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Is the Information Channel of Monetary Policy Alive in Emerging Markets?*

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Abstract

Central Bank policy decisions affect the economy not only by influencing market conditions through its market interventions but also by shaping the people's expectations of economic conditions via the announcement of those decisions. This paper studies how forecasts of inflation and output growth respond to unexpected policy rate decisions using datasets for Brazil and Chile that satisfy three conditions: high enough frequency, short-term horizons, and the same source for the dependent and independent variables. The results show that inflation and output forecasts increase in the short run after an unexpected increase in the policy rate, which supports the existence of an information shock behind the monetary policy decision. These results can be explained by a baseline Neo-Keynesian model only when the interest rate provides information about shocks other than the monetary policy shock.

Resumen

Las decisiones de política monetaria afectan a la economía no sólo al influir condiciones de mercados al cambiar tasas, sino también al cambiar las expectativas futuras afectadas por los anuncios de estas decisiones. Este artículo estudia cómo las expectativas de inflación y crecimiento responden ante cambios inesperados de la tasa de política monetaria utilizando datos para Brasil y Chile que satisfacen tres condiciones: alta frecuencia de recolección, horizontes de corto plazo para las expectativas y fuente común para la medición de variables dependientes e independiente. Los resultados muestran que las expectativas de inflación y producto aumentan en el corto plazo luego de un aumento inesperado en la tasa de política, lo que respalda la existencia de un shock de información detrás de esta decisión de política. Estos resultados pueden explicarse mediante un modelo básico neokeynesiano sólo cuando la tasa de interés proporciona información sobre shocks distintos del shock de política monetaria.

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1 Introduction

Central Bank policy decisions affect the economy not only by influencing market conditions through its market interventions but also by shaping the people's expectations of economic conditions via the announcement of those decisions. There is important debate in the literature about the kind of shocks that affect the economy because of monetary policy decisions, mainly because their effects on economic variables, including expectations, are very different. On the one hand, there is the old-fashioned monetary shock, which is the one that —all-else-being-equal— increases interest rates. This could be separated into a shock to current or future interest rates. Still, in both cases, a positive shock should diminish the incentive to consume and decrease the demand (and ultimately output) and inflation and all their expectations.[1]

On the other hand, there is a relatively new information shock, which shows reverse responses. This is so because, in general, a higher-than-expected monetary policy rate (MPR) would signal higher-than-expected demand and hence would increase expected inflation and output. Such effects are opposite to the policy's intended effects. For example, a policy meant to stimulate aggregate demand by lowering the interest rate may reveal that the central bank expects demand to be low, reducing people's forecast of aggregate demand and their willingness to spend rather than increasing it.

This paper contributes to the debate in the literature about the occurrence of monetary and information shocks when making the MPR decision. The empirical part identifies one shock during the MPR announcement and argues that if the shock affects expectations of realized but unknown variables or variables in the very short term, there is evidence of an information shock. If there were no information shocks, there should be no reaction of expectations in the past and near term. In contrast, in the longer term, expectations could react because of information or the effect of the monetary shock. If there were only monetary shocks, that reaction should be negative because a higher-than-expected interest rate decreases incentives to consume, inflation, and output. If there are also information shocks, that reaction depends on the timing of the information provided by the MPR decision. If it is about the short term, long-term expectations would not react, but if the information is about the future, there could also be a positive reaction. Ultimately, the

[1] Another literature has proposed that increases in the interest rate should drive up inflation even when these changes do not convey information that the central bank knows about the economy. This view has been called "Neo-Fisherian" and can be found on the internet, for example, in Smith (2014), Williamson (2014), and Cochrane (2015). García-Schmidt and Woodford (2019) show that the theory does not support this view.

movement of longer-term expectations could not be informative about the information channel.

This paper finds that short-term inflation expectations and past and short-term output expectations react, on average, positively to higher-than-expected changes in the MPR. These results are based on the reaction of inflation expectations of the main price indexes and of GDP growth expectations of Brazil and Chile, and on the reaction of the expectations of Industrial Production (IP) growth in Brazil. In the medium-to-long term, expectations show mixed results, but in all cases, the reaction is smaller than in the short term. These findings are consistent with an active information shock of monetary policy.

Then, this paper develops the simplest possible Neo-Keynesian model to disentangle which shock can be behind the short-term positive responses found in the empirical section. The model includes three types of current shocks, namely a monetary shock, a natural rate of interest shock, a cost-push shock, and three types of news shocks that signal future realizations of the same shocks. The results show that the surprise in the MPR has to give enough information about the natural rate (current or future) to get positive revisions of current output and inflation to an unexpected positive realization of the MPR.

The monetary and information shocks are hard to identify because they happen simultaneously and affect the same variables. The literature has implemented several methods to separate these, which include co-movement between interest rates and stocks (Jarociński and Karadi, 2020; Cieslak and Schrimpf, 2019), orthogonality to the central bank's information set (Miranda-Agrippino and Ricco, 2021), and differentiated effects in different interest rates (Bu et al., 2021) among others. There is also active discussion about whether information shocks still exist or they were a thing of the past (Hoesch et al., 2023 and D'Agostino and Whelan, 2008 updating the analysis of Romer and Romer, 2000, who found previous asymmetries of information between the Federal Reserve and a survey) or are endogenous reactions to other information and so the effects disappears when controlling for different variables (Bauer and Swanson, 2023).

This paper makes several contributions to the debate about the responses of expectations to monetary policy surprises and the existence of the information channel. First, and in contrast to the vast majority of the literature, the dataset presents several advantages of studying the reaction of expectations to monetary versus information shocks. The most important characteristics that satisfy both datasets are three: (i) In comparison to other surveys (such as Blue Chip in the U.S.), these datasets have closer pre- and postmeeting measurements, which is very important to avoid getting spurious effects (Bauer and Swanson, 2023)). (ii) It includes expectations of past and short-term variables, which is important because these are the ones that do not move as a response to a monetary shock and hence identify an information shock. (iii) The datasets include measures of the shock and the expectation reaction from the same source. How the expectations of an agent react to a shock depends on what the agent expected, not what others expected.

One can argue that if the measures are based on market data, there should be market consensus, but this is hard to argue when the measures of the dependent and independent variables come from different sources.[2] Additional characteristics include the fact that The shock and revision measurements are direct measures of expectations, instead of relying on approximations of one or both variables using different methods (Acosta, 2023; Faust et al., 2004 among others). Finally, and in the case of Chile, this paper is, to the best of my knowledge, the only one in the literature that studies using individual responses of a group of institutions, which is very beneficial in this particular case since the monetary authorities do not surprise the market very often.

Third, we contribute to analyzing the information channels in two emerging markets, which are very scarce in the current literature. The reason for using Chile and Brazil was their datasets' quality. Still, using these two countries is very beneficial since both are inflation targeters and have similar monetary policy frameworks.

Fourth, it highlights the importance of the information channel not only on the whole communication delivered on the day of the monetary policy meeting but also on the information about only the decision of the MPR. This is important because it implies that care must be taken not only about the information released during policy meetings but also about the policy decision itself. The rest of the literature uses, in general, a surprise component that includes the change in the rate and information given about the short and medium run (Faust et al., 2004; Jarociński and Karadi, 2020 among many others).

This paper relates directly to the empirical literature that studies the effect of surprises in monetary policy on revisions of expectations and discusses the existence of information shocks. Before 2020, the literature was scarce and included only a handful of papers. It started with Romer and Romer (2000), who found a reaction of forecasts because of

[2] Kuttner (2001) and Gürkaynak et al. (2005) began measuring monetary shocks based on market instruments that have been extensively used since then, including the study of the reaction of expectations measures from other sources as, for example, Faust et al. (2004).

an informational advantage from the Federal Reserve.[3] Then the literature was followed by Campbell et al. (2012) and Nakamura and Steinsson (2018), which present results for changes in inflation and unemployment or output expectations to a monetary surprise that not only take into account the surprise in the current policy rate but also the surprise in future rates. Using different methods, the former finds positive reactions to inflation forecasts (not very significant, but higher in number in the initial quarter ahead) and negative responses to unemployment forecasts (higher in the initial quarter ahead). In contrast, the latter finds no effect on two-year to 10-year inflation forecasts and a positive impact on output growth forecasts, especially in the first quarters. All these studies find positive coefficients, which contribute to the evidence of the information channel, but are based on monthly surveys and measures of the dependent and independent variables from different sources.

Since 2020, there was an increase in the monetary and information shocks of monetary decisions, focusing on disentangling both shocks and seeing if the "well-identified" monetary shock affects inflation and output with the correct theoretical signs. These include Jarociński and Karadi (2020), Miranda-Agrippino and Ricco (2021), Bu et al. (2021) and Nunes et al., 2023 among others. Among these, the ones that investigate the responses of expectations are Jarociński and Karadi (2020) and Nunes et al. (2023), which find evidence of positive reactions of one-year-ahead inflation and growth expectations to an information shock. Related to these studies, Güntner (2022) studied Blue Chip's forecasts revision to the information shock identified using the method in Jarociński and Karadi (2020) and found significant responses of output forecasts while non-significant of inflation forecasts. In all these cases, the expectations data is based on monthly surveys. The dependent and independent variables are not from the same source, and only Güntner (2022) includes the short term.

The only papers that investigate the revision of expectations to a monetary shock and that use inflation expectations measured at frequencies higher than one month are Andrade and Ferroni (2021) and Acosta (2023). The first uses market-based expectations starting one year ahead and measures the response to different monetary shocks (target, Delphic, and Odyssean). The closest to our shock is the target factor, which shows negative, non-significant responses of one-year inflation expectations. Compared to this study, the dependent and independent variables are measured from the same source; we

[3] D'Agostino and Whelan (2008) extended the analysis of Romer and Romer (2000), and found a deterioration of the informational advantage, but still superior forecast accuracy than professional forecasters for the very short term.

include shorter-term expectations, which is more beneficial for testing the information shock hypothesis, and our measurements are direct instead of including other variables that could be changing in response to the shock.

Acosta (2023), on the other hand, decomposes monetary policy announcements to shocks identified with the help of newspaper articles and shows the response of high-frequency, text-based measures of inflation and output expectations to those shocks. The results show positive responses of both expectations variables to perceived-demand shocks, negative in response to monetary shocks (current and news), positive growth response, and negative inflation response to a perceived supply shock. The measures of expectations are relatively short term and show an average of movements between the expectations of the same quarter and two quarters ahead. In comparison to this paper, the main differences are two-fold. First, they estimate different shocks based on the newspapers' reaction to the monetary announcement, and this paper estimates one shock, which is directly the unexpected component of the monetary decision since the interest is in whether the decision itself creates an informational effect. Secondly, they create high-frequency expectations measures, while the measures used in this paper are direct, so more accurate. In any case, the papers offer a different dimension to discussing monetary policy, the existence of different shocks, and their effects on expectations.

Specifically about Chile or Brazil, Aruoba et al. (2021) is the only paper that, with an identified monetary shock for Chile, shows the response of various economic variables, which include one-year-ahead inflation forecast using surveys. They show an initial positive response of inflation expectations. Among the differences with this paper is that the dependent and independent variables come from different sources, do not include shorter-term responses, and are not about revising expectations over some horizon but about the evolution of a fixed horizon.

The related theoretical literature includes papers with a signaling role to the monetary policy instrument. Melosi (2017) includes such a role in a dispersed information model to study the empirical relevance of the signaling effects of monetary policy for the United States and their implications for the spillover of policy and non-policy disturbances. In contrast to that model, the one presented in this paper assumes that all firms have the same information to focus on the conditions under which the model can explain the empirical results while keeping tractability. For this study, it is not necessary to go to dispersed information and introduce higher-order beliefs and the role of the interest rate as a coordination mechanism.[4] If the mechanism under study is put in such an environment, the general conclusions will not be altered, but additional complications will be encountered. The model presented here is the baseline Neo-Keynesian model with a signaling role.[5]

The paper proceeds as follows. Section 2 briefly describes the monetary policy frameworks of the countries used in the empirical section and the specific datasets. It highlights the benefits of using that data and also the remaining concerns and what was done to deal with them. Section 3 presents the empirical analysis, including the main regressions and findings. It also shows the results of additional exercises and discusses some robustness exercises. Section 4 presents the model, describing the departures from the 3-equation baseline New-Keynesian model, the expectation formation processes, and the results about which shock can be behind the results found in the empirical section. Section 5 concludes.

2 Description of the Monetary Policy Frameworks and Datasets

As said in the introduction, the reason for using Chile and Brazil is because they meet three desirable conditions for studying the effects of monetary policy (including a possible information effect) on expectations. This section will present the main characteristics of the monetary policy frameworks of both countries and the main advantages and concerns about their datasets.

2.1 Monetary Policy Frameworks

Both countries are inflation targeters since 1999.[6] Both set an overnight interest rate (the Selic rate in Brazil and the TPM in Chile) in order to achieve their inflation targets

[4]For theoretical literature about the role of public information and higher order beliefs Morris and Shin (2002) and (2003).

[5]Other papers include a signaling role in the monetary policy actions, but the instrument is not the interest rate. For example, Adam (2007), Tamura (2013), and Baeriswyl and Cornand (2010) study optimal monetary policy, Tang (2014) and Mertens (2011) study the effects that this signaling role has on discretionary policy and Berkelmans (2011) studies the effect of a signaling role on the propagation of shocks.

[6]Brazil had a formal change in June 1999, but only gained legal independence in 2021. Chile had the legal change including independence in 1989, but started with a crawling band until September 1999. Since then, a fully fledged inflation targeting regime has had a floating exchange rate.

set based on headline inflation measures of their main consumer price indexes.[7] Both have operational independence, have a board that make their decisions by vote, currently meet 8 times per year (in normal times), among other common characteristics.

Both have operational independence, have a board that make their decisions by vote, currently meet eight times per year (in normal times), among other common characteristics. The main differences in their monetary policy frameworks since the periods of floating exchange rate regimes, is the setting of the targets, the general stability of the countries and their macroeconomic policies. Brazil sets inflation targets more than two years in advance, but that target moves around.[8] In contrast, Chile has had a constant target centered at 3% since the flexible exchange rate period began.

Chile has been fairly stable for the whole period while Brazil has presented more instabilities. Carvalho and Nechio (2023) show and discuss that Brazil has experienced some episodes in which there were instabilities related to fiscal sustainability concerns and un-anchoring of inflation expectations.[9] Chile on the other hand has experienced no critical change in its macroeconomic policy. The most important instability is the social unrest that erupted at the end of 2019, but did not have obvious macroeconomic policy repercussions.

2.2 Datasets

2.2.1 Brazilian Dataset

The analysis uses forecasts reported by the Market Expectations System (MES) of the Central Bank of Brazil, known as the Focus Survey. The MES was created in 1999 as part of the monetary policy framework and reports forecasts for several variables, including different inflation measures, output growth and the MPR, at different horizons. The survey is nowadays conducted online to professional forecasters and provides daily statistics of the responses in the system, so it is a high-frequency measure. The number of institutions is around 160, which undergo a pre-approval process and includes for example banks and asset managers.

[7] Selic stands for "Sistema Especial de Liquidação e Custódia" which means Special System for Settlement and Custody and TPM stands for "Tasa de Política Monetaria" which means Monetary Policy Rate.

[8] The first target was set in June 1999 and was 8% for the year 1999. The last target on record was decided in June 2023 and is 3% for the year 2026.

[9] Particularly high instabilities happen until end of 2002 and between the second-half of 2015 and August 2016 (Carvalho and Nechio, 2023; and references cited there).

The forecasts are not reported every day and are included in the statistics as long as they were reported in the last 30 days. There are incentives to update forecasts on specific dates because the MES publishes annual and monthly Top 5 rankings, which are closely followed by economic agents, making these rankings a significant factor in the financial landscape.

The sample used in the analysis is from the meetings held between November 2001 and December 2022, which implies 186 measurable meetings.[10] The analyzed variables are monthly inflation expectations of the IPCA index, which is the main price index in Brazil, and of IP, and quarterly expectations of GDP.[11]

2.2.2 Chilean Datasets

The datasets used for Chile are the EOF (Financial Traders Survey in Spanish) and the EEE (Economic Expectations Survey in Spanish). Both of them are professional forecasters' surveys conducted by the Centrak, Bank of Chile. The EOF is the preferred option, but it does not include output growth forecasts, which is the reason why a part of the analysis uses the EEE.

The EOF is less frequent than the Brazilian survey, but it has pre-meeting and an after-meeting versions and includes questions about inflation and the MPR.[12] The available data includes the median and mean and the individual observations of each institution, which are around 50.[13]

Unlike the Brazilian survey, which is web-based and allows forecasters to enter data at their convenience, the Chilean survey is conducted each time, ensuring its complete up-to-dateness.

The CBC conducts another professional forecasters' survey, the EEE . This survey is used for the output expectations results. It is not our preferred option due to its monthly frequency and less up-to-date nature at the monetary policy meeting (its release date

[10]There was an extraordinary meeting in October 2002, which was excluded because of the lack of measure of the expected MPR.

[11]The sample for IP stops in August 2021, because that forecast was discontinued.

[12]The release dates went from the 2nd and 4th Wednesdays of each month between 2009 and 2017 to 3 days before the press release of the meeting and 2 days after the release of the minute of the same meeting since 2018 (which happens around 2 weeks after the meeting). The reason behind this is that until 2017 the CBC had monthly meetings, starting in 2018 it had eight meetings every year.

[13]To secure the privacy of the individual agents, the Central Bank of Chile mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the author and did not involve nor compromise the Central Bank of Chile.

depends on the release date of inflation), but it is the only option to study the reaction of output in Chile.

The sample for the analysis of inflation in Chile includes 137 meetings between January 2010 and October 2022. It analyzes the response of two monthly and two yearly inflation expectations. The sample for the GDP is between January 2002 and October 2022.

2.3 Benefits (and Concerns) of the Datasets

The main objective of the analysis is to measure responses of short-term output growth and inflation forecasts to surprises in the monetary policy decisions. To argue that a change in the monetary policy decision *causes* changes in expectations, one must control for many potential problems in doing this exercise. This section discusses the reasons behind the choice of the datasets, while highlighting remaining problems and the strategy to control them.

The reasons for choosing Brazil and Chile for this analysis, is because as far as my knowledge, their datasets are the only ones that meet three conditions: *(i)* they have "close-enough" observations before and after meetings; *(ii)* They include expectations at short term horizons; and *(iii)* they include expectations of the dependent and independent variable from the same source.

The first condition is important to avoid the occurrence of too many shocks between the measurements, which makes isolating the monetary shock very difficult. If frequency is low and the regressions lack enough controls, the results can show an information channel that is not there (as shown by Bauer and Swanson (2023)). This problem is not present in the Brazilian data because it has daily measures. In Chile, the frequency is longer, yet still very good in comparison with international standards.[14] The concern using frequent surveys lies actually in allowing enough days for the survey measures to react.[15]

The second reason is the inclusion of short-term forecasts to connect with the information channel of monetary policy. Without an information channel, short-term expectations should not react, while medium-long term expectations should react negatively to a positive surprise. This is so because a higher-than-expected interest rate increases real rates, decreases current consumption, aggregate demand and inflation (and output). In

[14] For example, Blue Chip —the most common survey of professional forecasters cited in the literature— has only monthly measures.

[15] This contrast with market-based measures, as discussed by Nakamura and Steinsson (2018)), that react to many shocks even during one day. For discussion about the unresponsiveness of surveys refer to Coibion and Gorodnichenko (2012) and Coibion and Gorodnichenko (2015).

contrast, with an information channel, short-term expectations should react and medium-to-long term expectations are unclear, since the two shocks go in opposite directions. This condition contrasts with, for example, Andrade and Ferroni (2021) and Nakamura and Steinsson (2018) that report data only for longer horizons.

The last condition is that the surprise and the correction of the expectations come from the same source. This is important because different agents have different expectations and so when measuring from different sources they could be disconnected. The same decision can be a positive surprise for an agent (or group thereof) and a negative surprise for another, which would be especially problematic when connecting the shock and response of a variable, as is the case of this paper.

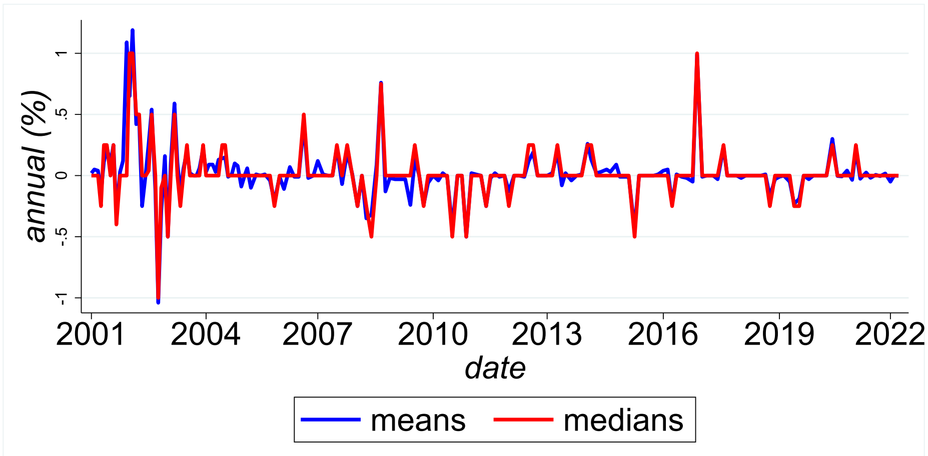
There are some issues from the use of these datasets that need to be recognized and that the analysis tries to control for. First, the monetary authorities do not surprise the market very often, which is shown in Figure 1. The figure shows in red the surprises measured using the median and in blue using the means. Using the medians, from a total of 186 and 131 measured surprises in Brazil and Chile, only 26% and 27% are non-zero, respectively. To control for this problem, the results shown in both countries use medians and means and in the case of Chile, also individual data.[16]

Second, and related to the previous, is that when measuring the expectations, especially using medians, not only are the surprises very few, but also the revision of the forecasts. This problem is related to the evidence that surveys are unresponsive (Coibion and Gorodnichenko, 2012) and is particularly problematic in Brazil, since there is no obligation to change the projections between measures. Figure 2 shows statistics about the relation between the surprises in the monetary policy decisions and the revision of inflation expectations. The figure shows the percentage of answers in the sample, per country and measure (medians/means/individual data) that have a positive correlation (blue), a negative correlation (red), both measures are zero (black), the surprise measure is zero, but the change of inflation expectations is not zero (dark gray), and the surprise is not zero, but the change in expectations is (light gray).

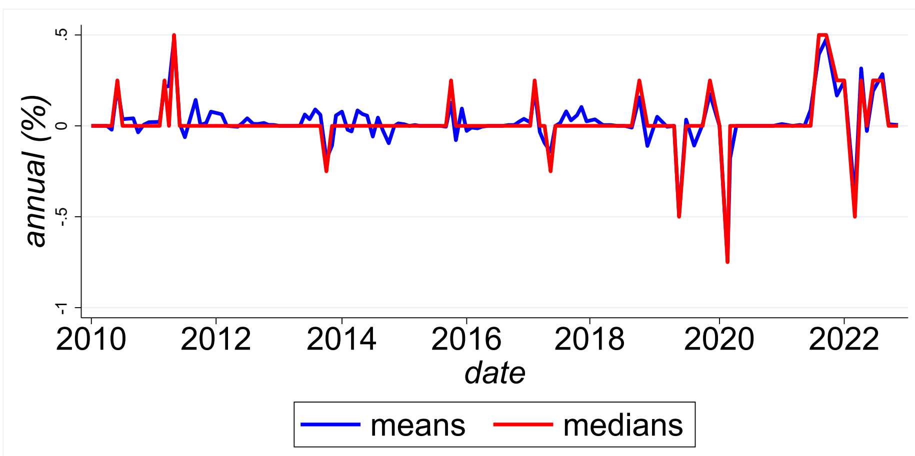
There are several interesting features that can be seen in the figure. First, there is a lot of black and dark gray using medians and individual data, which are the observations with no surprise in the policy rate, and so are uninformative. This problem is much

[16]Using means, 79% and 97% are non zero (75% if non-zero is defined as having an absolute value above 0.001). The percentages of non-zero observations are similar with individual data and medians. However, the availability of non-zero observations is much higher.

a. BRAZIL

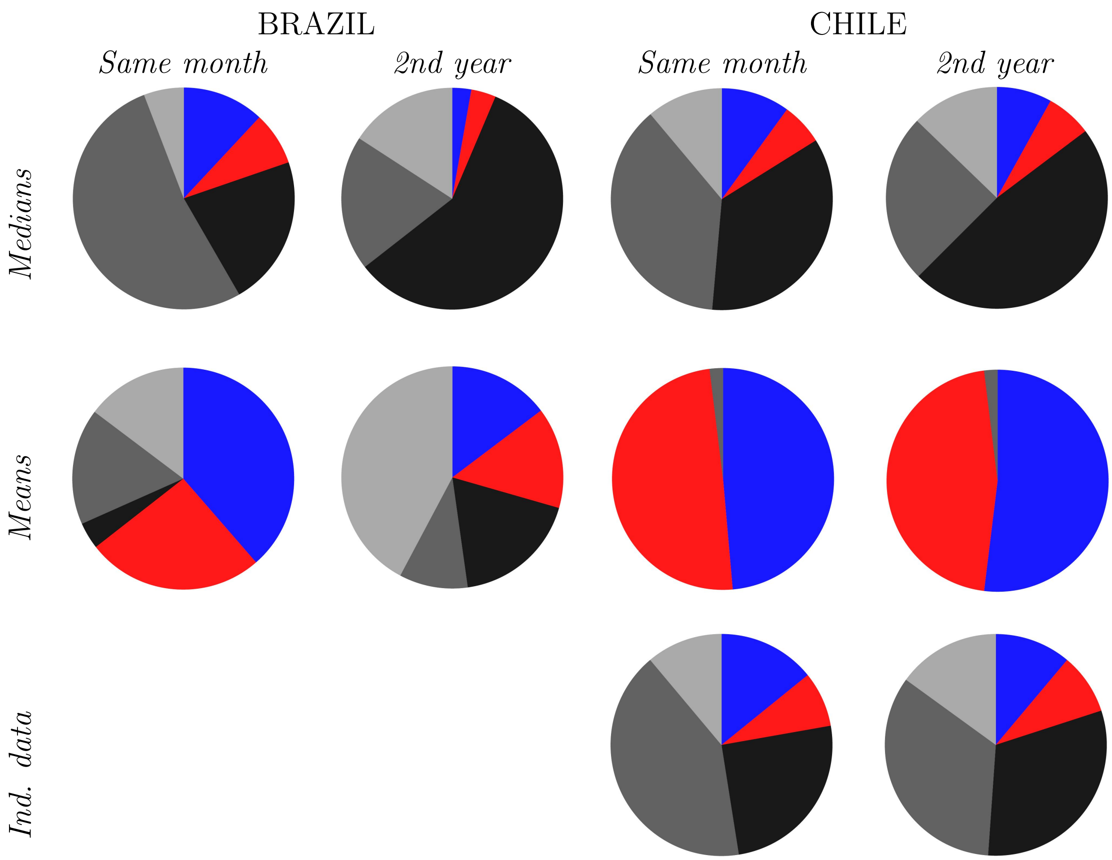


b. CHILE



Notes: The graphs show the surprises available in the samples of each country. The surprises are measured as the difference between the decision and the mean forecast in blue and the median forecast in red. The top figure shows the case of Brazil and the bottom figure the case of Chile.

Figure 1: Evolution of Surprises: Brazil and Chile



Notes: The graphs show the percentage of responses in different categories depending on the surprise in the MPR and the revision of inflation expectations. Blue is when both go in the same direction; red is when they go in opposite directions; black is when both are zero; dark gray is when they revision of expectations is not zero, but the surprise is zero and light gray is when the surprise is not zero, but the revision of expectations is.

FIGURE 2: Relation Surprises and Revision of Inflation Expectations

smaller when using means in Brazil.[17] In Chile, the problem is much less important using means and with individual data, even though there are big areas with those colors, the quantities are very large (over 4,000).

It is also important to highlight that using survey data with direct measures of expectations (inflation and monetary rates) avoids using approximate measures that can affect the results. On the one hand, when measuring inflation expectations using market-based measures, monetary shocks can affect the implicit expectation and other characteristics and, if not isolated properly, can contaminate the findings. On the other hand, when measuring the monetary surprise based on a rate different from the current policy rate itself (as in Nakamura and Steinsson (2018) or Jarociński and Karadi (2020) among others)), it has to be noted that this measure includes not only the surprise of the monetary policy decision itself, but also information given by the press release and short-term forward guidance. The shock measure here is then a lower bound of the information channel, since it excludes the information given (if any) by short-term forward guidance and also any endogenous reaction of expected short-term interest rate to a revision in expectations because of the monetary policy decision.[18]

3 Empirical Analysis

This section estimates the reaction of inflation and output growth forecasts in response to unexpected changes in the MPR. It presents the empirical strategy and the main results.

Even before going to the empirical strategy, Figure 2 shows the sign of the correlations between the surprises and the revision of expectations of the same month of the meeting and the second year after the date of the meeting in both countries. In most cases for the same month, the blue area is larger than the red area, meaning the positive correlation is more common than the negative one. In contrast, the areas are similar in the second year. Both observations contrast significantly with the prediction when there is only a monetary shock, which would be zero in the short term and negative in the long term.

[17]For Brazil, the differences in inflation expectations are taken waiting three days after the meeting. When waiting one, the dark-gray and black areas were even larger. See the Appendix for details.

[18]As in Nakamura and Steinsson (2018), Faust et al. (2004), Campbell et al. (2012) among others.

3.1 Main Regressions

The identification assumption is that during the period between the expectations measures before and after the meeting, the only shock that occurred was due to the monetary policy meeting. This assumption is natural for Brazil but more problematic for Chile. As a result, the exercises will include controls for Chile. The general regression of interest is:

$$\boxed{z^e_{d+s,t+j} - z^e_{d-m,t+j} = \alpha_j + \beta_j(i_t - i^e_{d-m,t}) + C\left(_{\{d+s\}-\{d-m\}}\right) + \epsilon_{t,j}} \tag{1}$$

where the meetings are held at day d of month t. The variables of the equation are the following: $z^e_{d+s,t+j}$ is the expectation of variable z j months in the future held s days after the meeting (the same way, $z^e_{d-m,t+j}$ is the expectation of the same variable for the same horizon, but m days before the meeting); i_t is the MPR decided by the Board at the meeting of day d and $i^e_{d-m,t}$ is the forecast of the MPR m days before the meeting. Finally, $C\left(_{\{d+s\}-\{d-m\}}\right)$ are controls between the two dates that the dependent variable is measured. The coefficient of interest is β_h, which measures the effect that a surprise in the MPR decided at month t has on the change in the forecasts of z at month $t+h$.

The definitions of the specific variables and horizons are country-specific. For Brazil, z is inflation, IP, and GDP; m is zero because the initial expectations are from the same day of the meeting; and $s = 3$ because the expectations after the meeting are from three days after. In addition, j depends on each variable z and is $j = \{0, ..., 17\}$ for inflation, $j = \{-1, ..., 12\}$ for IP and $j = \{-1, 3\}$ for GDP.[19] Because of the high frequency of data, these exercises exclude controls, $C = \emptyset$, but excludes dates that coincided with the release of the variable under study.

In the case of Chile, the primary variable under study is inflation (z), and the available horizons are $j = \{0, 1, 12, 24\}$, meaning the same month, one month ahead, one year ahead, and two years ahead. The measure before the meeting is, on average, done three days before, $m = 3$, and the measure after the meeting is, on average, done nine days after the meeting, $s = 9$. In addition, we include several controls that can affect macro variables: a measure of the surprise in inflation if the data was released (Surp. Infl.), change in the stock market index (Δ IPSA), change in the nominal exchange rate (Δ NER), change in the price of Copper (Δ Copp.P.), change in the price of oil (Δ WTI),

[19] In the case of GDP, the horizon is in quarters instead of months, so j changes accordingly. The appendix shows the results for $s = \{1, 2\}$.

change in the external price index (Δ IPE) and the last available output growth based on an index of economic activity (Δ Imacec).

Also in the case of Chile, there is a panel data version of (1) with horizon and individual-horizon fixed effects, and the measure of the expectations (both sides) depends on the institution i that answered the survey.

The main analysis also includes the reaction of expected GDP growth to the MPR surprise for Chile based on the Survey EEE. In that case z is GDP Growth, j is zero, because it is the same quarter of the meeting, and m and s vary more because the release of the survey is not fixed with respect to the meeting.

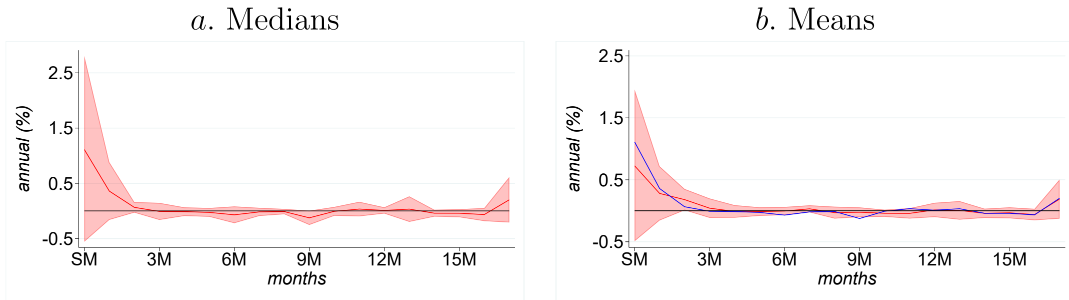
The regressions were estimated with OLS and robust standard errors to control for heteroskedasticity. For the panel, the results used clustered standard errors at the surveyed institution level.

3.2 Main Empirical Results

This section presents the reaction of inflation and output to surprises in the MPRs. It shows that both variables increase in the short run, and the response of the shorter run is higher than the response of the medium term.

3.2.1 The Response of Inflation Expectations

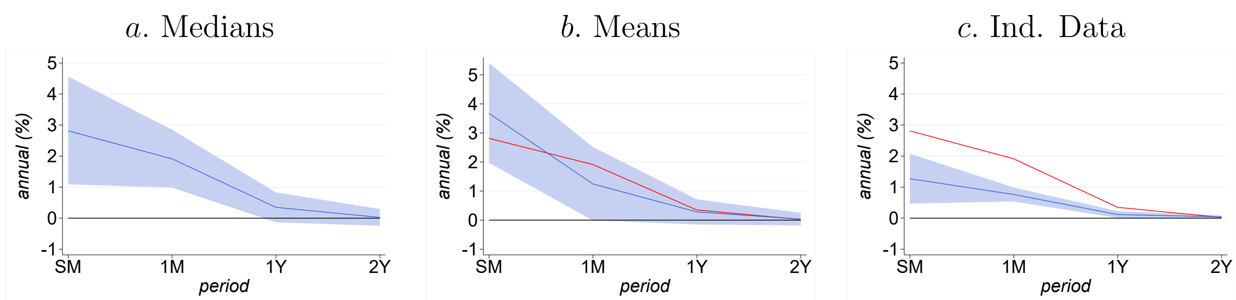
Figures 3 and 4 show the annualized coefficients of interest. The first columns show the results using medians, the second uses means, and the third (for Chile), uses individual data. The means and individual data graphs include a line with the results using medians for comparison. The Chilean results show the regressions using all the controls. For cases with fewer controls and the rest of the details, such as the rest of the coefficients and the number of observations, refer to Appendix A.2.



Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Each graph shows the response of the current month (SM) until 17 months ahead (17M). The corresponding regressions are in Appendix A.2. The graph in *b.* shows the coefficients of graph *a.* in blue.

FIGURE 3: Brazil: Change in Inflation Forecasts

The figures show a positive short-term reaction of inflation expectations, given a positive surprise in the MPRs. This reaction is marginally significant for Brazil while very significant for Chile. The same graphs show that the reaction in the shorter terms is much stronger than in the medium term. The results using medians and means are comparable in both countries. In the case of Chile, the results based on the individual data are smaller than the ones using means and medians but highly significant.



Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision (RPM in Chile) and their confidence intervals. Each graph shows the response of the following month, one month ahead, one year, and two years ahead. The graphs show the response of the regressions given all the controls. The regressions are in Appendix A.2. Graphs *b.* and *c.* show the coefficients of graph *a.* in red.

FIGURE 4: Chile: Change in Inflation Forecasts

The coefficients are also economically meaningful since the graphs show annualized inflation measures in percentages. Interpreting the coefficients, we have that in response to a 25-basis-point positive surprise in the MPRs, the forecast of the same month inflation increases by $0.17\% - 0.25\%$ in annualized terms for Brazil and $0.32\% - 0.91\%$ in the case of Chile.

Note also that the response to longer-term expectations is either non-significant or very small in magnitude. This result also contrasts with the case that the MPR only provides information on the monetary shock since one would expect inflation and output to decrease in the horizon that monetary policy affects the economy, which is between one and two years.

3.2.2 The Response of Output Expectations

Figure 5 and Table 1 show the results for output. In the case of Brazil, the results show that GDP increases for all available horizons, and IP shows an evolution similar to inflation, which increases more in the shorter term and less later. The first horizon of these cases is of particular importance since these are data that have already happened at the moment of the meeting but are not yet known. The importance of these relies on that, by definition, the monetary shock in these cases is non-existent, so there is only an information shock.

As with inflation, the Brazilian results using means and medians are similar in both cases and generally give the same message. In addition, it can be seen that both measures of output give a similar message in the first months, which is that output expectation increases in the short term and only differs slightly around one year in the future. GDP still shows a positive response, while IP decreases to zero or even slightly into negative territory.

The values are also economically significant. An unexpected increase of 25 basis points in the MPR implies an upward revision of around 0.01% in GDP and around 0.05% in IP.

The results for Chile, shown in Table 1, as discussed in section 2.2, are based on another survey (EEE), which is conducted monthly and asks only for the forecast of the same quarter of the survey. The results show positive coefficients in all the versions of the regressions, which is relatively stable in value, although it changes significance depending on the controls included.

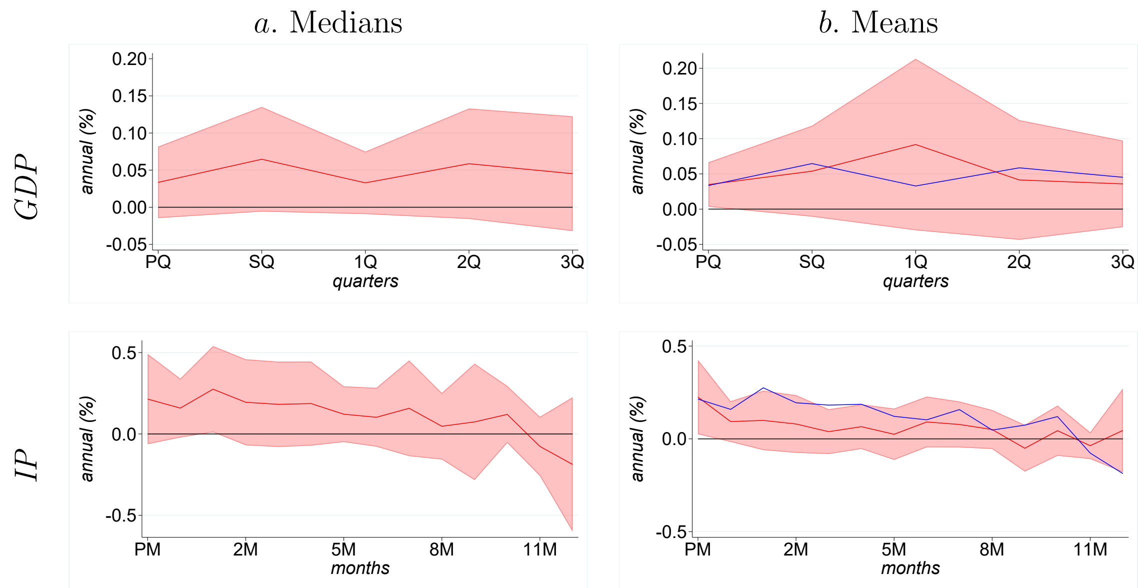
The economic meaning in this case is that an unexpected increase of 25 basis points in the MPR increases GDP growth by around 0.15% in annualized terms.

To sum up, the results for short term inflation and output expectations show positive responses to a positive MPR surprise. These contrast with the interest rate, giving information only about the monetary shock and supporting the hypothesis of including an informational shock. In the medium term, the responses are mixed, which is more expected if there are informational and monetary shocks than only monetary shocks,

Table 1: Chile: Reaction Same Quarters' GDP, EEE, Median

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.626*	0.710**	0.709**	0.690**	0.683**	0.551*	0.398	0.612
	(0.323)	(0.331)	(0.328)	(0.335)	(0.335)	(0.326)	(0.374)	(0.463)
Surp. Infl.		-0.262	-0.261	-0.270	-0.280	-0.297	-0.297	-0.256
		(0.250)	(0.248)	(0.240)	(0.245)	(0.256)	(0.252)	(0.241)
Δ IPSA			0.059	0.404	0.475	1.022	1.069	1.359
			(1.514)	(1.305)	(1.285)	(1.353)	(1.306)	(1.301)
Δ NER				1.566	0.950	0.824	0.487	0.568
				(3.860)	(4.160)	(3.852)	(3.673)	(3.647)
Δ Copp.P.					-0.579	1.053	0.949	0.787
					(1.014)	(1.172)	(1.093)	(1.143)
Δ WTI						-2.694	-2.861*	-2.762
						(1.722)	(1.697)	(1.786)
Δ IPE							0.145*	0.157**
							(0.078)	(0.079)
Δ Imacec								-0.041
								(0.038)
Constant	-0.008	0.001	0.000	-0.001	0.003	0.002	-0.035	0.118
	(0.084)	(0.086)	(0.082)	(0.085)	(0.087)	(0.086)	(0.090)	(0.208)
N	213	213	213	213	213	213	213	213
Adj. R^2	0.004	0.004	-0.001	-0.004	-0.008	0.034	0.052	0.066

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$



Notes: The graphs show the response of GDP and IP expectations given a change in the unexpected component of the MPR decision and their confidence intervals. The GDP graphs show the previous quarter's (PQ) response until three quarters ahead (3Q). For IP, the graphs show the response from the previous month (PM) until 12 months ahead (12M). The regressions are in Appendix A.2. The graphs in *b.* show in blue the coefficients of graphs *a.* for GDP and IP, respectively.

Figure 5: Brazil: Change in Output Forecasts

because in these last cases those responses should be negative.

3.3 Additional Empirical Results

This section has two purposes. First, it allows for the possibility that the shock given by the unexpected component of the interest rate delivers different kinds of information depending on other characteristics happening at the same time. Second, it discusses some robustness exercises using different samples and additional measures.

The first set of exercises allows the effect of the MPR surprise to depend on the movement of the MPR and then to depend on the response of the stock market.

Finally, the section discusses some robustness exercises first checking if the results remain for small surprises and then using different samples for the analysis and different measures. For additional information about these exercises, refer to Appendix A.3.

This section reports only the results based on means and individual data to keep enough informative observations.

Dependence on Movements of the MPR

These results allow for the possibility that the surprise's effect on the expectations is different if that surprise happened when the rate was not changed, decreased, or increased. The reason behind this is that in a world with imperfect information, agents could try to uncover information from different imperfect signals, including the change itself.

For example, if the interest rate is raised and a positive surprise occurs, both signals could be interpreted as information about high inflation (current or future). In contrast, if the same surprise occurs with no movement or with a reduction, the information given by the two signals goes in different directions, and so, expectations' responses could be different.

Figure 6 shows the results for inflation, GDP, and IP measured with means for Brazil and inflation measured with means and individual data for Chile. Three columns show the results, separating the cases with dummies. The first column presents the coefficient when there is no change in the interest rate, the second when the surprises and the movements go in the opposite direction (positive surprises with decreases and negative surprises with increases), and the last column when they go in the same direction (positive surprises with increases and negative surprises with decreases).

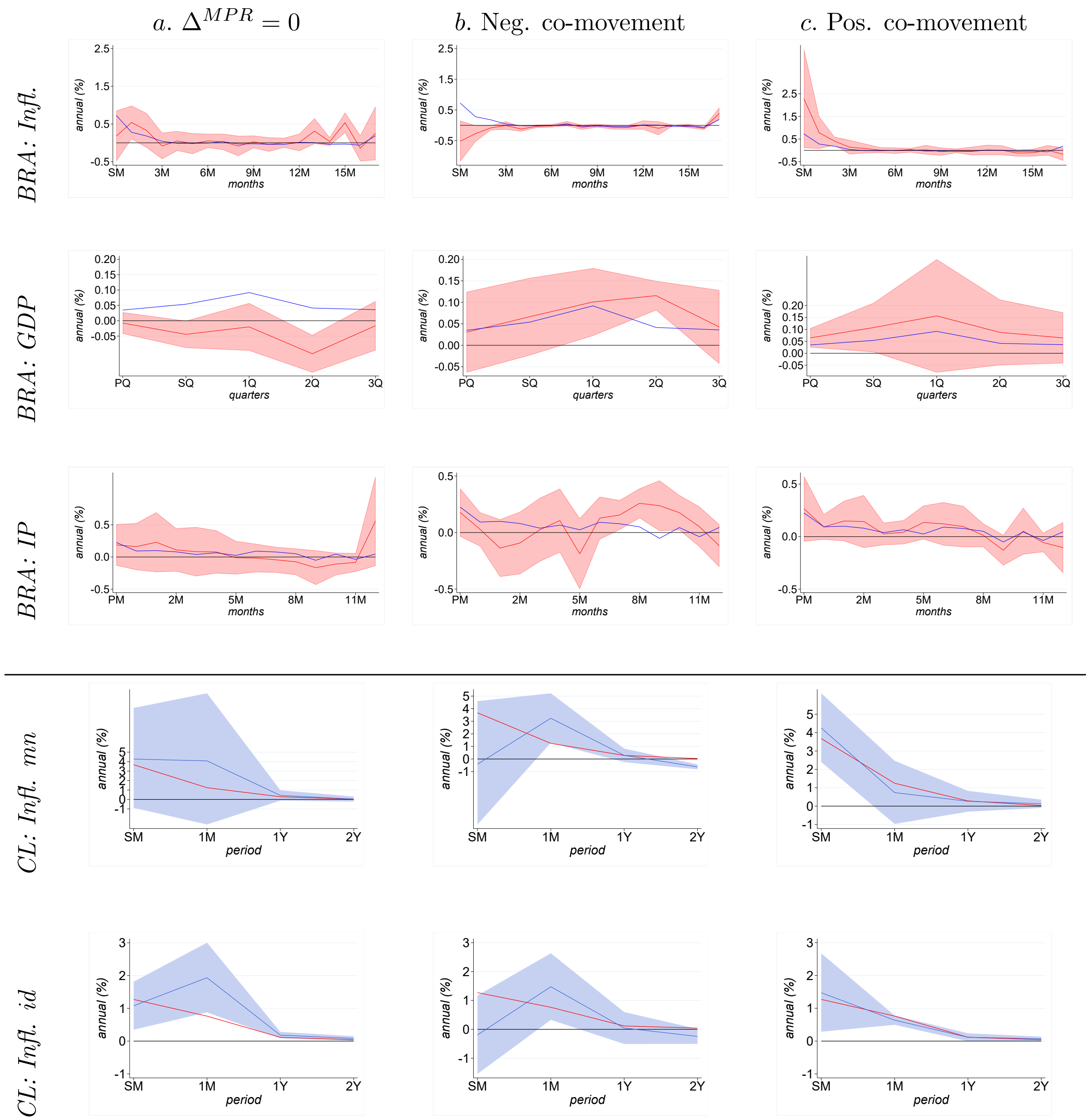
The results show that there are some changes, in general, in the expected direction. For Brazil, the biggest effect in inflation is when the movement and the surprise in the MPR go in the same direction. In contrast, when they go in opposite directions, the positive initial effect goes to negative territory, and when there is no change, it decreases in the first month. For output, there are mixed results. In the case of GDP, the effect increases when the surprise and the movement go in the same direction, is not much altered when they go in the opposite direction, and decreases without a movement in the interest rate. For IP, there is no apparent difference.

In the case of Chile, the analysis shows mixed results for inflation. As seen in Figure 6, the baseline results are very similar to the ones when the surprise and the movement go in the same direction. When they go in opposite directions, the initial positive coefficient disappears, the expectation for one month ahead slightly increases, and for further ahead decreases. When there is no change in the rate, shown in the first column of the figure, the results do not change much but lose significance and increase in the second month.

In short, the movement appears to be affecting the effect of the surprise in the majority of cases in the expected direction, but there is still an effect even without movement in the MPR.

Dependence on the Response of the Stock Markets

Some authors in the latest literature interpret a positive co-movement between the stock



Notes: The first three rows show the reaction of the Brazilian inflation, GDP, and IP expectations, measured with means. The last two rows show the reaction of Chilean inflation expectations measured with means ("mn") and individual data ("id"). The graphs separate the reaction when the surprise occurs without a change in the MPR (column *a.*), when there is a negative correlation between the surprise and the change (column *b.*), and when there is a positive correlation between the surprise and the change (column *c.*). The graphs show in blue the baseline results from Figures 3, 5 and 4. All the regressions for Chile include all the controls, and the ones with individual data have clusterized standard errors and individual fixed effects.

FIGURE 6: Dependence on the Movement of the MPR

market and the monetary surprise as an information shock, starting with Jarociński and Karadi (2020). This section presents the results when the regression separates the coefficients in cases with a positive and negative co-movement. It is important to note that this is an open debate, and other measures show no apparent relation, as in Bu et al. (2021).

Figure 7 shows the results for Brazil and Chile. As with Figure 6, the first three rows are the results for inflation, GDP, and IP measured with means for Brazil, and the last two are the results for inflation expectations measured with means and individual data for Chile. The column on the left shows the results when the surprise and the stock market negatively co-move, while the right column shows the positive case.

In Brazil, the reaction of inflation and GDP are effectively higher with a positive co-movement, while in the case of IP, they are similar in the first month and lower in the following ones.

For Chile, the negative correlation results are similar to the main results without separation. In contrast, the initial month shows no update for the case with a positive co-movement, while one month ahead it is much higher and significant. The results for the last two versions, i.e., one year and two years ahead, are similar.

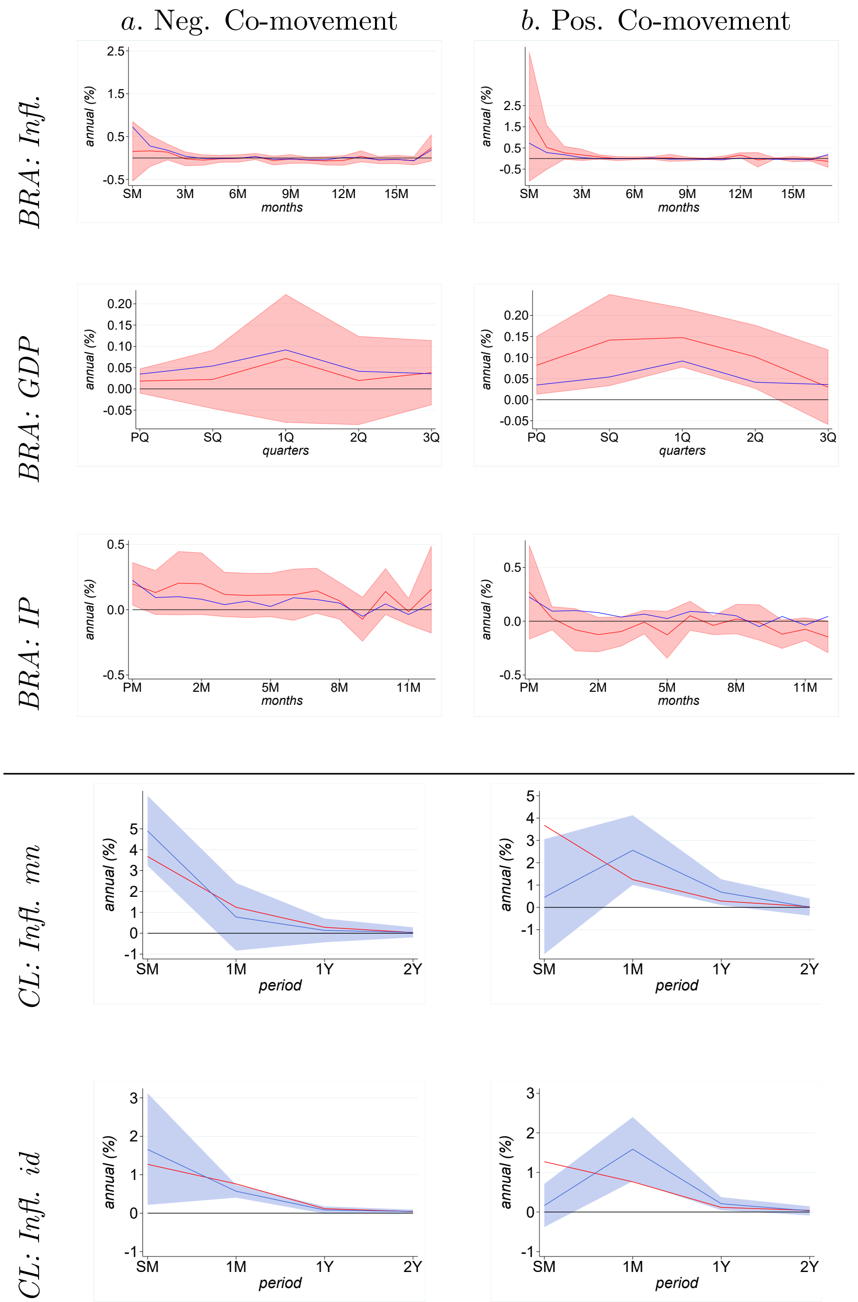
In sum, it is unclear whether the information shock happens when the stock market positively co-moves with the surprise. The results suggest that it is not necessary to have a positive co-movement to get these results. However, some variables differ when separating the reaction between a positive and negative co-movement with the stock market.

Additional Exercises

This subsection presents the main conclusions of several exercises that check for robustness and control by country-specific issues. Appendix A.3 shows more details.

There are three types of exercises: (i) testing for the dependence of the coefficients on small v/s big surprises, (ii) testing for the maintenance of the results in sub-samples, and (iii) testing using alternative inflation expectations measures.

The first exercise separates the coefficients between the cases where the surprises were "big" (greater than or equal to 50 basis points in absolute terms) and "small," which is the rest. The reason behind this exercise is to check if the results only happen when there are big surprises, or also in general. The findings show that in both countries, the coefficients for small surprises are higher and more significant than for large surprises, which leads to the conclusion that the channel is generally active, not only in extreme cases.



Notes: The first three rows show the reaction of the Brazilian inflation, GDP, and IP expectations, measured with means. The last two rows are the reactions to Chilean inflation expectations measured with means ("mn") and individual data ("id"). Column *a.* shows the result when the surprise coincides with the stock market's reaction in the opposite direction. Column *b.* shows when the surprise coincides with a movement in the Stock market in the same direction. The graphs show in blue the baseline results from Figures 3, 5, and 4. All the regressions for Chile include all the controls, and the ones with individual data have clusterized standard errors and individual fixed effects.

Figure 7: Dependence on the Reaction of the Stock Market

The second set of exercises investigates different sub-samples for each country. Brazil introduced the IT framework in 1999 and according to Carvalho and Minella (2009) and Cerisola and Gelos (2009) among others, there can be three periods defined: implementation and initial years (1999 until mid-2001), problematic period (mid-2001 until end of 2003) and consolidation (2004 onward).[20] In addition, there has been evidence of a period of un-anchored inflation expectations in Brazil between mid-2015 and September 2016. These sets of results then present the coefficients when excluding these unstable periods separately.

The results for the sub-samples in Brazil show a general decrease in the coefficient and significance of the effects on inflation in the first months. In contrast, there are no significant effects on GDP and IP expectations. If anything, they increase in general when excluding the instabilities.

For Chile, there are several exercises in this category. The first set of exercises excludes periods in which Chile was at the effective lower bound (ELB, between July 2009 and June 2010 and between April 2020 and July 2021). Secondly, exercises allowed different coefficients before and after 2018 because of changes in the regime. The changes included a decrease from twelve to eight meetings per year, more coordination between the meetings and the monetary report, and a lengthening of the press releases after every meeting. The last exercises include the possibility that the effect is different if the meeting occurs around the release of the Monetary Policy Report (IPoM). The amount of information given by the press release and the IPoM can be very different, and so can their effects, but many times they happen close enough, so their effect is difficult to separate.

Chile's results show no change in the signs or shape of the responses of any of the analyses mentioned above. The exercise that shows the most significant change is the differentiation between before and after 2018 and shows that the coefficients before 2018 were lower and less significant, while the ones after 2018 are close to the main results.

The last set of exercises shows the effects of a similar analysis but measures the change in expectations using market-based instruments. For Chile, the results show regressions using the one-day change in inflation expectations for different horizons using breakeven inflation measures and inflation insurance. Both cases show a relatively positive short-term reaction, although they are less significant than the results based on surveys.

[20] During the second period Brazil experienced many problems including a confidence crisis from the end of 2002 until the beginning of 2003 in which agents considered a regime change to a more controlled exchange rate likely. During this period, inflation forecasts from the MES changed their behavior. For additional information please refer to Bevilaqua et al. (2008), Minella et al. (2003), Cerisola and Gelos (2009).

In sum, in some cases the significance of the results depends on the sample, but not their signs. That is expected and is part because there are fewer observations and also because there could be changes in the regimes that can alter the sensitivity of the effect of MPR surprises.

4 Simple Model with an Information Shock

This section presents the simplest possible model in which we can allow for the interest rate decision made by the central bank to cause expectations to react. We will maintain the assumption of rationality, and allow a temporary asymmetry of information, which resolves before making consumption and pricing decisions.[21] The model is FIRE (Full Information Rational Expectations), but it is very explicit on how and which kind of information agents receive from seeing the interest rate.

The final equations and equilibrium of the model are the same as the log-linearized baseline three equations Neo-Keynesian model, as in Gertler et al. (1999), Woodford (2003, Chapter 4), Galí (2008, Chapter 3) and Walsh (2010, Chapter 8).

The first part presents the final equations and equilibrium of the model; it then explains the temporary asymmetry of information and the timing when expectations of inflation and output are measured. It finally shows how expectations react depending on the type of information given by the interest rate.

4.1 Log-linearized Equilibrium Conditions

This subsection presents the log-linearized equilibrium conditions of the model to explain the potential sources of information given by the interest rate. Appendix A.4 presents the problems of each agent, the first-order conditions, and the equilibrium equations. The 3-equation log-linearized equilibrium conditions are:

$$\pi_t = \kappa x_t + \beta \mathbb{E}_t \pi_{t+1} + u_t \tag{2}$$

$$x_t = \mathbb{E}_t x_{t+1} - \sigma(i_t - \mathbb{E}_t \pi_{t+1} - r_t^*) \tag{3}$$

$$i_t = \phi_\pi \pi_t + \phi_x x_t + \epsilon_t \tag{4}$$

[21] This is not necessary to get the results, but it simplifies the equations and does not affect the sign of the results.

where the endogenous variables are π_t, x_t, and i_t, which are inflation, the output gap, and the interest rate, respectively. The first equation is the Phillips curve, which comes from the optimality conditions of the firms. The second equation is the IS relation, which comes from the households' Euler equation, and the final equation is the Taylor rule, which describes the monetary policy.

Three exogenous processes or shocks in these equations are the source of variations in the endogenous variables. The first is the cost-push shock, u_t, which is in the Phillips curve equation and arises due to variations in the elasticity between the varieties of goods that become the final consumption good. The second is the natural rate of interest, r_t^*, arising from variations in government expenditure and productivity. Finally, a monetary shock, ϵ_t, arises as the exogenous component of the Taylor rule.

The rational expectations equilibrium is defined by the processes $\{\pi_t, x_t, i_t\}$ consistent with (2)-(4) given the exogenous shocks $\{u_t, r_t^*, \epsilon_t\}$ and their distributions. These equations, written in terms of a 2x2 system, are:

$$\mathbb{E}_t z_{t+1} = A z_t + \xi_t \tag{5}$$

with

$$z_t = \begin{bmatrix} \pi_t \\ x_t \end{bmatrix} \quad \xi_t = \begin{bmatrix} -\frac{1}{\beta} u_t \\ \sigma(\epsilon_t - r_t^*) + \frac{\sigma}{\beta} u_t \end{bmatrix} \quad A = \begin{bmatrix} \frac{1}{\beta} & -\frac{\kappa}{\beta} \\ \sigma\left(\phi_\pi - \frac{1}{\beta}\right) & 1 + \sigma\left(\phi_x + \frac{\kappa}{\beta}\right) \end{bmatrix}$$

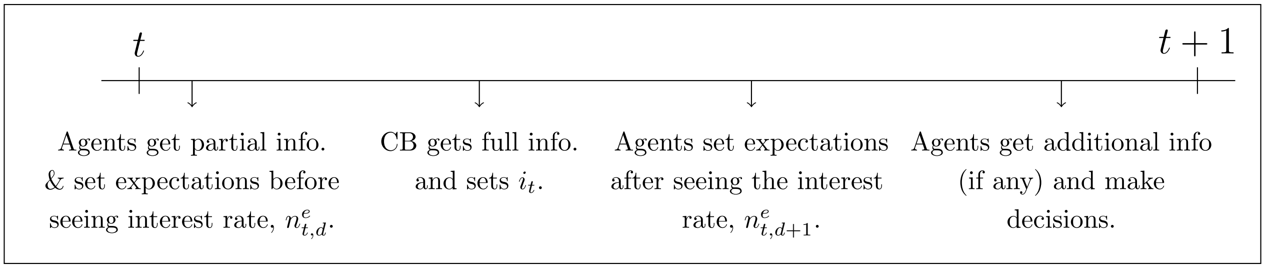
Assuming the Taylor principle, $\phi_\pi + \phi_x(1-\beta)/\kappa > 1$, the unique bounded rational expectations solution is:

$$z_t = -\sum_{j=0}^{\infty} A^{-(j+1)} \mathbb{E}_t \xi_{t+j} \tag{6}$$

This shows that the endogenous variables, including the interest rate, are a function of current and expected future exogenous shocks.

4.2 Timeline and Expectations Formation

This section analyzes the signs of the responses of inflation and output expectations when the interest rate gives information of different shocks. To do that, the model assumes a temporary information asymmetry between the monetary authority that sets the



Notes: CB = Central Bank.

FIGURE 8: TIMELINE

interest rate and the rest of the agents. Before the agents make their final decisions, the information becomes perfect for all (hence symmetric).

As shown in Figure 8, the timeline is as follows. At the beginning of the period, agents can get partial information and set expectations of any variable n before seeing the interest rate, $n^e_{t,d}$. Then, the central bank gets information on the shocks hitting the economy in period t, and with that information, it sets the interest rate, which everybody sees. After seeing the interest rate, agents set new expectations, $n^e_{t,d+1}$. Finally, agents get the rest of the information not given by the interest rate (if any) and make their pricing and consumption decisions.

The model presented here is the simplest model in which the interest rate provides information. Expectations are still rational and constrained only temporarily by pending information but are common for all. The model excludes many departures from these assumptions that could also affect the results, such as imperfect information (common or dispersed) from the firm side, or from the household side or both.[22] In all cases, though, the intuition behind the results shown in this section remains.

For simplicity, it will be assumed that the three shocks are *i.i.d.* normally distributed, $\omega_t \sim N(0, \sigma^2_\omega)$, with $\omega_t = \{\epsilon_t, u_t, r^*_t\}$. Additionally, to allow the interest rate to give information about future events in the economy, the model includes news shocks in the form of a noisy signal about a future shock. The news shocks in t are the following: $s^\omega_t \sim N(\omega_{t+1}, \sigma^2_{s^\omega})$, with $\omega = \{\epsilon, u, r^*\}$.

Solving equation (6) (with equation (4) to solve for the interest rate) and the shocks described in the previous paragraph gives solutions of the form:

$$\omega_t = \Lambda^\omega_\epsilon \epsilon_t + \Lambda^\omega_u u_t + \Lambda^\omega_r r^*_t + \Lambda^\omega_{s^\epsilon} s^\epsilon_t + \Lambda^\omega_{s^u} s^u_t + \Lambda^\omega_{s^{r^*}} s^{r^*}_t \tag{7}$$

[22]For models with dispersed information from the firm side see Melosi (2017) and from the household side see Wiederholt (2015).

for $\omega_t = \{\pi_t, x_t, i_t\}$, with Λ^ω_ξ function of the parameters in equation (3)-(5) for $\omega_t = \{\pi_t, x_t, i_t\}$ and $\xi = \{\epsilon, u, r^*_t, s^\epsilon, s^u, s^{r^*}\}$. With equation (7), we can calculate the expectation of any of the variables at day d as:

$$\omega^e_{t,d} \quad = \quad \Lambda^\omega_\epsilon \epsilon^e_{t,d} + \Lambda^\omega_u u^e_{t,d} + \Lambda^\omega_r r^{*,e}_{t,d} + \Lambda^\omega_{s^\epsilon} s^{\epsilon,e}_{t,d} + \Lambda^\omega_{s^u} s^{u,e}_{t,d} + \Lambda^\omega_{s^{r*}} s^{r^*,e}_{t,d} \tag{8}$$

with $y^e_{t,d}$ the expectations of variable/shock y_t held at day d for any y. This equation shows that the interest rate will affect inflation and output expectations if it gives information about any of these shocks that was not available before. By also using this equation we can calculate the revision in expectations of any variables between day d and $d+1$, which are defined as the dates before seeing the interest rate and after seeing the interest rate respectively. Note that the expectation of the rate will be the rate itself at $d+1$, which means $i^e_{t,d+1} = i_t$. The expectation and realization of inflation and output though, could perfectly still differ in $d+1$ if with the information provided by the interest rate there remains some asymmetry of information.

With all this in hand, we can get the coefficients of interest which are the ones that relate the surprise in the interest rate with the revision in inflation and output expectations, which are χ_π and χ_x in the following relations:

$$\pi^e_{t,d+1} - \pi^e_{t,d} \quad = \quad \chi_\pi(i_t - i^e_{t,d}) \tag{9}$$

$$x^e_{t,d+1} - x^e_{t,d} \quad = \quad \chi_x(i_t - i^e_{t,d}) \tag{10}$$

Note that all terms concerning shocks that agents know perfectly (get that info in the first arrow of the timeline shown in Figure 8) before the central bank sets the interest rate are going to be canceled out on both sides of equations (9) and (10). Only new relevant information is going to remain.

It is essential to highlight that these agents have a lot of information about the economy. They know with certainty the equations of the economy, how the central bank sets the interest rate, and which shocks can hit.

4.3 Results of the Model

This subsection will present qualitative results about the coefficients in (9) and (10) when the interest rate gives information about different shocks. In the first part, the interest gives information about one shock each time, while in the second part, it gives

Table 2: The Interest Rate Gives Information about One Shock

	Current Shocks			*News shocks*		
	ϵ_t	u_t	r^*_t	s^ϵ_t	s^u_t	$s^{r^*}_t$
χ_π	$-$	$+$	$+$	$+$	$+$	$+$
χ_x	$-$	$-$	$+$	$+$	$-$	$+$

Notes: All results are for parameter values that satisfy the Taylor Principle ($\phi_\pi + \phi_x(1-\beta)/\kappa > 1$). For the expressions in each case, refer to Appendix A.4. The results of the news shocks depend on parameter values. The Appendix also reports the parameter values.

information about two shocks: the current monetary shock and an additional one.

The exact expression of the coefficients depends on the information provided by the interest rate. Take for example the case that the interest rate gives information only about the current monetary shock, ϵ_t. In that case, since it is one signal about one unknown, the agents get full information after seeing the interest rate and the differences in expectations are going to be the following:

$$
\begin{aligned}
\pi^e_{t,d+1} - \pi^e_{t,d} &= \Lambda^\pi_\epsilon(\epsilon_t - \epsilon^e_{t,d}) \\
x^e_{t,d+1} - x^e_{t,d} &= \Lambda^x_\epsilon(\epsilon_t - \epsilon^e_{t,d}) \\
i_t - i^e_{t,d} &= \Lambda^i_\epsilon(\epsilon_t - \epsilon^e_{t,d})
\end{aligned}
$$

leading to the coefficients of interest:

$$
\chi_\pi = \frac{\Lambda^\pi_\epsilon}{\Lambda^i_\epsilon} < 0 \qquad \chi_x = \frac{\Lambda^x_\epsilon}{\Lambda^i_\epsilon} < 0
$$

Appendix A.4 shows the specification of the coefficients of interest and demonstrate that they are both negative, which is the information given in the first column of Table 2. The rest of the table shows the signs of the coefficients χ_π and χ_x when the interest rate gives information about one shock each time, for each current and news shock. These exercises imply that if, for example, the interest rate gives information about the news of the monetary shock (first column of *News shocks*), the agents can see all shocks except that one since the beginning of the period perfectly.[23]

The results for current shocks show that inflation and output expectations respond positively only to the natural rate of interest shock. The intuition behind the results for

[23]There can be two interpretations about this: either all the shocks except the one under study are perfect information for all agents since the beginning of the period, or all the other shocks do not exist (except the shock about which news exists in the case of news shocks).

each shock is straightforward. First, both expectations react negatively to information about the monetary shock since it increases the short-term real rate, decreases current demand, and causes a drop in inflation and output.

In contrast, when the information is about the cost-push shock, there is an upward revision of inflation expectations and downward of output expectations since this shock causes an increase in the desired markup, which raises inflation and contracts output. Only the natural interest rate causes a positive update in both expectations because that shock causes an increase in both variables and an increase in the nominal interest rate as a result of the endogenous reaction of inflation and output.[24]

When the interest rate gives information about news, shown in the right columns of Table 2, the signs about monetary news are reversed compared to the current monetary policy shock. The reason is that while a positive monetary policy shock tomorrow (and hence news about it) decreases inflation and output today, as with current monetary policy shocks, it also decreases the interest rate today.

In the case of news about the natural rate, current inflation, output and interest rate increase as a reaction. The effects of positive future monetary shocks in this model are the same as a negative future natural rate of interest. Finally, when the interest rate gives information about future cost-push shocks, the results show the same signs as in the case of current cost-push shocks.

To sum up, if the interest rate gives information about one shock each time, the information has to be about the natural rate and about news of the future monetary shock and future natural rate to two positive coefficients.

The limitation of the results shown in the previous version is that the interest rate can only give information about one shock each time. When shocks other than monetary shocks were analyzed, the assumption was that agents had received information about the shock from another source or that this shock did not exist. While it is likely that agents have information about the cost-push shock and the natural rate of interest from other sources, they are unlikely to have a source other than the MPR about the monetary shock. A more realistic assumption is that the interest rate gives information about the current monetary shock and something else.

Table 3 shows the results when the interest rate gives information about the current monetary shock, ϵ_t, and an additional shock in each column. The first column reports the result for the natural rate, r_t^*, the second about news of the monetary shock, s_t^ϵ, and the

[24]For example, an increase in current government expenditure, which increases demand and prices and output.

Table 3: The Interest Rate Gives Information about Two Shocks

	Monetary shock, ϵ_t*, and* r_t^*	s_t^{ϵ}	$s_t^{r^*}$
χ_π	+ if $\sigma_r^2/\sigma_\epsilon^2 > \frac{1}{\sigma(\phi_x+\kappa\phi_\pi)}$	+/−	+ if $\sigma_r^2/\sigma_\epsilon^2 >> 1$
χ_x		−	

Notes: All results are for parameter values that satisfy the Taylor Principle $(\phi_\pi+\phi_x(1-\beta)/\kappa > 1)$. Refer to Appendix A.4 for the exact expressions. The results of the last two columns are numerical for the ranges of parameters described in the Appendix.

last one about news of the natural rate, $s_t^{r^*}$. The exercise excludes current and news about the cost-push shock since the combination with the monetary shock can never provide a positive answer to the output gap (shown by the negative coefficients in that response in table 2).

The table shows that positive coefficients become a possibility when the interest rate provides information about the monetary shock and the natural rate and about the monetary shock and news of the natural rate. In contrast, the output response is never positive when the interest rate gives information about current and future monetary shocks. This result is because in that case the information provided about the current shock always more than outweighs the information about the future shock.

In contrast, when the interest rate provides information about the monetary shock and the current or future natural rate, the responses can be positive as long as the latter's information is "more important" than the former's. Moreover, this happens when the variability of the natural rate is high enough compared to the variability of the monetary shock. And the intuition is as follows: when the agent sees a surprise in the interest rate, it will attribute more of that surprise to a change of the shock that is more variable.

These findings, while acknowledging the potential influence of other factors such as private information of the agents, provide valuable insights. They suggest that, on average, in the economy, the responses of inflation and output expectations to a surprise movement in the interest rate can be interpreted as agents perceiving the interest rate as a source of information about a demand shock. This interpretation, encapsulated in the model as the natural rate or news about the natural rate, has significant implications for our understanding of macroeconomic dynamics.

5 Conclusion

This paper presented evidence on the responses of inflation and output growth forecasts to unexpected increases in the MPR. The analysis reported results based on the best possible datasets that met three conditions: (i) they provide close "before meeting" and "after meeting" measures (ii) they include expectations at short-term horizons; and (iii) they include expectations of the dependent and independent variable from the same source.

The results show that, in response to an unexpected increase in the MPR, professional forecasters revise their inflation and output forecasts upward in the short run. For the medium term, the effects are near zero.

This is a surprising result for current macroeconomic theory since surprises in the interest rate set by the central bank are associated with monetary shocks, which have negative effects on inflation and output. So, if rational, the responses of current inflation and output growth forecasts should be negative.

A baseline New-Keynesian model can explain the results if it allows the interest rate to provide information about shocks other than the monetary shock. It was shown that in order to obtain positive responses to inflation and output forecasts, the interest rate must provide "enough" information about the current natural rate of interest or news about the future natural rate of interest.

This analysis focuses only on the average reaction of expectations to the surprise MPR decision. It has to be highlighted that there are other types of communication at the time of the decisions, which are also present and could also affect expectations. This is for example the case of the information provided by the press releases, in addition to the decision, which is also present in Brazil and Chile among other countries as shown by González and Cruz Tadle (2021). The information given by the rest of the press release could be an additional information channel of monetary policy and separate the information given by the decision itself and by the rest of the release. This is a matter for future research.

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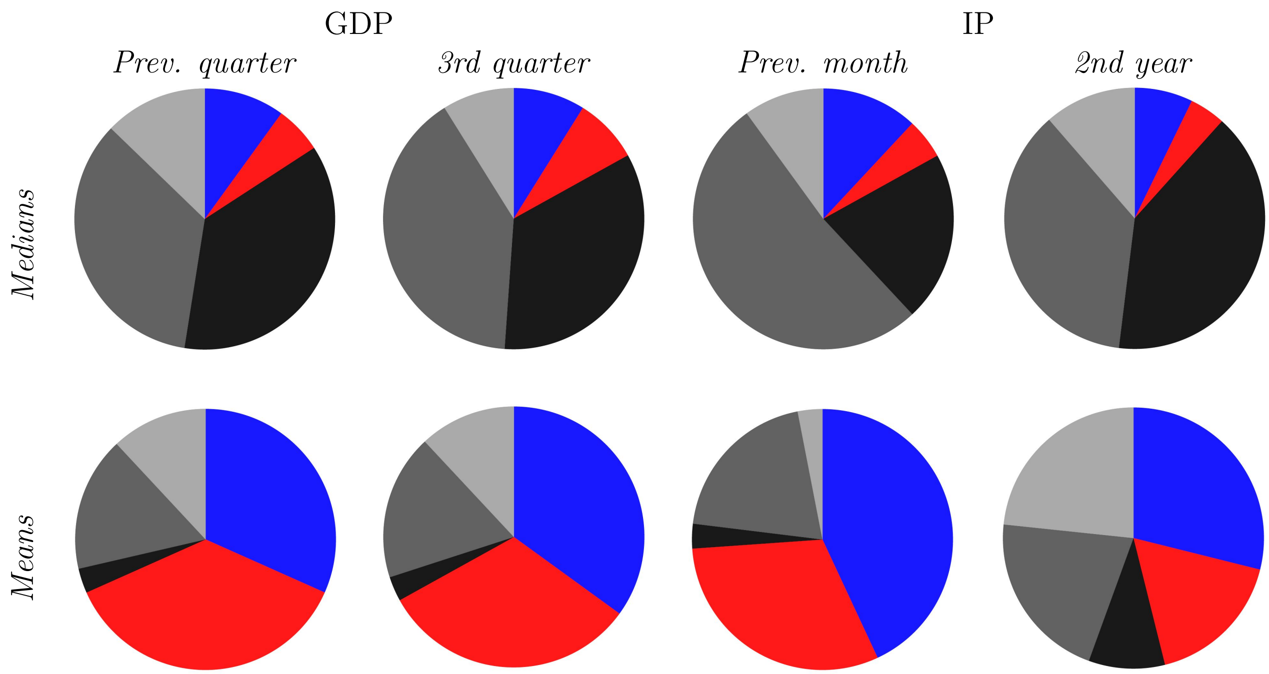
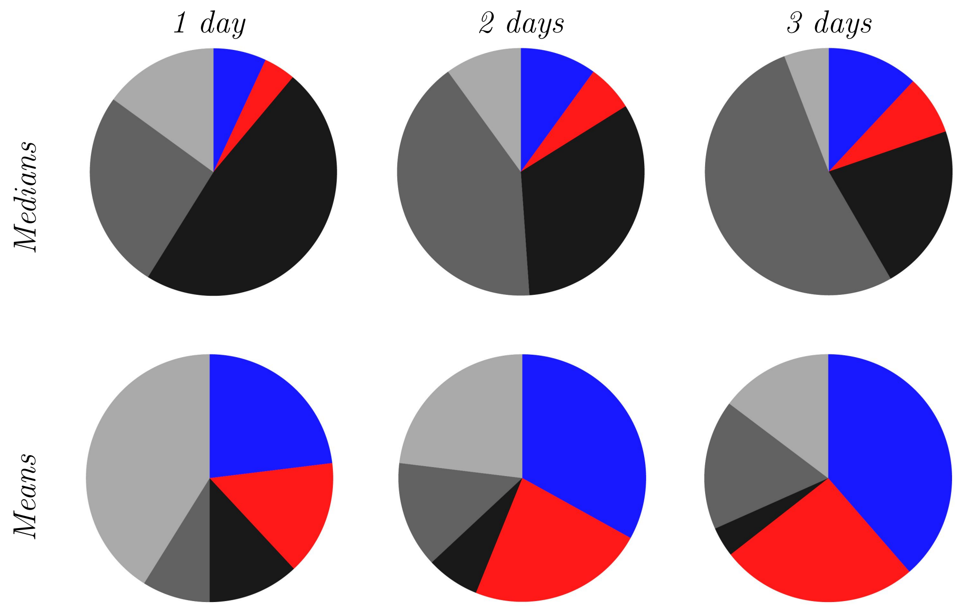
Appendix

A.1 Additional Descriptive Statistics



Notes: The graphs show the percentage of responses in different categories depending on the surprise in the MPR and the revision of GDP/IP expectations using medians and means and for different horizons. Blue indicates when both go in the same direction; red indicates when they go in opposite directions; black indicates when both are zero; dark gray indicates when the revision of expectations is not zero, but the surprise is zero; and light gray indicates when the surprise is not zero, but the revision of expectations is.

FIGURE 9: Characteristics of Output Samples in Brazil



Notes: The graphs show the percentage of responses in different categories depending on the surprise in the MPR and the revision of IPCA expectations when waiting one, two, and three days. Blue is when both go in the same direction; red is when they go in opposite directions; black is when both are zero; dark gray is when the revision of expectations is not zero, but the surprise is zero, and light gray is when the surprise is not zero, but the revision of expectations is.

FIGURE 10: Characteristics of IPCA per day

A.2 Appendix to the Main Empirical Results

A.2.1 Brazil

This appendix shows the tables with all the regressions for Brazil presented in the main part of the paper. These regressions are based on waiting 3 days for the expectations to react. In addition, the section also shows graphs when allowing 1 and 2 days in all the measures.

Table 4: Brazil: Reaction of Inflation Forecasts, Medians

	Surp. MPR		Constant		N	R^2
SM	0.092	(0.07)	0.005	(0.003)	138	0.132
1M	0.03	(0.022)	0.005***	(0.002)	138	0.071
2M	0.005	(0.004)	-0.001	(0.001)	138	0.013
3M	-0.001	(0.007)	-0.002*	(0.001)	138	0
4M	-0.001	(0.003)	0.001	(0.001)	138	0.001
5M	-0.002	(0.003)	0.001	(0.001)	138	0.003
6M	-0.006	(0.006)	0	(0.001)	138	0.016
7M	-0.001	(0.003)	0	(0.001)	138	0.001
8M	-0.001	(0.002)	0	(0.001)	138	0.001
9M	-0.01*	(0.005)	0	(0.001)	138	0.08
10M	-0.001	(0.003)	0	(0.001)	138	0
11M	0.003	(0.006)	0	(0.001)	138	0.004
12M	0.001	(0.002)	0.002***	(0.001)	138	0.001
13M	0.003	(0.01)	0.002	(0.002)	135	0.001
14M	-0.003	(0.003)	0	(0.001)	77	0.017
15M	-0.003	(0.003)	0	(0.001)	77	0.013
16M	-0.005	(0.005)	0	(0.001)	77	0.024
17M	0.017	(0.017)	-0.001	(0.002)	71	0.051

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Brazil: Reaction of Inflation Forecasts, Means

	Surp. MPR		Constant		N	R^2
SM	0.06	(0.051)	0.006*	(0.003)	138	0.062
1M	0.023	(0.018)	0.004**	(0.002)	138	0.039
2M	0.015**	(0.007)	0	(0.001)	138	0.057
3M	0.004	(0.007)	-0.001	(0.001)	138	0.002
4M	-0.001	(0.004)	-0.001	(0.001)	138	0.001
5M	-0.001	(0.003)	0.001	(0.001)	138	0.001
6M	0	(0.003)	0	(0)	138	0
7M	0.003	(0.002)	0	(0)	138	0.008
8M	-0.003	(0.004)	0.001	(0.001)	138	0.006
9M	-0.002	(0.003)	-0.001	(0)	138	0.005
10M	-0.003	(0.002)	-0.001	(0)	138	0.02
11M	-0.003	(0.004)	0	(0)	138	0.016
12M	0.001	(0.005)	0	(0.001)	138	0.001
13M	0.001	(0.006)	0	(0.001)	135	0
14M	-0.003	(0.003)	0	(0.001)	77	0.014
15M	-0.003	(0.004)	0	(0.001)	77	0.007
16M	-0.005	(0.004)	0	(0.001)	77	0.02
17M	0.016	(0.013)	0	(0.001)	71	0.066

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Brazil: Reaction of GDP Forecasts, Medians

	Surp. MPR		Constant		N	R^2
PQ	0.034	(0.024)	-0.003	(0.006)	112	0.013
SQ	0.065*	(0.036)	-0.021***	(0.007)	169	0.023
1Q	0.033	(0.021)	-0.018***	(0.007)	169	0.006
2Q	0.059	(0.038)	-0.025***	(0.007)	169	0.022
3Q	0.045	(0.039)	-0.029***	(0.006)	169	0.014

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Brazil: Reaction of GDP Forecasts, Means

	Surp. MPR		Constant		N	R^2
PQ	0.035**	(0.016)	-0.004	(0.005)	112	0.023
SQ	0.054	(0.033)	-0.017**	(0.007)	169	0.019
1Q	0.092	(0.062)	-0.03**	(0.012)	169	0.019
2Q	0.041	(0.043)	-0.026***	(0.007)	169	0.011
3Q	0.036	(0.031)	-0.018***	(0.006)	169	0.011

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Brazil: Reaction of IP Forecasts, Medians

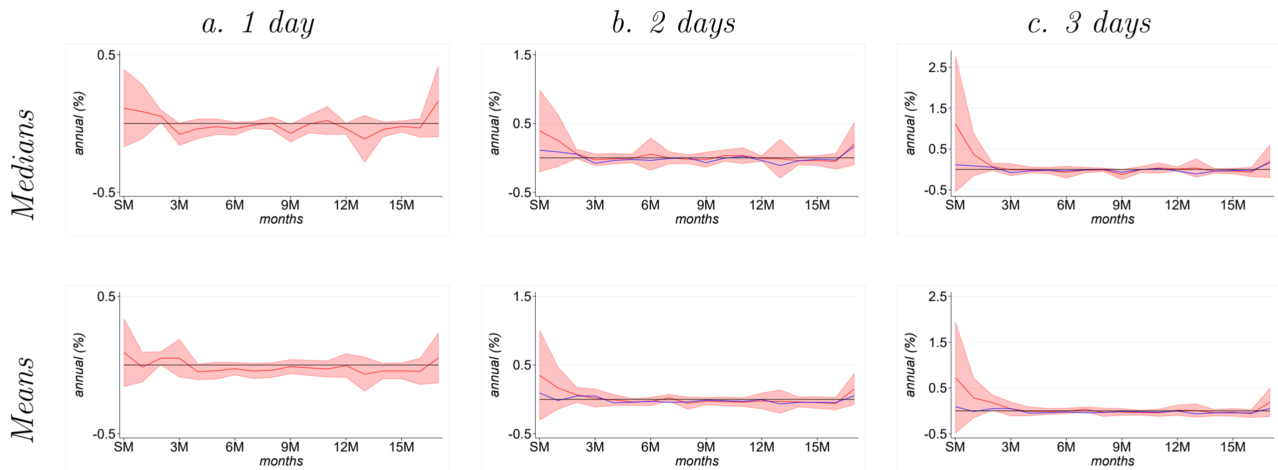
	Surp. MPR		Constant		N	R^2
PM	0.214	(0.14)	-0.057	(0.064)	160	0.004
SM	0.159*	(0.092)	-0.101***	(0.033)	163	0.008
1M	0.275**	(0.134)	-0.06**	(0.029)	163	0.03
2M	0.195	(0.134)	-0.094***	(0.028)	163	0.017
3M	0.182	(0.133)	-0.047	(0.028)	163	0.014
4M	0.187	(0.131)	-0.028	(0.036)	163	0.009
5M	0.121	(0.087)	-0.009	(0.026)	163	0.008
6M	0.103	(0.091)	-0.009	(0.026)	163	0.005
7M	0.158	(0.149)	-0.009	(0.021)	163	0.018
8M	0.047	(0.103)	-0.097*	(0.054)	163	0
9M	0.074	(0.181)	-0.037	(0.038)	163	0.001
10M	0.12	(0.089)	0.007	(0.053)	163	0.002
11M	-0.077	(0.092)	0.006	(0.034)	163	0.002
12M	-0.187	(0.209)	0.015	(0.032)	157	0.014

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Brazil: Reaction of IP Forecasts, Means

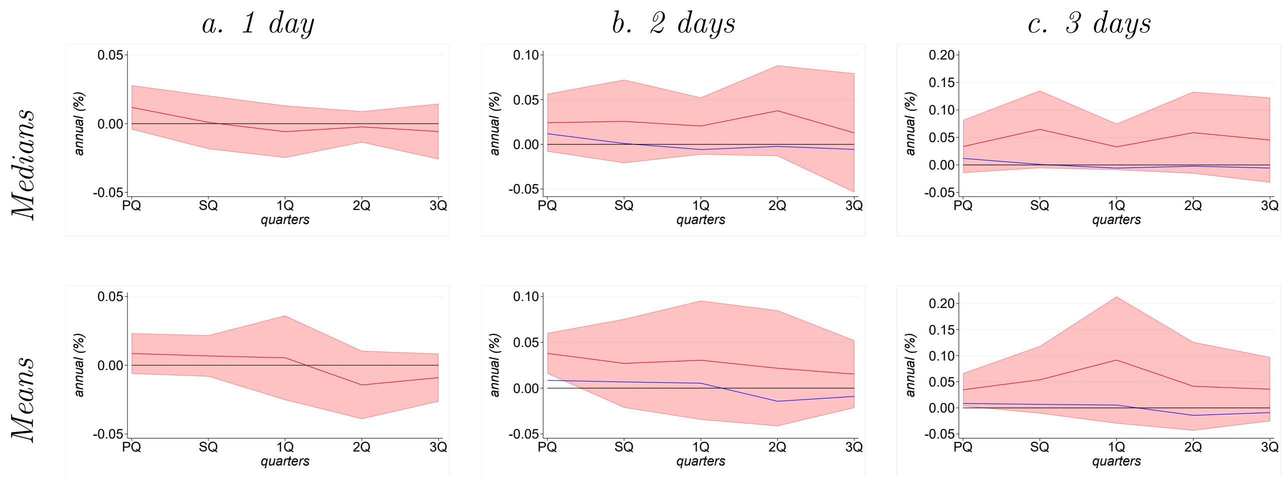
	Surp. MPR		Constant		N	R^2
PM	0.225**	(0.101)	-0.105***	(0.039)	146	0.016
SM	0.093*	(0.055)	-0.037	(0.025)	163	0.005
1M	0.099	(0.081)	-0.052**	(0.025)	163	0.006
2M	0.08	(0.079)	-0.004	(0.024)	163	0.004
3M	0.039	(0.061)	0	(0.02)	163	0.001
4M	0.066	(0.061)	-0.03	(0.02)	163	0.004
5M	0.025	(0.07)	-0.007	(0.024)	163	0
6M	0.091	(0.069)	0.014	(0.02)	163	0.008
7M	0.078	(0.063)	-0.029	(0.022)	163	0.005
8M	0.051	(0.053)	-0.065***	(0.023)	163	0.002
9M	-0.051	(0.064)	-0.041*	(0.024)	163	0.002
10M	0.044	(0.068)	-0.018	(0.033)	163	0.001
11M	-0.037	(0.036)	0.024	(0.024)	163	0.001
12M	0.045	(0.114)	-0.005	(0.033)	161	0.001

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$



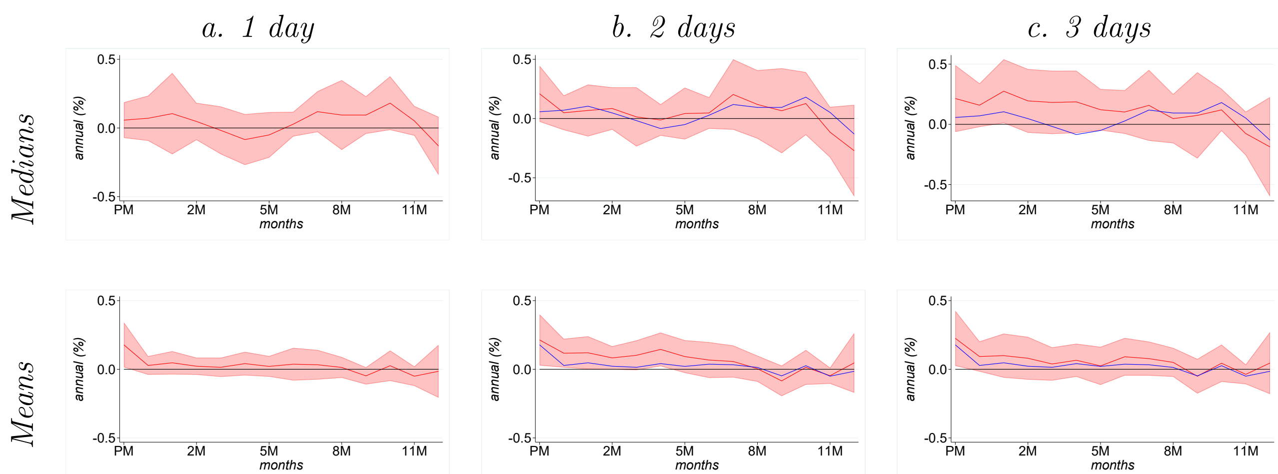
Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Each column corresponds to the days waited to measure the expectations after the meeting. Each graph shows the response of the current month (SM) until 17 months ahead (17M). The graphs in *b.* and *c.* show the coefficients of graph *a.* in blue.

Figure 11: Brazil: Change in Inflation Forecasts, 1-3 Days



Notes: The graphs show the response of GDP growth expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Each column corresponds to the days waited to measure the expectations after the meeting. Each graph shows the previous quarter's (PQ) response until three quarters ahead (3Q). The graphs in *b.* and *c.* show the coefficients of graph *a.* in blue.

FIGURE 12: Brazil: Change in GDP Forecasts, 1-3 Days



Notes: The graphs show the response of IP growth expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Each column corresponds to the days waited to measure the expectations after the meeting. Each graph shows the response of the previous month (PM) until 12 months ahead (12M). The graphs in *b.* and *c.* show the coefficients of graph *a.* in blue.

FIGURE 13: Brazil: Change in IP Forecasts, 1-3 Days

A.2.2 Chile

This appendix shows the tables with all the regressions for Chile. The graphs in the main part of the paper show the coefficients of the regressions that include all controls, but this appendix shows the changes when adding one control each time.

The specification of the regressions using individual data is:

$$\boxed{z^e_{d+s,t+j,i} - z^e_{d-m,t+j,i} = \alpha_{i,j} + \alpha_j + + \sum_{k=0}^{K} \beta_{j,k} D_k (i_t - i^e_{d-m,t,i}) + C \left(_{\{d+s\}-\{d-m\}}\right) + \epsilon_{t,j,i}} \tag{11}$$

The variables are the same as described in the main text but in their individual versions. As seen in equation (11), these results include individual fixed effects.

Table 10: Chile: Reaction to Next Month's Inflation Forecast, Median

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.194**	0.200***	0.257***	0.257***	0.253***	0.233***	0.234***	0.232***
	(0.078)	(0.070)	(0.067)	(0.067)	(0.066)	(0.071)	(0.070)	(0.071)
Surp. Infl.		0.115	0.100	0.102	0.108	0.102	0.099	0.096
		(0.086)	(0.093)	(0.095)	(0.093)	(0.093)	(0.093)	(0.096)
Δ IPSA			-0.389**	-0.407**	-0.310	-0.200	-0.210	-0.214
			(0.186)	(0.190)	(0.216)	(0.219)	(0.224)	(0.229)
Δ NER				-0.081	-0.301	-0.176	-0.153	-0.159
				(0.383)	(0.427)	(0.414)	(0.418)	(0.420)
Δ Copp.P.					-0.293	-0.270	-0.272	-0.267
					(0.270)	(0.265)	(0.268)	(0.276)
Δ WTI						0.018	0.020	0.021
						(0.082)	(0.086)	(0.086)
Δ IPE							0.004	0.004
							(0.008)	(0.008)
Δ Imacec								0.000
								(0.001)
Constant	0.015*	0.011	0.009	0.009	0.009	0.011	0.011	0.011
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
N	99	99	99	99	99	98	98	98
Adj. R^2	0.086	0.100	0.131	0.123	0.127	0.093	0.086	0.075

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Chile: Reaction of One-Month's ahead Inflation Forecast, Median

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.187***	0.201***	0.218***	0.218***	0.215***	0.196***	0.197***	0.158***
	(0.053)	(0.030)	(0.033)	(0.034)	(0.033)	(0.034)	(0.034)	(0.037)
Surp. Infl		0.185***	0.183***	0.185***	0.187***	0.177***	0.179***	0.144***
		(0.044)	(0.043)	(0.046)	(0.045)	(0.048)	(0.049)	(0.047)
Δ IPSA			-0.106	-0.113	0.041	0.124	0.129	0.073
			(0.152)	(0.161)	(0.194)	(0.196)	(0.201)	(0.212)
Δ NER				-0.043	-0.221	-0.122	-0.136	-0.185
				(0.400)	(0.373)	(0.385)	(0.383)	(0.355)
Δ Copp.P.					-0.408	-0.400	-0.379	-0.208
					(0.324)	(0.354)	(0.372)	(0.384)
Δ WTI						0.021	0.015	0.016
						(0.047)	(0.056)	(0.054)
Δ IPE							-0.003	-0.002
							(0.007)	(0.008)
Δ Imacec								0.003**
								(0.001)
Constant	-0.003	-0.019	-0.021*	-0.021*	-0.020	-0.015	-0.015	-0.019
	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
N	37	37	37	37	37	36	36	36
Adj. R^2	0.255	0.439	0.430	0.413	0.430	0.407	0.387	0.444

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Chile: Reaction of One-year's Ahead Inflation Forecast, Median

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.398*	0.398*	0.464*	0.461*	0.456*	0.390	0.387	0.348
	(0.227)	(0.226)	(0.249)	(0.245)	(0.243)	(0.260)	(0.261)	(0.243)
Surp. Infl.		-0.001	-0.012	-0.008	-0.003	-0.013	-0.013	-0.029
		(0.125)	(0.124)	(0.122)	(0.120)	(0.120)	(0.120)	(0.120)
Δ IPSA			-0.502	-0.681	-0.594	-0.290	-0.303	-0.346
			(0.469)	(0.553)	(0.529)	(0.423)	(0.427)	(0.434)
Δ NER				-0.835	-1.009	-0.640	-0.616	-0.711
				(1.087)	(1.311)	(1.289)	(1.297)	(1.312)
Δ Copp.P.					-0.252	-0.269	-0.274	-0.203
					(0.532)	(0.430)	(0.433)	(0.422)
Δ WTI						0.141	0.147	0.146
						(0.222)	(0.221)	(0.220)
Δ IPE							0.005	0.004
							(0.016)	(0.016)
Δ Imacec								0.003
								(0.004)
Constant	-0.004	-0.004	-0.006	-0.003	-0.003	0.002	0.002	-0.008
	(0.017)	(0.018)	(0.019)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)
N	122	122	122	122	122	121	121	121
Adj. R^2	0.068	0.060	0.065	0.066	0.060	0.042	0.034	0.033

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Chile: Reaction of Two-Years' ahead Inflation Forecast, Median

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.034	0.051	0.063	0.063	0.065	0.074	0.067	0.024
	(0.141)	(0.115)	(0.133)	(0.133)	(0.133)	(0.138)	(0.135)	(0.137)
Surp. Infl.		0.178*	0.176*	0.176*	0.173*	0.176*	0.175*	0.158**
		(0.091)	(0.093)	(0.093)	(0.093)	(0.093)	(0.089)	(0.079)
Δ IPSA			-0.090	-0.106	-0.157	0.014	-0.022	-0.069
			(0.190)	(0.237)	(0.262)	(0.290)	(0.265)	(0.258)
Δ NER				-0.075	0.026	0.117	0.184	0.080
				(0.484)	(0.586)	(0.563)	(0.561)	(0.550)
Δ Copp.P.					0.146	0.289	0.274	0.353
					(0.257)	(0.230)	(0.233)	(0.238)
Δ WTI						-0.148	-0.131	-0.132
						(0.120)	(0.109)	(0.104)
Δ IPE							0.015*	0.014
							(0.009)	(0.009)
Δ Imacec								0.004*
								(0.002)
Constant	0.002	-0.006	-0.006	-0.006	-0.006	-0.005	-0.005	-0.016
	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
N	122	122	122	122	122	121	121	121
Adj. R^2	-0.006	0.084	0.078	0.070	0.065	0.074	0.094	0.122

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Chile: Reaction of Next Month's Ahead Inflation Forecast, Mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.263**	0.269***	0.324***	0.323***	0.317***	0.297***	0.295***	0.301***
	(0.101)	(0.086)	(0.065)	(0.065)	(0.060)	(0.068)	(0.068)	(0.070)
Surp. Infl.		0.135*	0.117	0.121	0.130	0.126	0.123	0.128
		(0.080)	(0.087)	(0.090)	(0.087)	(0.086)	(0.085)	(0.088)
Δ IPSA			-0.387**	-0.425**	-0.296	-0.220	-0.228	-0.221
			(0.189)	(0.176)	(0.205)	(0.239)	(0.242)	(0.248)
Δ NER				-0.172	-0.464	-0.392	-0.368	-0.358
				(0.417)	(0.415)	(0.417)	(0.422)	(0.424)
Δ Copp.P.					-0.390	-0.373	-0.375	-0.383
					(0.273)	(0.278)	(0.280)	(0.285)
Δ WTI						0.004	0.007	0.005
						(0.092)	(0.096)	(0.096)
Δ IPE							0.004	0.004
							(0.008)	(0.008)
Δ Imacec								-0.000
								(0.001)
Constant	0.012	0.007	0.005	0.006	0.006	0.007	0.007	0.008
	(0.009)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
N	99	99	99	99	99	98	98	98
Adj. R^2	0.154	0.183	0.219	0.213	0.230	0.178	0.172	0.163

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Chile: Reaction of One-Month's ahead Inflation Forecast, Mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.165***	0.169***	0.176***	0.176***	0.175***	0.144***	0.147***	0.103*
	(0.050)	(0.035)	(0.044)	(0.044)	(0.043)	(0.043)	(0.043)	(0.051)
Surp. Infl.		0.126***	0.125***	0.124***	0.128***	0.116***	0.118***	0.085**
		(0.031)	(0.029)	(0.034)	(0.033)	(0.039)	(0.040)	(0.038)
Δ IPSA			-0.039	-0.034	0.106	0.261	0.264	0.206
			(0.168)	(0.189)	(0.193)	(0.184)	(0.185)	(0.183)
Δ NER				0.027	-0.139	0.005	-0.009	-0.050
				(0.286)	(0.265)	(0.286)	(0.291)	(0.239)
Δ Copp.P.					-0.376	-0.282	-0.260	-0.086
					(0.245)	(0.259)	(0.297)	(0.244)
Δ WTI						-0.024	-0.031	-0.027
						(0.047)	(0.065)	(0.060)
Δ IPE							-0.003	-0.002
							(0.010)	(0.009)
Δ Imacec								0.003**
								(0.001)
Constant	0.011	-0.000	-0.001	-0.001	-0.000	0.008	0.008	0.003
	(0.010)	(0.010)	(0.011)	(0.012)	(0.011)	(0.012)	(0.012)	(0.011)
N	37	37	37	37	37	36	36	36
Adj. R^2	0.252	0.380	0.363	0.343	0.367	0.334	0.313	0.409

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Chile: Reaction of One-Year's Ahead Inflation Forecast, Mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.389*	0.392*	0.455**	0.453**	0.450**	0.346	0.346	0.284
	(0.213)	(0.210)	(0.224)	(0.222)	(0.221)	(0.242)	(0.238)	(0.218)
Surp. Infl.		0.063	0.047	0.048	0.052	0.046	0.046	0.026
		(0.100)	(0.100)	(0.100)	(0.099)	(0.099)	(0.099)	(0.097)
Δ IPSA			-0.501	-0.543	-0.470	-0.240	-0.239	-0.300
			(0.401)	(0.454)	(0.457)	(0.411)	(0.414)	(0.420)
Δ NER				-0.194	-0.338	-0.081	-0.083	-0.214
				(0.971)	(1.131)	(1.133)	(1.140)	(1.143)
Δ Copp.P.					-0.209	-0.279	-0.279	-0.181
					(0.477)	(0.406)	(0.407)	(0.384)
Δ WTI						0.166	0.165	0.168
						(0.197)	(0.196)	(0.197)
Δ IPE							-0.000	-0.001
							(0.014)	(0.014)
Δ Imacec								0.005
								(0.004)
Constant	-0.002	-0.005	-0.007	-0.006	-0.006	-0.001	-0.001	-0.014
	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
N	122	122	122	122	122	121	121	121
Adj. R^2	0.077	0.073	0.082	0.075	0.069	0.036	0.027	0.037

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Chile: Reaction of Two-Years' ahead Inflation Forecast, Mean

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.097	0.103	0.097	0.096	0.094	0.085	0.076	0.034
	(0.109)	(0.089)	(0.099)	(0.099)	(0.100)	(0.112)	(0.112)	(0.110)
Surp. Infl.		0.142**	0.143**	0.144**	0.146**	0.145**	0.145**	0.131**
		(0.064)	(0.066)	(0.066)	(0.066)	(0.066)	(0.063)	(0.056)
Δ IPSA			0.042	-0.015	0.011	0.071	0.057	0.016
			(0.145)	(0.164)	(0.177)	(0.209)	(0.202)	(0.192)
Δ NER				-0.267	-0.319	-0.273	-0.239	-0.326
				(0.321)	(0.392)	(0.398)	(0.400)	(0.394)
Δ Copp.P.					-0.075	-0.053	-0.063	0.003
					(0.196)	(0.183)	(0.187)	(0.194)
Δ WTI						-0.013	-0.003	-0.001
						(0.088)	(0.083)	(0.079)
Δ IPE							0.008	0.007
							(0.007)	(0.007)
Δ Imacec								0.003*
								(0.002)
Constant	0.005	-0.001	-0.001	-0.000	-0.000	0.001	0.000	-0.008
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
N	122	122	122	122	122	121	121	121
Adj. R^2	0.018	0.103	0.096	0.094	0.087	0.074	0.077	0.107

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Chile: Reaction of Next Month's Inflation Forecasts, Individual Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.119***	0.119***	0.128***	0.128***	0.126***	0.109***	0.109***	0.105***
	(0.032)	(0.032)	(0.038)	(0.037)	(0.037)	(0.033)	(0.033)	(0.033)
Surp. Infl.		0.113***	0.106***	0.109***	0.120***	0.110***	0.106***	0.099***
		(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.021)
Δ IPSA			-0.185***	-0.212***	-0.052	0.020	0.011	-0.006
			(0.053)	(0.048)	(0.072)	(0.069)	(0.067)	(0.066)
Δ NER				-0.118	-0.487***	-0.351***	-0.324***	-0.340***
				(0.116)	(0.075)	(0.070)	(0.069)	(0.072)
Δ Copp.P.					-0.508***	-0.519***	-0.524***	-0.505***
					(0.136)	(0.142)	(0.143)	(0.145)
Δ WTI						0.068***	0.072***	0.072***
						(0.021)	(0.022)	(0.022)
Δ IPE							0.005**	0.005**
							(0.002)	(0.002)
Δ Imacec								0.001*
								(0.000)
Constant	0.017***	0.013***	0.012***	0.013***	0.012***	0.014***	0.014***	0.012***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	4,718	4,718	4,718	4,718	4,718	4,671	4,671	4,671
Adj. R^2	0.029	0.039	0.042	0.042	0.055	0.047	0.048	0.048

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 19: Chile: Reaction of One-Month's ahead Inflation Forecasts, Individual Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.099***	0.098***	0.095***	0.095***	0.093***	0.078***	0.078***	0.063***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.015)	(0.015)	(0.009)
Surp. Infl.		0.109***	0.110***	0.111***	0.116***	0.103***	0.102***	0.074***
		(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Δ IPSA			0.057	0.053	0.181***	0.320***	0.317***	0.225***
			(0.047)	(0.048)	(0.062)	(0.068)	(0.068)	(0.069)
Δ NER				-0.020	-0.175	0.003	0.011	-0.032
				(0.105)	(0.108)	(0.106)	(0.104)	(0.104)
Δ Copp.P.					-0.348***	-0.291***	-0.302***	-0.109
					(0.086)	(0.087)	(0.088)	(0.092)
Δ WTI						0.009	0.012	0.005
						(0.018)	(0.018)	(0.018)
Δ IPE							0.002	0.002
							(0.002)	(0.002)
Δ Imacec								0.003***
								(0.000)
Constant	0.015***	0.006***	0.007***	0.007***	0.007***	0.014***	0.014***	0.007***
	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
N	1,835	1,835	1,835	1,835	1,835	1,788	1,788	1,788
Adj. R^2	0.060	0.091	0.091	0.091	0.098	0.093	0.093	0.118

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 20: Chile: Reaction of One-Year's ahead Inflation Forecasts, Individual Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.189***	0.188***	0.200***	0.200***	0.199***	0.146**	0.144**	0.117**
	(0.066)	(0.066)	(0.073)	(0.073)	(0.073)	(0.062)	(0.061)	(0.054)
Surp. Infl.		0.091***	0.085**	0.085**	0.090**	0.083**	0.083**	0.063*
		(0.033)	(0.034)	(0.034)	(0.034)	(0.033)	(0.033)	(0.033)
Δ IPSA			-0.240*	-0.223*	-0.110	0.082	0.066	-0.043
			(0.125)	(0.130)	(0.142)	(0.142)	(0.141)	(0.135)
Δ NER				0.076	-0.150	0.192	0.218	0.080
				(0.303)	(0.306)	(0.298)	(0.293)	(0.299)
Δ Copp.P.					-0.340**	-0.431***	-0.444***	-0.305**
					(0.132)	(0.139)	(0.139)	(0.135)
Δ WTI						0.237***	0.246***	0.236***
						(0.073)	(0.072)	(0.072)
Δ IPE							0.007	0.005
							(0.005)	(0.004)
Δ Imacec								0.006***
								(0.001)
Constant	0.009***	0.005**	0.004**	0.004*	0.005**	0.009***	0.009***	-0.008**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
N	5,790	5,790	5,790	5,790	5,790	5,743	5,743	5,743
Adj. R^2	0.014	0.017	0.017	0.017	0.018	0.019	0.019	0.025

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE 21: Chile: Reaction of Two-Years' ahead Inflation Forecasts, Individual Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Surp. MPR	0.066**	0.066**	0.062**	0.062**	0.062**	0.059**	0.056**	0.042*
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.026)	(0.023)
Surp. Infl.		0.103***	0.105***	0.106***	0.106***	0.106***	0.105***	0.095***
		(0.028)	(0.028)	(0.028)	(0.029)	(0.029)	(0.029)	(0.028)
Δ IPSA			0.075	0.064	0.079	0.169	0.149	0.092
			(0.092)	(0.093)	(0.106)	(0.115)	(0.113)	(0.115)
Δ NER				-0.048	-0.078	-0.005	0.027	-0.046
				(0.200)	(0.227)	(0.219)	(0.216)	(0.221)
Δ Copp.P.					-0.045	-0.001	-0.017	0.056
					(0.115)	(0.100)	(0.101)	(0.101)
Δ WTI						-0.033	-0.023	-0.028
						(0.049)	(0.048)	(0.048)
Δ IPE							0.008**	0.008**
							(0.004)	(0.004)
Δ Imacec								0.003***
								(0.001)
Constant	0.008***	0.004**	0.004***	0.004**	0.004**	0.005***	0.005***	-0.004
	(0.000)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
N	5,790	5,790	5,790	5,790	5,790	5,743	5,743	5,743
Adj. R^2	0.008	0.014	0.014	0.014	0.014	0.014	0.015	0.018

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A.3 Appendix to the Additional Results of the Empirical Section

The exercises of this section use dummies to allow for different responses when the surprise in the interest rate occurs under different circumstances. The general regressions for the first part are of the form:

$$\boxed{z^e_{d+s,t+j} - z^e_{d-m,t+j} = \alpha_j + \sum_{k=0}^{K} \beta_{j,k} D_k (i_t - i^e_{d-m,t}) + C\left(_{\{d+s\}-\{d-m\}}\right) + \epsilon_{t,j}} \qquad (12)$$

where the variables are the same as in the main text and D_k are dummies that vary according to the exercise the following way:

- Dependence on the Movement of the MPR: D_0 is equal to one when there is no movement in the MPR, zero otherwise; D_1 is equal to one when the movement in the MPR goes in the opposite direction as the surprise, zero otherwise; D_2 is equal to one when the movement in the MPR goes in the same direction as the surprise, zero otherwise.

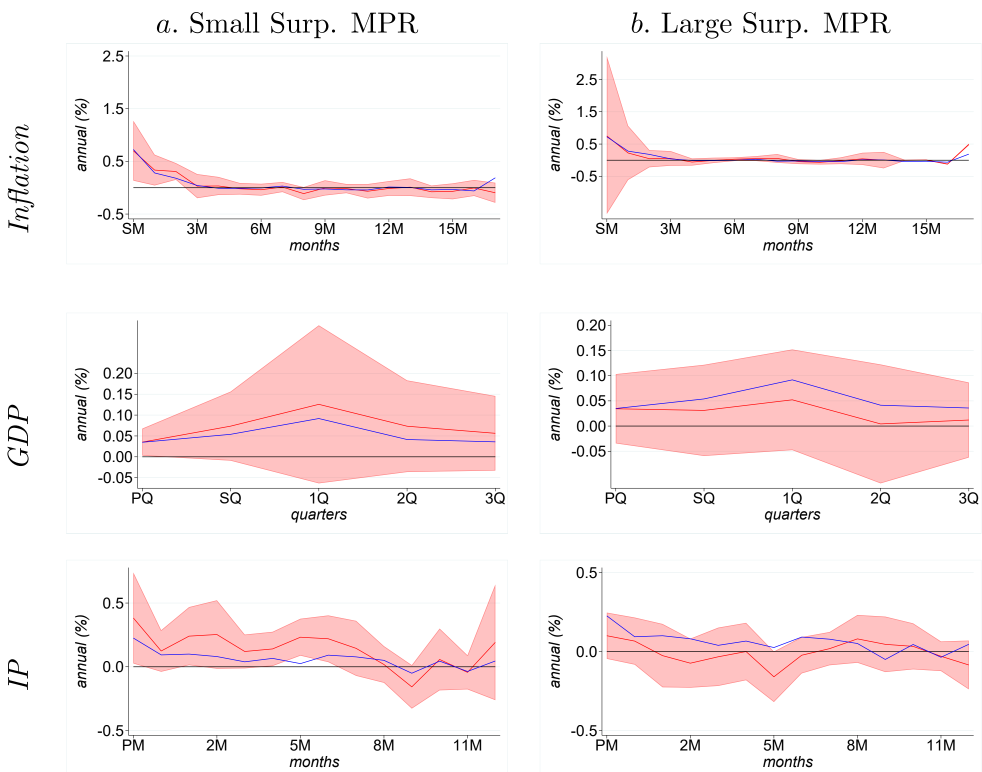
- Dependence on the response of the stock market: D_0 is equal to one when the daily movement in the stock market index the day after the meeting goes in the opposite direction as the surprise, zero otherwise; D_1 is equal to one when the daily movement in the stock market index the day after the meeting goes in the same direction as the surprise, zero otherwise.

- Dependence on the Intensity of the surprise: D_0 is equal to one when the surprise is small (below 50 basis points) and zero otherwise; D_1 is equal to one when the MPR surprise is 50 basis points or above and zero otherwise.

- Subsamples: There are different exercises in this part. On the one hand, some excluded part of the sample to get results (the periods at the effective lower bound or the unstable periods in Brazil), while others defined different dummies.

  - In the exercise for Chile to differentiate when there is an IPoM and not, D_0 is equal to one when there is an IPoM at the same time of the MPR decision and zero otherwise; D_1 is equal to one when there is no IPoM and zero otherwise.

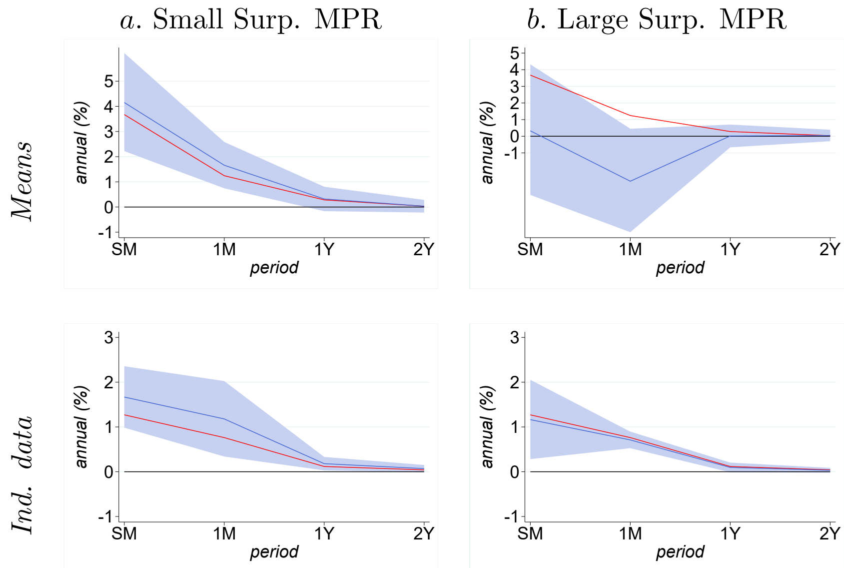
  - In the exercise for Chile to differentiate before and after 2018, D_0 is equal to one when before 2018 and zero otherwise; D_1 is equal when the year is 2018 or above and zero otherwise.



Notes: The graphs show the response of Inflation, GDP, and IP expectations, given a change in the unexpected component of the MPR and its confidence intervals. The graphs separate the reaction when the surprise is small (column *a.*) and big (higher or equal to 50 basis points, column *b.*). For Inflation, the graphs show the response from the same month of the decision (SM) until 17 months ahead (17M), for GDP from the previous quarter (PQ) until three quarters ahead (3Q), and for IP from the previous month (PM) until 12 months ahead (12M). The graphs show in blue the baseline results from Figures 3 and 5.

FIGURE 14: Brazil: Dependence on the Intensity of the Surprise

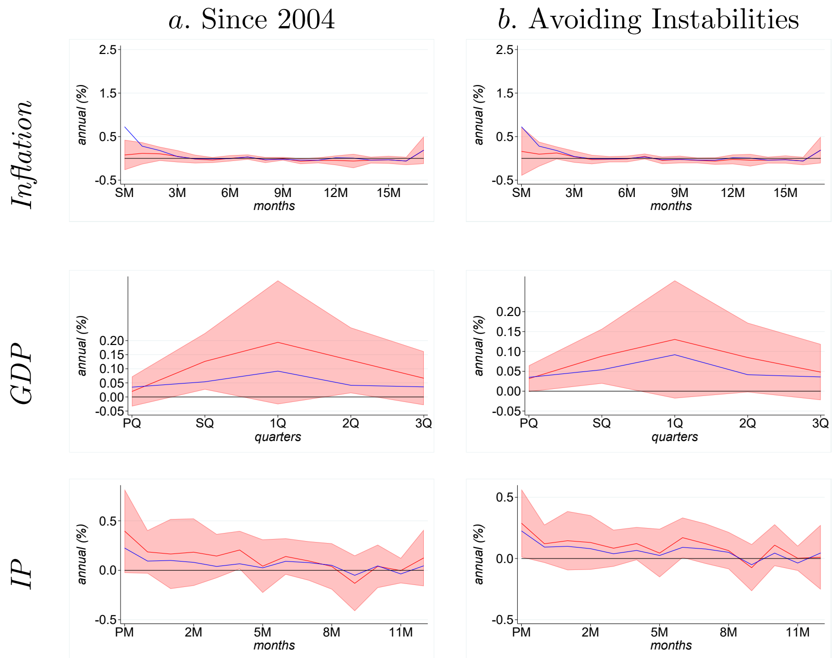
A.3.1 Intensity of Surprise



Notes: The graphs show the response of Inflation expectations given a change in the unexpected component of the MPR and its confidence intervals. The graphs separate the reaction when the surprise is small (column *a.*) and big (higher or equal to 50 basis points, column *b.*). The graphs show the response for the same month, one month ahead, the first year ahead, and the second year ahead. The graphs show the baseline results from Figure 4 in red. All the regressions include all the controls, and the ones with individual data have clusterized standard errors and individual fixed effects. The coefficients of interest are the only ones included.

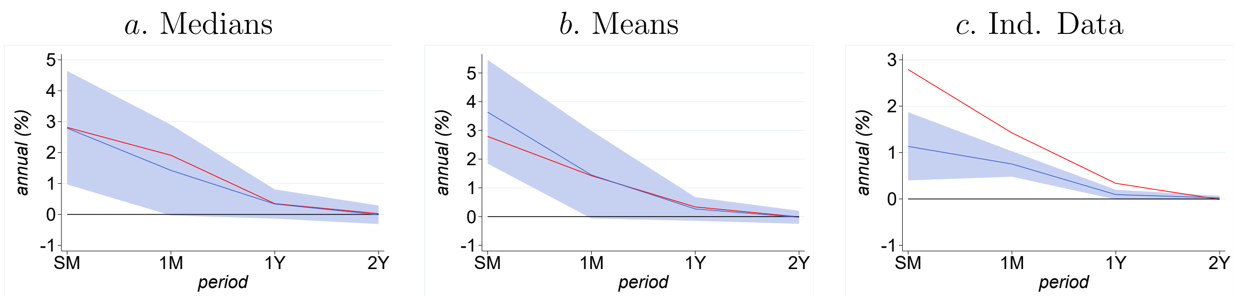
FIGURE 15: Chile: Dependence on the Intensity of the Surprise

A.3.2 Different subsamples



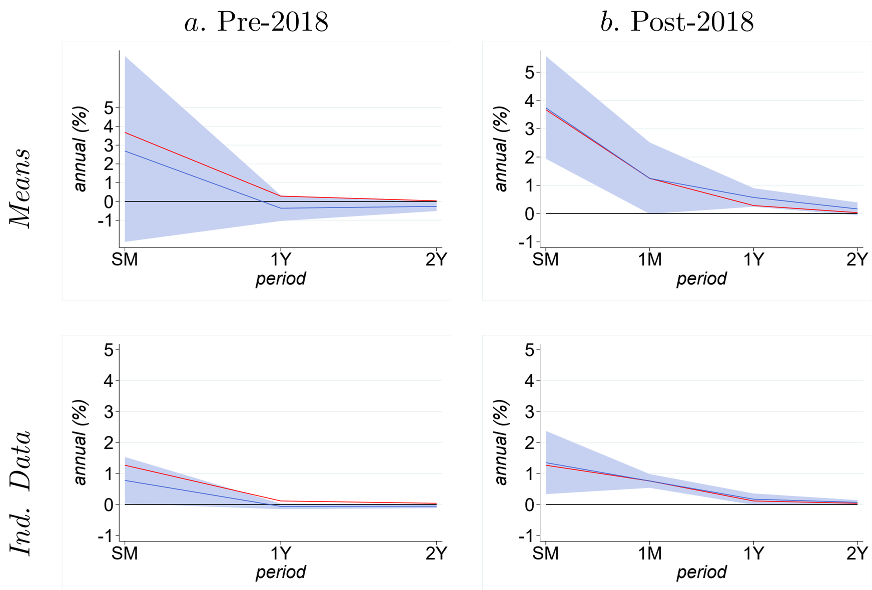
Notes: The graphs show the response of Inflation, GDP, and IP expectations, given a change in the unexpected component of the MPR and its confidence intervals. The graphs show the results for subsamples; the first excludes the years before 2004, and the second excludes unstable periods: the years before 2003 and between mid-2015 and September 2016. For Inflation, the graphs show the response from the same month of the decision (SM) until 17 months ahead (17M), for GDP from the previous quarter (PQ) until three quarters ahead (3Q), and for IP from the previous month (PM) until 12 months ahead (12M). The graphs show in blue the baseline results from Figures 3 and 5.

FIGURE 16: Brazil: Different Subsamples, Means



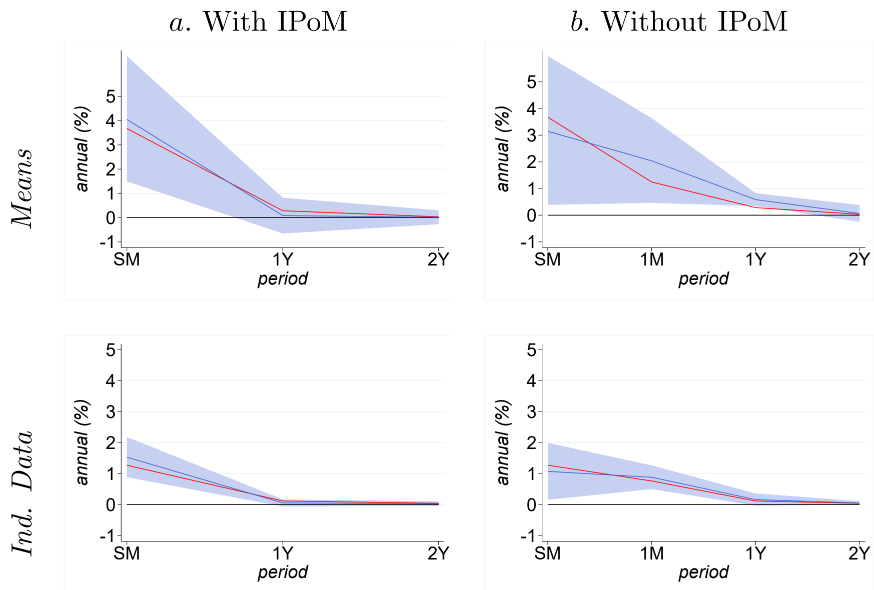
Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Each graph shows the response of the following month, one month ahead, one year ahead, and two years ahead. The regressions include all the controls. Graph *a.* shows the response without excluding the ELB in red, and the ones in *b.* and *c.* show the coefficients of graph *a.* in red.

FIGURE 17: Chile: Excluding ELB



Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. Graphs in *a.* show the results for surprises before 2018, and the ones in *b.* for the surprise after 2018.The graphs on the left show the response of the following month, one year and two years ahead. The graphs on the right also include the 1-month ahead (only available starting in 2018). The regressions include all the controls.

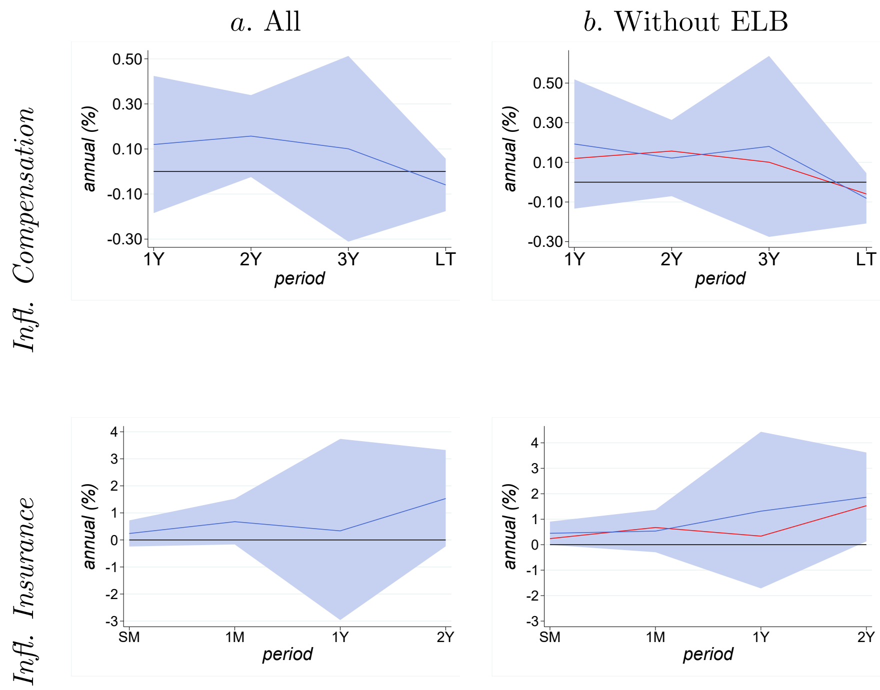
Figure 18: Chile: Differentiating between Surprises before and after 2018



Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. The graphs in *a.* show when the surprise does not coincide with the release of an IPoM, while the ones in *b.* show cases when it does coincide. Each graph shows the response of the following month, one month ahead, one year ahead, and two years ahead. The regressions include all the controls.

Figure 19: Chile: Differentiating between Surprise with and without IPoM

A.3.3 Different measures



Notes: The graphs show the annualized response of inflation expectations given a change in the unexpected component of the MPR decision and their confidence intervals. The graphs on the left show the response using the complete sample (2010-2022), and the ones on the right exclude the period at the ELB (the red line in these graphs corresponds to the results of the whole sample). The graphs on the top use break-even inflation as the measure, and the ones on the left use Inflation Insurance. In all cases the regressions include all the controls.

FIGURE 20: Chile: Other Inflation Measures

Using break-even inflation based on nominal and real Swaps

This measure uses Swaps at different horizons. The ones reported in the graph are one year (1Y), 1-in-1 (2Y, 1 year but starting one year in the future), 1-in-2 (3Y, 1 year starting two years in the future), and 5-in-5 (LT, 5 years starting five years in the future).

The calculations are based on the instruments called "Swap Promedio Cámara" in Pesos and UF, and breakeven inflation is the difference between the two.[25] The inflation estimated from these documents corresponds to an average of inflation during the period under study. For more information, refer to Varela (2007).

Using Inflation Insurance

These are financial instruments in which one side pays a fixed inflation (expressed over

[25]The UF means "Unidad de Fomento" which is an indexed measure of account in Chile.

the value of UF) over some capital and horizon, and the counterpart pays actual inflation. With these in hand, one gets expectations of accumulated inflation and expectations at different horizons. For more information, refer to .

A.4 Appendix to Motivating Model

A.4.1 Environment and Problems of Every Agent

Households

Assume there is a representative household that seeks to maximize the discounted sum of utilities of the form:

$$\mathbb{E}_t \left\{ \sum_{T=t}^{\infty} \beta^{T-t} \left[\frac{C_T^{1-1/\sigma}}{1-1/\sigma} - \frac{H_T^{1+1/\xi}}{1+1/\xi} \right] \right\}$$

C_t is consumption, and H_t is the quantity of labor supplied in time t. In this formulation, σ is the elasticity of intertemporal substitution, and ξ is the Frisch elasticity of labor supply. The index C_t is a Dixit-Stiglitz aggregate of differentiated consumer goods:

$$C_t = \left[\int_0^1 C_t(j)^{(\theta_t-1)/\theta_t} dj \right]^{\theta_t/(\theta_t-1)}$$

with $\theta_t > 1$ the elasticity of substitution between varieties, which is a stochastic shock with mean $\mathbb{E}(\theta_t) = \bar{\theta}$. The shock to the elasticity allows for a cost-push shock. The price index that defines the minimum cost of a unit of C_t is:

$$P_t = \left[\int_0^1 P_t(j)^{1-\theta_t} dj \right]^{1/(1-\theta_t)}$$

For simplicity, assume only one traded asset each period: a one-period riskless nominal bond, which allows the central bank to set that interest rate. The households own the firms (same share each household) and face a tax set by the government. So, its budget constraint in t is:

$$P_t C_t + B_t = (1 + \tilde{i}_{t-1}) B_{t-1} + W_t H_t + \int_0^1 \Pi_t(j) dj - T_t$$

where B_t is the one period nominal bond that pays $\tilde{i}_t$ in period $t+1$, W_t is the nominal wage determined in the labor market, $\Pi_t(i)$ are the nominal profits of firm j and T_t is a tax set by the government.

Each household is the same, and so they make the same decisions. Households choose the amount consumed, worked, and saved, taking prices as given. So their three optimality conditions are: (*i*) optimality across differentiated goods, (*ii*) intertemporal optimality, which is the Euler equation, and (*iii*) optimal supply of labor.

Firms
Each firm j is the monopolistic supplier of good (j), so given the household demand, it chooses its price. Its production function uses only labor as input:

$$Y_t(j) = A_t H_t(j)$$

Where A_t is a productivity factor common to all firms. The profits of each firm j are:

$$\Pi_t(P_t(j), .) \quad = \quad P_t(j)Y_t(j) - W_t H_t(j)$$

Additionally, assume as Calvo (1983) that they can only choose their price in any given period with probability $(1-\alpha)$. Firms that choose their price maximize the present discounted value of profits in all future states prior to the next reconsideration of its price:

$$\hat{\mathbb{E}}_t \left\{ \sum_{s=0}^{\infty} \alpha^s Q_{t,t+s} \Pi_{t+s}(P_t(j)) \right\}$$

where $Q_{t,t+s} = \beta^s[U'(C_{t+s})/U'(C_t)][P_t/P_{t+s}]$ is the stochastic discount factor of the household.

Government
The government is assumed to consume the same composite of the goods demanded by households:

$$G_t = \left[\int_0^1 G_t(i)^{(\theta_t - 1)/\theta_t} di \right]^{\theta_t/(\theta_t - 1)}$$

where $G_t(i)$ is the quantity consumed of good i and G_t is the Dixit-Stiglitz aggregate. It is also assumed to hold a balanced budget:

$$T_t = P_t G_t$$

Central Bank

The Central Bank sets the interest rate following a Taylor rule of the form:

$$(1+\tilde{i}_t) = \bar{i}\left(\frac{P_t}{P_{t-1}}\right)^{\phi_\pi}\left(\frac{Y_t}{Y_t^*}\right)^{\phi_x} e^{\epsilon_t}$$

Where Y_t^* is the efficient level of output in period t, ϵ_t is the monetary shock in period t and ϕ_π, ϕ_x are such that the Taylor principle is satisfied.

Market Clearing

In Equilibrium the goods market, the bonds market and the labor market clear, which means:

$$\begin{aligned} Y_t &= C_t + G_t \\ H_t &= \int_0^1 H_t(i)di \\ B_t &= 0 \end{aligned}$$

A.4.2 Model Solution

Rewriting the solution of the model given in (6), we have:

$$\begin{bmatrix} \pi_t \\ x_t \end{bmatrix} = -\sum_{j=0}^{\infty} A^{-(j+1)} \begin{bmatrix} -1/\beta & 0 & 0 \\ \sigma/\beta & \sigma & -\sigma \end{bmatrix} \begin{bmatrix} \mathbb{E}_t u_{t+j} \\ \mathbb{E}_t \epsilon_{t+j} \\ \mathbb{E}_t r^*_{t+j} \end{bmatrix} \tag{13}$$

With

$$A = \begin{bmatrix} \frac{1}{\beta} & -\frac{\kappa}{\beta} \\ \sigma\left(\phi_\pi - \frac{1}{\beta}\right) & 1+\sigma\left(\phi_x + \frac{\kappa}{\beta}\right) \end{bmatrix}$$

Defining $B \equiv A^{-1}$ and $C \equiv A^{-2}$ and having only information about the current shocks and signals about one period ahead, we can write this solution as:

$$\begin{bmatrix} \pi_t \\ x_t \end{bmatrix} = -B \begin{bmatrix} -1/\beta & 0 & 0 \\ \sigma/\beta & \sigma & -\sigma \end{bmatrix} \begin{bmatrix} u_t \\ \epsilon_t \\ r^*_t \end{bmatrix} - C \begin{bmatrix} -1/\beta & 0 & 0 \\ \sigma/\beta & \sigma & -\sigma \end{bmatrix} \begin{bmatrix} \mathbb{E}_t u_{t+j} \\ \mathbb{E}_t \epsilon_{t+j} \\ \mathbb{E}_t r^*_{t+j} \end{bmatrix} \tag{14}$$

$$\omega_t = \Lambda^\omega_\epsilon \epsilon_t + \Lambda^\omega_u u_t + \Lambda^\omega_r r^*_t + \Lambda^\omega_{\epsilon'} \mathbb{E}_t(\epsilon_{t+1}) + \Lambda^\omega_{u'} \mathbb{E}_t(u_{t+1}) + \Lambda^\omega_{r^{*\prime}} \mathbb{E}_t(r^*_{t+1})$$

for $\omega = \{\pi, x, i\}$.

To calculate that, we have

$$B = A^{-1} = \frac{\beta}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \begin{bmatrix} 1+\sigma\left(\phi_x+\frac{\kappa}{\beta}\right) & \frac{\kappa}{\beta} \\ -\sigma\left(\phi_\pi - \frac{1}{\beta}\right) & \frac{1}{\beta} \end{bmatrix} = \frac{1}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \begin{bmatrix} \beta+\sigma\left(\beta\phi_x+\kappa\right) & \kappa \\ -\sigma\left(\beta\phi_\pi - 1\right) & 1 \end{bmatrix}$$

$$C = B^2 = \frac{1}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \begin{bmatrix} (\beta+\sigma(\beta\phi_x+\kappa))^2+\sigma\kappa(1-\beta\phi_\pi) & \kappa(1+\beta+\sigma(\beta\phi_x+\kappa)) \\ -\sigma\left(\beta\phi_\pi-1\right)\left(1+\beta+\sigma(\beta\phi_x+\kappa)\right) & 1+\sigma\kappa-\beta\sigma\kappa\phi_\pi \end{bmatrix}$$

And defining the coefficient of the matrices as B_{ij} as the one of row i and column j of B (and the same with C), we have that the coefficients of inflation are:

$$\begin{aligned}
\Lambda^\pi_\epsilon &= -\sigma B_{12} = -\frac{\sigma\kappa}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^\pi_u &= \frac{1}{\beta}\left(B_{11}-\sigma B_{12}\right) = \frac{1+\sigma\phi_x}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\\
\Lambda^\pi_r &= \sigma B_{12} = \frac{\sigma\kappa}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\\
\Lambda^\pi_{\epsilon'} &= -\sigma C_{12} = \frac{-\sigma\kappa(1+\beta+\sigma(\beta\phi_x+\kappa))}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^\pi_{u'} &= \frac{1}{\beta}\left(C_{11}-\sigma C_{12}\right) = \frac{(\beta+\sigma(\beta\phi_x+\kappa))(1+\sigma\phi_x)-\sigma\kappa\phi_\pi}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^\pi_{r^{*\prime}} &= \sigma C_{12} = \frac{\sigma\kappa(1+\beta+\sigma(\beta\phi_x+\kappa))}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2}
\end{aligned}$$

Coefficients for output:

$$
\begin{aligned}
\Lambda^x_\epsilon &= -\sigma B_{22} = -\frac{\sigma}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^x_u &= \frac{1}{\beta}\left(B_{21}-\sigma B_{22}\right) = -\frac{\sigma\phi_\pi}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^x_r &= \sigma B_{22} = \frac{\sigma}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^x_{\epsilon'} &= -\sigma C_{22} = \frac{-\sigma(1+\sigma\kappa-\beta\sigma\kappa\phi_\pi)}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^x_{u'} &= \frac{1}{\beta}\left(C_{21}-\sigma C_{22}\right) = -\frac{\sigma\left[(\beta\phi_\pi-1)(1+\beta+\sigma\beta\phi_x)+1\right]}{\beta(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^x_{r^{*\prime}} &= \sigma C_{22} = \frac{\sigma(1+\sigma\kappa-\beta\sigma\kappa\phi_\pi)}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2}
\end{aligned}
$$

And for the interest rate:

$$
\begin{aligned}
\Lambda^i_\epsilon &= 1+\phi_\pi\Lambda^\pi_\epsilon+\phi_x\Lambda^x_\epsilon = \frac{1}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^i_u &= \phi_\pi\Lambda^\pi_u+\phi_x\Lambda^x_u = \frac{\phi_\pi}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^i_r &= \phi_\pi\Lambda^\pi_r+\phi_x\Lambda^x_r = \frac{\sigma\phi_x+\sigma\kappa\phi_\pi}{1+\sigma\phi_x+\kappa\sigma\phi_\pi} \\
\Lambda^i_{\epsilon'} &= \phi_\pi\Lambda^\pi_{s^\epsilon}+\phi_x\Lambda^x_{s^\epsilon} = -\frac{(1+\sigma\kappa)(\sigma\kappa\phi_\pi+\sigma\phi_x)+\beta\sigma\kappa\phi_\pi}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^i_{u'} &= \phi_\pi\Lambda^\pi_{s^u}+\phi_x\Lambda^x_{s^u} = \frac{1}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2} \\
\Lambda^i_{r^{*\prime}} &= \phi_\pi\Lambda^\pi_{s^r}+\phi_x\Lambda^x_{s^r} = \frac{(1+\sigma\kappa)(\sigma\kappa\phi_\pi+\sigma\phi_x)+\beta\sigma\kappa\phi_\pi}{(1+\sigma\phi_x+\kappa\sigma\phi_\pi)^2}
\end{aligned}
$$

Given the distribution of the shocks: $\xi_t \sim N(0,\sigma^2_\xi)$, and $s^\xi_t = \xi_{t+1}+\zeta^\xi_t$, with $\zeta^\xi_t \sim N(0,\sigma^2_{s^\xi})$ for $\xi = \{\epsilon, u, r^*\}$, we can write the general solution then as a function of the observable variables:

$$
\omega_t = \Lambda^\omega_\epsilon \epsilon_t + \Lambda^\omega_u u_t + \Lambda^\omega_r r^*_t + \Lambda^\omega_{s^\epsilon} s^\epsilon_t + \Lambda^\omega_{s^u} s^u_t + \Lambda^\omega_{s^r} s^r_t
$$

for $\omega = \{\pi, x, i\}$.

Define $\mathbb{E}(x)$ as the expectations before seeing the interest rate and $\mathbb{E}(x|i_t)$ as the one after seeing the interest rate. Then the expectation of the exogenous variables before and after are seeing the interest rate are:

$$\mathbb{E}(\omega_t) = \Lambda_\epsilon^\omega \mathbb{E}(\epsilon_t) + \Lambda_u^\omega \mathbb{E}(u_t) + \Lambda_r^\omega \mathbb{E}(r_t^*) + \Lambda_{s^\epsilon}^\omega \mathbb{E}(s_t^\epsilon) + \Lambda_{s^u}^\omega \mathbb{E}(s_t^u) + \Lambda_{s^r}^\omega \mathbb{E}(s_t^r) \tag{15}$$

$$\mathbb{E}(\omega_t|i_t) = \Lambda_\epsilon^\omega \mathbb{E}(\epsilon_t|i_t) + \Lambda_u^\omega \mathbb{E}(u_t|i_t) + \Lambda_r^\omega \mathbb{E}(r_t^*|i_t) + \Lambda_{s^\epsilon}^\omega \mathbb{E}(s_t^\epsilon|i_t) + \Lambda_{s^u}^\omega \mathbb{E}(s_t^u|i_t) + \Lambda_{s^r}^\omega \mathbb{E}(s_t^r|i_t) \tag{16}$$

A.4.3 Extracting information from the signal

The expectation of future shocks comes from a signal extraction problem. Defining $\gamma_{s^\xi} = \sigma_{s^\xi}^{-2}$ and $\gamma_\xi = \sigma_\xi^{-2}$ for $\xi = \{\epsilon, u, r^*\}$, we calculate the posterior distribution and expectations of the shock given the signal and the knowledge of the distributions:

$$\begin{aligned}
p\left(\xi_{t+1}|s_t^\xi\right) &\propto p\left(s_t^\xi/\xi_{t+1}\right) p\left(\xi_{t+1}\right) \\
&\propto \exp\left\{-\frac{1}{2}\left(\frac{(s_t^\xi - \xi_{t+1})^2}{\sigma_{s^\xi}^2} + \frac{\xi_{t+1}^2}{\sigma_\xi^2}\right)\right\} \\
&\propto \exp\left\{-\frac{1}{2}\left(\xi_{t+1}^2(\gamma_{s^\xi} + \gamma_\xi) - 2 s_t^\xi \xi_{t+1}\gamma_{s^\xi}\right)\right\} \\
&\propto \exp\left\{-\frac{1}{2\frac{1}{\gamma_{s^\xi}+\gamma_\xi}}\left(\xi_{t+1} - \frac{s_t^\xi \gamma_{s^\xi}}{\gamma_{s^\xi} + \gamma_\xi}\right)^2\right\}
\end{aligned}$$

So, the expectation is $\mathbb{E}_t(\xi_{t+1}|s_t^\xi) = \frac{\gamma_{s^\xi}}{\gamma_{s^\xi}+\gamma_\xi} s_t^\xi$, implying that $\Lambda_{s^\xi}^\omega = \frac{\gamma_{s^\xi}}{\gamma_{s^\xi}+\gamma_\xi}\Lambda_{\xi'}^\omega$ for $\xi = \{\epsilon, u, r^*\}$.

Note that the sign of $\Lambda_{s^\xi}^\omega$ is the same as the sign of $\Lambda_{\xi'}^\omega$.

A.4.4 Extracting Information About One Shock

When agents do not know the information of only one shock, the solution has two characteristics: (i) they get perfect information after seeing the interest rate; (ii) the only terms that survive the difference between the expectation after the interest rate and before the interest, (16)-(15), is the one of the shock in question.

For example, take the case of the current monetary shock. Then we have:

$$\mathbb{E}(\omega_t|i_t) - \mathbb{E}(\omega_t) = \Lambda_\epsilon^\omega(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t))$$

since for the rest of the shocks $\mathbb{E}(\xi_t|i_t) = \mathbb{E}(\xi_t)$ for $\xi_t = \{u_t, r_t^*, \epsilon_{t+1}, u_{t+1}, r_{t+1}^*\}$.

Since we are looking for the coefficient that relates the difference of inflation and output expectations to the difference in expectations of the interest rate, we will have in this case:

$$\begin{aligned}
\mathbb{E}(x_t|i_t) - \mathbb{E}(x_t) &= \Lambda_\epsilon^x(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t)) \\
\mathbb{E}(\pi_t|i_t) - \mathbb{E}(\pi_t) &= \Lambda_\epsilon^\pi(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t)) \\
\mathbb{E}(i_t|i_t) - \mathbb{E}(i_t) = i_t - \mathbb{E}(i_t) &= \Lambda_\epsilon^i(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t))
\end{aligned}$$

and so the coefficients of interest are:

$$\begin{aligned}
\mathbb{E}(x_t|i_t) - \mathbb{E}(x_t) = \chi_x(i_t - \mathbb{E}(i_t)) &= \frac{\Lambda_\epsilon^x}{\Lambda_\epsilon^i}(i_t - \mathbb{E}(i_t)) \\
\mathbb{E}(\pi_t|i_t) - \mathbb{E}(\pi_t) = \chi_\pi(i_t - \mathbb{E}(i_t)) &= \frac{\Lambda_\epsilon^\pi}{\Lambda_\epsilon^i}(i_t - \mathbb{E}(i_t))
\end{aligned}$$

The same way, we analyze one shock each time and get the coefficients χ_π and χ_x of Table 2 in each case:

- With only the monetary Shock, ϵ_t:

$$\chi_\pi = -\sigma\kappa < 0 \qquad \chi_x = -\sigma < 0$$

- With only the cost push shock, u_t:

$$\chi_\pi = \frac{1 + \sigma\phi_x}{\phi_\pi} > 0 \qquad \chi_x = -\sigma < 0$$

- With only the Natural rate of interest, r_t^*:

$$\chi_\pi = \frac{\kappa}{\phi_\pi\kappa + \phi_x} > 0 \qquad \chi_x = \frac{1}{\phi_\pi\kappa + \phi_x} > 0$$

- With only a signal of future monetary shock, s_t^{ϵ}:

$$\begin{aligned}
\chi_\pi &= \frac{\kappa(1+\beta+\sigma(\beta\phi_x+\kappa))}{\kappa\phi_\pi(1+\beta+\sigma\kappa)+\phi_x(1+\sigma\kappa)} > 0 \\
\chi_x &= \frac{1+\sigma\kappa(1-\beta\phi_\pi)}{\kappa\phi_\pi(1+\beta+\sigma\kappa)+\phi_x(1+\sigma\kappa)} > 0 \quad \text{if } \boxed{\phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}}
\end{aligned}$$

- With only a signal of future cost push shock, s_t^u:

$$\begin{aligned}
\chi_\pi &= \frac{(\beta+\sigma(\beta\phi_x+\kappa))(1+\sigma\phi_x)-\sigma\kappa\phi_\pi}{(\sigma\phi_x+\sigma\kappa\phi_\pi)(1+\sigma\phi_x-\phi_\pi)+\beta\phi_\pi(1+\sigma\phi_x)} \\
\chi_x &= -\sigma\frac{(\beta\phi_\pi-1)(1+\sigma\phi_x)+\phi_\pi}{(\sigma\phi_x+\sigma\kappa\phi_\pi)(1+\sigma\phi_x-\phi_\pi)+\beta\phi_\pi(1+\sigma\phi_x)}
\end{aligned}$$

  The condition for the denominators to be positive is:

$$\boxed{\phi_\pi \text{ btw. } \frac{\sigma\phi_x-(1+\sigma\phi_x)(\sigma\kappa+\beta)\pm\sqrt{[\sigma\phi_x-(1+\sigma\phi_x)(\sigma\kappa+\beta)]^2+4\sigma^2\kappa\phi_x(1+\sigma\phi_x)}}{-2\sigma\kappa}}$$

  which is always met under the coefficients described in the table below.

  The condition for the numerator of the reaction of inflation to be positive is:

$$\boxed{\phi_\pi < \frac{(\beta+\sigma(\beta\phi_x+\kappa))(1+\sigma\phi_x)}{\sigma\kappa}}$$

  which is always met under the coefficients described in the table below.

  The condition for the numerator of the reaction of output to be positive is:

$$\boxed{\phi_\pi < \frac{1+\sigma\phi_x}{1+\beta(1+\sigma\phi_x)}}$$

  which is never met and goes in conflict with the Taylor principle.

- With only a signal of future natural rate of interest, $s_t^{r^*}$:

$$\begin{aligned}
\chi_\pi &= \frac{\kappa(1+\beta+\sigma(\beta\phi_x+\kappa))}{\kappa\phi_\pi(1+\beta+\sigma\kappa)+\phi_x(1+\sigma\kappa)} > 0 \\
\chi_x &= \frac{1+\sigma\kappa(1-\beta\phi_\pi)}{\kappa\phi_\pi(1+\beta+\sigma\kappa)+\phi_x(1+\sigma\kappa)} > 0 \quad \text{if } \boxed{\phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}}
\end{aligned}$$

The coefficients need to satisfy then the Taylor principle (written in the main part of the text) and the conditions boxed above to be positive. For the cases that the conditions depended on specific values, the ranges that were analyzed were:

TABLE 22: Parameter Values for Numerical Exercises

α	β	σ	κ	ϕ_x	ϕ_π
$0.6-0.9$	0.99	$0.5-10$	$0.01-0.05$	$0-0.5$	$1-2.9$

The sign for those coefficients were then the ones given in Table 2.

A.4.5 Extracting Information About Two Shocks

In this case, the information extracted comes from a signal extraction problem in which the agents get an expectation of two shocks each time after observing only one signal: the interest rate. For simplicity, it is assumed that there is no information besides the interest rate and there is full knowledge of the distributions and parameters. Each cases analyzed uses the following solutions of a signal extraction problem from normal distributions: Suppose the unobservable is $X_t \sim N(B_t, \Sigma)$ and the observable $S_t|X_t \sim N(AX_t, \Omega)$. The posterior is $X_t|S_t \sim N(\mu_t, \Gamma)$, with:

$$\mu_t = \Gamma(A'\Omega^{-1}S_t + \Sigma^{-1}B_t)$$

$$\Gamma^{-1} = (A'\Omega^{-1}A + \Sigma^{-1})$$

- *Current monetary and natural rate of interest shocks*: In this case, we can write the interest rate as $i_t = \Lambda^i_\epsilon \epsilon_t + \Lambda^i_r r^*_t$ and applying the previous definitions we have:

$$X_t = \begin{bmatrix} \epsilon_t \\ r^*_t \end{bmatrix} \qquad B_t = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \qquad \Sigma = \begin{bmatrix} \sigma^2_\epsilon & 0 \\ 0 & \sigma^2_r \end{bmatrix}$$

$$S_t = i_t \qquad A = \begin{bmatrix} \Lambda^i_\epsilon & \Lambda^i_r \end{bmatrix} \qquad \Omega = \sigma^2_\xi \to 0$$

So, replacing and defining $\gamma_z = \sigma_z^{-2}$, the posterior mean and variance are:

$$\mu_t = \begin{bmatrix} \mu^\epsilon \\ \mu^r \end{bmatrix} i_t = \frac{1}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2} \begin{bmatrix} \gamma_r \Lambda^i_\epsilon \\ \gamma_\epsilon \Lambda^i_r \end{bmatrix} i_t \qquad \Gamma = \frac{1}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2} \begin{bmatrix} (\Lambda^i_r)^2 & -\Lambda^i_r\Lambda^i_\epsilon \\ -\Lambda^i_r\Lambda^i_\epsilon & (\Lambda^i_\epsilon)^2 \end{bmatrix}$$

With that in hand, we can now write the difference of expectations of output and inflation as:

$$
\begin{aligned}
\mathbb{E}(\omega_t|i_t) - \mathbb{E}(\omega_t) &= \Lambda^{\omega}_{\epsilon}(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t)) + \Lambda^{\omega}_{r}(\mathbb{E}(r^*_t|i_t) - \mathbb{E}(r^*_t)) \\
&= \Lambda^{\omega}_{\epsilon}\mu^{\epsilon} i_t + \Lambda^{\omega}_{r}\mu^{r} i_t \\
&= (\Lambda^{\omega}_{\epsilon}\mu^{\epsilon} + \Lambda^{\omega}_{r}\mu^{r})(i_t - \mathbb{E}(i_t))
\end{aligned}
$$

And with this in hand the coefficients of interest are:

$$
\begin{aligned}
\chi_\pi &= \Lambda^{\pi}_{\epsilon}\mu^{\epsilon} + \Lambda^{\pi}_{r}\mu^{r} \\
&= \Lambda^{\pi}_{\epsilon}\left(\frac{\gamma_r\Lambda^i_\epsilon}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2}\right) + \Lambda^{\pi}_{r}\left(\frac{\gamma_\epsilon\Lambda^\pi_r}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2}\right) \\
&= \frac{\frac{-\sigma\kappa\gamma_r + \sigma\kappa\gamma_\epsilon(\sigma\phi_x + \sigma\kappa\phi_\pi)}{(1+\sigma\phi_x+\sigma\kappa\phi_\pi)^2}}{\frac{\gamma_r + \gamma_\epsilon(\sigma\phi_x+\sigma\kappa\phi_\pi)^2}{(1+\sigma\phi_x+\sigma\kappa\phi_\pi)^2}} \\
&= \frac{-\sigma\kappa\gamma_r + \sigma\kappa\gamma_\epsilon(\sigma\phi_x + \sigma\kappa\phi_\pi)}{\gamma_r + \gamma_\epsilon(\sigma\phi_x + \sigma\kappa\phi_\pi)^2}
\end{aligned}
$$

$$
\begin{aligned}
\chi_x &= \Lambda^{x}_{\epsilon}\mu^{\epsilon} + \Lambda^{x}_{r}\mu^{r} \\
&= \Lambda^{x}_{\epsilon}\left(\frac{\gamma_r\Lambda^i_\epsilon}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2}\right) + \Lambda^{x}_{r}\left(\frac{\gamma_\epsilon\Lambda^x_r}{\gamma_r(\Lambda^i_\epsilon)^2 + \gamma_\epsilon(\Lambda^i_r)^2}\right) \\
&= \frac{-\sigma\gamma_r + \sigma\gamma_\epsilon(\sigma\phi_x + \sigma\kappa\phi_\pi)}{\gamma_r + \gamma_\epsilon(\sigma\phi_x + \sigma\kappa\phi_\pi)^2}
\end{aligned}
$$

Both are positive if

$$\boxed{\sigma^2_r(\sigma\phi_x + \sigma\kappa\phi_\pi) > \sigma^2_\epsilon}$$

- *Current monetary and news about the future monetary shock*: In this case, we can write the interest rate as $i_t = \Lambda^i_\epsilon\epsilon_t + \Lambda^i_{s^\epsilon}s^\epsilon_t$ and applying the previous definitions we have:

$$
X_t = \begin{bmatrix} \epsilon_t \\ s^\epsilon_t \end{bmatrix} \qquad B_t = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \qquad \Sigma = \begin{bmatrix} \sigma^2_\epsilon & 0 \\ 0 & \sigma^2_{s^\epsilon} + \sigma^2_\epsilon \end{bmatrix}
$$

$$
S_t = i_t \qquad A = \begin{bmatrix} \Lambda^i_\epsilon & \Lambda^i_{s^\epsilon} \end{bmatrix} \qquad \Omega = \sigma^2_\xi \to 0
$$

So, replacing and defining $\gamma_z = \sigma_z^{-2}$, the posterior mean and variance are:

$$
\begin{aligned}
\mu_t &= \begin{bmatrix} \mu^{\epsilon} \\ \mu^{s^{\epsilon}} \end{bmatrix} i_t = \frac{1}{(\Lambda^i_{\epsilon})^2\gamma_{s^\epsilon} + (\Lambda^i_{s^\epsilon})^2(\gamma_\epsilon + \gamma_{s^\epsilon})} \begin{bmatrix} \gamma_{s^\epsilon}\Lambda^i_{\epsilon} \\ (\gamma_\epsilon + \gamma_{s^\epsilon})\Lambda^i_{s^\epsilon} \end{bmatrix} i_t \\
\Gamma &= \frac{\gamma_{s^\epsilon} + \gamma_\epsilon}{(\Lambda^i_{\epsilon})^2\gamma_{s^\epsilon}\gamma_\epsilon + (\Lambda^i_{s^\epsilon})^2\gamma_\epsilon(\gamma_{s^\epsilon} + \gamma_\epsilon)} \begin{bmatrix} (\Lambda^i_{s^\epsilon})^2 & -\Lambda^i_{s^\epsilon}\Lambda^i_{\epsilon} \\ -\Lambda^i_{s^\epsilon}\Lambda^i_{\epsilon} & (\Lambda^i_{\epsilon})^2 \end{bmatrix}
\end{aligned}
$$

With that in hand, we can now write the difference of expectations of output and inflation as:

$$
\begin{aligned}
\mathbb{E}(\omega_t|i_t) - \mathbb{E}(\omega_t) &= \Lambda^{\omega}_{\epsilon}(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t)) + \Lambda^{\omega}_{s^\epsilon}(\mathbb{E}(s^{\epsilon}_t|i_t) - \mathbb{E}(s^{\epsilon}_t)) \\
&= \Lambda^{\omega}_{\epsilon}\mu^{\epsilon} i_t + \Lambda^{\omega}_{s^\epsilon}\mu^{s^\epsilon} i_t \\
&= (\Lambda^{\omega}_{\epsilon}\mu^{\epsilon} + \Lambda^{\omega}_{s^\epsilon}\mu^{s^\epsilon})(i_t - \mathbb{E}(i_t))
\end{aligned}
$$

And with this in hand the coefficients of interest are:

$$
\chi_\pi = \frac{\Lambda^{\pi}_{\epsilon}\Lambda^i_{\epsilon}\gamma_{s^\epsilon} + \Lambda^{\pi}_{s^\epsilon}\Lambda^i_{s^\epsilon}(\gamma_{s^\epsilon} + \gamma_\epsilon)}{(\Lambda^i_{\epsilon})^2\gamma_{s^\epsilon} + (\Lambda^i_{s^\epsilon})^2(\gamma_\epsilon + \gamma_{s^\epsilon})}
$$

This is positive if:

$$
\underbrace{\underbrace{\Lambda^{\pi}_{\epsilon}}_{<0}\,\underbrace{\Lambda^i_{\epsilon}}_{>0}}_{<0}\,\underbrace{(\gamma_{s^\epsilon}}_{>0} + \underbrace{\underbrace{\Lambda^{\pi}_{s^\epsilon}}_{<0}\,\underbrace{\Lambda^i_{s^\epsilon}}_{<0}\,\underbrace{(\gamma_{s^\epsilon} + \gamma_\epsilon)}_{>0}}_{>0} \;>\; 0
$$

And

$$
\chi_x = \frac{\Lambda^{x}_{\epsilon}\Lambda^i_{\epsilon}\gamma_{s^\epsilon} + \Lambda^{x}_{s^\epsilon}\Lambda^i_{s^\epsilon}(\gamma_{s^\epsilon} + \gamma_\epsilon)}{(\Lambda^i_{\epsilon})^2\gamma_{s^\epsilon} + (\Lambda^i_{s^\epsilon})^2(\gamma_\epsilon + \gamma_{s^\epsilon})}
$$

This is positive if:

$$\underbrace{\underbrace{\Lambda^x_\epsilon}_{<0}\underbrace{\Lambda^i_\epsilon}_{>0}}_{<0}\underbrace{(\gamma_{s^\epsilon})}_{>0}+\underbrace{\underbrace{\Lambda^x_{s^\epsilon}}_{<0 \text{ if } \phi_\pi<\frac{1+\sigma\kappa}{\beta\sigma\kappa}}\underbrace{\Lambda^i_{s^\epsilon}}_{<0}\underbrace{(\gamma_{s^\epsilon}+\gamma_\epsilon)}_{>0}}_{>0 \text{ if } \phi_\pi<\frac{1+\sigma\kappa}{\beta\sigma\kappa}} \quad > \quad 0$$

The reaction of inflation then is sometimes positive depending on the model's parameters (happens when σ, ϕ_x, κ, ϕ_π are relatively high). The output reaction is negative for all the parameter values described in Table 22 and any combination of the standard deviation of the shocks. The reason is that even if the equations generally meet the condition $\phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}$, it is impossible to increase the importance of the second factor, which is the positive one, relative to the first. The reason behind this is that they are both from the same shock (cannot decrease γ_ϵ below zero and changes in γ_{s^ϵ} affect both terms at the same time.

- *Current monetary and news about the future natural rate shock*: In this case, we can write the interest rate as $i_t = \Lambda^i_\epsilon \epsilon_t + \Lambda^i_{s^r} s^r_t$ and applying the previous definitions we have:

$$X_t = \begin{bmatrix} \epsilon_t \\ s^r_t \end{bmatrix} \qquad B_t = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \qquad \Sigma = \begin{bmatrix} \sigma^2_\epsilon & 0 \\ 0 & \sigma^2_{s^r}+\sigma^2_r \end{bmatrix}$$

$$S_t = i_t \qquad A = \begin{bmatrix} \Lambda^i_\epsilon & \Lambda^i_{s^r} \end{bmatrix} \qquad \Omega = \sigma^2_\xi \to 0$$

So, replacing and defining $\gamma_z = \sigma_z^{-2}$, the posterior mean and variance are:

$$\begin{aligned}
\mu_t &= \begin{bmatrix} \mu^\epsilon \\ \mu^{s^r} \end{bmatrix} i_t = \frac{1}{(\Lambda^i_\epsilon)^2\gamma_r\gamma_{s^r} + (\Lambda^i_{s^r})^2(\gamma_r+\gamma_{s^r})\gamma_\epsilon} \begin{bmatrix} \gamma_r\gamma_{s^r}\Lambda^i_\epsilon \\ \gamma_\epsilon(\gamma_r+\gamma_{s^r})\Lambda^i_{s^r} \end{bmatrix} i_t \\
\Gamma &= \frac{\gamma_{s^r}+\gamma_r}{(\Lambda^i_\epsilon)^2\gamma_{s^r}\gamma_r + (\Lambda^i_{s^r})^2\gamma_\epsilon(\gamma_{s^r}+\gamma_r)} \begin{bmatrix} (\Lambda^i_{s^r})^2 & -\Lambda^i_{s^r}\Lambda^i_\epsilon \\ -\Lambda^i_{s^r}\Lambda^i_\epsilon & (\Lambda^i_\epsilon)^2 \end{bmatrix}
\end{aligned}$$

With that in hand, we can now write the difference of expectations of output and inflation as:

$$\begin{aligned}
\mathbb{E}(\omega_t|i_t) - \mathbb{E}(\omega_t) &= \Lambda^{\omega}_{\epsilon}(\mathbb{E}(\epsilon_t|i_t) - \mathbb{E}(\epsilon_t)) + \Lambda^{\omega}_{s^r}(\mathbb{E}(s^r_t|i_t) - \mathbb{E}(s^r_t)) \\
&= \Lambda^{\omega}_{\epsilon}\mu^{\epsilon} i_t + \Lambda^{\omega}_{s^r}\mu^{s^r} i_t \\
&= (\Lambda^{\omega}_{\epsilon}\mu^{\epsilon} + \Lambda^{\omega}_{s^r}\mu^{s^r})(i_t - \mathbb{E}(i_t))
\end{aligned}$$

And with this in hand the coefficients of interest are:

$$\chi_\pi = \frac{\Lambda^{\pi}_{\epsilon}\Lambda^{i}_{\epsilon}\gamma_r\gamma_{s^r} + \Lambda^{\pi}_{s^r}\Lambda^{i}_{s^r}\gamma_\epsilon(\gamma_{s^r} + \gamma_r)}{(\Lambda^{i}_{\epsilon})^2\gamma_r\gamma_{s^r} + (\Lambda^{i}_{s^r})^2(\gamma_r + \gamma_{s^r})\gamma_\epsilon}$$

This is positive if:

$$\underbrace{\underbrace{\Lambda^{\pi}_{\epsilon}}_{<0}\underbrace{\Lambda^{i}_{\epsilon}}_{>0}}_{<0}\underbrace{(\gamma_{s^r}\gamma_r)}_{>0} + \underbrace{\underbrace{\Lambda^{\pi}_{s^r}}_{>0}\underbrace{\Lambda^{i}_{s^r}}_{>0}\underbrace{\gamma_\epsilon(\gamma_{s^r} + \gamma_r)}_{>0}}_{>0} > 0$$

$$\chi_x = \frac{\Lambda^{x}_{\epsilon}\Lambda^{i}_{\epsilon}\gamma_r\gamma_{s^r} + \Lambda^{x}_{s^r}\Lambda^{i}_{s^r}\gamma_\epsilon(\gamma_{s^r} + \gamma_r)}{(\Lambda^{i}_{\epsilon})^2\gamma_r\gamma_{s^r} + (\Lambda^{i}_{s^r})^2(\gamma_r + \gamma_{s^r})\gamma_\epsilon}$$

This is positive if:

$$\underbrace{\underbrace{\Lambda^{x}_{\epsilon}}_{<0}\underbrace{\Lambda^{i}_{\epsilon}}_{>0}}_{<0}\underbrace{(\gamma_{s^r}\gamma_r)}_{>0} + \underbrace{\underbrace{\Lambda^{x}_{s^r}}_{>0 \text{ if } \phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}}\underbrace{\Lambda^{i}_{s^r}}_{>0}\underbrace{\gamma_\epsilon(\gamma_{s^r} + \gamma_r)}_{>0}}_{>0 \text{ if } \phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}} > 0$$

Similarly to the previous case, the output's reaction can become positive first if the parameters satisfy $\phi_\pi < \frac{1+\sigma\kappa}{\beta\sigma\kappa}$. And then, for both to become positive, we need to increase the importance of the part about the news about the natural rate. The positive part will more than outweigh the negative one when the variability of the natural rate is relatively high (precision low), and the variability of the monetary shock is relatively low (precision high). The conclusion is then similar to the case of current monetary and natural rate shocks, but the condition to satisfy a positive value is even more challenging for output.

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