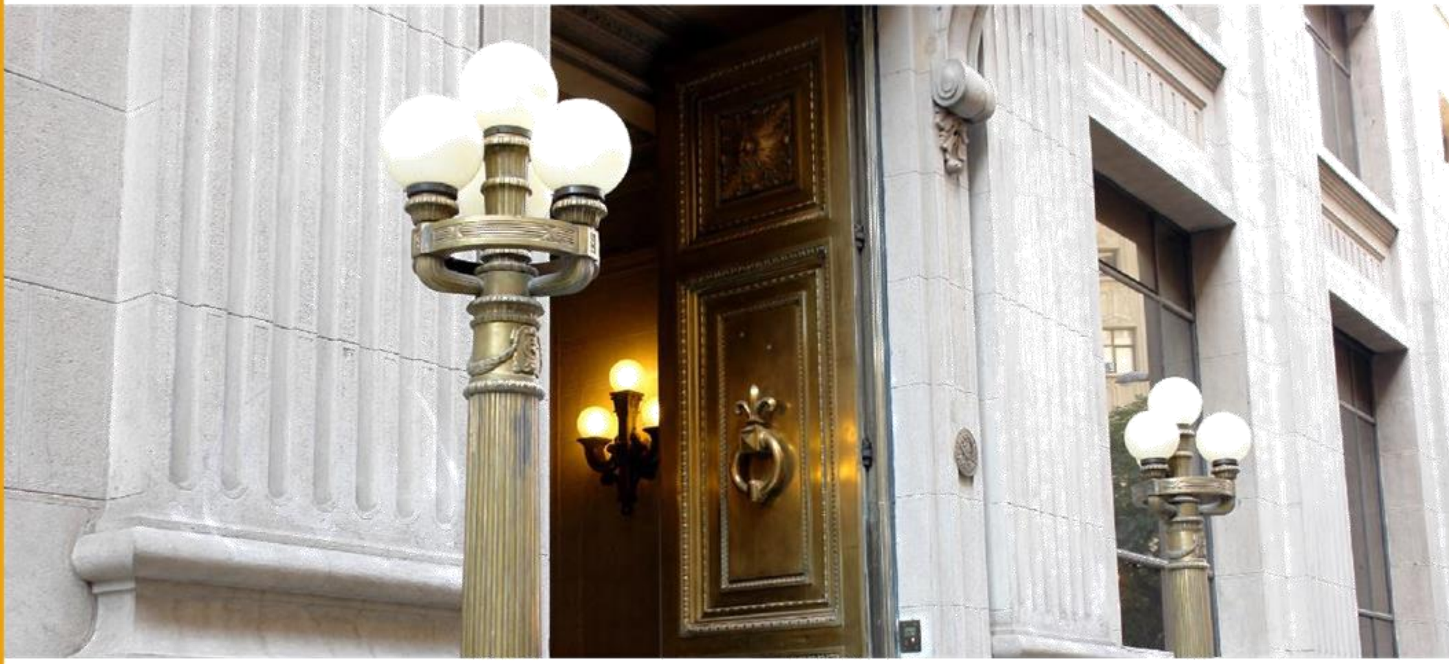
DOCUMENTOS DE TRABAJO

Monetary Policy Surprises in Chile: Measurement & Real Effects

Boragan Aruoba
Andrés Fernández
Daniel Guzmán
Ernesto Pastén
Felipe Saffie

N° 921 Agosto 2021



La serie Documentos de Trabajo es una publicación del Banco Central de Chile que divulga los trabajos de investigación económica realizados por profesionales de esta institución o encargados por ella a terceros. El objetivo de la serie es aportar al debate temas relevantes y presentar nuevos enfoques en el análisis de los mismos. La difusión de los Documentos de Trabajo sólo intenta facilitar el intercambio de ideas y dar a conocer investigaciones, con carácter preliminar, para su discusión y comentarios.

La publicación de los Documentos de Trabajo no está sujeta a la aprobación previa de los miembros del Consejo del Banco Central de Chile. Tanto el contenido de los Documentos de Trabajo como también los análisis y conclusiones que de ellos se deriven, son de exclusiva responsabilidad de su o sus autores y no reflejan necesariamente la opinión del Banco Central de Chile o de sus Consejeros.

The Working Papers series of the Central Bank of Chile disseminates economic research conducted by Central Bank staff or third parties under the sponsorship of the Bank. The purpose of the series is to contribute to the discussion of relevant issues and develop new analytical or empirical approaches in their analyses. The only aim of the Working Papers is to disseminate preliminary research for its discussion and comments.

Publication of Working Papers is not subject to previous approval by the members of the Board of the Central Bank. The views and conclusions presented in the papers are exclusively those of the author(s) and do not necessarily reflect the position of the Central Bank of Chile or of the Board members.

Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
Agustinas 1180, Santiago, Chile
Teléfono: (56-2) 3882475; Fax: (56-2) 3882231

Documento de Trabajo
N° 921

Working Paper
N° 921

Monetary Policy Surprises in Chile: Measurement & Real Effects*

Boragan Aruoba
U. of Maryland

Andrés Fernández
Central Bank of Chile

Daniel Guzmán
Central Bank of Chile

Ernesto Pastén
Central Bank of Chile

Felipe Saffie
U. of Virginia

Abstract

This paper accomplishes two goals: First, it proposes a way to compute monetary policy surprises in Chile based on a survey of financial market participants regularly conducted by Bloomberg. We argue this is the most suitable one among alternatives. Second, we use these monetary policy surprises as input in a Bayesian Vector Auto Regression analysis to estimate the effect of contractionary monetary policy. Output and inflation tend to fall while funding costs tend to increase. Expected inflation a has hump-shaped response and nominal exchange rates tend to depreciate instead of appreciating. We argue the latter two effects are consistent with an "information channel" embedded in monetary policy decisions.

Resumen

Este articulo tiene dos objetivos. Primero, propone una forma de calcular sorpresas de política monetaria en Chile basándose en una encuesta a participantes del mercado financiero realizada por Bloomberg. El articulo discute las ventajas y desventajas de esta propuesta respecto a alternativas posibles de implementar. El segundo objetivo es usar la serie obtenida de sorpresas para estimar el efecto de una política monetaria contractiva usando Vectores Autoregresivos Bayesianos. Se obtiene, consistentemente con la teoría, que tanto el producto como la inflación tienden a caer mientras que varias medidas de costo de financiamiento tienden a aumentar. Por su parte, las expectativas de inflación tienen una respuesta no monotónica mientras que el tipo de cambio nominal tiende a depreciarse en vez de apreciarse. El articulo discute estos resultados y argumenta que estos dos últimos efectos son consistentes con un “canal informacional” implícito en las decisiones de política monetaria.

---

* The views and conclusions presented here are exclusively those of the authors and do not necessarily reflect the position of the Central Bank of Chile or its Board members.

1. Introduction

The contribution of this paper is two-fold. First, it obtains estimates of macroeconomic effects of monetary policy in Chile. Understanding how monetary policy affects the economy is a first-order important question for a central bank. The second contribution is methodological. Central banks make their decisions for a reason: monetary policy reacts to macroeconomic conditions. Thus, it is difficult to empirically estimate its causal effect on the economy, which requires identifying exogenous variation from endogenous responses. To address this technical issue, this paper proposes a time series of monetary policy surprises for Chile.[1] To demonstrate its usefulness, this series is then used as external instrument which enters as input in a structural Bayesian VAR (BVAR). In a nutshell, interest rate innovations in the BVAR that are consistent with the series of monetary policy surprises are interpreted as non-systematic variation of monetary policy and their impact on the rest of the variables can be studied. A similar methodology can be used in other contexts where a measure of exogenous variation of monetary policy in Chile is required.

We start by conducting a comparative analysis of time series of monetary policy surprises obtained from alternative sources: the Survey of Financial Traders ("EOF" for "Encuesta de Operadores Financieros" in Spanish), and the Survey of Economic Expectations ("EEE" for "Encuesta de Expectativas Económicas" in Spanish), both of them run by the Central Bank of Chile, as well as the survey of financial market participants run by Bloomberg which we simply label as the "Bloomberg' survey." We also include monetary policy surprises implicit in swaps rates at three-, six- and twelve-months horizons. We conclude that the most suitable source for our empirical analysis is the Bloomberg' survey. This is because it allows to construct a long sample that consistently measures expectations for every monetary policy meeting since 2001. This is challenging for alternative surveys as they are conducted at monthly frequency although the frequency of monetary policy meetings has been changing throughout the sample. In turn, information available for swaps spans a much shorter sample. The downside of the Bloomberg' survey, however, is that the number of responders is smaller than in alternative surveys.

A necessary discussion here is about the key assumption to identify monetary policy shocks. Ideally, one would require that nothing else is happening in the economy besides a monetary policy decision. This assumption is never true but it is less so as the time window widens between the time that data on expectations or swaps are collected and monetary decisions are made. In this regard, most surveys we analyze have a long window which is also varying in length through the sample. Swap data can in principle be implemented with a much narrower time window, but such markets are not sufficiently liquid and/or prices may not be consistently collected in one market. Thus, noise may affect the measurement

[1] Given the goal of this paper, we concentrate attention only on monetary policy decisions leaving out other decisions made by the Board of the Central Bank of Chile such as exchange rate interventions or changes in financial regulations.

of monetary policy surprises. In addition, this data does not cover a long sample period, as argued above. In contrast, the Bloomberg' survey records the day of responses, so we can consider responses that are close to the monetary policy decisions. Although we acknowledge this is imperfect, we conclude this survey provides the data source that is most suitable to compute monetary policy shocks.

We then move to our econometric analysis. In particular, we compute impulse response functions to contractionary monetary policy shocks. The picture that emerges from our results is that monetary policy in Chile has effects consistent with macroeconomic theory and international evidence: An unexpected increase in the monetary policy rate decreases both inflation and output, and increases funding costs according to sovereign, banking, and, in lesser extent, corporate spreads. We also find evidence that expected inflation has a hump-shaped response to monetary policy shocks.

After a contractionary shock, expectations of inflation increase in the short run and the nominal exchange rate tends to depreciate although insignificant. These results are at odd with textbook monetary models. Contractionary monetary policy is supposed to decrease inflation, as it does according to our estimates, and expected inflation should follow the response of actual inflation, but it does not. Similarly, contractionary monetary policy should in theory appreciate and not depreciate the nominal exchange rate according to the uncovered interest rate parity condition and the implied increase in interest rate differentials between Chile and the rest of the world due to the monetary policy shock.

However, this result regarding the nominal exchange rate is consistent with evidence for emerging markets, such as Kohlscheen (2013); Hnatkovska, Lahiri and Vegh (2016); Albagli, Ceballos, Claro and Romero (2019); Gürkaynak, Kara, Kısacıkoğlu; and Lee (2020). Overall, the responses of expected inflation and the nominal exchange rate are consistent with an "informational effect" of monetary policy in Chile. According to recent literature, such as Hnatkovska et al (2016) and Jarocinski and Karadi (2020), a monetary policy shock acts, in addition to its direct effect, through the information it reveals about the beliefs of the central bank about the current state of the economy and the future monetary policy path. Thus, following a contractionary monetary shock, expected inflation may increase by incorporating information that inflationary pressures are stronger than previously thought by private agents. Therefore, expected inflation may rise with a monetary shock while actual inflation decreases. Similarly, although a domestic contractionary monetary policy shock does imply an increase in interest rate differentials between Chile and the rest of the world, the information revealed by the unanticipated component in a monetary policy decision may lead to nominal exchange rate depreciation instead of appreciation.

Overall, we interpret our result as evidence of the strong effect of monetary policy in Chile: Inflation does decrease after a contractionary monetary policy shock in spite that expected inflation and the nominal exchange rate increase in the short run.

Outline. Section 2 presents an abridged literature review. Section 3 describes the methodology used to extract implicit monetary policy surprises and presents alternative data sources including a comparative discussion. Section 4 introduces the BVAR methodology and shows results regarding the effect of monetary policy on a variety of relevant variables for the Chilean economy. Section 5 describes the data sources and the codes. Section 6 concludes.

2. Literature review

As stressed by Christiano, Eichenbaum and Evans (1999), the empirical estimation of impulse-response functions using exogenous variation in monetary policy is useful from practical and theoretical points of view. As it isolates the causal effect of monetary policy, it allows to estimate the macroeconomic impact of monetary policy which, as pointed out above, is important input for the conduction of monetary policy. In addition, empirical estimates of monetary policy are informative for the construction of models for counterfactual policy analysis, allowing to discriminate among modelling assumptions and alternative ways to construct models' building blocks. Our paper has these very same goals with an application to Chile.

However, the extraction of exogenous variation in monetary policy has proven to be technically challenging. Alternative methodologies proposed are based on structural assumptions in Vector Auto Regression analysis (e.g., Sims, 1992 and, more recently, Rubio-Ramirez and Antolin-Diaz, 2018), a narrative approach (Romer and Romer, 2004), and the use of financial data (e.g., Cochrane and Piazzesi, 2002, and, more recently, Nakamura and Steinsson, 2018). Our approach follows Gertler and Karadi (2015) and Jarocinski and Karadi (2020) in that we use high-frequency surprises around policy announcements as external instruments in order to identify monetary policy shocks. Most of the literature that relies on this method uses financial markets to identify the surprises following the work of Gurkaynak, Sack, and Swanson (2005). Our approach relies on the surprises we obtain from the Bloomberg survey. Finally, we rely on one of the results in Plagborg-Moller and Wolf (2021) and use a Cholesky-ordering with the Bloomberg surprise ordered as the first variable in order to identify a monetary policy shock. Plagborg-Moller and Wolf show that this approach is equivalent to the external instruments approach more commonly used in the literature. We use a Bayesian Vector Auto Regression (BVAR) to carry out our estimation. (See for example Sims, 1980, and Sims and Zha, 1998.)

In turn, even if exogenous variation in monetary policy is properly identified, a discussion has emerged to disentangle its pure macroeconomic effect from the effect of the information it contains about the state of the economy and future monetary policy (Jarocinski and Karadi, 2020). Some of our results are reminiscent of this literature, such as in Hnatkovska et al (2016). However, formally disentangling these two effects for Chile is beyond the scope of this paper.

In Chile, there is a bulk of literature accumulated in the last two decades. Valdes (1998) estimates a VAR that identifies monetary policy surprises by exploiting updates in indexed interest rate used as monetary policy instrument to approximate ex-post real interest rates. Among many others, some examples of papers that study the impact of monetary policy are Calvo and Mendoza (1999), Parrado (2001), Chumacero (2005), Mello and Moccero (2008), and Pedersen (2017). We share with them our goal of studying the effect of monetary policy in Chile, although with a different methodology and using an updated sample. Overall, most of our results are consistent to theirs at least in sign.

3. Measurement of Monetary Policy Surprises in Chile

a. Methodology

Based on the expectations obtained from surveys to market participants, a time series of monetary policy surprises (MPS) is calculated as

$$MPS_t = MPR_t - MPR_t^e$$

where, MPR_t is the level of the monetary policy rate decided in a Monetary Policy Meeting in t, and MPR_t^e corresponds to the median expectation of responders about the monetary policy decision in t collected in a time window of days before each meeting. Alternatively, we calculate surprises from the series of interest rate swap contracts as

$$MPS_t = SWAP_{t+1} - SWAP_{t-1}$$

where $SWAP_{t-1}$ is the rate observed the day before the meeting and $SWAP_{t+1}$ corresponds to the rate observed the day after the meeting. In some cases, a maximum distance of two working days was tolerated for this calculation.

b. Data

We approximate the unanticipated component in the policy rate by economic agents using multiple sources. Specifically, we analyze expectations collected from three alternative surveys to market participants and economic experts in Chile: Economic Expectations Survey (EEE), Financial Traders Survey (EOF), and expectations surveyed by Bloomberg.

Additionally, we address monetary policy surprises based on the price movements of financial assets such as interest rate swap contracts. After a detailed evaluation of the advantages and trade-offs involved in these sources, we favor the Bloomberg survey for our empirical analysis.

Bloomberg's survey asks economic research and analysis departments of its domestic and international clients about their expectations for the MPR. This survey allows us to retrieve information from 2001 to 2020, with a median of 19 participants. With a total of 215 monetary policy meetings in which we can observe the expectations, this survey constitutes the most extended observation period available together with the EEE, the longest-established expectations survey conducted by the Central Bank of Chile.

Bloomberg presents participants' answers publicly under the institution's name or institution/researcher name. According to Bloomberg's experts, most large companies use only the institutional name, intending to preserve their forecast history, which is used to rank them according to their accuracy level. Based on these conditions, we expect to have up-to-date responses from participants on each round of the survey.

The survey data collection period corresponds to the two weeks before the monetary policy meeting. During these weeks and until 5:00 p.m. of the day before the meeting, participants can update their responses, and the platform records the exact date on which this happened. This characteristic of the protocol lets us assume that respondents make their forecast with the most information available. Unlike other surveys, Bloomberg's survey ensures better coordination with the official schedule of policy meetings and the relevance of their responses. An analysis of Bloomberg's microdata lets us verify that answers are usually concentrated in the last week of the surveyed period and forecast delivery/updates are observed until the last possible day (see Figure 1).

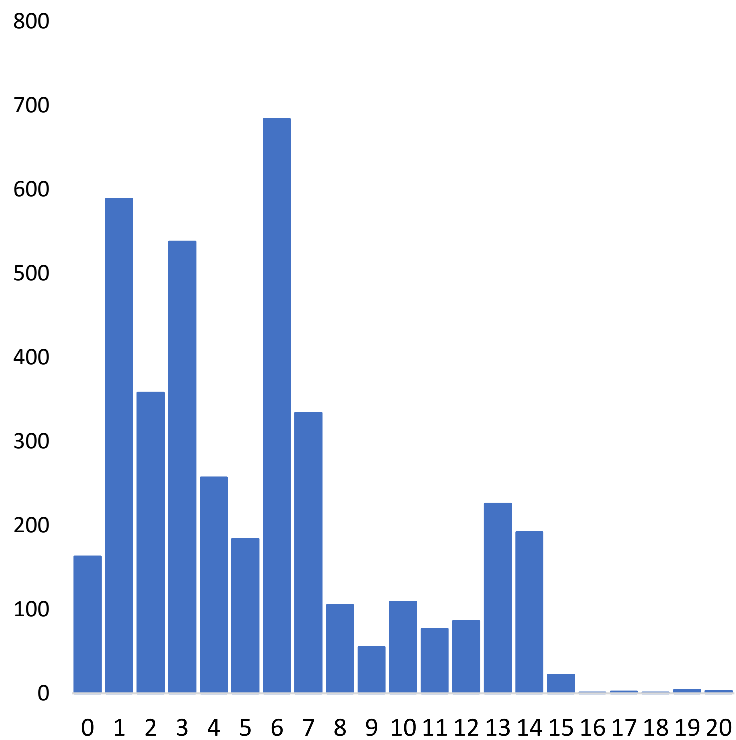


Figure 1 – Number of responses to Bloomberg' survey according to days before monetary policy meeting

As a supplement to the surveys' study, we analyze swap rates' behavior around monetary policy meetings as an alternative measure of market-based measure of expectations. We consider rates at four maturities: three months, six months, one year, and two years. These rates correspond to the fixed component of a swap contract, for which the floating component is the average of the daily interbank interest rate. In this sense, we consider it a natural and high-frequency approximation of market expectations about the monetary policy rate path. Nevertheless, this source is limited by the lack of market depth in Chile, the unavailability of intraday prices, and the absence of information on traded volume.

c. Differences of Bloomberg' survey relative to alternative surveys

Bloomberg's survey implementation protocol presents a set of features that make it preferable for our research purposes over alternative available surveys. Primarily, Bloomberg's survey perfectly aligns with the official schedule of monetary policy meetings. In contrast, the EEE's protocol stipulates a release of results between the 10th and 13th each month. This rigid schedule implies that answers collected vary with the dates defined for monetary policy meetings, which in turn take place 8 times a year since 2018 in varying points in time with months when there are such meetings. This same desynchronization was evidenced in the EOF protocol, which until 2017 had a biweekly frequency with publication dates on the second and fourth Tuesday of the month. Since 2018, the EOF has released its data three days before each meeting and two days after the minute publication.

A greater interval between the collection of expectations and the monetary policy meeting date gives room for significant changes in the set of information available. This fact seems to have been internalized by Bloomberg since 2001. Bloomberg's survey allows its participants to submit their forecasts from two weeks before the monetary policy meeting date and until 5:00 pm the day before. During this period, they can update their predictions, and the platform records the precise date of their last update. In comparison, the EEE defines a sampling period that starts one week before its publication and ends the day after the CPI publication corresponding to the immediately preceding month. The EOF, on the other hand, collects its data two days before its publication. In other words, neither the EEE nor the EOF has a clear objective to collect forecasts based on a set of information closer to the one considered by the Board when making policy decisions.

Another important feature is that the Bloomberg survey allows us to analyze unanticipated monetary policy movements since 2001, the same year in which the EEE began to be implemented. The EOF presents a clear disadvantage in this regard given that it starts in 2010. Finally, the three surveys allow us to analyze the microdata collected and track trajectories of expectations associated with specific participants. However, only Bloomberg records the exact date on which each respondent submits their forecast.

d. Comparative descriptive analysis

We now turn to characterize the Bloomberg and Swaps data relative to the alternative surveys (EOF and EEE). Table 1 provides descriptive statistics of the MPS calculated from all alternative sources. This table displays the average difference in days between the survey release and the Monetary Policy Meetings date.[2] By construction, Bloomberg's survey offers the best performance. In contrast, a comparative disadvantage of Bloomberg's survey relative to EEE and EOF is a smaller average number of respondents. The table also highlights that both the EEE and Bloomberg let us assess the unanticipated policy rate movements for more than 200 MPM, equivalent to almost two decades of observations.

For most of the Monetary Policy Meetings, there are no unanticipated policy rate movements by economic agents. For the Bloomberg data set, such surprises occur 35 times, corresponding to 16% of the sample. Out of 35, 24 are surprises in which the policy rate was

[2] We consider only Board meetings for monetary policy decisions. In the sample we analyze all monetary policy meetings are conducted at planned schedule, so there is no exceptional meeting.

below the median expectation. These negative surprises are characterized by being larger on average and less homogeneous than positive surprises.

Stats	EEE	EOF	Bloomberg	Swap-3M
1. Median days b/w release and MP meeting	3	6	0	0
2. Median No. of respondents	42	60	19	
3. No. of MP surprises (MP meetings)	214	115	215	157
4. Surprises diff. from 0 (%)	43 (20)	12 (10)	35 (16)	139 (89)
5. Positive surprises (%)	14 (7)	6 (5)	11 (5)	69 (44)
6. Negative surprises (%)	29 (14)	6 (5)	24 (11)	70 (45)
7. Cond Avg. of MP surprises (diff. from 0) (BP)	-20	-7	-21	-2
8. Cond Avg. of MP surprises – positive (BP)	27 (14)	23 (6)	23 (11)	6 (69)
9. Cond Avg. of MP surprises – negative (BP)	-43 (29)	-38 (6)	-41 (24)	-9 (70)
10. Cond SD of MP surprises – positive (BP)	7	5	5	8
11. Cond SD of MP surprises – negative (BP)	32	21	30	18
12. Avg. SD of forecasts (BP)	10	9	6	
13. Corr surprises – Level MPR	-0.04	-0.01	-0.13*	-0.1
14. Corr surprises – diff days	0.17**	0.3**		

Table 1 – Descriptive Statistics for surprises obtained from EEE, EOF, Bloomberg' survey and 3-months swaps data

Figure 2 presents the time series of monetary policy surprises obtained from the EOF, EEE, and Bloomberg survey, while Figure 3 compares the monetary policy surprises obtained from three-month swap rates with those obtained from the Bloomberg survey. Three episodes stand out in which the various sources reflect that the monetary policy decision constituted a clean surprise for the market. The first is on March 13, 2009 when the monetary policy rate was cut by 250 basis points responding to the unfolding of the financial crisis. On June 7, 2019, the Central Bank of Chile reduced the monetary policy interest rate by 50 basis points after an updating of the structural parameters pointed to greater potential and trend growth. Finally, on March 16, 2020, the Bank decided in an extraordinary meeting to reduce the monetary policy rate by 75 basis points; in our data set, this decision is recorded as a negative surprise.

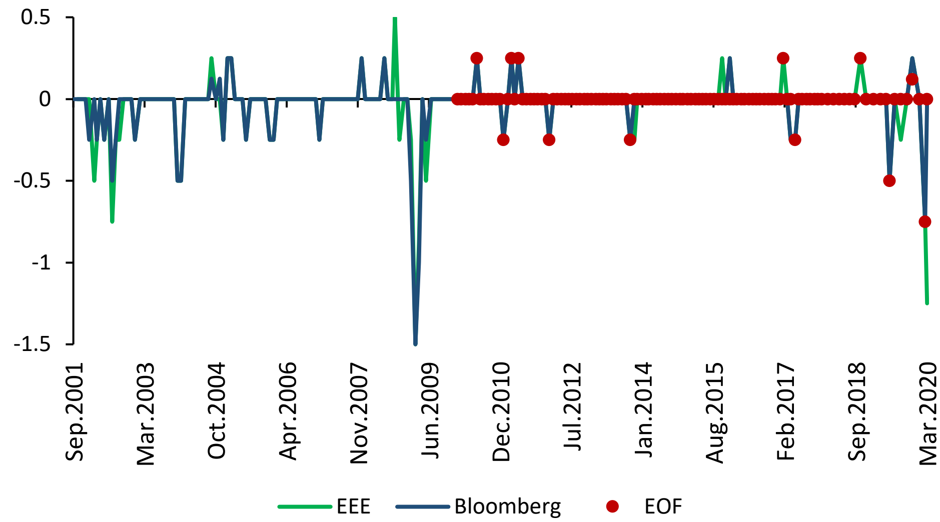


Figure 2 – Surprises of monetary policy obtained from EEE, EOF and Bloomberg' survey, 2001M9 – 2020M3

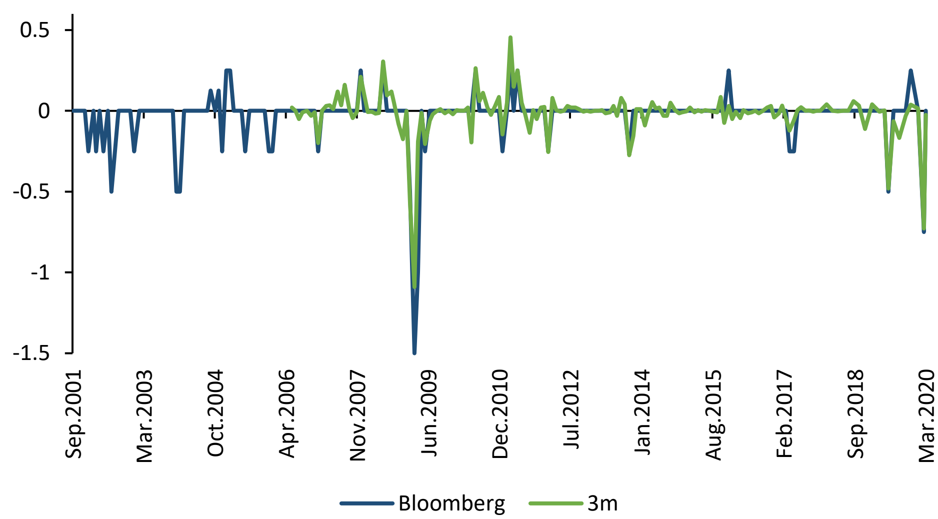


Figure 3 – Surprises of monetary policy obtained from Bloomberg' survey and 3-months swaps, 2001M9 – 2020M3

Table 2 shows the correlation between the time series of monetary policy surprises obtained from all alternative sources as well as swaps data at different horizons. Correlation is not perfect among any pair of alternative measures of surprises, but they are all high. The series obtained from Bloomberg' survey is highly correlated with EOF and a bit less with surprises implicit in 3-months swaps and the EEE. For completeness, we also consider surprises implicit from swaps at higher horizons: 6 months, 1 year and 2 years. Correlations are decreasing on the length of the horizon.

	EEE	EOF	Bloomberg	Swap-3M	Swap-6M	Swap-1Y	Swap-2Y
EEE	1						
EOF	0.65***	1					
Bloomberg	0.83***	0.91***	1				
Swap-3M	0.83***	0.84***	0.85***	1			
Swap-6M	0.75***	0.81***	0.75***	0.92***	1		
Swap-1Y	0.59***	0.74***	0.62***	0.84***	0.93***	1	
Swap-2Y	0.44***	0.68***	0.47***	0.76***	0.88***	0.77***	1

Table 2 – Unconditional correlation between monetary policy surprises obtained from alternative sources

One possible source of the statistical noise in Table 2 is that answers in different surveys are not submitted on the same day, so responders could potentially differ in the information set they have access to. As a way to control for this, Table 3 shows correlation between the monetary surprises implicit in the EEE survey, the EOF survey, Bloomberg's survey and three-months yield data considering only those answers given at most four days prior to each monetary policy meeting. We observe that the correlation between the alternative measures of surprises, particularly with the Bloomberg survey's surprises. However, the overall assessment emerging from Table 2 remains.

	EEE	EOF	Bloomberg	Swap-3M
EEE	1			
EOF	0.77***	1		
Bloomberg	0.96***	0.93***	1	
Swap-3M	0.85***	0.86***	0.83***	1

Figure 3 – Conditional correlation matrix between monetary policy surprises obtained from alternative sources

4. Real Effects of Monetary Policy Surprises in Chile

a. BVAR Methodology

Since the seminal work by Sims (1980), vector autoregressions (VARs) are a popular econometric tool to model how multiple time series evolve. A technical challenge in their implementation is that, with a reasonable number of variables and lags, the number of parameters estimated becomes large and leads to the problem of over-parametrization. Since the number of observations relative to the parameters estimated is usually too few, this leads to imprecise estimates. This becomes particularly problematic when parameters that would have been estimated as precise zeros are instead estimated as non-zero. As a result, everything computed using these estimates, like impulse-responses, become noisy—parameters that were supposed to disappear instead enter the calculations, introducing extra variations that should not be there.

Bayesian VARs (BVARs) provide a solution to this problem known as shrinkage (see, for example, Litterman, 1986; Doan, Litterman, and Sims, 1984; and Sims and Zha, 1998). As with any Bayesian estimation, BVARs combine priors that are set before estimation with the likelihood that comes from the data to arrive at the posterior distribution of the parameters. In BVARs, the priors are set in a way to make sure only the parameters that show strong evidence for being different from zero have come out of the estimation with nonnegligible mass away from zero in the posterior distribution. A typical BVAR has priors (also referred to as Litterman or Minnesota priors) that are of the following type:

- The first lag of every variable in their own equation has a prior mean of 1.
- All other coefficients have a prior mean of 0 (lags of other variables in a given equation, and higher lags of itself).
- The variances of the priors for each parameter are set such that the variances go down as the lags increase—higher lags have a smaller variance.
- Lags of other variables have a smaller variance in a given variable's equation.

We also report 68% and 90% credible sets in order to quantify parameter uncertainty. In particular, we obtain draws from the posterior distribution for the VAR parameters, and for every draw we compute the impulse-response functions. Then for every horizon, along with the mean response, we report the 5^{th}, 16^{th}, 84^{th}, and 95^{th} percentiles of the responses across the draws from the posterior distribution.

b. Data.

We use monthly series of macroeconomic variables between 2001 and 2020. Our core VAR includes natural logarithms of general CPI, non-mining monthly indicator of economic activity (IMACEC), monthly average nominal exchange rate (measured in pesos per dollar), as well as the level of the monetary policy rate (MPR).

Once we estimate the core VAR, we add one variable at a time to see how various variables react to monetary policy shocks. We study inflation expectations for a 1-year horizon collected through the EEE (question: Inflation in 11 months (range 12 months)) and the EOF (question: Inflation (CPI var. in%), 12 months (1 to 12)). We also add a series of interest rates of sovereign bonds that correspond to the weighted average of the Central Bank and Treasury bonds issued in the primary market and of the bonds traded on the Santiago Stock Exchange with maturities of 1, 2, 5, and 10 years. The bank bond spreads are calculated as the difference between the weighted average IRR of bank bonds in the 2 to 5-year maturity tranche with AA and AAA ratings and the simple average of swap rates in UF consistent with the bonds' terms. The same procedure was used to calculate corporate bond spreads, but in this case, only AA-rated bonds with maturities of 7 to 10 years were considered.

c. Baseline Results

Figure 4 shows the impulse-response function from a BVAR with CPI, output, nominal exchange rate, and monetary policy as variables. The impulse is a contractionary monetary policy shock of one standard deviation—that is, an increase in the monetary policy rate—which corresponds on average a 10 basis point increase. Red lines represent the mean responses. Dark shades represent credibility sets at 5%–95% and light shades at 16%–84%; the x axis is at a monthly frequency. CPI is unresponsive in the short run to decrease only after two years to converge at a lower level. The contractionary effect on output, however, takes place much sooner during the second quarter and is also highly persistent.

Monetary policy surprises also have a persistent effect on the monetary policy rate itself, which remains low for almost two years. In contrast with a classical UIP framework, our results show that a positive monetary policy surprise triggers an exchange rate depreciation. In fact, the monetary policy surprise that triggers a 25bp increase in the interest rate leads to a 100bp depreciation of the exchange rate. This seemingly puzzling results is consistent with the empirical literature. In fact, Kohlscheen (2013) finds a similar exchange rate response for Chile with an alternative identification strategy. Moreover, Hnatkovska, Lahiri and Vegh (2016) show that while developed economies show responses consistent with UIP, developing markets exhibit exchange rate dynamics consistent with our BVAR.[3] Consistent with the close economy literature, Jarocinski and Karadi (2020) and Gürkaynak, Kara, Kısacıkoğlu and Lee (2020) argue that there is an informational content in monetary surprises that can change inflation expectations beyond the monetary policy rate adjustment causing a depreciation of the currency.

Overall, we conclude that the transmission mechanism of monetary policy in Chile is consistent with the theory and the international evidence: An unexpected increase in monetary policy rate decreases output and inflation, while causing a depreciation.

[3] In emerging markets, there is a weak demand for liquid assets denominated in local currency when the interest rate increases and inflation expectations raise due to the deteriorated fiscal position and the expected economic contraction.

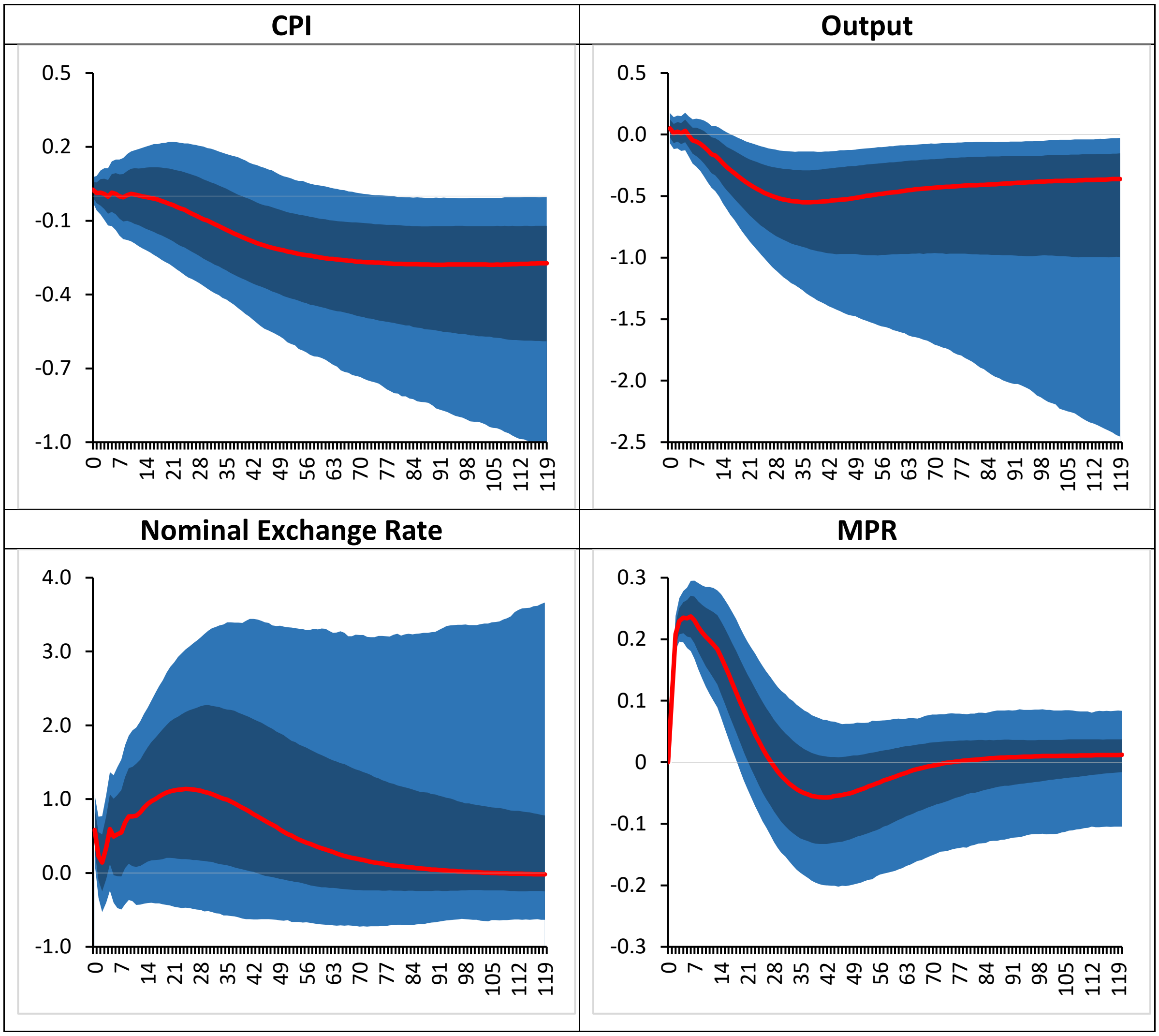


Figure 4 – Impulse-Response function of CPI, output, nominal exchange rate and monetary policy rate to a 1 S.D. contractionary monetary policy shock
(y-axis in percentage points)

In turn, Figure 5 shows the response of expectations of inflation on a one-year horizon according to the EEE and the EOF surveys once the BVAR is expanded to include such variables. Expected inflation increases on impact, although this surge is reversed shortly thereafter when expected inflation decreases consistently with the lower activity and lower inflation. This is a reinforcing mechanism of the effect of monetary policy on inflation. This is because lower inflation expectations push down actual inflation beyond the downward inflationary pressure generated by the effect of monetary policy on decreasing economic activity.

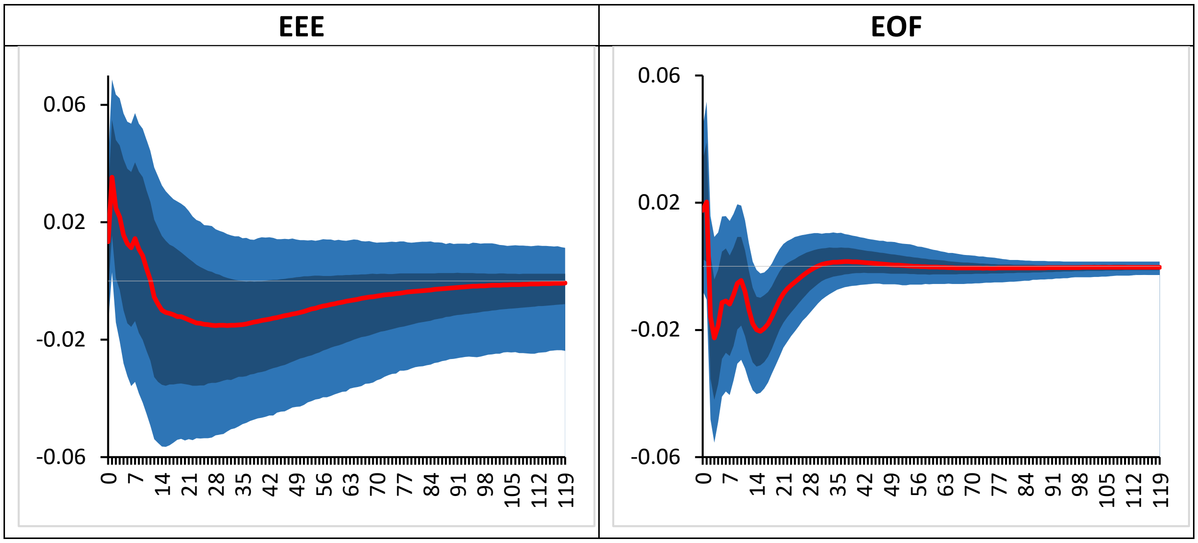


Figure 5 – Impulse-Response functions of alternative measures of expected inflation at one year horizon to a 1 S.D. contractionary monetary policy shock
(y-axis in percentage points)

The expected inflation responses estimated for Chile are aligned with results obtained for the US by Jarocinski and Karadi (2020). These authors argue that monetary policy surprises affect the economy through two confounding channels. First, there is the direct effect of the contractionary monetary policy. Second, the unexpected change in monetary policy reveals information in possession of the central bank about future inflation and output as well as future monetary policy decisions. This latter effect may induce agents to respond with higher expected inflation to a contractionary monetary policy by providing information of higher-than-expected inflationary pressure. A formal analysis on the validity of this hypothesis is beyond the scope of this paper.

a. Financial effects

Next, we augment the baseline BVAR to explore the effect of monetary policy on a selection of financial variables. Figure 6 shows impulse response functions of spreads of sovereign bonds at 1-, 2-, 5-, and 10-year horizons to a one standard deviation contractive monetary policy shock. These spreads are computed as the weighted average of the implicit rate of Chilean bonds issued by the Central Bank and the Treasury and traded either in the primary or secondary markets relative to the implicit rate of US Treasury bonds traded at the same time and at the same maturity.

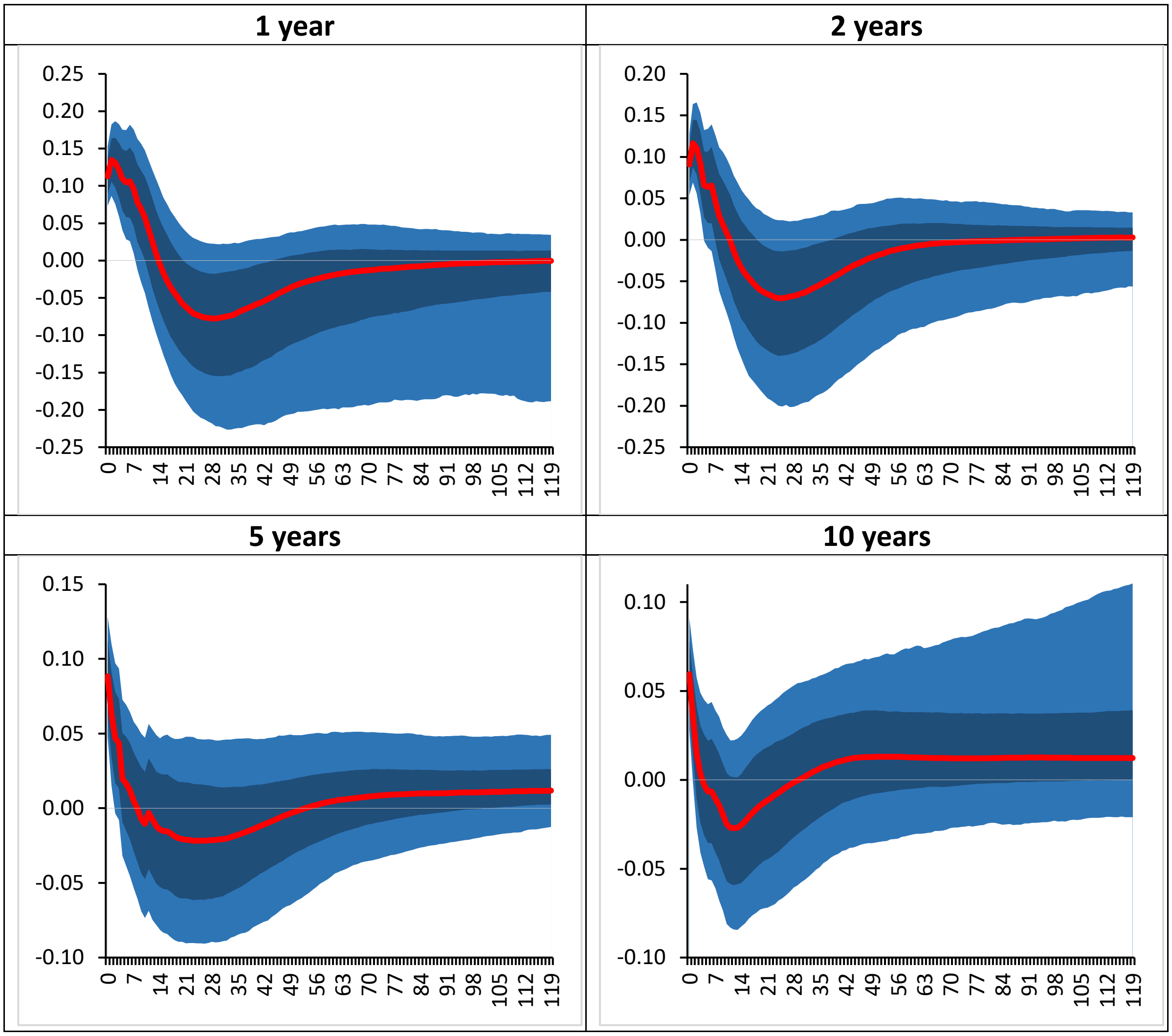


Figure 6 – Impulse-Response of sovereign yields at a 1 year, 2 years, 5 years and 10 years horizons to 1 S.D. contractionary monetary policy shock

(y-axis in percentage points)

In response to a surprise increase in the policy rate, spreads increase on impact especially for shorter maturities. The persistence and shape of these responses are more similar to the shock as shown in Figure 4 than the response of the monetary policy rate, although less hump-shaped, especially for longer maturities. Overall, the effect becomes insignificant after about two years, although there is some statistical evidence of overshooting between two and four years after the shock for the spread at a one-year horizon.

Finally, we look at the response of spreads of banking and corporative bonds in Figure 7. Due to the limitation of data, we pull together maturities at 2–5 years and 7–10 years to compute the spreads. For banking spreads, we distinguish between bonds with AAA and AA classifications. For corporate spreads, we focus on AA classification.

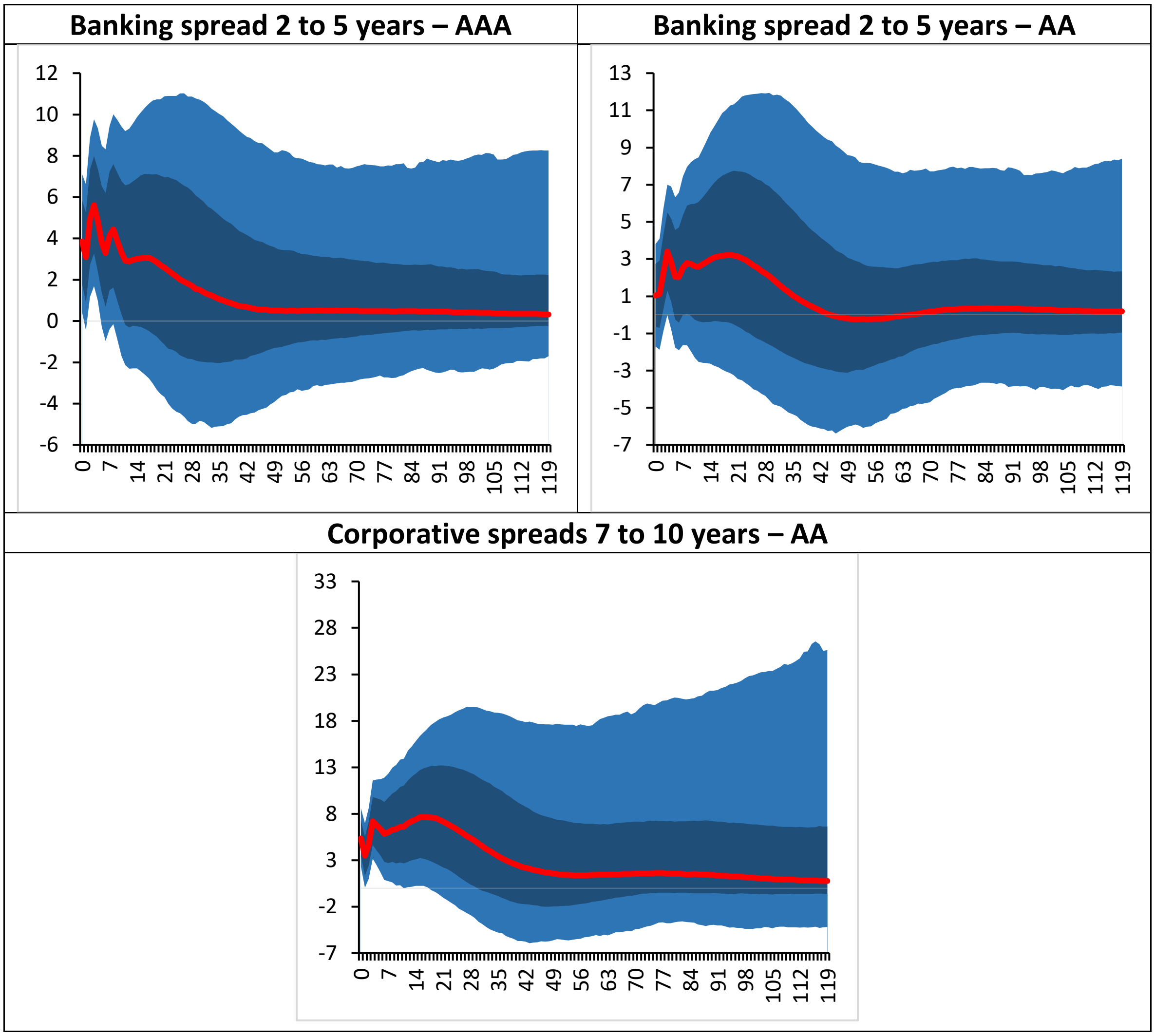


Figure 7 – Impulse-Response functions of banking and corporate spreads to 1 s.d. contractionary monetary policy shock

(y-axis in percentage points)

Perhaps due to the data limitations, responses are much more diffused, as shown in Figure 7. Spreads tend to increase on impact, although only AAA banking bonds at 2–5 years of maturity seem to be significant at 5%. AA banking bonds at 2–5 years of maturity follow the same path, although it is barely non-significant. The response of corporate spreads for AA at 7–10 years of maturity seems insignificant.

We conclude this section by stressing that monetary policy tends to have the standard effect of increasing funding costs, either measured as spreads of sovereign bonds or banking and corporate bonds, although for the latter the effect seems less clear.

5. Data and codes

The file "Chapter 4.2.3.xlsx" contains the time series of monetary policy surprises presented in Figures 2 and 3. In addition, the codes and daily data that allow the construction of these time series are stored in the folders codes and data, respectively. Bloomberg data are excluded due to confidentiality policies.

6. Conclusion

This paper empirically estimates the effect of monetary policy on several macroeconomic aggregates in Chile. As a by-product, this paper also provides a discussion of several measures of monetary policy surprises obtained from alternative data sources on expectations of monetary policy decisions.

Our analysis favors the use of data obtained by the Bloomberg survey to construct monetary policy surprises, mainly but not only because it consistently spans a long sample from 2001 keeping a regularity relative to the frequency of monetary policy meetings, which has been subject to changes throughout the sample. Our empirical analysis based on BVARs shows that a contractionary monetary policy has an effect in Chile consistent with macroeconomic theory and international evidence: An unexpected increase in the monetary policy rate decreases inflation and output and increases funding costs according to sovereign, banking, and, in a lesser extent, corporate spreads. There is also evidence of smoothness in the conduction of monetary policy which takes the form of persistence in the response of the policy rate to the shock. The nominal exchange rate and expected inflation seem to depreciate and increase, respectively. We interpret these results as the acting of an “informational effect” of monetary policy surprises by revealing information about inflationary pressure and country risk not already included in private agents’ information sets.

7. References

Albagli, E., L. Ceballos, S. Claro and D. Romero (2019). “Channels of US Monetary Policy Spillovers to International Bond Markets.” Journal of Financial Economics, vol. 134(2), 447-473.

Antolín-Díaz, J. and J. Rubio-Ramírez. (2018). “*Narrative Sign Restrictions for SVARs.*” The American Economic Review, vol. 108(10), 2802-2829.

Bloomberg (2020). *Economist Estimates (ECOS): Chile Monetary Policy Rate*. (accessed June 1, 2020)

Calvo, G. and E. Mendoza (1999). *“Empirical Puzzles of Chilean Stabilization Policy”* in G. Perry and D. Leipziger (eds.) Chile, Recent Policy Lessons and Emerging Challenges. The World Bank.

Christiano, L., M. Eichenbaum and C. Evans (1999). “*Monetary Policy Shocks: What Have We Learned and to What End.*” In Handbook of Macroeconomics. Vol. 1A, edited by J.B. Taylor and M. Woodford. Amsterdam, The Netherlands: North-Holland.

Chumacero, R. (2005). *“A Toolkit for Analyzing Alternative Policies in the Chilean Economy.”* In General Equilibrium Models for the Chilean Economy, edited by R. Chumacero and K. Schmidt-Hebbel, Central Bank of Chile

Cochrane, J. and M. Piazzesi (2002). “*The Fed and Interest Rates—A High-Frequency Identification.*” *The American Economic Review*, vol. 92(2), 90-95.

De Mello, L. and D. Moccero (2008). *“Monetary Policy and Macroeconomic Stability in Latin America: The Cases of Brazil, Chile, Colombia and Mexico.”* In Monetary Policy and Inflation Targeting in Emerging Countries, edited by L. de Mello. Paris, France: OECD.

Doan T., R. Litterman and C Sims (1984). *“Forecasting and conditional projection using realistic prior distributions.”* Econometric reviews, vol. 3 (1): 1-100.

Gürkaynak, R., A. Kara, B. Kısacıkoğlu and S. Lee (2020). “Monetary Policy Surprises and the Exchange Rat Behavior.” NBER Working Paper 27819.

Hnatkovska, V., Lahiri, A. and C. Vegh (2016). “The Exchange Rate Response to Monetary Policy Innovations.” American Economic Journal: Macroeconomics, vol. 8(2), 137-181.

Jarocinski, M. and P. Karadi (2020) “*Deconstructing Monetary Policy Surprises – The Role of Informayion Shocks.*” American Economic Journal: Macroeconomics, vol. 12(2), 1-43.

Kohlscheen, E. (2013). “The Impact of Monetary Policy on the Exchange Rate: Puzzling Evidence from Three Emerging Economies.” Journal of International Money and Finance, vol. 44.

Litterman, R. (1986). “Forecasting with Bayesian vector autoregressions—five years of experience.” Journal of Business & Economic Statistics, vol. 4 (1): 25-38.

Nakamura, E. and J. Steinsson (2018). *“High-Frequency Identification of Monetary Non-Neutrality: The Information Effect.”* Quarterly Journal of Economics, vol. 133, Issue 3, August 2018, Pages 1283–1330.

Parrado, E. (2001). *“Effects of Foreign and Domestic Monetary Policy in a Small Open Economy: The Case of Chile.”* Working Paper 108. Central Bank of Chile.

Pedersen, M. (2017). *"Revisiting the price puzzle in Chile."* Notas de Investigación Journal Economía Chilena, Central Bank of Chile, vol. 20(1), pages 072-079, April.

Plagborg-Møller, M., and Ch. K. Wolf (2021). *“Local Projections and VARs Estimate the Same Impulse Responses.”* Econometrica 89 (2): 955-980.

Romer, C. and D. Romer (2004). “*A new Measure of Monetary Shocks: Derivation and Implications.*” The American Economic Review, vol. 94(4):1055-1084.

Sims, C. (1980). *“Macroeconomics and Reality.”* Econometrica, vol. 48:1-48.

Sims, C. (1992). *“Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy.”* European Economic Review, vol. 36(5): 975–1000.

Sims, C. and T. Zha (1998). *“Bayesian Methods for Dynamic Multivariate Models.”* International Economic Review, vol. 39: 949–968.

Valdés, R. (1998). *“Efectos de la Política Monetaria en Chile*”. Cuadernos de Economía 104, 97-125.

Documentos de Trabajo **Banco Central de Chile**	**Working Papers** **Central Bank of Chile**
NÚMEROS ANTERIORES	PAST ISSUES
La serie de Documentos de Trabajo en versión PDF puede obtenerse gratis en la dirección electrónica: www.bcentral.cl/esp/estpub/estudios/dtbc. Existe la posibilidad de solicitar una copia impresa con un costo de Ch$500 si es dentro de Chile y US$12 si es fuera de Chile. Las solicitudes se pueden hacer por fax: +56 2 26702231 o a través del correo electrónico: bcch@bcentral.cl.	Working Papers in PDF format can be downloaded free of charge from: www.bcentral.cl/eng/stdpub/studies/workingpaper. Printed versions can be ordered individually for US$12 per copy (for order inside Chile the charge is Ch$500.) Orders can be placed by fax: +56 2 26702231 or by email: bcch@bcentral.cl.

DTBC – 921
Monetary Policy Surprises in Chile: Measurement & Real Effects
Boragan Aruoba, Andrés Fernández, Daniel Guzmán, Ernesto Pastén, Felipe Saffie

DTBC – 920
The Effects of Firms' Lobbying on Resource Misallocation
Federico Huneeus, In Song Kim

DTBC – 919
Learning Your Own Ability
Carlos Madeira

DTBC – 918
Commodities Fundamental Model
Francisco Arroyo Marioli, Fernando Letelier

DTBC – 917
Firm Sorting, College Major, and the Gender Earnings Gap
Federico Huneeus, Conrad Miller, Christopher Neilson, Seth Zimmerman

DTBC – 916
Optimal Monetary Policy and Incomplete Information: Does the Real Exchange Matter?
Rodrigo Caputo, Felipe Leal

DTBC – 915

Estimating Shadow Policy Rates in a Small Open Economy and the Role of Foreign Factors
Jorge Fornero, Markus Kirchner, Carlos Molina

DTBC – 914
Measuring Small and Medium-Size Enterprises Contribution to Trade in Value Added: The case of Chile 2013-2016
Mario Marcel, Diego Vivanco

DTBC – 913
Toward a general framework for constructing and evaluating core inflation measures
Guillermo Carlomagno, Jorge Fornero, Andrés Sansone

DTBC – 912
Monetary Policy Press Releases: An International Comparison
Mario Gonzalez, Raul Cruz Tadle

DTBC – 911
The Credit Channel Through the Lens of a Semi-Structural Model
Francisco Arroyo Marioli, Juan Sebastian Becerra, Matias Solorza
DTBC – 910
Contracts, Firm Dynamics, and Aggregate Productivity
Bernabe Lopez-Martin, David Perez-Reyna

DTBC – 909
Optimal Spending and Saving Strategies for Commodity-Rich Countries
Alvaro Aguirre

DTBC – 908
Uncertainty, Risk, and Price-Setting: Evidence from CPI Microdata
Mario Canales, Bernabe Lopez-Martin

DTBC – 907
Earnings Inequality in Production Networks
Federico Huneeus, Kory Kroft, Kevin Lim

DOCUMENTOS DE TRABAJO Agosto 2021