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Monetary Policy Effects on the Chilean Stock Market: An Automated Content Approach *

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Abstract

The latest financial crisis has increased the interest in understanding how monetary policy announcements impact financial markets. For the US there are several studies that cover this area of research, however, for emerging markets the number of studies is scarce. This paper studies how the Chilean stock market is affected by monetary policy announcements made by the Central Bank of Chile. In their monthly monetary policy meetings the Central Bank of Chile decides the monetary policy rate and circulates press releases that effectively explain their decision. The information contained in those documents include policy decisions for the current month, the central bank's economic outlook, and the signals about likely future central bank policy decisions. We therefore examine these monetary policy changes and the corresponding additional information from the meeting statements. Using Automated Content Analysis, we identify qualitative information from the statement releases of the Central Bank of Chile and create a quantitative measure for the signals indicating likely future monetary policy. This quantitative measure, which we call them sentiment score - proxies for the monetary policy tilt. We then evaluate how the surprise component of the sentiment scores - together with unexpected policy changes - impact Chilean financial assets.

Resumen

La reciente crisis financiera ha aumentado el interés por entender cómo los anuncios de política monetaria afectan a los mercados financieros. Para Estados Unidos existe una amplia literatura, no obstante, los estudios para las economías emergentes son más bien escasos. Este trabajo estudia cómo el mercado accionario chileno reacciona a los anuncios de política monetaria hechos por el Banco Central de Chile. En sus reuniones de política monetaria el Consejo del Banco Central de Chile decide la tasa de política monetaria y publica un comunicado en el cual explica su decisión. La información contenida en dichos documentos incluye tanto sus decisiones de política, como sus perspectivas respecto al futuro de la economía, y señales respecto a posibles decisiones futuras de política. Por lo anterior, examinamos estas decisiones de política en conjunto con la información adicional de los comunicados de política monetaria. Usando análisis automático del contenido, identificamos la información cualitativa de los comunicados y construimos una medida cuantitativa para las señales indicando posible política monetaria futura. Esta medida, la cual llamamos índice de sentimiento económico, es un proxy para el sesgo de la política monetaria. Luego evaluamos cómo el componente de sorpresa de este índice de sentimiento, en conjunto con movimientos sorpresivos en la tasa, impactan los mercados financieros.

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1 Introduction

The latest financial crisis has increased the interest in understanding how monetary policy is developed and implemented, and how the implementation impacts the rest of the economy. One of the branches of the literature examining monetary policy effects analyzes the influence that regular policy announcements have on financial markets. This line of study has developed from the work of Cook and Hahn (1989), who measure the one-day response of bond rates to changes in the Fed Funds target rate. More recent studies include Kuttner (2001) and Bernanke and Kuttner (2005) who evaluate the effect of the unexpected component of the target rate changes on U.S. interest rates and broad equity indices.

In recent years, this literature has developed beyond the analysis of the central bank target rate and has analyzed the qualitative information found in statements, minutes, speeches, and other types of policy documents, and has examined the effects of such information on financial markets. These market reactions depend on the type of information the documents contain and a nascent literature has turned to using Content Analysis, a common method used in other academic fields, to evaluate the qualitative information of the documents. In this paper, we look into the effects of the monetary policy decisions of the Central Bank of Chile on the returns of the Chilean Stock market between January 2003 and August 2016. We do this by evaluating the effects of monetary policy rate (MPR) surprises in conjunction with the qualitative content of the monetary policy statements.

Some of these studies which examine qualitative policy information have used a heuristic approach, which is conducted manually by the researcher. Specifically, the researcher analyzes each of the documents and, using his or her own judgment, quantifies the information content. An example of this approach is conducted by Rosa (2011). He examines the impact of monetary policy statements - in conjunction with policy changes - on exchange rates. He finds that the statements have large and significant effects on the valuation of the U.S. dollar against other global currencies. The main issue with this approach is that it is subject to much of the bias of the evaluator.

In contrast, our paper uses the Automated Content Analysis approach, in which the evaluator creates a computer algorithm to extract the qualitative information from policy statements. The main advantage of this method is that it is less susceptible to the influence of the bias of the evaluator(s). An example comparing the differences between the heuristic and automated

approach can be found in the work of Lucca and Trebbi (2009). They conduct both a heuristic and an automated evaluation of the statements and find that the automated approach seems to be more accurate in depicting the information in the documents.

Using this methodology we study the information released in the monetary policy statements regarding inflation outlook. We examine each statement and assess if it leans toward decreasing large inflationary pressures, in what the literature calls a *hawkish* tone or sentiment. The statements may instead lean towards promoting growth, in what the literature represents as *dovish* sentiment. Using this evaluation, we create an index that tracks the evolution of this sentiment. We then extract the surprise sentiment component of this index and, in conjunction with of monetary policy rate surprises, we study its impact on the Chilean stock market.

The results show that the index we have created does a good job in tracking the intention of the Chilean Central Bank Board. First, abrupt changes in the index predict movements in the MPR. When we look at particular episodes, during the latest financial crisis, the index shows that the communication of the Board leaned toward promoting growth. After the crisis, our index indicates that the Board placed more weight on inflation in Chile. However, the Board's sentiment was not as hawkish as what was seen prior to the financial crisis. In terms of monetary surprises, the results show that prior to the financial crisis, the market reacted mainly to surprises in the monetary policy rate (MPR), whereas after the financial crisis, the stock market also responds to the surprises in the information revealed in monetary policy statements.

To the best of our knowledge, there are only two papers that look into the information provided in the monetary policy statements. In Pincheira et al. (2010) the authors built a communicational bias index that showed the most likely future evolution of monetary policy (easing, tightening or neutral). In constrast to our automated approach, the authors asked to people that participated in the monetary policy meetings to classify the message into categories. Their results showed that their index is a more accurate predictor of the future direction of monetary policy rates.

In a more recent paper, Garcia-Herrero et al. (2017) examined the impact of Chilean monetary policy shocks while accounting for the information provided in the statements. Using a heuristic approach, the authors assess whether the Chilean interest rates of futures reacted to the information revealed by the Central Bank of Chile. Using the information from monetary statements,

minutes, and inflation reports, they create an index that measures the communication sentiment of each of the documents. Using this index, they evaluate how the communication of the Central Bank affects the interest rates of futures. In contrast, we use an automated approach to analyze the complete document. [1] In addition, the index that we built is a continuous variable from -100 to 100, which states the degree of hawkishness (or dovishness) of the documents, while theirs is a discrete index that takes integer values between -2 and 2, going from very dovish to very hawkish. Finally, we analyze the impact of sentiment surprises and monetary policy shocks on the stock market, while they focus on the interest rate futures market.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 discusses the evolution of monetary policy implementation in Chile. Section 4 explains the data, the sources from which they are obtained, and some issues that we faced when analyzing them. Section 5 describes the methodology for building the sentiment index. Section 6 provides the results from regression analyses. Finally, section 7 conducts some robustness and extensions while section 8 concludes with a few remarks.

2 Related Literature

Much of the literature evaluating the impact of policy documents are those that relate to the Federal Reserve (Fed). A significant number of these studies examine the short-term effects of Fed monetary policy announcements on financial markets. In his seminal work, Kuttner (2001) uses data from the federal funds futures market to estimate the impact of monetary policy actions on Treasury bills, notes, and bonds yields. Consistent with the expectations hypothesis, the results show that only unanticipated changes lead to large and significant responses. Bernanke and Kuttner (2005) add to these discussions by evaluating the impact of the unexpected component of the target rate changes on equity prices. They find that the unexpected component causes very large equity market reactions.

Along the same lines, Kiley (2014) analyzes the movements in long-term rates that are attributed to FOMC statements using the first-principal component of short-term interest rates. He then evaluates how these movements impact equity markets before and during the period when the fed funds target rate is set at its Zero Lower Bound (ZLB) value. He finds that equity

[1] Garcia-Herrero et al. (2017) focus only on some sections of the texts whereas we consider all discussions relevant to the economic outlook.

prices are much more sensitive to the changes in long-term rates prior to 2009 compared to the period during the ZLB. Additionally, Gürkaynak et al. (2005) evaluate the impact of FOMC statements on financial markets. They observe that much of the reactions of the markets are due to the information about the future path of policy as conveyed by the statements.

Other papers have also studied the effects of the information released in Federal Open Market Committee (FOMC) statements, speeches and minutes on international financial markets. For instance, Aizenman et al. (2014) examine FOMC member speeches during the 'tapering tantrum' period. They find that during this period, tapering news, particularly those relayed by the chairmen, have a large and adverse impact on exchange rates. The observed effect is largest among those countries with a combination of low external debt, current account surpluses, and large amounts of international reserves.

Studies that analyze the content of documents released by different central banks have also been done at the international level. Reeves and Sawicki (2007) study how financial markets react to the minutes and inflation reports from the Bank of England. The authors find that the publication of these documents affects near-term interest rate expectations in England. Hendry and Madeley (2010) extract information from Bank of Canada statements to find the type of information that affects returns and volatility of interest rate markets over the 2002-2008 period. For Brazil, Carvalho et al. (2013) use Google search queries to build a time series that measures whether each monetary policy statement is perceived as more *hawkish* or *dovish*. This time series is then used in regressions to explain changes in the term structure of interest rates.

For Chile, several papers that study the impact of monetary policy surprises on the financial markets have been written. The main differences among these papers are the way that monetary policy surprises are estimated. The earliest studies are conducted by Larraín (2005, 2007) who use forward rates to estimate the surprise component of monetary policy decisions. The results show that the nominal yield curve reacts positively to monetary surprises, while the response of the real yield curve is subdued. In contrast, Meyer (2006) utilizes the answers from Bloomberg surveys to estimate the surprise component of monetary decisions between 2002 and 2006. In line with previous findings, the results show that monetary policy surprises have positive effects on nominal interest rates.

More recent papers include Ceballos (2014), who estimates the main components of the yield curve and analyzes the effects of macroeconomics news. He finds that monetary surprises have

positive effects on the level of the yield curve, but have a negative impact on its slope. Acuña and Pinto (2015) use a low-frequency event study approach in measuring the effect of monetary surprises in a broad number of Chilean stock market indices. Contrary to what has been found in the literature, the results of their paper indicate that anticipated changes in monetary policy have negative effects on stock market returns, while non-anticipated changes do not seem to have any impact.

3 Monetary Policy in Chile

3.1 Monetary Policy before the 2008 Crisis

Monetary policy in Chile is currently conducted using an inflation targeting regime and is the result of a transitional process that has taken about fifteen years. In 1989, the Basic Constitutional Act of the Central Bank of Chile established that the objectives of the Central Bank would be the stability in the value of the currency and the normal functioning of the internal and external payment system. This means that contrary to the objectives of the Federal Reserve, the Central Bank of Chile only has to make sure that inflation is low and that the central bank is not mandated to target maximum employment levels.

The main tool in the implementation of monetary policy in Chile is the Monetary Policy Rate (MPR). The level of this rate is decided monthly in monetary policy meetings, whose schedule is publicized six months in advance.[2] The decisions made at these meetings are made public through statements, one-page documents released at 6 PM on the same day the policy meeting is held. In these documents, the board explains its decision based on current inflation forecasts, economic shocks, and international developments that could have an impact on the inflation level in Chile. Although unemployment and growth are not part of the mandate of the Central Bank of Chile, those are referenced in the statements because of their impact on inflation.[3,4]

Although monetary policy in Chile finished its transition process in 1999, important changes in its implementation had taken place since, notably the nominalization of the reference rate

[2]Monetary policy meetings usually take place after the 10th day of each month.

[3]Longer documents that contain more details, the meeting minutes, are released around two weeks after the policy meeting.

[4]For more information about the conduction of monetary policy in Chile refer to Banco Central de Chile (2007).

and the fixation of the inflation rate target band. Until August 2001, the reference rate used in conducting monetary policy was an inflation-adjusted interest rate. In order to decrease inflation inertia, economic indexation was reduced by switching the MPR target to a nominal interest rate level. Another important change that occurred in 2001 was the definition of the inflation rate target to a band between 2 percent and 4 percent and aimed at the center of 3 percent. This objective was set for an undefined period of time.[5]

3.2 Monetary Policy around the Crisis Period

The situation in Chile was slightly different to that of the rest of the world prior to the Great Recession. This is because Chile was affected by a strong drought, which impacted food and energy production, among other things. Therefore, the Chilean economy was not only affected by the increase in international prices of food and energy commodities as was the rest of the world, but also by the effects of the draught in 2007. This complex picture led the inflation to rise from 2.8 percent at the beginning of 2005 to 9.9 percent by October 2008, Figure 1. Although the crisis was well on its way to becoming a major event, the board decided to maintain the monetary policy rate at 8.25 percent until inflation subsided.

Once inflation began to decrease and economic activity showed signs of weakening, the central bank took several measures to counteract the effects of the financial crisis. These measures included the reduction of the monetary policy rate from 8.25 percent to 0.5 percent between January and July 2009. In addition, the Central Bank of Chile implemented a number of measures to ease the management of liquidity in the financial market and the enactment of complementary monetary policy measures starting in July 2009.[6]

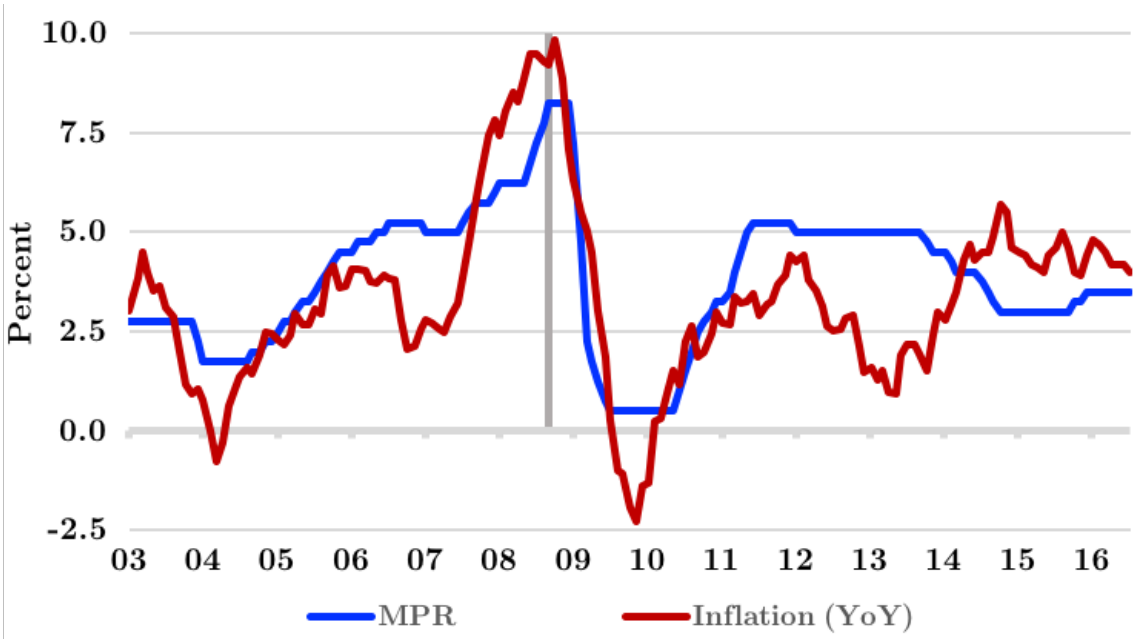
As shown in figure 1, the Central Bank of Chile decided to keep the MPR at a minimum of 0.5 percent for eleven months starting in July 2009. During 2010, inflation began to show signs of acceleration so the Board decided in June of that year to increase the MPR to one percent. This decision was followed by a number of increases that quickly raised the rate to 5.25 percent. Finally, the Central Bank of Chile decided to make a sterilized intervention of the foreign exchange rate market in January 2011. Beginning on the 5th of that same month,

[5]For more information about this transition period and the nominalization of the MPR, refer to Banco Central de Chile (2000), Morande (2002) and Massad (2003).

[6]The measures aimed at managing financial market liquidity were announced on October 10th, December 3rd and December 10th of 2008.

the central bank implemented daily asset purchases of $50 million until December 2011. This measure was taken with the intention to increase the amount of reserves by $12 billion during 2011.

Figure 1: Chilean Monetary Policy and Inflation Rates



Source: Central Bank of Chile

Note: The vertical line marks the Lehman Brothers bankruptcy

4 Data

In the literature that examines the effect of monetary policy surprises on financial markets in the United States, during a very small period of time, it is assumed that when the Federal Reserve release its policy statements, everything else is constant and there is no other relevant information that could affect the markets. This is because the FOMC meeting statements and minutes are released while the markets are still open. The case is different with Chile. The statements are released after the closing of the markets, so the effect on prices and returns are observed the following morning. It is reasonable to assume that after the release of the statements and before the opening of the markets, there is new information that affects prices and returns.

To account for this possibility, in our analysis, we include a measure that would capture

relevant events in the foreign markets. The measures that we examine have to satisfy two criteria. First, important events in the international markets must affect the measure before, or at the same time, as the Chilean stock market. Second, the direction of causality must be that the changes in this measure impact the Chilean stock market and not the other way around. Otherwise, our estimated effect will not be capturing the influence of foreign events in the Chilean markets.

Following this criterion, we use the return of a US stock market index to capture the effect of foreign news on the Chilean stock. The measures we test include the S&P 500 and the Dow Jones Industrial average, the main broad equity indices of the U.S., as well as the Exchange Traded Funds (ETF) that follow these indices. We also incorporate the VIX index, which is the implied measure of risk of the S&P 500, as a measure to capture risk in U.S. equity markets. Stock market indices from other countries, such as European or Asian indexes, do not qualify for our criteria given that they leave too much time without trading so there are long periods of time when foreign information reflected by these markets is not captured.[7]

To measure the return of the Chilean stock market, we consider the IPSA index, which is the main stock market index in Chile.[8] Since the release of the statements occur after the closing of the financial markets, we find that the proper return is the one that is obtained by comparing the closing level of the IPSA on the same day as the policy meeting with the opening level of the following day. However, we found that in roughly the first half of the sample, the opening level of the index is the same as the closing level on the previous day. Interestingly, in the second half of the sample, the opening level is generally different to the closing level of the previous day. We assume that there must have been a change in the methodology in calculating the index.[9]

In light of the issues surrounding the calculation of the return of the stock market indices, we have decided to compare the closing level on the day after the policy meeting with the closing level on the release day. By including a measure of the US stock market, we expect to capture the new information released outside Chile. Since Chile is mainly a copper exporter, we include

[7]We also focus on the U.S. stock index given that much of the financial market activity within the same timeline as Chile occurs in U.S. markets.

[8]Other stock market indexes either have a more limited number of stocks (inter-10 only measures the return of 10 stocks) or are simply a disaggregation of the IPSA.

[9]We called the department in charge of producing the index, The Chilean Exchange, and they could not provide an answer to explain this characteristic of the data. We also tried obtaining intraday data to use as an alternative; however, records of this type are not kept by the exchange, and Bloomberg only keeps data for the last 200 days.

the change in the copper price. Lastly, we also include the price of WTI oil since oil is the main import of the country.

The data used for the analysis ranges from January 2003 to August 2016. In total, the dataset accounts for 164 policy meetings. Removing the meetings that coincide with a holiday in the US leaves a total of 151 observations. Data for financial variables are obtained from Bloomberg. We have also procured the expected level of the MPR from the Bloomberg survey. Finally, the effective level of MPR, as well as the policy statements, are acquired directly from the website of the Central Bank of Chile. With the exception of the policy statements issued in January, February, and March 2003, all of the other statements are obtained in English. The statements that are not available in English are translated by the authors following the style of the statements.

5 Sentiment Analysis

5.1 The Dictionary Method

Monetary policy statements include information not only about policy decisions but also discussions regarding economic outlook. These statements update the beliefs regarding Chile's current economic fundamentals as well as the expectations regarding future policies.[10] In order to assess the type of information in these documents, we conduct the Dictionary Method of Automated Content Analysis.

In order to conduct this methodology, we follow Tadle (2016) and create a compilation of key terms and modifiers based on the content of the policy statements. We account for two categories, referenced as sentiments, which represent the policy tilt based on the overall economic discussion. Those terms that relate to higher inflationary pressures and are contractionary policy leaning are denoted as *Hawkish*, while those that convey a more subdued inflation outlook and show expansionary policy leaning discussions are referred to as *Dovish*. Table 1 shows the collection of key terms considered in the analysis.

In addition, we compile a set of modifiers that are widely used in the policy statements. These modifiers can be either positive or negative, as shown in table 2 and table 3, respectively. They can be nouns, adjectives, verbs, or adverbs, and have their unique conjugations.[11]

The keys are categorized as either *hawkish* or *dovish*. In order for a key term to be classified

Table 1: Key Terms

Hawkish Keys

accounts	activity	confidence	consumption	copper
demand	economic	economies	economy	employment
expenditure	federal	financial	growth	indicators
inflation	inflationary	international	investment	job
lending	markets	output	price	prices
yen				

Dovish Keys

exchange	peso	recession	
turbulence	unemployment		

as *hawkish*, it must be true that when it is used in conjunction with a positive modifier, it conveys a contractionary policy leaning sentiment. If the same *hawkish* term is used together with a negative modifier, it signals a stronger sentiment towards expansionary monetary policies. For example, the combination of the key term 'prices' and the modifier 'high' results to the phrase 'high prices', which indicates a hawkish sentiment. On the other hand, replacing the term 'high' with 'low', which is categorized as a negative modifier, results in the dovish phrase 'low prices'. Following this classification method, we categorize the keyword 'prices' as hawkish.

An analogous process is used to select *Dovish* key terms. In order for a key term to be classified as *Dovish*, it must be true that when it is used in conjunction with a positive modifier, it conveys an expansionary policy sentiment. If the same *Dovish* term is used together with a negative modifier, it relays a contractionary leaning sentiment. For example, the combination of the key term 'recession' and the modifier 'significant' results to the phrase 'significant recession', which indicates a dovish sentiment. On the other hand, replacing the term 'significant' with 'subdued', which is categorized as a negative modifier, results in the dovish phrase 'subdued recession'. Following this classification method, we categorize the keyword 'recession' as dovish.

[10]Due to the construction of available data, we could not create a distinction between which of the expectations are driving the effect. The results we obtain are the aggregate effect of these changes in expectations.

[11]Taking the roots of the terms changes the context of the examined information. For this reason, their conjugations are maintained.

Table 2: Positive Modifiers

above	accelerated	acceleration	active	advantageous
appreciate	appreciated	appreciation	aggravated	better
dynamic	elevated	exceed	exceeded	expand
expanded	expanding	expansionary	favorable	gained
good	grow	high	higher	highs
improve	improved	improvement	improvements	increase
increased	increasing	normalize	normalizing	optimistic
outpacing	outperformed	over	positive	progressing
propitious	raise	rapidly	rebound	recover
recovered	regained	rise	risen	rising
robust	rose	significant	solvency	sound
stabilization	steadily	stirring	strengthening	strengthened
strong	stronger	strongly	up	upturn
vigor	vigorous	vigorously		

Note: 'intensification' is denoted as negative since it is only used with 'downside risk'.

The Dictionary Method is then implemented by keeping all those sentences that contain any of the key terms and eliminating the rest of the sentences. These sentences that are removed do not incorporate information related to the economic outlook, particularly regarding inflation. Those that are kept are evaluated based on the number of modifiers they contain and the types of keywords they have.

Sentences with hawkish keywords that have more positive than negative key terms are given a score of '+1'. On the other hand, sentences with hawkish key terms that have more negative than positive modifiers are scored a '-1'. The opposite scoring strategy is conducted for sentences with dovish key terms. If a sentence with a dovish term has relatively more positive modifiers,

Table 3: Negative Modifiers

adverse	below	constrained	cuts	decelerate
decelerating	decline	declined	declines	decreased
depreciated	depreciation	depressed	descend	deteriorated
deterioration	diminishing	diminished	dismal	doubts
down	downward	downwards	drop	dropped
dropping	ease	eased	eases	fall
fallen	falling	fell	flat	fragile
fragility	harsher	idle	intensification	limited
lose	losing	lost	low	lower
lowered	milder	mitigated	moderating	negative
pause	pessimistic	poor	postponed	postponing
receded	reduced	reductions	restrictive	slack
slow	slowdown	slowed	slower	slowly
sluggish	smaller	stringent	subdued	suffering
tension	tensions	tight	tightened	turbulence
undermined	volatile	vulnerable	weak	weaker
weakness	worse	worsened		

Table 4: Example of Sentence Evaluations

Sentence Example 1

'copper (hawkish) and oil prices (hawkish) have posted substantial reductions (negative) in recent weeks'

- Source: August 2011 Policy Statement
- Sentence Score: -1 (hawkish keyword and more negative than positive modifiers)

Sentence Example 2

'annual inflation (hawkish) dropped (negative) but it remains above (positive) 5% and core indicators (hawkish) are above (positive) 4%'

- Source: December 2014 Policy Statement
- Sentence score: +1 (hawkish keywords and more positive than negative modifiers)

it is given a score of '-1'. However, if it has relatively more negative modifiers, it is scored a '+1'. For sentences with equal numbers of positive and negative modifiers, we give a score of '0'.We do not differentiate among the degree of hawkishness within sentence for two reasons. We want to avoid exposing the scoring metric to additional subjectivity. Moreover, the addition of within-sentence variation in scoring creates ambiguity that makes the categorization much

more difficult to quantify.

We present some examples of the sentence evaluations in Table 4. In the first example taken from the August 2011 policy statement, the sentence has a hawkish keyword and only has one modifier, which is negative. Following the scoring metric, this sentence is given a score of '-1', implying that it conveys a dovish sentiment. On the other hand, the second sentence, extracted from the December 2014 policy statement, has hawkish keywords and two positive and one negative modifier. Based on the described scoring procedure, this sentence has a score of '+1', which reflects its hawkish information.

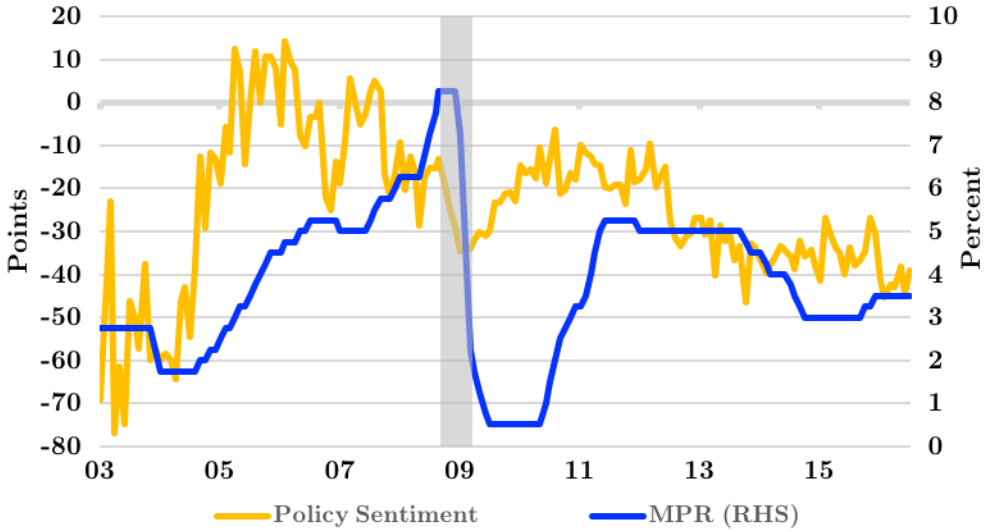
The next step we take is aggregating the scores of individual sentences by policy statement. We then divide the aggregate score by the number of evaluated sentences in each document. After scaling by 100, we create a continuous document sentiment measure that ranges from -100 to 100.

5.2 Applying the Dictionary Method to the Policy Statements

We apply the Dictionary Method on the monthly policy statements released since January 2003 to August 2016. This period covers both the extreme drought, the international financial crisis of 2008-2009, and the occurrence of the effective monetary policy rate lower bound in Chile. Figure 2 shows the corresponding series. Although we observe that the statements reflect a more dovish trend overall, the sentiment score series shows movements that are closely related to the movements of the monetary policy rate. After a period of great volatility in 2003, the sentiment index increases rapidly during 2004 and leads the rapid increase of the monetary policy rate. The index then moved to a period of low *dovishness* during 2007 in line with the drought. It is worth noting that the index does not decrease much during the financial crisis. This fact is explained by the high level of inflation that existed at the end of 2009.

After the spike in inflation in 2008 and the short period of deflation that followed, the inflation rate returned to levels close to that of the target. During the subsequent recovery period, the sentiment index stabilized within the range of '-10' and '-20' points. However, an important change occurred between June 2012 and August 2012 when the index dropped from -15 points to -31 points. This reflects the concern regarding the growth prospects about the economy. Since then the index has mostly moved within a band -30 points and -40 points, in line with a slower economy.

Figure 2: Sentiment Scores of Statements and MPR



Source: Authors Calculations and Central Bank of Chile

Figure 2 shows the pattern in which movements in the statement sentiment index are followed shortly by similar changes in the MPR, particularly in the increases of the MPR in 2005 and 2010, as well as its decreases in 2009 and 2014. These observations suggest that sharp changes in the index signal changes in the monetary policy rate. This may well be due to the fact that risks to growth and inflation are highlighted in the statements well before actual changes in the MPR and that these documents reflect information that affect future decisions about the MPR.

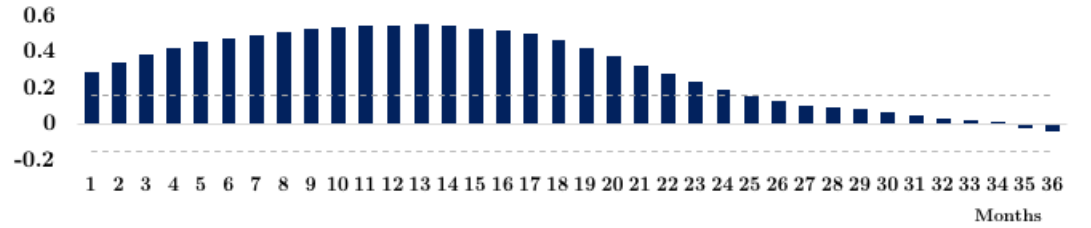
To test this hypothesis, we build a cross correlogram between the sentiment score index and the monetary policy rate. The results, shown in Figure 3, demonstrate a positive and significant correlation between the statement score index and the MPR. The correlation is highest around the twelfth month after the statements are released. This evidence supports our hypothesis that changes in the statement score index signal future changes in the MPR.

6 Empirical Analysis

6.1 The Surprise Component of Document Sentiments

Figure 2 shows that the statement sentiment scores have fluctuated over time, and beginning in 2005, changes in the sentiment have only occurred gradually. Rosa (2011) finds a similar observation with the FOMC statements, and he argues that this follows from the small changes

Figure 3: Cross Correlogram Between Statement Score Index and MPR



Source: Authors Calculations

in fundamentals that are reflected by the wording in the meeting documents. Given that there seems to be some persistence in the sentiments, there may be some expected component in the discussions of these documents. Therefore, we need to differentiate the unexpected component from the expectations since the surprise information is what causes financial market reactions.

To obtain the unexpected component, we use the specification[12]

$$\begin{aligned} PSS_t =& \alpha_0 + \alpha_1 PSS_{t-1} + \alpha_2 PSS_{t-2} + \alpha_3 CPI_t^{ex} + \alpha_4 CPI_{t-1}^{ex} \\ &+ \alpha_5 CPI_{t-2}^{ex} + \alpha_6 Y_t^{ex} + \alpha_7 Y_{t-1}^{ex} + \alpha_8 Y_{t-2}^{ex} + u_t \end{aligned} \tag{1}$$

where PSS_t is the policy statement score for period t, CPI_t^{ex} is the one year ahead expected CPI inflation rate, and Y_t^{ex} is the one year ahead expected monthly GDP growth as measured by the growth rate of the IMACEC index.[13] These forecasts are obtained from the *Encuesta de Expectativas Economicas*.[14]

Table 5 show the results of two versions of regression 1. In the first version, the terms relating to the expected growth rate of the IMACEC index are omitted, while the second version presents the results of the full regression. The results show that the monetary policy sentiment is affected mainly by expected inflation and by lagged values of the sentiment itself, while expected growth does not seem to have effects on the sentiment score. Therefore, we take a parsimonious approach by selecting as our main specification the version of the regression that excludes growth terms.

[12]Using the Maximum Likelihood Estimation gives similar results.

[13]The IMACEC index is an estimation that summarizes activity in different sectors of the economy. It is published monthly and its yearly change is an approximation of the evolution of the GDP.

[14]This translates to 'Economics Expectations Survey'. Every month, the Central Bank of Chile surveys a group of academics, consulting firms, and executives from financial institutions about a broad number of macroeconomic variables. The results from the responses are reported in the *Encuesta de Expectativas Economicas*.

Table 5: Regression Results for Equation 1

Dep. Var: Sentiment Score	1	2
Constant	0.87	0.23
	(3.26)	(3.24)
Sentiment_{t-1}	0.58***	0.57***
	(0.10)	(0.10)
Sentiment_{t-2}	0.31***	0.30***
	(0.11)	(0.12)
Inflation_t	6.95***	6.80***
	(2.24)	(2.31)
Inflation_{t-1}	-3.24	-3.31
	(3.51)	(3.54)
Inflation_{t-2}	-4.81**	-4.76**
	(2.34)	(2.43)
IMACEC_t^E		0.01
		(0.43)
IMACEC_{t-1}^E		0.27
		(0.54)
IMACEC_{t-2}^E		0.04
		(0.45)
R^2	0.77	0.77
F-test	0.00	0.00
AIC	1154.97	1160.11
BIC	1173.46	1187.84
N. Obs	161	161

Note: *, **, ***, denote 10 percent, 5 percent and 1 percent level of significance

The surprise component is the part of PSS_t not explained by the first version of equation 1. We denote this surprise component as

$$Sent_t^s = u_t$$

$Sent_t^s$ provides a measure of the news shock, the unexpected component of the statements information that is unaccounted for by market asset prices.

6.2 Regression Analysis

Given the timing of the release of the policy statements, we use the IPSA daily returns as the main dependent variable. This way of measuring the impact of monetary policy on Chilean financial variables has been used by Meyer (2006), Larraín (2007), Ceballos (2014), and Garcia-Herrero et al. (2017).[15] Denoting the days with monetary policy meetings as $t-1$, the return for some financial variable X is calculated as

$$x_t = \frac{X_t - X_{t-1}}{X_{t-1}} \tag{2}$$

where X_t represents the value for the financial variable at the end of day t. To calculate the monetary surprise, MPR_t^s, we compare the effective value of the MPR with the median value of the Bloomberg survey MPR forecast. In this case, the surprise element is of the form

$$MPR_t^s = MPR_t - E_t(MPR_t^{BBG}) \tag{3}$$

where $E_t(MPR_t^{BBG})$ is the expected value of the monetary policy rate from Bloomberg and MPR_t is the effective value of the monetary policy rate.

To estimate the effect of monetary surprises on the financial variables of interest, we run the regression

$$x_t = \beta_0 + \beta_1 r_t^{US} + \beta_2 MPR_t^s + \beta_3 Sent_t^s + \beta_4 WTI + \beta_5 Copper \tag{4}$$

where x_t is the daily return of the financial variable, r_t^{US} is the daily return of SPY, the US stock market Exchange Traded Funds, $Sent_t^s$ is the surprise component of the sentiment indicator, WTI is the daily return of the WTI oil commodity, and $Copper$ is the daily return of the copper price.[16]

We test for the possibility of a structural break in the relationship between monetary policy and the return of the stock market, since the sample period analyzed includes the financial crisis of 2007-2009. As explained in section 1, the types of policies that were implemented before the crisis were mainly movements of the MPR, whereas after the crisis a number of different

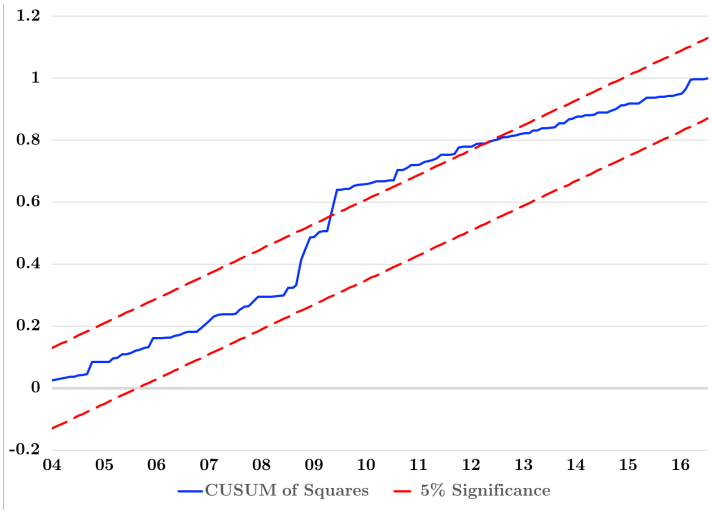
[15] Acuña and Pinto (2015) uses monthly returns instead.

[16] Similar results are obtained in the regression if we change the SPY for alternatives measures of the return of the US stock market. The measures we tested were the Dow Jones Industrial Average index (DJIA), the S&P500 index and the ETF that follow the DJIA. .

policies were implemented.[17] To test this hypothesis, we use the Cumulative Sum (CUSUM) of Squares Test for coefficient stability, following Brown et al. (1975). This test is based on the cumulative sum of the quadratic values of the recursive residuals, which are the one step ahead forecast errors of the dependent variable. This test plots the cumulative sum alongside 5 percent critical lines. Any movement of the cumulative sum outside the critical values suggests coefficient instability.

The results of the test, as represented by figure 4, indicate that there is reason to believe there is structural break around September 2008. To account for this structural break, we include a dummy variable, $D08$, which takes the a value of zero between the beginning of the sample and August 2008 and takes the value of 1 for the rest of the sample.[18]

Figure 4: Test of Stability



Source: Authors Calculations

Then the estimated equation that takes into account the possibility of structural break is given by:

$$x_t = \beta_0 + \beta_1 r_t^{US} + \beta_2 MPR_t^s + \beta_3 Sent_t^s + \beta_4 WTI + \beta_5 Copper + \beta_6 MPR_t^s \times D08 + \beta_7 Sent_t^s \times D08 \quad (5)$$

Table 6 shows the results for both of our regressions: the baseline regression and the one that accounts for a structural change in September 2008. The baseline regression shows that

[17] The policies implemented after September 2008 are not quantifiable. Hence, we are not able to include those measures in our analysis.

[18] This approach of dividing the sample in two is also used by Garcia-Herrero et al. (2017).

the Chilean stock exchange has a positive reaction to the US stock market. In addition, changes in the copper price have positive and significant effects on the Chilean stock market index, although the magnitudes of the effects are small. These reduced effects might be due to the fact that increases in the price of copper encourages economic growth in Chile. However, there is no copper producing firm in the stock market so copper has an indirect effect over the stock market.[19] On the other hand, the price of WTI has a strong and significant effect on the stock market. Contrary to what has been found in the literature, monetary surprises do not seem to have an effect on the equity market when using the whole sample. In the same token, the new information revealed by the surprise component of the statements do not seem to have any effect on the Chilean stock market index.

The results take a radical turn when the structural change is taken into account. The US stock market, copper price and the price of WTI oil continue to have positive and significant effects on the Chilean stock market. In contrast to what is found in the baseline regression, monetary surprises for the first half of the sample have a negative and significant impact on the stock market, in line with the economic intuition as well as the results of the literature. In this case, a monetary policy surprise rise of 25 bp decreases the return of the index by 47 bp.

Similarly, in the first half of the sample, the surprise component of the statements still indicates that the market does not seem to react to new information revealed in the statements. For the second half of the sample, a formal coefficient test shows that monetary surprises do not seem to affect the return of the stock market. However, a formal coefficient test show that the news shock has a positive impact on the stock market index, Table 7. This is perhaps due to the fact that an unexpectedly more hawkish statement reveals a more positive economic forecast, thereby situating Chile's economic outlook in a more positive light.

The differences between the baseline and the structural change regression results show that there has been a change in the way the market respond to monetary policy announcements. This could be explained by the diverse number of policies that were implemented after September 2008. In that sense, the results imply that before the crisis, the market focused almost exclusively in changes to the monetary policy rate. As the market observes signals about the downturn, it has begun to focus more on the information revealed in the statements.

[19]We have also considered examining assets whose value closely follow copper prices. However, there is no individual stock that is directly affected by the price of copper.

Table 6: Baseline vs. Main Regression Results

Dep. Var: IPSA	Baseline	Structural Break
Constant	1.52	1.61
	(6.70)	(6.46)
SPY	23.43**	22.18**
	(10.12)	(9.04)
Monetary Surprise	-0.25	-1.88**
	(0.39)	(0.77)
Monetary Surprise×Dum		2.29**
		(0.89)
Sentiment Surprise	0.02	-0.32
	(0.68)	(0.72)
Sentiment Surprise×Dummy		3.51**
		(1.63)
WTI	7.90**	8.35***
	(3.66)	(3.15)
Copper	10.88**	10.15**
	(5.13)	(4.52)
R^2	0.2372	0.3004
F-test	0.0084	0.0001
N. Obs.	152	152

Note: *, **, ***, denote 10 percent, 5 percent and 1 percent level of significance

Table 7: Coefficient Tests

Intuition	Formal Test	P-Value
Effect of Monetary Surprises	$\beta_2 + \beta_6 = 0$	0.15
Effect of Statement Surprises	$\beta_3 + \beta_7 = 0$	0.03

7 Robustness and Extensions

7.1 Altering the Specification used for the News Shock

The estimation of the news shock may be subject to different specifications of equation 1. In order to evaluate the sensitivity of the results, we alter the specification. In one of the checks, we include an additional lag of the statement sentiment scores in the equation. This enables us to account for the sentiment of the policy statements for a whole quarter beforehand.

The results with the altered statement shocks are given in table 8. We again compare the results from the baseline regression to those obtained using the main specification. Comparing these values of table 6, we find that the results barely change and remain qualitatively the same.

Table 8: Regression Results: Adjusted News Shocks

Dep. Var: IPSA	Baseline	Structural Break
Constant	1.54	1.16
	(6.80)	(6.58)
SPY	23.45**	22.19**
	(10.16)	(8.98)
Monetary Surprise	-0.25	-1.88**
	(0.39)	(0.77)
Monetary Surprise×Dum		2.27**
		(0.89)
Sentiment Surprise	-0.03	-0.34
	(0.74)	(0.84)
Sentiment Surprise×Dummy		2.93*
		(1.70)
WTI	7.87**	8.39***
	(3.66)	(3.16)
Copper	10.88**	10.05**
	(5.14)	(4.57)
R^2	0.2371	0.2939
F-test	0.0082	0.0002
N. Obs.	151	151
Note: *, **, ***, denote 10 percent, 5 percent and 1 percent level of significance		

Table 9: Coefficient Tests

Intuition	Formal Test	P-Value
Effect of Monetary Surprises	$\beta_2 + \beta_6 = 0$	0.17
Effect of Statement Surprises	$\beta_3 + \beta_7 = 0$	0.09

To further evaluate the robustness of the results when equation 1 is altered differently, we take into account the forecasts for changes in the real GDP, as measured by the IMACEC index. We also incorporate other measures of inflation forecasts, particularly those that project the two year level of inflation. Even with these changes, we find that the results hold.

7.2 Asymmetric Effects of Monetary Policy Annoucements

We also test whether there are asymmetric effects in the response to surprises in the sentiment component of the monetary policy statements. For this, we create two dummy variables. The first is the variable $INCREASE$, which takes the value of one when there are increases in the MPR, and 0 otherwise. The other dummy variable, $DECREASE$, is set equal to one when there are decreases in the MPR, and 0 otherwise. Taking into account the results of the previous sections, we additionally test for changes in the asymmetric response to surprises in the sentiment component of the monetary policy statements.

$$\begin{aligned} x_t = \beta_0 + \beta_1 r_t^{US} + \beta_2 MPR_t^s + \beta_3 Sent_t^s + \beta_4 WTI + \beta_5 Copper + \beta_6 MPR_t^s \times D08 + \beta_7 Sent_t^s \times D08 \\ + \beta_8 INCREASE + \beta_9 DECREASE + \beta_{10} Sent_t^s \times INCREASE + \beta_{11} Sent_t^s \times DECREASE \\ + \beta_{12} Sent_t^s \times D08 \times INCREASE + \beta_{13} Sent_t^s \times D08 \times DECREASE \end{aligned} \quad (6)$$

The results of this test can be seen in Table 10, where the first column denotes the results of the analysis that assumes no structural change in the relationship of the variables. The lack of any significant coefficient indicates that there is no evidence that supports the idea of asymmetric responses to surprise in the statements. The results are similar when structural change are taken into account, as in the second column. These claims are formally tested and the results of these tests are presented in Table 11. We observe that there is no asymmetry in stock market reaction to statement surprises before or after the structural change. [20]

[20] When the variable that captures the movements in the US market is replaced by the Dow Jones Index the coefficient that accompanies increases in MPR for the second half of the sample is marginally significant.

Table 10: Asymmetric Effects

Dep. Var: IPSA	Baseline	Structural Break
Constant	8.10	6.54
	(7.40)	(7.31)
SPY	23.09**	20.35**
	(10.18)	(8.78)
Monetary Surprise	-0.39	-2.43**
	(0.47)	(1.13)
Monetary Surprise×Dum		2.75**
		(1.32)
Sentiment Surprise	0.51	0.06
	(0.79)	(0.81)
Sentiment Surprise×Dummy		3.19**
		(1.60)
WTI	8.38**	9.30***
	(3.63)	(3.20)
Copper	10.83**	10.53**
	(5.13)	(4.56)
INCREASE	-18.03	-15.98
	(17.89)	(18.93)
DECREASE	-29.99	-22.95
	(37.54)	(35.16)
Sentiment Surprise×INCREASE	-0.44	-0.19
	(2.00)	(1.95)
Sentiment Surprise×DECREASE	-4.11	18.06
	(3.97)	(16.24)
Sentiment Surprise×INCREASE×Dummy		9.66
		(6.92)
Sentiment Surprise×DECREASE×Dummy		-22.98
		(14.44)
R^2	0.25	0.33
F-test	0.0043	0.00
N. Obs	152	152

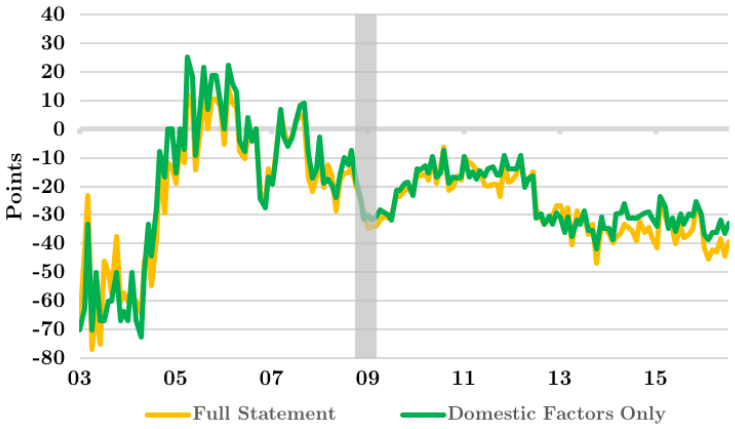
Note: *, **, ***, denote 10 percent, 5 percent and 1 percent level of significance

Table 11: Coefficient Tests After 2008

Intuition	Formal Test	P-Value
Effect of Monetary Surprises	$\beta_2 + \beta_6 = 0$	0.49
Effect of Statement Surprises	$\beta_3 + \beta_7 = 0$	0.02
Effect of Statement Surprises with Increase in MPR	$\beta_{10} + \beta_{12} = 0$	0.15
Effect of Statement Surprises with Decrease in MPR	$\beta_{11} + \beta_{13} = 0$	0.22

7.3 Sentiment Component Index: Domestic Indicators only

Figure 5: Full Statement vs Domestic Only Factors



Source: Authors Calculations

Given that the policy statements of the Central Bank of Chile discuss economic indicators of other countries, we want to determine whether such discussions drive a significant portion of the results. In order to evaluate this possibility, we recalibrate the sentiment score of each policy statement while focusing only on discussions about domestic outlook.[21] Referring to figure 5, we find that the sentiments calculated using only domestic factors follow a very similar pattern as the main measure.

We also evaluate the results using this measure. Our findings indicate that the news shock is still significant at the 95% level after accounting for the structural break in the reactions of the

[21]In particular, we omit the sentences that contain the terms 'developed', 'emerging', 'europe', 'european', 'external', 'federal', 'global', 'globally', 'greece', 'greek', 'industrial', 'international', 'internationally', 'internationals', 'japan', 'subprime', 'us', 'united', and 'world'.

stock market. Thus, much of the estimated impact of the discussions in the statements seem to result from the information related to domestic indicators.

8 Conclusion

In this paper, we present a study of the short term effects of monetary policy shock in the Chilean stock market. Although this types of studies have been done extensively for the US, there is only a small number of studies that have done this for Chile. The novelty of this study is that it also looks at surprises in the announcements in the policy meetings.

Using Automated Content Analysis, we measure the tone of each monetary policy statements released after each of the policy meeting between January 2003 and August 2016. With this information, we are able to build a series that tracks the evolution of the economic outlook of the monetary policy statements. We find that this series, which we refer to as sentiments, leads changes in the monetary policy rate. In particular, when the sentiment does not show relevant movements, there are no observed changes in the monetary policy rate.

Using regression analysis, we then extract the surprise component of the series using inflation forecasts and lagged values of the sentiment component. We use the surprise component along with surprises in changes of the monetary policy rate and other explanatory variables to find the overall effect of monetary policy shocks on the stock market. We find that from the beginning of the sample to August 2008, the stock markets seems to react to surprises in the monetary policy rate, while surprises in the sentiment component are not significant. On the other hand, after August 2008 to the end of the sample, we find that surprises in the monetary policy rate are not relevant for the stock market, while surprises in the sentiment component shows significant effects on the stock market.

Future research agenda include using the surprise component to understand the effects of monetary policy surprises on the Chilean exchange rate and local interest rate market. In addition, future research might try to assess the reason why there is a structural break in the reaction of the stock market to monetary policy surprises.

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