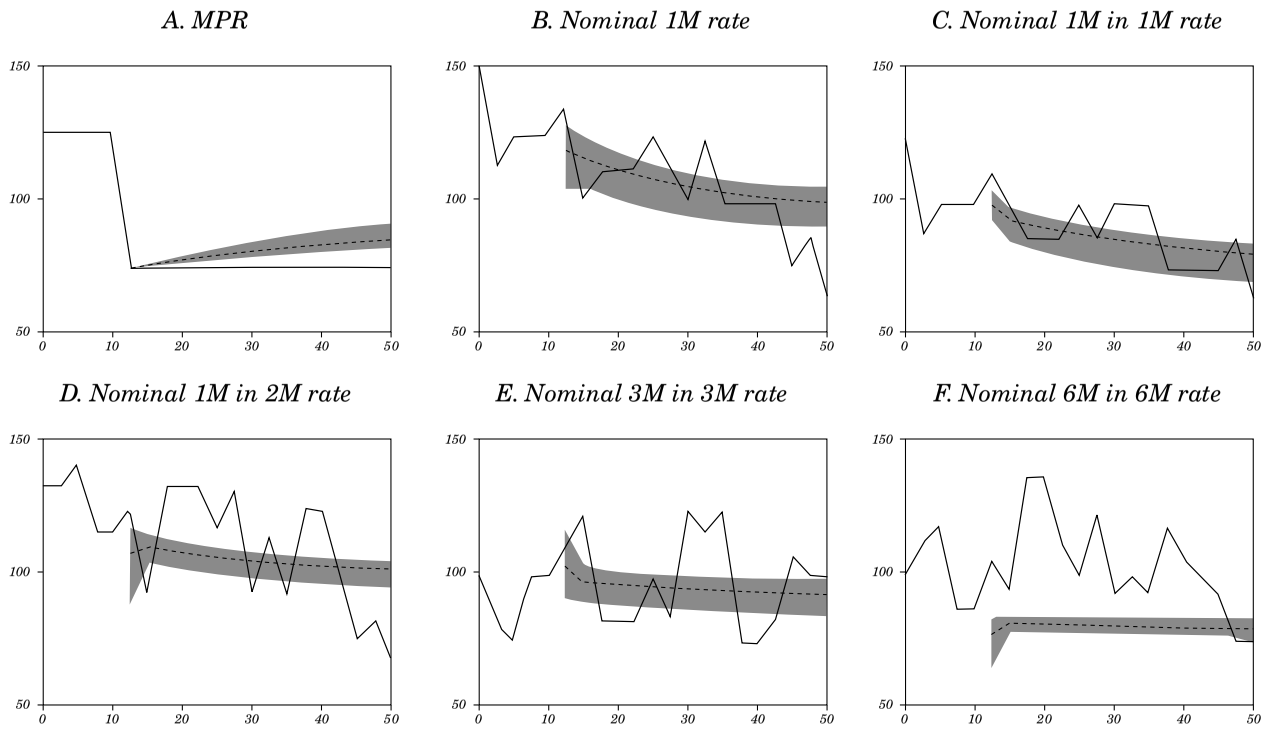
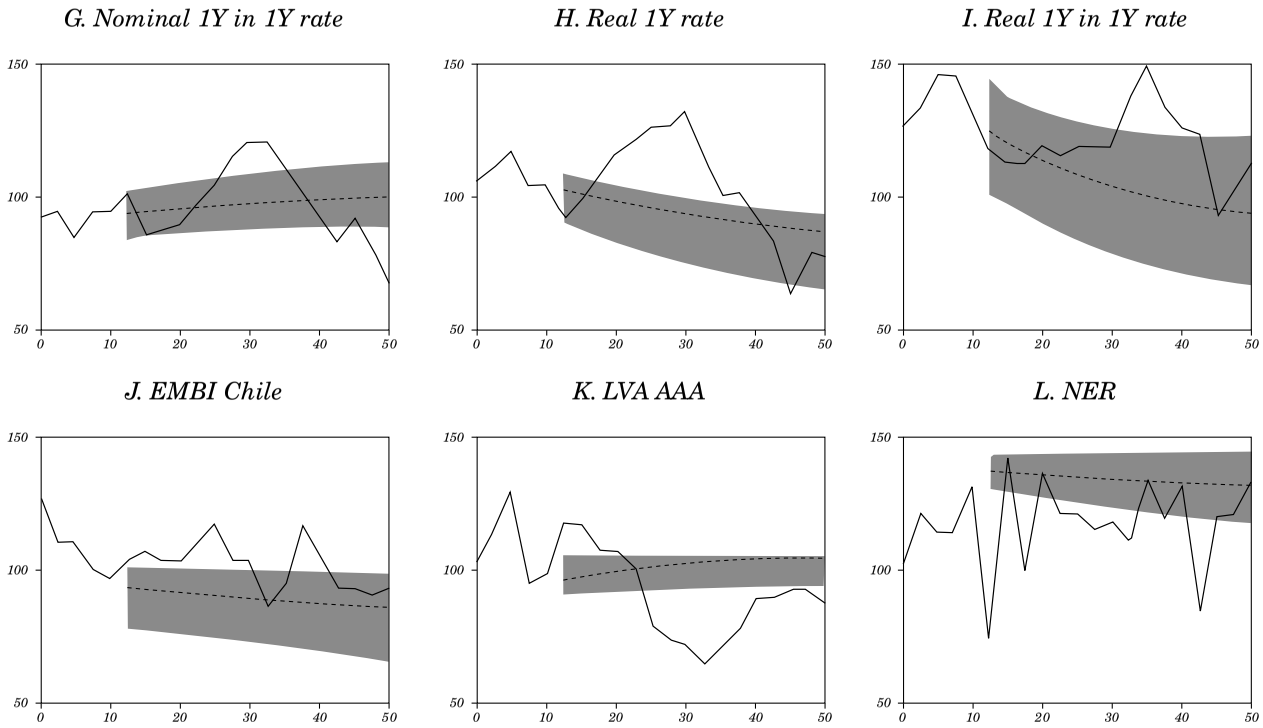


Figure 15. (continued)



Source: Authors' calculations.

the announced change in the monetary policy rate (50 basis points in this case). After that meeting the observed variables did not seem to move in any clear direction. This is particularly the case for nominal yields, whose evolution coincides with the estimated confidence bands for normal times. If anything, all the yields tended to move upwards after the June announcement, particularly those with maturities of 6 or more months. The spreads did not display a path significantly different from the usual response either. The nominal exchange rate was quite erratic around and after the meeting. Overall, it appears that at June meeting the Central Bank was not able to convey the message that the monetary stance was to remain expansive for a prolonged period.

The observed behavior was quite different after the July meeting, that included not only a reduction in the policy rate of 25 basis points, but also the announcement of the FLAP as a way to commit to keep the policy rate at the lower bound for an extended period of time. Figure 16 displays the evolution of the variables along with the estimated responses to a monetary policy shock for normal times, normalized to represent a drop of 25 basis points in the policy rate.

While the evolution of nominal yields up to a 3-month horizon was not significantly different from the usual response (if anything, they increased), in the 3 month in 3 month, and the 1 year in 1 year horizons, they decreased significantly. In particular, the former experienced a drop of almost 50 a.b.p., while for the latter, the reduction was around 30 a.b.p. The real rates fell as well, although not significantly different from the usual response.

Taken the behavior of real and nominal yields together, inflation expectations measured by the Fischer equation would indicate a drop in expected inflation, which in principle seems at odds with the conceptual framework discussed in the previous section (i.e. that an expansionary policy stance for a prolonged period of time should generate an increase in inflation expectations). A possible explanation for this observation is that computing inflation expectations using the Fischer equation, abstracts for the presence of inflation risk premium.[15] Thus, an alternative explanation for the decrease in the nominal yield is a reduction in that premium.

The evolution of the EMBI after the announcement did not

15. This premium is positive (i.e. the nominal rate is larger than the real minus expected inflation) whenever the correlation between the stochastic discount factor en future inflation is positive. See, for instance, Ang et al. (2008).

Figure 16. Interest Rates and the Nominal Exchange Rate after the July Meeting

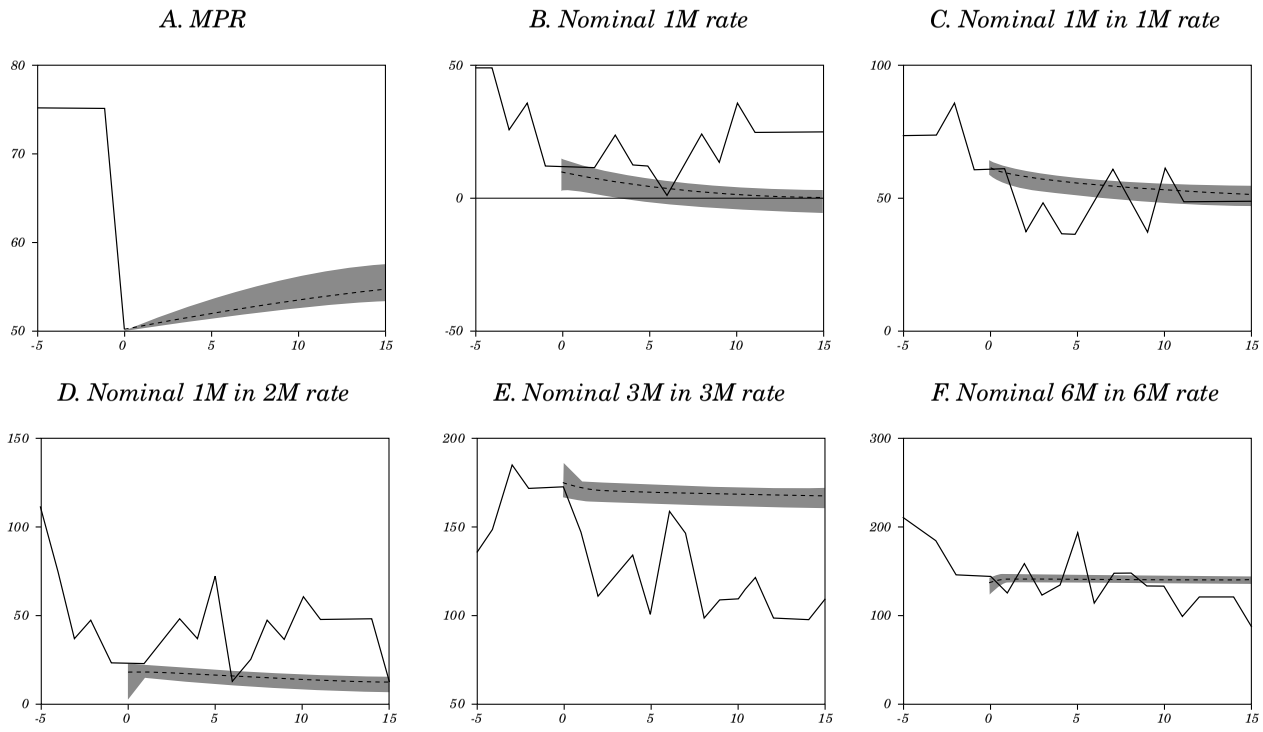
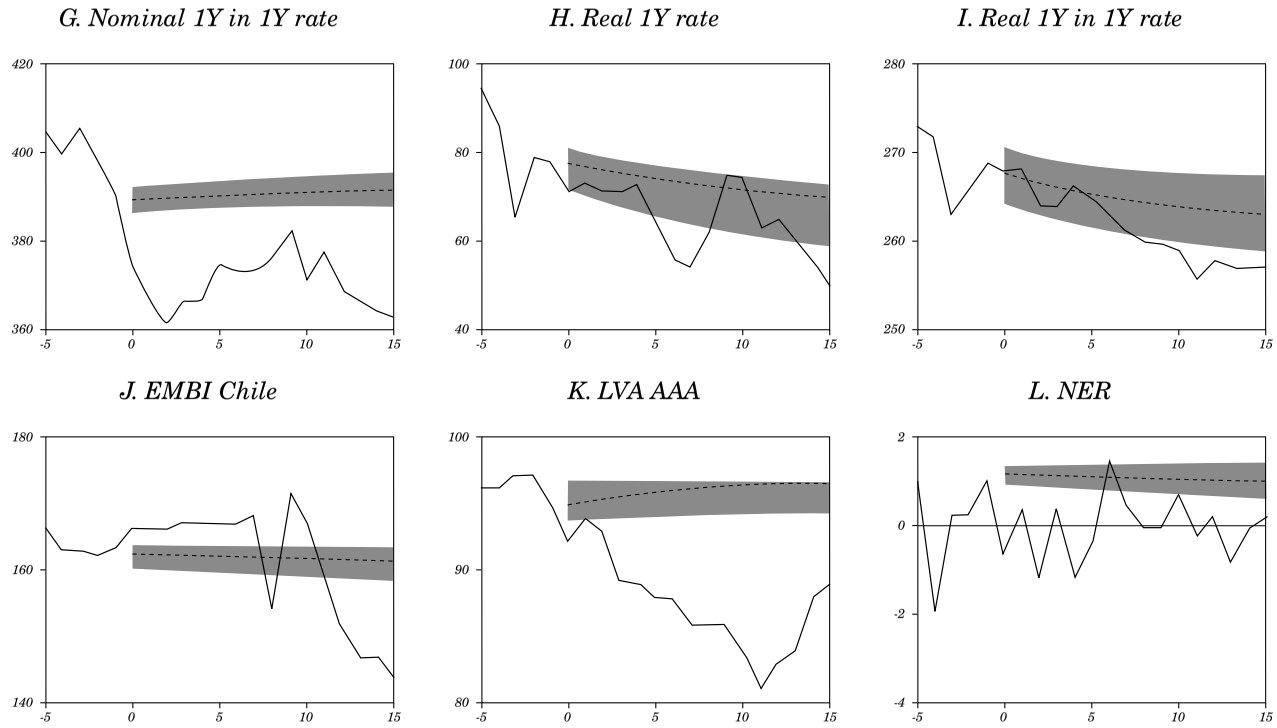


Figure 16. (continued)



Source: Authors' calculations.

significantly differ from the usual response after a 25 basis point cut in the policy rate. However, the corporate spread appears to have fallen significantly, by nearly 10 basis points. Finally, the nominal exchange rate significantly appreciated, which, although not consistent with the UIP prediction,[16] is in line with the perception at that time that future prospects for Chile were more favorable than those for the U.S.

To conclude this part of the analysis, it is important to compare these results with those papers previously mentioned that evaluate the effect of announcements regarding unconventional policies in other countries. While these studies also found that the announcement had a flattening impact on the yield curve, for these more developed countries the effect appears to be larger in the longer end of the curve (5 or 10 years). On the contrary, for Chile, the largest effect was in the 2-year horizon that as we mentioned, is the relevant policy horizon for Chile.

This difference could be an indication of the perceived severity of the recession that people expected at that time in different countries. While in developed countries like Europe or the U.S., (that were at the centers of the financial crisis) the recession was expected to be quite significant; for some other emerging countries like Chile, the impact of the crisis was perceived to be a more transitory phenomenon. Moreover, looking at the macroeconomic dynamics after 2009, Chile seems to have recovered from the crisis, experiencing GDP growth rates at pre-crisis levels and with inflation around the target, while the recovery in more developed economies appears to be quite slow.

4. The Effects of the FLAP on Bank Lending

In this section we study the lending behavior of Chilean banks during the FLAP period. The goal is to identify if the use of this liquidity facility had an effect on the loans issued by banks. We discuss first the data sources and variables used and then present the methodology and the result.

16. The UIP would have predicted that, taken the foreign rate as given, the flatter the domestic yield curve, the more depreciated the nominal exchange rate should be. Again, the presence of currency risk premium can generate deviations from the UIP prediction.

4.1 Data Sources and Variables

Our database includes monthly data on eleven banks, which represent 75% of the total assets in the Chilean banking system.[17] In terms of FLAP usage, they represent close to 90% of the total amount borrowed in this facility. The information regarding banks' financial situations comes from their monthly balance sheets, and the source is the *Superintendencia de Bancos e Instituciones Financieras* (*SBIF*). The data on FLAP usage is from the Central Bank of Chile. The sample spans across the whole FLAP period (eleven months, from July 2009 to May 2010).

To conduct the analysis, we use two variables related to the FLAP. The first one is a dummy variable indicating whether a particular bank used the program in a given month. The second one is a variable indicating the amount demanded in the facility by each bank during a given month.

From the balance sheets we extract information on banks' net worth: liquid and illiquid assets, liabilities, loans (commercial, consumer and mortgage) and provisions. In addition to these variables we also use an index of the Chilean economic activity (Imacec, published by the Central Bank of Chile) and the 12-month CPI inflation rate (from *Instituto Nacional de Estadísticas*, *INE*).

4.2 Methodology and Results

The goal is to assess whether or not the use of the FLAP facility affected the loans supplied by banks. To this end we estimate the following equation,

$$\frac{L^k_{i,t}}{A_{i,t}} = c + \beta FLAP^j_{i,t} + \delta X_{i,t} + \alpha Y_{i,t} + e_i + u_{i,t}.$$

Here $L^k_{i,t}$ denotes loans of type k (Total, Commercial, Consumer, or Mortgage) of bank i in month t, $A_{i,t}$ represents total assets, $X_{i,t}$

17. These are the banks for which we have observations for all the months and all the variables during the FLAP period. As a robustness check, we ran the regressions using four additional banks, for which, we only have observations for six months of the eleven in the FLAP period (i.e. an unbalanced panel). The sample adding these banks accounts for 91% of the total assets in the system. The point estimates that we obtained were not significantly different, although they were estimated with less precision.

is a vector of banks' specific variables in each month (in particular, we include net worth over liabilities, liquid assets over total assets, and provisions over total credit),[18] Y_t contains the activity indicator and inflation, e_i is an individual effects and u_{it} is the error term that varies both across banks and time. We use two alternative variables related to the use of the FLAP facilities ($FLAP^j_{i,t}$) a dummy that takes the value of one, if the bank borrowed from the facility in that month, and the amount borrowed from the facility as a percentage of total assets. The main goal is to estimate the parameter β for each alternative type of loan.

We estimate the equation using a fixed-effect model with instrumental variables. The fixed effect assumption allows for the possibility that the bank-specific, right-hand-side variables are correlated with individual unobserved effects (e_i).[19] Nonetheless, there is still a chance that the unobserved components in $u_{i,t}$ can be correlated with the regressors $FLAP^j_{i,t}$ and $X_{i,t}$ along the time dimension.[20] To avoid this problem we use as instrumental variables, two lags of the variables in $X_{i,t}$ and Y_t.[21] These are valid instruments under the assumption of weak exogeneity. In other words, we are assuming that shocks that affect individual variables at a given month are uncorrelated with the lagged values of these variables for the same individual.

Table 1 presents the results for each type of loan that we considered, when the variable $FLAP^j_{i,t}$ is the dummy for FLAP usage in that month. As we can see, the use of the FLAP had a significant effect on total, commercial and consumption loans. In particular, a bank that borrowed from the facility in a given month had a loans-to-total-assets ratio (relative to a bank that did not use the facility in that month) of almost 4 percentage points (p.p.) higher for total loans, 3 p.p. for commercial loans and less that 1 p.p. for consumer loans. The effect on mortgage loans was insignificant. The coefficients for the other regressors have the expected signs whenever they are significant.

18. These control variables are also used in the recent literature assessing the role of the different credit facilities implemented in the U.S. in response to the crisis (e.g. Talafierro, 2009; Veronesi and Zingales, 2010; and Li, 2011).

19. We also estimated a version with random effect as a robustness check, but there were no significant changes with this alternative method.

20. The correlation between $u_{i,t}$ and Y_t is ruled-out by assumption, for the latter are aggregate variables.

21. We also evaluated using one and three lags as instruments. However, the Stock-Yogo approach to weak instruments suggested using two lags.

Table 1. Credit Regressions with FLAP Dummy

Variables	*Total*	*Commercial*	*Consumption*	*Mortgage*
FLAP Dummy	0.038**	0.031**	0.007***	0.000
	(0.016)	(0.014)	(0.002)	(0.003)
Net Worth/Liabilities	0.056**	0.055**	-0.002	0.004
	(0.025)	(0.023)	(0.004)	(0.005)
Liquid Assets/Total Assets	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Provisions	-0.064*	-0.067**	0.003	-0.000
	(0.035)	(0.033)	(0.005)	(0.007)
Economic Activity	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Inflation (12 months)	0.398**	0.361**	0.092***	-0.055
	(0.196)	(0.180)	(0.030)	(0.039)
Constant	0.257**	0.211**	0.045***	0.001
	(0.110)	(0.102)	(0.017)	(0.022)
Observations	121	121	121	121

Source: Authors' calculations.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Credit Regressions with FLAP Borrowing

Variables	*Total*	*Commercial*	*Consumption*	*Mortgage*
FLAP/Assets	1.576**	1.304*	0.279**	-0.007
	(0.717)	(0.671)	(0.111)	(0.161)
Net Worth/Liabilities	0.0607***	0.0587***	-0.002	0.003
	(0.0219)	(0.0205)	-0.004	-0.005
Liquid Assets/Assets	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Provisions/Liabilities	-0.064*	-0.066**	0.003	0.000
	(0.034)	(0.032)	(0.005)	(0.007)
Economic Activity	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Inflation (12 months)	0.267*	0.256*	0.067***	-0.0570
	(0.156)	(0.146)	(0.024)	(0.0349)
Constant	0.231**	0.190**	0.041***	0.001
	(0.0983)	(0.0920)	(0.015)	(0.022)
Observations	121	121	121	121

Source: Authors' calculations.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

To put these results in context, it is useful to compare these estimated effects with the average values for the loans to assets ratios. During the FLAP period, the average (across months and banks) for total loans was 28%, for commercial 23%, for consumer 4%, and for mortgages was nearly 2%. Thus, the effect of using the FLAP represented around 13% of average total and commercial loans, and 17% of average consumer loans.

In table 2, we re-estimated the model but using the ratio of the amount borrowed in the FLAP program as a fraction of total assets as the explanatory variable. Because total assets normalize both the explained variable and the FLAP regressor, the coefficient on the FLAP variable can be interpreted as the increase in amount lent for each peso borrowed at the FLAP. The results indicate that each peso borrowed under the FLAP increased total loans at around 1.6 pesos, commercial loans at around 1.3 pesos, and consumer loans at almost 0.3 pesos. Mortgage credit, in line with the previous results, was not significantly changed. Given that commercial loans have generally shorter maturity than the other two types of loans, the evidence indicates that short-term borrowing (the FLAP) was used mainly to finance short-term lending.

Summarizing, the evidence suggests that there was an effect of the FLAP on loans, and in the desired direction. These effects were more important in commercial loans, and to a smaller degree, for consumption loans. The maturity of these two types of loans is shorter than for mortgages, which is reasonable given that the FLAP was a source of short-term funding for banks.

5. Conclusions

In this paper we have analyzed the effects of the unconventional monetary policy implemented by the Central Bank of Chile (a term liquidity facility) to deal with the zero-lower-bound situation originating from the recent global financial crisis and recession. The first part of the analysis was aimed to assess the main goal behind this policy; namely, to convey the message that the policy rate was going to remain at its lower bound for a prolonged period of time. The second part studied how banks used these additional available funds. In particular, we wanted to analyze if this source of liquidity was destined to increase the amount lent.

Overall, the results seem to indicate that the main goal was

achieved, for the FLAP significantly flattened the nominal yield curve, particularly in the neighborhood of the relevant policy horizon for Chile (two years). In terms of the effects that the FLAP had on loans, banks that borrowed from the facility seem to have increased mainly commercial loans and, to a smaller degree, consumer loans as well. However, loans at longer horizons (mortgages) were not modified by the use of the facility.

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