The Transmission of International Monetary Policy Shocks to Firms' Expectations*

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August 4, 2023

Abstract

Motivated by the dominant role of the US dollar, we explore how monetary policy (MP) shocks in the US can affect a small open economy through the expectation channel. We combine data from a panel survey of firms' expectations in Uruguay with granular information about firms' debt position and total imports. We show that a contractionary MP shock in the US reduces firms' inflation and cost expectations in Uruguay. This result contrasts with the effect of this shock on the Uruguayan economy, suggesting uncertainty about the policy regime. We discuss the issues and challenges of this expectation channel.

Keywords: Firms' Expectations, Global Financial Cycle, Monetary Policy Spillovers
JEL codes: E31, E58, F41, D84, E71

*We thank Katharina Bergant, Larry Christiano, Olivier Coibion, Ed Knotek, Ina Hajdini, Aeimit Lakdawala, Gerardo Licandro, Tumisang Loate, Juan Pablo Medina, José Mourelle, Ernesto Pastén, Giovanni Ricco, Alejandro Vicondoa, Michael Weber and seminar participants at the Federal Reserve Bank of Cleveland, the Uruguayan Central Bank, SECHI, LACEA-LAMES and the ERSA CEPR conference for useful comments and suggestions. The views expressed here are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Cleveland or the Federal Reserve System.

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1 Introduction

Expectations about *future* conditions are relevant as they significantly affect firms' *current* decisions. The impact of expectations on decisions operates by transmitting news and as a source of shocks (Born et al. (2021)). Existing evidence suggests that expectations matter for firms' current hiring, pricing, investment and borrowing decisions (Coibion, Gorodnichenko, and Ropele (2020), Ropele, Gorodnichenko, and Coibion (2022)). Although there is evidence studying the different factors that shape agents' expectations, very little is known about whether policy decisions across borders matter for firms' expectations in small open economies.

In this paper, we study the transmission of international monetary policy (MP) shocks on firms' expectations about the local economy and their idiosyncratic conditions. We characterize the main channels along which shocks across borders propagate through expectations and discuss their effects on the local economy. Using a panel survey of Uruguayan firms' expectations, we provide novel evidence about a new channel by which monetary policy abroad can push firms to revise expectations about their local economy and markets, both in the short *and* medium run. Hence, besides the local monetary authority's response to attenuate the direct effects of an external shock, we document that there are additional indirect consequences of such shocks as it also affects the beliefs of price-setters in the local economy. Thus, the task of domestic central banks to stabilize expectations becomes even more challenging as policy decisions abroad are not inconsequential for local expectations.

Every month, a panel of Uruguayan firms are asked to report their expectations about the country's inflation and how much they expect their costs to change over different time horizons. Previous work (for example, Frache, Lluberas, and Turen (2021) and Weber et al. (2023)) have shown that firms in this survey are well informed about current inflation. Motivated by the role of US monetary policy in the "global financial cycle" (GFC, Miranda-Agrippino and Rey (2020)) we show that a contractionary monetary policy shock in the US significantly reduces inflation expectations at both 12 and 24 months ahead. An unexpected

1 percentage point increase in the policy rate in the US decreases Uruguayan firms' inflation expectations one and two years ahead by about 0.8 percent after 10 months. We find a similar effect for firm's cost expectations at 12 and 24 months: a 1 percentage point increase in the policy rate in the US decreases firms' cost expectations one and two years ahead by around 0.4 percent after one year. Our results suggest that global shocks significantly affect firms' expectations *outside* the US.

This result is consistent with the contractionary effects of a US MP shock discussed by Degasperi, Hong, and Ricco (2020). We estimate the impact of such shock on the Uruguayan economy and find that the contractionary shock depreciates the peso against the US dollar and leads to a drop in economic activity.[1] Inflation reaction is statistically zero. The effect is small and mildly positive after 8-12 months, but remains not statistically significant after 24 months. The response of inflation is therefore at odds with firms' expectations, that adjust their predictions negatively. While this result sounds puzzling initially, it can be rationalized by looking at the recent history of exchange rate interventions in Uruguay. The result is consistent with firms expecting an intervention from the monetary authority to defend the currency's value, leading to a contraction in economic activity, which would reduce prices. We use the data to learn about the expectation process of firms and argue that policy history might scar firms' beliefs.[2] Under misspecified beliefs, firms might not know the true policy regime, hindering monetary authorities' policy. Our result then lays out additional challenges central banks can face in the presence of global shocks and information frictions. Before going through these results in further detail, we gather evidence on firms' decisions using other data sources.

We merge the survey with administrative data containing rich information about the

[1]Throughout the paper, we will refer to the nominal exchange rate as the amount of Uruguayan pesos per one US Dollar. Hence, an increase in the exchange rate is interpreted as a depreciation of the local currency relative to the US dollar.

[2]Therefore, our interpretation is consistent with Kozlowski, Veldkamp, and Venkateswaran (2020), which argues that recessions have long-lasting and persistent effects on the real economy, since they scar agents' beliefs. In particular, once an extreme economic event is realized, it becomes part of the agents' information set affecting their future risk assessment and beliefs.

firm. In particular, we have information about firms' debt with details about the currency and maturity position. In addition, we have information about firms' exports and imports. With these data we run two types of exercises. First, we assess the heterogeneous effects of the MP shock on expectations as a function of firms' debt position. We find that indebted firms decrease less their inflation expectations; the overall effect is compensated by firms with debt denominated in US dollars. We then explore firms' decisions. We show that a contractionary MP shock in the US decreases the share of debt denominated in US dollars. This effect is stronger for medium- and long-term debt. We also find that firms with a larger share of debt denominated in US dollars tend to *increase* their total imports immediately after the shock. This suggests an anticipation effect caused by the expected depreciation of the Uruguayan *peso* relative to the US dollar due to the shock.[3]

In light of our results, we use the survey to understand the expectation formation process of firms. The survey includes a question about inflation expectations over a fixed period (end of the year). Using this information and relying on the panel structure, we can measure forecasting revisions at the firm level. Through this measure, and building on the test proposed by Bordalo et al. (2020), we estimate whether firms tend to over or under-react to information. We find strong evidence of *under-reaction* to new information across firms, which is consistent with models of costly information or with firms being tied to their past forecasts or memory (Coibion and Gorodnichenko (2015), Pedemonte, Toma, and Vertugo (2023)). Since firms do not incorporate all the available information to update their beliefs, we conjecture that they tend to rely on past knowledge or experience to revise their forecasts.

Furthermore, and in line with the previous empirical results, we incorporate this information formation process into a simple DSGE model a là Gali and Monacelli (2005). We allow firms to have a misperception about the policy framework. In particular, firms react to the current macroeconomic outcomes but form expectations putting some weight on the possibility that the economy is in an exchange rate peg, as it has been historically. This behavior might come

[3] Candia and Pedemonte (2021) discuss a similar anticipation effect after the US left the gold standard and the US dollar slowly depreciated in 1933.

from the use of memory (Bordalo et al. (2023)) or other availability heuristic (Tversky and Kahneman (1973)). In the model, firms observe a depreciation and expect a local tightening of the monetary policy with a certain probability. We discipline that probability through the empirical results of the forecasting revision exercise. Due to this misperception, firms react by expecting a reduction in prices. The model economy reacts to the shock with lower CPI inflation and a strong local currency depreciation. Hence, it helps us rationalize some of the underlying mechanisms that could explain the observed responses.

To the best of our knowledge, our paper is the first empirical attempt to show that US MP can also have an impact on firms' expectations beyond its already studied effects. We show that policy uncertainty about the reaction of the monetary authority to external shocks can produce puzzling responses of firms. This finding adds another challenge for local central banks beyond the ones discussed in the GFC literature. These results have important implications for emerging economies where the US dollar price is an important indicator tracked by households and firms. While the central bank can have a defined policy rule, households and firms might perceive the depreciation of the local currency negatively, and then react accordingly. In that sense, good policy communication can help to align expectations with policies. This finding also applies to developed economies. Coibion et al. (2023) show that the public remained mainly uninformed about changes in the policy regime in the US.

Firms' inflation expectations play an important role in economic decisions. Recent work has shown that changes in inflation expectations can affect economic decisions, as shown in Coibion, Gorodnichenko, and Ropele (2020). While Coibion, Gorodnichenko, and Kumar (2018) show that firms' inflation expectations in countries with low inflation are disperse and apparently unanchored, Frache, Lluberas, and Turen (2021) show that this is not necessarily the case in higher inflationary environments. Moreover, Frache, Lluberas, and Turen (2021), using the same survey from Uruguay, show that price-adjustment decisions are correlated with firms' beliefs about the evolution of their future cost. D'Acunto et al. (2021) show that

consumers' inflation expectations are shaped by their own experiences. Similarly, Binder and Makridis (2022) find that consumers that experienced the oil crisis in the 70s are more pessimistic about oil shocks today. This result is in line with our modeling approach, where firms remember the past policy framework and adjust expectations considering that experience. As explained in Coibion et al. (2020), communication from monetary authorities can affect firms expectations under certain conditions. In addition, they show that changes in firms' inflation expectations, measured by surveys, affect firms' economic decisions. While there is evidence on how local shocks affect firms' expectations, in this paper we explore how international shocks can affect expectations and how this channel matters when analyzing the implications of international shocks.

The GFC has been studied recently and many works have shown how international shocks can affect the local economy. This was initially motivated by Rey (2015) and Miranda-Agrippino and Rey (2022), but new studies, such as Degasperi, Hong, and Ricco (2020), also show that international monetary policy shocks affect other economies. The consequence outlined in this literature is that local economic authorities, in particular central banks, have a harder time when trying to stabilize output. In this paper we add a new layer to understand the mechanisms behind those effects. On one side we show that a MP shock in the US affects firms' inflation and cost expectations, suggesting an expectation channel of the GFC. In addition, we provide micro-level evidence of firms' reactions after a global MP shock in terms of debt and imports. These findings help us to understand the mechanism behind the effects found in works such as Miranda-Agrippino and Rey (2020) and Degasperi, Hong, and Ricco (2020).

Gopinath et al. (2020) exposed the role of the US dollar as a dominant currency and studied how US MP shocks can affect outcomes abroad. In that context, Egorov and Mukhin (2021) show that the effect of a US MP shock on prices abroad depends on the policy reaction of the local central bank. An increase in the US policy rate produces a depreciation of the local currency, while there is little expenditure switching for exports, as firms export their

products in US dollar everywhere. The depreciation increases the price of imports, thus increasing local CPI inflation, producing a decrease in output. Depending on the policy rule, this effect can be offset by the local central bank. If the central bank wants to protect the currency, local CPI can decrease as a result of the aggressive policy reaction. Our empirical result suggests that firms react in line with these predictions.

The rest of the paper is organized as follows. Section 2 describes the data we use in this paper. Section 3 discusses empirically how an international MP shock affects firms' expectations in Uruguay. Section 4 then shows the effects of the shock on firms' dollar-denominated debt and on their import decisions, operating through the expectation channel. Section 5 concludes.

2 Data

In this section, we describe the data sources we use. As discussed, we do not rely solely on a fairly novel and unexplored panel survey of firms' expectations in Uruguay; instead, we combine this information with granular data at a monthly frequency from firms' credit records and administrative customs data.

2.1 Firms' data

We use the Uruguayan survey on firms' expectations carried out by the National Statistical Institute (INE) and commissioned by the Central Bank of Uruguay (BCU). Each month since October 2009 a representative sample of around 600 firms with at least 50 employees are questioned about their expectations. The firms receive the questionnaire by e-mail on the first day of each month and have until the end of the month to answer it. Even though it is not compulsory to answer the questionnaire, the response rate has ranged between 54% and 88%. The resulting sample is an unbalanced panel and representative of all the economic sectors, except for the financial, agricultural, and public sectors. The database

we use in this paper, from October 2009 to March 2020, is a long panel with a total of 132 months. During the sample period, 573 firms completed the survey at least once, with 6% answering less than 20 times and 80% at least 57 times. There are 377 firms (65% of the total) that regularly answer the questionnaire and for which we have at least 80 monthly observations. We restrict our sample period until March 2020 to remove the possible effects of the COVID-19 pandemic. We don't trim any answer for our sample period, as there are not large outliers as in other surveys.

Firms are asked about their inflation expectations, i.e., the expected annual change in the consumer price index, along with their own cost expectations, i.e., the expected change in their total production costs in local currency over different time horizons: (1) until the end of the current year, (2) over the next 12 months and (3) over the next 24 months. We focus on expectations at the 12- and 24-month horizon.

For further specific details about the survey, along with a comparison with other existing surveys of firms' expectations, we refer the reader to Appendix A and Frache, Lluberas, and Turen (2021).

Endowed with this unique long survey, we merge firms' expectations with monthly data on firms' credit positions with the financial sector. We extract this information from the Credit Register of the *BCU*. The Credit Register is a public database with information on all loans issued by the regulated financial sector to firms and households. In particular, we are able to collect information about firms' total credit, the specific bank that is lending money to the firm, the length of the credit (short, medium and long term) and more importantly, whether the credit was *issued* in either local currency (Uruguayan peso) or US dollars. Hence, we are able to characterize firms' financial position and merge this information with firms' expectations on a monthly basis.

Since Uruguay lacks a well-developed equity market, credit access by firms is not common. Even though our expectations survey sample is composed of relatively large firms (i.e., with more than 50 employees), about 40 percent of the firms included in the original sample do

not borrow from the financial sector during our sample period. Although there has been a decline in USD-denominated credit, firms still borrow in USD. On average, the proportion of USD-denominated credit among firms is 71 percent.

Finally, we also collect customs data at the firm level extracted from the General Customs Administration (*Direccón General de Aduanas, DGA*). We have monthly data on total goods imports of each firm available continuously for all years covering our sample of analysis. In our study we use the quarterly average of total imports by firm and classify them using the Broad Economic Categories (BEC Revision 5) to analyze how goods' imports evolve by end-use category.

2.2 Monetary policy shocks

We rely on the series for monthly US monetary policy shocks proposed by Bu, Rogers, and Wu (2021). This series has appealing features relative to existing alternatives. First, it bridges conventional and unconventional monetary policy episodes while removing the Fed's information effects. This is relevant for us to cleanly assess the transmission of a pure MP shock to foreign firms' expectations. Moreover, the shock series is also orthogonal to relevant available information from agents.[4] Second, this series is constantly updated at a monthly frequency, so we have more up-to-date information relative to existing alternatives, such as Romer and Romer (2004) or Nakamura and Steinsson (2018). Third, while the identification procedure differs from other MP shock series, the correlation between Bu, Rogers, and Wu (2021) series and others is high and significant. In particular, before 2008 the series display a very similar patterns relative to other MP shock series. Then, after 2008, while Bu, Rogers, and Wu (2021)'s series exhibits large movements, other existing shock series are quite small and less volatile mostly due to the presence of the Zero-Lower Bound. Based on the time-

[4]The shock series is computed through a two-step estimation procedure. The first step studies the sensitivity of zero-coupon yields with different maturities to monetary policy, which is proxied with the 2-yr Treasury Yield. Using the estimated sensitivity, the second step aims to recover the monetary policy shock using cross-sectional regressions of the change in the different yields on the estimated sensitivity index recovered from the first step. We will refer to Bu, Rogers, and Wu (2021) for further details about the identification and estimation procedure.

window of our firm's survey, this is another appealing feature of this particular series.

Although our main results are all based on Bu, Rogers, and Wu (2021)'s MP shock series, for completeness in Appendix E we show that our main results are robust to other MP shocks, such as the one proposed by Nakamura and Steinsson (2018) and extended by Acosta (2022) and the series proposed by Gürkaynak, Sack, and Swanson (2005). In addition, in Appendix D we contrast the implications of an international shock with a series of monetary policy shocks in Uruguay according to Basal et al. (2016).

3 The transmission of US monetary policy shocks

There is a relevant strand of literature, motivated by Rey (2015), that studies the existence of a global financial cycle. In particular, the work of Miranda-Agrippino and Rey (2020) documents a financial channel through which monetary policy conducted by the Federal Reserve has a global impact. In addition, work on the role of the US dollar as the dominant currency explains how a US monetary contraction can have global effects, through changes in the nominal exchange rate, since firms price their exports in this currency (Gopinath et al. (2020)). In that context, Miranda-Agrippino and Rey (2020) find that after a contractionary US monetary policy shock, there is a short-term decrease in real global activity outside the US, which then recovers and expands after a year. Nominal exchange rates in the UK and the EU increase (i.e. local currencies depreciate against the US dollar) on impact and remain at the new level for between one and two quarters.

Similarly, Degasperi, Hong, and Ricco (2020) estimate the effect of US monetary policy shocks on a panel of countries. They show that US monetary policy strongly affects relevant economic variables outside of the US. While we rely on these results, in this section, we compute the effects of US monetary policy on the Uruguayan economy.

3.1 MP in Uruguay and the "Fear of floating"

After the 2002 financial and economic crisis, Uruguay started a process to gradually adopt an inflation-targeting regime, leaving a period during which the policy target was the exchange rate. During this process, both the inflation target range and the monetary policy instrument were revised on many occasions. While initially, the target was not explicit and the objective was M1 growth, the objective turned to an inflation range shortly afterward. The inflation target range was between 4 and 6 percent until June 2014, then widened to 3 and 7 percent until August 2022. From July 2013 until August 2020, a window that covers all our sample period, the monetary policy instrument adopted by the Central Bank was $M1'$.[5] With few exceptions, inflation was most of the time above the upper bound of the central bank target range (see Figure 9 in Appendix A).

Uruguay has a dollarized economy with a recent history of Central Bank's interventions in the foreign exchange market. In the analyzed period, the authorities claim a floating exchange rate regime is in place. Therefore, the match between agents' perceptions and the actual exchange rate regime is crucial. This is related with the term "fear of floating". This concept was originally proposed by Calvo and Reinhart (2002) to characterize countries that claim they allow their exchange rate to freely float, but frequently intervene to avoid abrupt fluctuations in the nominal exchange rate. In their setting, fear of floating arises due to the dollarization of debt, a lack of credibility that results in high risk premiums, a high pass-through of the exchange rate to domestic prices, and inflation targeting. According to Calvo and Reinhart (2002), floaters should show high fluctuations in their exchange rate and low fluctuations in their foreign reserves.

Ilzetzki, Reinhart, and Rogoff (2019) show that the majority of countries remain under a limited flexibility exchange rate regime, at least in the period between 1946 and 2016. They propose a classification based on the anchor currency and the exchange rate regime.

[5] $M1'$ includes currency in circulation, checking account deposits, and non-interest-bearing savings accounts.

Under their classification, Uruguay followed a *de facto crawling band that is narrower than or equal to +/-5 percent* between 2003, after abandoning a pre-announced crawling band. If we extend the analysis of Ilzetzki, Reinhart, and Rogoff (2019) to the period 2017-2019, just before the COVID-19 pandemic, the absolute value of the average monthly change in the exchange rate suggests that Uruguay can still be considered to be following a *de facto crawling band that is narrower than or equal to +/-5 percent*. Also, in the early 2000s, the Central Bank of Uruguay intervened several times. As an example, Puppo and Gari (2009) show that between 2004 and 2006, the central bank intervened the exchange rate market in 351 opportunities.

In Appendix B we complement this evidence with the help of text analysis tools. First, we use an open question of the inflation expectations survey, which asks about the arguments supporting the reported expectations. We find that during the sample period, the word "dollar" comes after inflation and before wages, costs, and macroeconomics, reflecting how relevant is the exchange rate for firms. Secondly, we construct a text index to reflect the relative relevance of the exchange rate over time. We build this index based on the firms' voluntary responses and the Monetary Policy Committee memo. On average, 31.3% of the sentences in the firms' answers contain the word dollar, instead, that frequency falls to 2.9% in the monetary policy reports. Finally, we study the correlation between those indexes with the exchange rate between the peso and the US dollar and, also, with inflation. While the firms' index correlates positively with the exchange rate, the central bank's index does not. Nonetheless, this situation reverses when we analyze the correlation with inflation. We take these results as suggestive evidence of firms' perception about the relevance of the exchange rate in the Uruguayan economy and how the Central Bank increases its mentions to the exchange rate when inflation accelerates, in spite of being in a floating exchange rate regime.

3.2 Effect of MP shocks on the domestic economy

When the Federal Reserve tightens, we expect an outflow of capital from Uruguay and consequently a depreciation of the Uruguayan peso against the US dollar. Given the exchange rate pass-through, the depreciation is expected to affect inflation as well, and this effect should be exacerbated in the context of the US dollar being the dominant currency. Depending on the magnitude of the adjustment, we expect the interest rate in Uruguay to react in line with the central bank's response to the external monetary policy shock.

To test whether an unexpected increase in interest rates in the US affects inflation, the nominal exchange rate and the interest rate in Uruguay, we estimate the following equation through Jordà's (2005) local projections method:

$$\Delta(\%)X_{t+h,t-1} = \alpha + \sum_{j=0}^{J} \beta^{h,j} MP_{t-j} + \sum_{j=1}^{J} \theta^{h,j} \Delta(\%)X_{t,t-j} + \varepsilon^{h}_{t+h}, \ \forall h \in [0, H] \qquad (1)$$

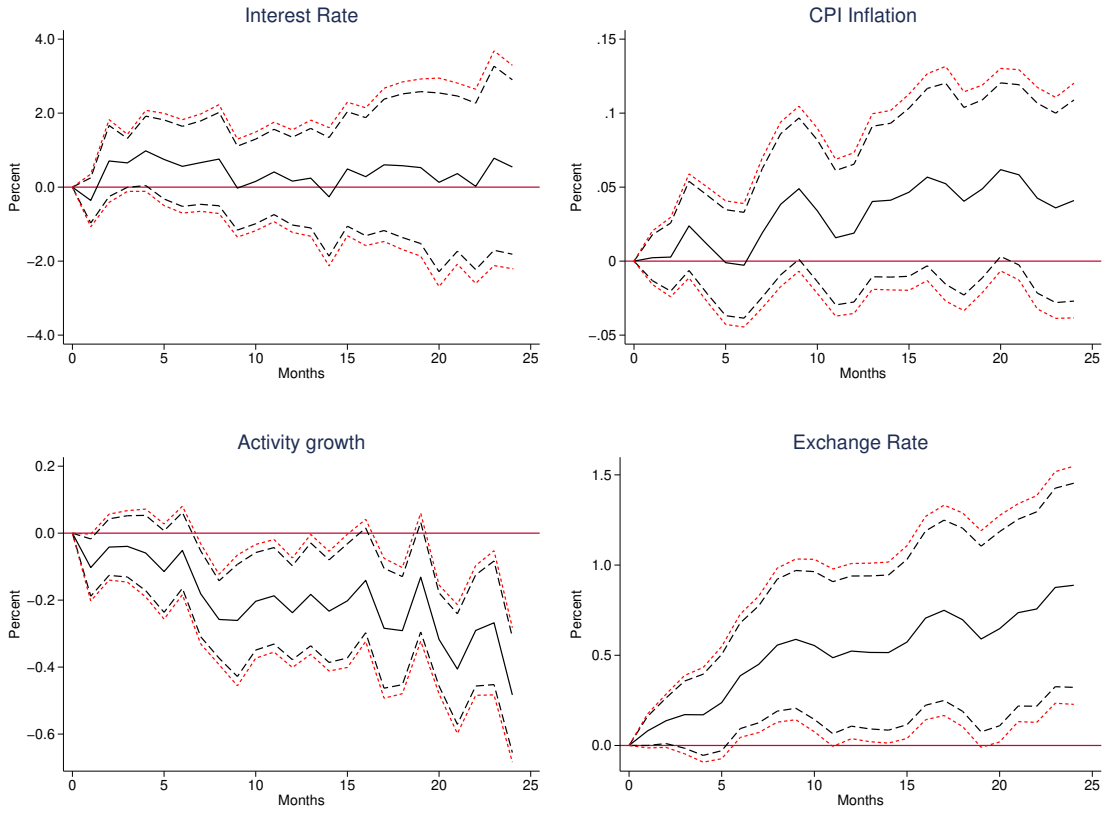
where $\Delta(\%)X_{t+h,t} = \frac{X_{t+h} - X_t}{X_t}$. X_t is an outcome in time t that could be i_t, a proxy for a short-term interest rate; π_t, the Uruguayan inflation rate; y_t, the growth of local activity; or FX_t, the nominal exchange rate in Uruguay.[6] Moreover, MP_t is the US monetary policy shock according to Bu, Rogers, and Wu (2021) at time t. We control for lags of the change in variable X_t and lags of the monetary policy shock. Our parameter of interest is $\beta^{h,0}$ which captures the direct effect of monetary policy shocks in the US on the interest rate, inflation, economic activity, and nominal exchange rate in Uruguay in period h after the shock. We use the sample from 2009 to February 2020.[7] The IRFs for each variable are shown in Figure 1.

We find that a contractionary monetary policy shock in the US causes a significant and

[6] Local economic activity in Uruguay is measured by the monthly index of economic activity (in Spanish, *Indice mensual de actividad economica (IMAE)*) constructed by the Central Bank of Uruguay. The nominal exchange rate is measured by the amount of Uruguayan pesos per US dollar.

[7] While our main results in terms of expectations use a smaller sample, from 2014 to February 2020, to be able to match the data with different samples, in Appendix F we show that the result for expectations are the same in terms of the direction for a sample from 2009.

Figure 1: Effect of US MP shocks on the domestic economy



Note: The upper panel shows the effect of a monetary shock in the US for the interest rate (upper left panel) and CPI (upper right panel) in Uruguay. The lower figures show the effect of that monetary policy shock for the years 2009 to 2020 on economic activity (lower left panel) and on the exchange rate, defined as Uruguayan Peso to US Dollar (lower right panel). For the lower panel figures, the results come from estimating (1), were the dependent variable is the percentage change between the base period and H. We use $J = 12$ and robust standard error. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

persistent contraction in economic activity in Uruguay that materializes approximately seven months after the shock. Moreover, the international shock also causes a depreciation of the Uruguayan peso against the US dollar. Both of these results are consistent with the findings of Degasperi, Hong, and Ricco (2020) for a panel of countries. This will obviously affect firms more exposed to the exchange rate, such as those holding a large share of their debt denominated in US dollars or those that import their inputs or final products to sell in the domestic market. The effect on interest and prices are not statistically significant.

To contrast these effects, we estimate (1), but now we use a monetary policy surprise *in*

Uruguay instead.[8] As expected, after a tightening of monetary policy in the local economy, domestic inflation reacts negatively and local interest rates rise. The accumulated effect on inflation is around a 2 percent drop five to six quarters after the shock. Interestingly, in this case, although there is a mild appreciation of the peso right after the shock, there is no meaningful or significant reaction of this variable to the local shock in contrast to the persistent and significant response after the external shock. The specific results for the local shock are discussed in Appendix D.

3.3 Effect of MP shocks on firms' expectations

We now move to study the effect of the international MP shocks on Uruguayan firms' expectations. While a monetary policy shock in the US can affect firms' expectations through different channels, as discussed in the previous section, we expect that the local economic authorities adjust their decisions to partially mute these potential effects. In particular, if local monetary authorities are actively trying to reduce the effects of those shocks, local inflation should not be affected and then expectations should remain relatively stable. Therefore, we will assess whether short-run expectations (one year ahead) and medium run expectations (two years ahead) respond to MP shocks abroad while studying any dynamic features. We will explore the reaction of both local inflation and expectations about costs separately. Then, we will also explore whether firms react to these changes conditioning on their different exposure to the US dollar.

Previously we discussed the effects of US monetary policy shocks in Uruguay and how a monetary policy tightening in the US would have different effects abroad depending on the policy reaction.In the case of Uruguay, the official policy is a medium-run inflation-targeting regime with a floating exchange rate. The empirical results are consistent with those findings: the Uruguayan peso depreciates and there is a small pass-through to inflation, while policy

[8]In this case, the series of MP surprises in the local economy are backed out from a DSGE model, which is one of the models used by the Central Bank of Uruguay to guide its policy decisions. For references see Basal et al. (2016). Although the interpretation is the same, the model is calibrated at the quarterly frequency, so we adjust our estimates accordingly.

tightens slightly and the economy contracts. The effect on prices is a moderate inflation. In this section, we will see whether firms form their expectations in line with those reactions. In Appendix D we show that firms form expectations in a similar fashion to what happens in the aggregate economy, after a monetary policy shock in Uruguay.

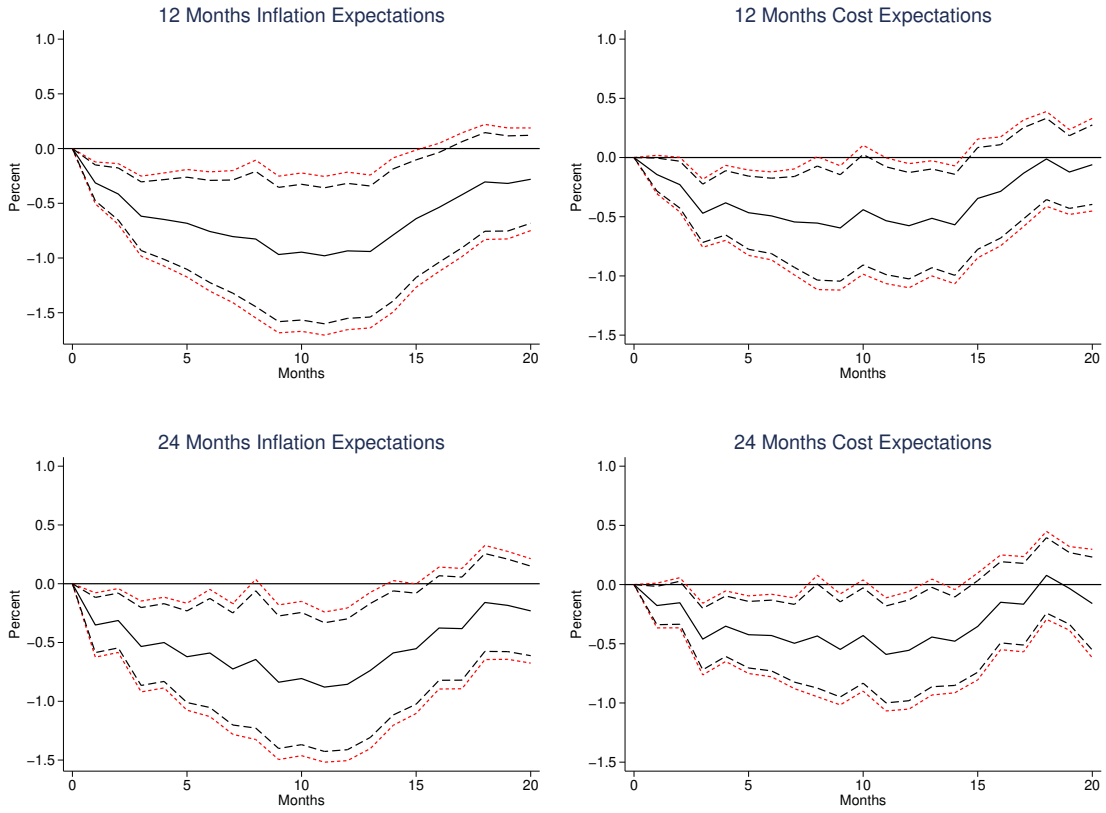
We again rely on Jordà's (2005) local projections method specification as in (1), but we specify it in a panel version as in Auerbach and Gorodnichenko (2012) and Herreño and Pedemonte (2022). Specifically, we run:

$$\Delta(\%)X_{i,t+h,t} = \alpha_i^h + \sum_{j=0}^{J} \beta^{h,j} MP_{t-j} + \sum_{j=0}^{J} \theta^{h,j} \Delta(\%)X_{i,t,t-j} + \varepsilon_{i,t+h}^h, \ \forall h \in [0, H] \qquad (2)$$

The dependent variable is $\Delta(\%)X_{i,t+h,t}$, defined as a percentage change as before, but for an individual firm. $X_{i,t}$ is firm i's expectation for inflation or costs at either 12 months or 24 months horizon. Since inflation was relatively volatile over that period of time and firms' expectations can have even more dispersed values, we use the percentage change of firms' expectation, as a way to control for the baseline inflation of the firm before the shock. Given the panel structure, we also include a firm-specific fixed effect α_i^h. That value capture the sample average, but does not necessarily sets a baseline before the shock. Instead it controls by the firm information over the sample, and any numerical bias that the firm might have on average, so we focus on firms' changes with respect to their average change. We use the monetary policy shock proposed by Bu, Rogers, and Wu (2021) as in the previous section. In Appendix E we show that our results are robust to the use of other shocks. In addition, we use a sample size from January 2014 to March 2020 so that our results are comparable with those in the next section, where we merge the survey with administrative data available only since 2014. In Appendix F, we also show that when we use a sample size starting in 2009 we obtain similar results. Figure 2 shows the results.

A positive monetary policy shock is associated with a significant decrease in inflation expectations and cost expectations on both horizons. This result shows that firms didn't

Figure 2: Effect of US MP shocks on firms' expectations



Note: This figure shows the effect of a monetary policy shock on firms' 12-month inflation expectations (upper left), 12-month own cost expectations (upper right), 24-month inflation expectations (lower left), and 24-month own cost expectations (lower right). The results come from estimating (2), where the dependent variable is the firms specific percentage change between the base period and H. We use $J = 12$. Standard errors are clustered at the time and firm level. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

follow what happened in the Uruguayan economy. In Section 3.2, we showed that, although not statistically significant, inflation slightly increased after a US monetary policy shock. The shock reduced economic activity and produced a slightly increase in the policy rate. In addition, it produced a depreciation of the Uruguayan peso against the US dollar. The results on the firm side are in line with a contractionary policy shock, but it seems that firms overestimate the effect of the shock on prices. In terms of magnitudes, the effects are significant. The plot shows the percentage changes for each individual firm. Over the sample, the shock has a standard deviation of 0.03, or 3 basis points. This means that one standard deviation of the shock decreased firms' inflation expectations by approximately 3 percent after 10 months. The average inflation expectation of firms over the sample is 9.33 percent,

meaning that the decrease after a one standard deviation of the shock is 0.28 percentage points in terms of inflation expectations.

For the case of the US, the empirical literature has studied the effects of a monetary policy shock. As discussed by Romer and Romer (2004), a contractionary monetary policy shock decreases wages and output in the economy. The drop in overall production should also reduce wages (Herreño and Pedemonte (2022) and Bergman, Matsa, and Weber (2022)), thus reducing firms' costs. Firms not only expect a drop in the overall price level as a consequence of the shock, they also revise their cost expectations downward. Related to the significance of the dynamic response, the results also suggest that the Central Bank of Uruguay was not able to neutralize the effect of the shock in terms of its effect on agents' expectations. In particular, the shock caused a revision of both short- and medium-run expectations. This finding is interesting since it adds a new layer to the implications discussed by Miranda-Agrippino and Rey (2022). Our results suggest that the GFC is also able to affect forward-looking decisions of local firms, by shifting their inflation and cost expectations.

While the results show that Uruguayan firms seem to overestimate the negative effects of the shock and might interpret the depreciation as a negative sign, they might also expect a different policy reaction. In Section 4 we discuss those implications in more detail.

3.4 Effect of MP shocks on exposed firms

Adding to the discussion in the previous section, we estimate the response of the change in the one-year-ahead expectations (percentage) at the firm level $\Delta\mathbb{E}(X)_{i,t+h,t}$ to monetary policy shocks while conditioning on firms' degree of exposure to the US economy. In particular, we study the consequences of firms' debt with the financial sector and then we assess the implications of having that debt denominated in US dollars.

3.4.1 Exposure to external debt

Before assessing the different responses of the subset of exposed firms to the external economy, it is worth to summarize some of its main characteristics. In particular, medium and large firms are the ones holding US-dollar-denominated debt. Of the subset of exposed firms, around 60 percent of them serves only the Uruguayan internal market, i.e., do not export. Hence, our measure is mostly informative about financial rather than trading exposure. Finally, it is worth mentioning in which sectors most of the exposed firms are concentrated: manufacturing, trade and transport, storage and communications.

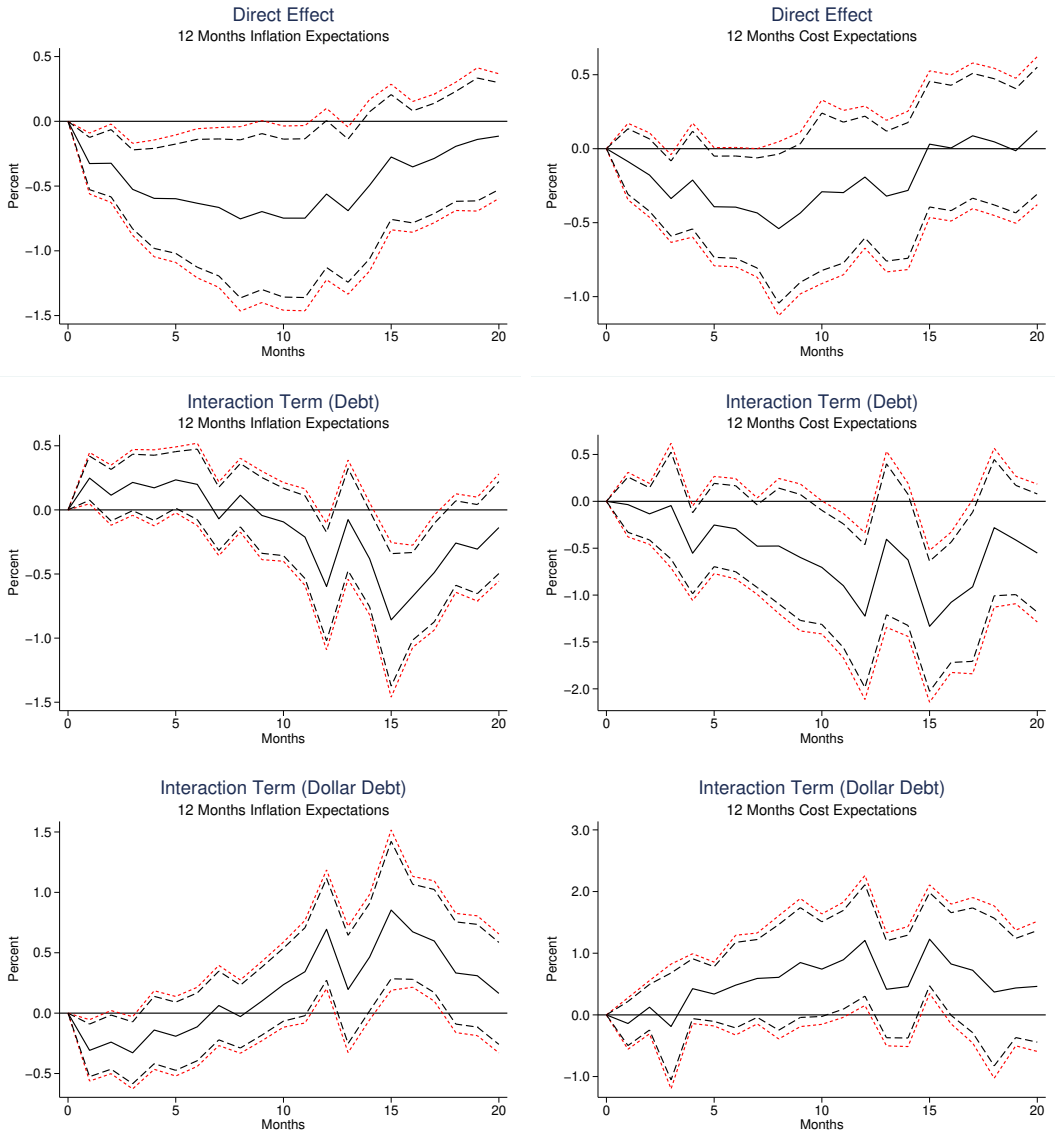
We estimate a local projection specification, where we also include interactions with other variables as in Cloyne, Jorda, and Taylor (2020) and in Herreño and Pedemonte (2022). In particular, we estimate:

$$\begin{aligned}\Delta\mathbb{E}(X)_{i,t+h,t} = \alpha_i^h + \sum_{j=0}^{J}\beta^{h,j}MP_{t-j} + \sum_{j=0}^{J}\gamma^{h,j}(MP_{t-j}\times Debt_{i,t-j-1}) + \\ \sum_{j=0}^{J}\eta^{h,j}(MP_{t-j}\times Dollar_{i,t-j-1}\times Debt_{i,t-j-1}) + \sum_{j=0}^{J}Z'_{t-j}\theta^{h,j} + \varepsilon^h_{i,t+h},\ \forall h\in[0,H]\end{aligned} \tag{3}$$

where $Z_{t-j} = [Dollar_{i,t-j-1}, Debt_{i,t-j-1}, Dollar_{i,t-j-1}\times Debt_{i,t-j-1}, \Delta\mathbb{E}(X)_{i,t,t-j}]$, and where $Debt_{i,t}$ is an indicator of whether firm i has debt at time t and $Dollar_{i,t}$ is the share firm i's debt in US dollars at time t. The specification also includes firm, month and year fixed-effects, and we cluster the standard errors at the firm level. In terms of the specification, Baek and Lee (2021) suggest that the number of lags should be as long as the shock lasts. In the case of this survey, firms do not necessarily have to answer the survey every month. In order to avoid too many missing values, we use $J = H = 12$. In equation (3), $\beta^{h,0}$ will capture the aforementioned direct effect of monetary policy shocks on the revision of firms' expectations at time h after the shock. The coefficient $\gamma^{h,0}$ captures the response of expectations for firms with debt to a MP shock, while $\zeta^{h,0}$ is interpreted as

the effect of the shock on expectations across firms with debt denominated in US dollars. The results of estimating (3) are presented in Figure 3. The first column shows the effects on inflation expectations and the second on cost expectations.

Figure 3: Response of MP shocks on Adjustment of expectations



Note: This figure shows the effect of a monetary policy shock on firms' expectations, exploiting their level of exposure to debt and debt in US dollars, using specification (3). The upper panels show the direct effect ($\beta^{h,0}$) or the effect on firms without debt. The middle panels plot $\gamma^{h,0}$, or the effect on firms with debt in Uruguayan pesos. The lower panels plot $\varsigma^{h,0}$, or the effect on firms with debt in US dollars. The dependent variable is the firms' inflation expectations (left) and cost expectations (right). We include a firm fixed effect. We use $J = 12$. Standard errors are clustered at the time and firm level. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

As noticed in the first row of Figure 3, and in line with our previous findings, the MP shock

is interpreted as recessionary by firms, leading them to revise their expectations downward. Similarly, the response of both inflation and cost expectations for firms with debt is negative approximately seven months after the shock. We interpret the negative reaction as indebted firms anticipating a future drop in interest rates as a consequence of the initial shock and the effects on local activity. The most interesting reaction arises when we observe the response across firms with a large share of debt in US dollars. As discussed, initially the shock results in a depreciation of the Uruguayan peso against the US dollar, which particularly affects this subset of firms. The observed response is completely in line with this intuition, since this group of firms revise their expectations upward. In particular, the overall cost expectations are revised upward by approximately 1 percent 12 months after the shock. Hence, it seems that one of the main mechanisms by which an international MP shock is transmitted to local firms' expectations is through firms' own exposure to the exchange rate.

The results imply an immediate and quick effect in terms of expectations. As found in Romer and Romer (2004) and Gertler and Karadi (2015), MP shocks could have a delayed effect on inflation. On the contrary, the fast reaction of firms' expectations suggests that they anticipate that those changes will occur in the future. Moreover, we conjecture that most of the immediate effects are in part disciplined by the relatively quick exchange rate adjustment which is particularly relevant in the case of a small open economy, such as Uruguay. Beyond the exposure through USD-denominated debt, there are other channels by which firms in Uruguay could be exposed to international shocks. In Appendix C we explore the exposure to imported goods and its interplay with monetary policy shocks abroad.

3.5 Effect of MP shocks on firms' decisions

We now turn to the possible effects of international shocks on firms' local decisions. In particular we focus on firms debt' position and import decisions. Initially we run specification (3) but now instead of the revision of expectations, the dependent variable is $\Delta(X)_{i,t+h,t} = Debt_{i,t+h} - Debt_{i,t-1}$. The variable $Debt_{i,t+h}$ can take either of two forms, it could account

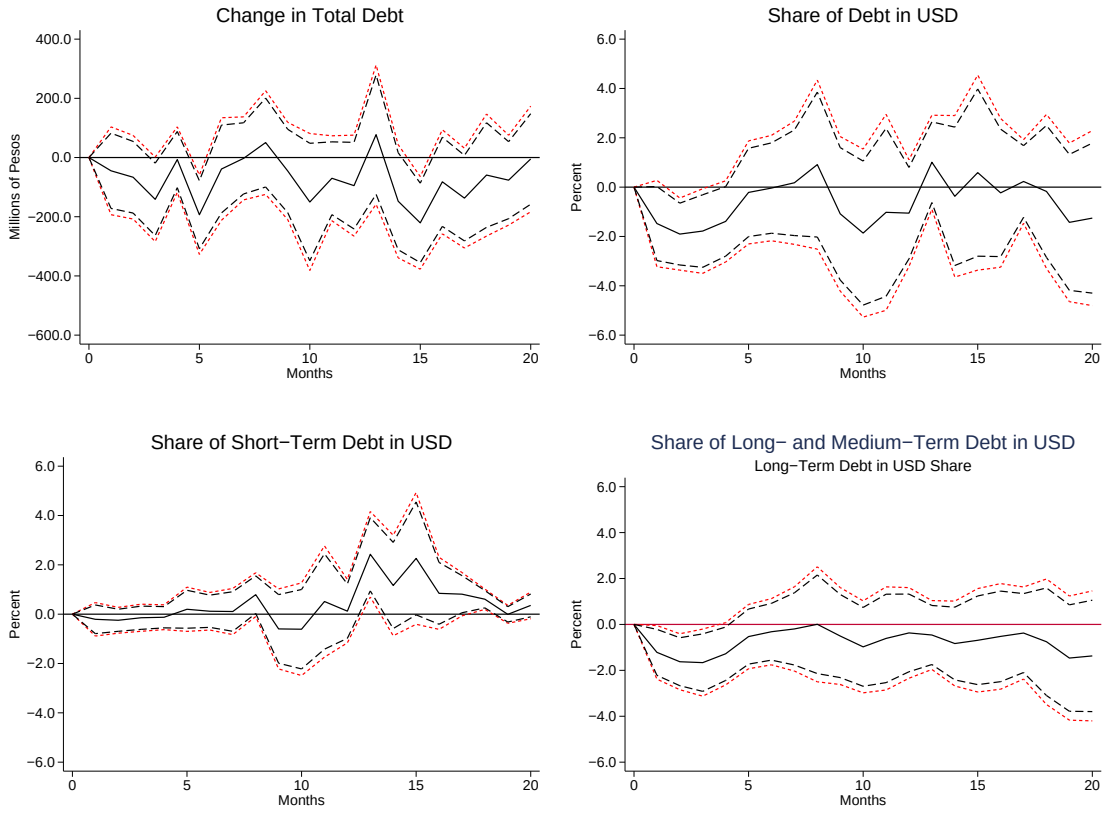
for the percent change in the share of firms i's total debt over time or it could be the change in debt denominated in US dollars as a percentage of total debt, in each month. Besides the currency of the debt, we also have information about its maturity, i.e., the proportion of short-, medium- or long-term debt. In this case, we adjust the dependent variable to reflect each subgroup's adjustment. We also explore a second specification where $\Delta(X)_{i,t+h,t} = Imports_{i,t+h} - Imports_{i,t-1}$, i.e., the adjustment in imports at the firm level over time.

3.5.1 Firms' debt decisions

The dynamic response of firms' debt position, both total and USD-denominated debt, to a US monetary policy shock is presented in Figure 4.

From the top-left panel of Figure 4, we notice total debt does not significantly react after the shock. Points estimates are negative but not significantly different from zero. However, there is a significant decrease in the share of debt in USD, particularly between the second and the fourth month, as a consequence of the shock. We conjecture that this is a response to the expected depreciation of the exchange rate and suggests that the occurrence of the international shock also affects firms decisions. Focusing on debt denominated in USD and splitting it by maturity, the results suggest that firms decrease by approximately 0.6 percent their share of medium- and long-term debt after a one standard deviation increase in the monetary policy shock (3 basis points) during the first few months after the shock. Hence, although the international shock is transitory, it has long-lasting effects on decisions, in particular, it alters firms' preferences for longer debt contracts. On the contrary, the short term debt does not present a statistically meaningful reaction. We interpret the heterogeneous reaction of debt as further evidence related to expected inflation and currency depreciation over longer horizons.

Figure 4: Effect of US MP shocks on Firms' Debt



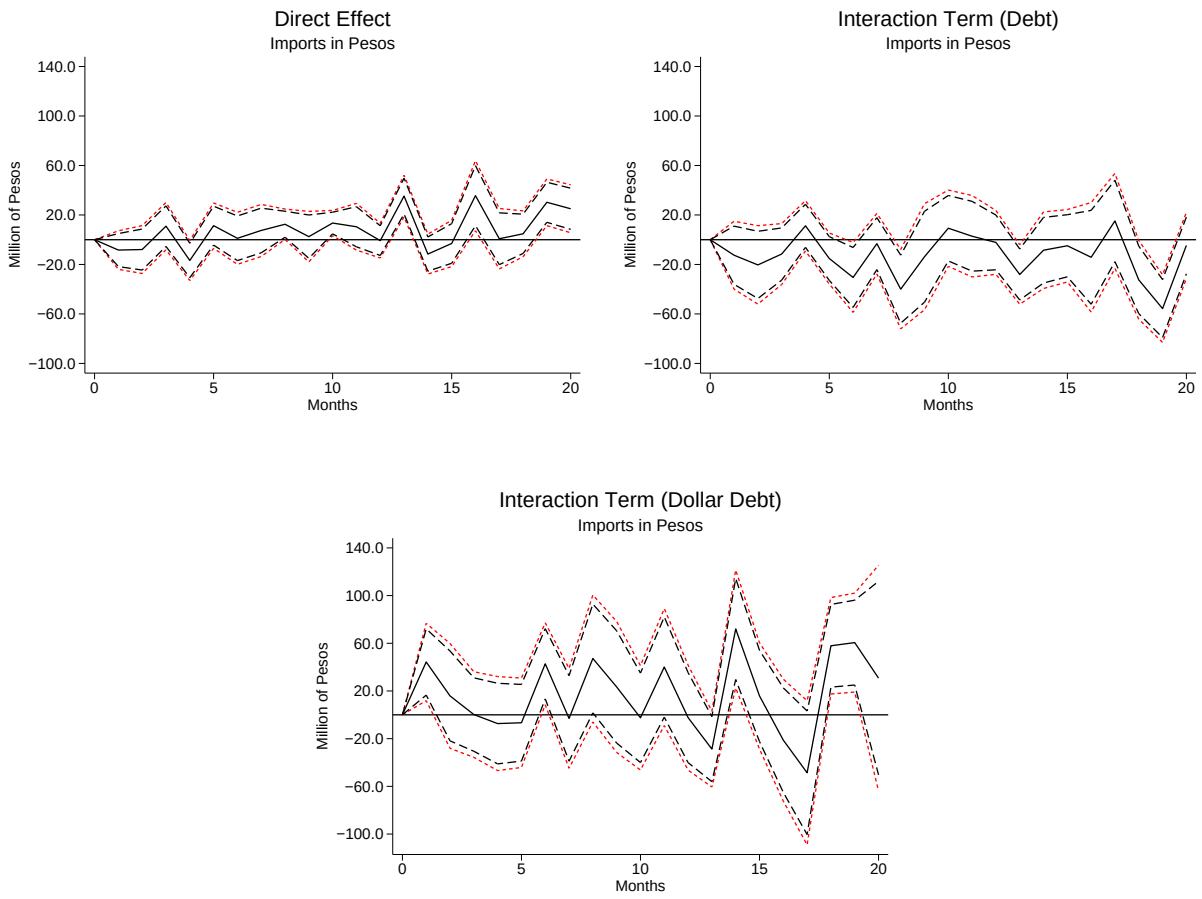
Note: This figure shows the effect of a monetary policy shock on firms' total debt (upper left), share of debt in US dollars (upper right), share of short-term debt in US dollar (lower left), and share of medium- and long-term debt in US dollars (lower right). The results come from estimating (3), where the dependent variable is the firms' specific percentage change between the base period and H. We include a firm fixed effect. We use $J = 12$ and standard errors are clustered at the time level. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

3.5.2 Firms' import decisions

Building on the previous exercise, we now focus on the change in total imports at the firm level. We collect total imports from administrative data since, as discussed, we have the universe of imports by firm in Uruguay on a monthly basis. Controls are similar relative to specification (3) $Z_{i,t-j} = [Dollar_{i,t-j-1}, Debt_{i,t-j-1}, Dollar_{i,t-j-1} \times Debt_{i,t-j-1}, \Delta X_{i,t,t-j}]$ and we use the same lags and number of controls. The results are robust to relying on actual imports, but we smooth this variable to generate a less volatile result. Figure 5 shows the results.

Imports of firms not exposed to debt do not seem to react differently to the shock. The

Figure 5: Change in imports (Thousands) and dollar debt position



Note: The figure shows the results of regression (3). The upper left panel plots $\beta^{h,0}$. The upper right panel plots $\gamma^{h,1}$ and the lower panel plots $\zeta^{h,0}$. We use firm fixed effects and $J = 12$. Standard errors are clustered at the time level. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

response of firms exposed to debt, although is negative, is not significant except for a few horizons. The effect is, however, different across firms that are exposed to debt denominated in US dollars. In this case, we actually observe an increase in their imports, relative to the firms indebted in Uruguayan pesos. The positive effect is significant right after the impact. As discussed, firms holding US-dollar-denominated debt have higher inflation expectations than firms with debt denominated in pesos. As they expect an increase of the nominal exchange rate in the near future, relative to other firms, they increase their imports today to avoid the expected depreciation of the peso, and with this, the subsequent increase in

the cost of imports. Candia and Pedemonte (2021) report and discuss a similar effect after the US left the gold standard in 1933. When the US dollar started depreciating, imports increased until the dollar stabilized. Reports of the time say that the motivation was an anticipatory effect to avoid higher prices in the future due to the lower expected value of the currency. We see a similar effect here for firms more exposed to the US dollar.

4 Discussion

In light of our results, we think it is important to discuss further why the response of firms expectations is different from the response and the dynamics of macro variables. In doing so, through our data, we first study the possible link between the expectation formation process of firms in Uruguay and our results, and then we frame this discussion within a DSGE model.

4.1 Expectation Formation Process

Initially, we study the expectation formation process of firms in order to understand the reported discrepancy between the expectation response to the shock relative to the aggregate reaction.

Related to the acquisition of relevant information, we start estimating whether firms in Uruguay tend to over- or under-react to the newly available information. Through our panel data, we run a simple test of forecasting errors following Bordalo et al. (2020). The Uruguayan survey includes a question especially suited for running this test. Most surveys, either panel or repeated cross-section, tend to ask firms' expectations over a fixed-horizon period, typically 12 months ($E_{i,t}\pi_{t+12}$). With this kind of question, it is difficult to construct a measure of forecasting revisions (a proxy for acquired information), as the revision could be either explained because there is more available information or because the predicted object changed. The Uruguayan survey has the distinct feature that besides the fixed-horizon 12 months ahead question, firms are also asked about expected inflation by the end of the year

($E_{i,t}\pi_{December}$). Relying on the panel structure, we can compute how firms reply to this question between two consecutive months and therefore measure a forecast revision where the forecasted variable (end-of-year inflation) has not changed. In particular, we could run the following regression:

$$\pi_{t+h} - E_{i,t}\pi_{t+h} = \alpha + \beta \left(E_{i,t}\pi_{t+h} - E_{i,t-1}\pi_{t+h}\right) + \varepsilon_{it} \tag{4}$$

and analyze the sign of β. If $\beta > 0$, a positive forecast revision correlates with a higher realization of inflation relative to the forecast, meaning that the firms under-react to new information. On the contrary if $\beta < 0$, firms over-react to news. Moreover, we can adapt equation (4) and write it as:

$$E_{i,t}\pi_{t+h} = \frac{\alpha}{1+\beta} + \frac{1}{1+\beta}\pi_{t+h} + \frac{\beta}{1+\beta}E_{i,t-1}\pi_{t+h} + \varepsilon_{it}, \tag{5}$$

Given our limited sample size, having inflation expectation in the current period in the right and left hand size of equation (4) can bias the estimation of β if the errors of that measure are not canceled when calculating the forecasting revision.[9] Equation (5) has some advantages in terms of estimation. This formulation gives weights between the true forecast (or what should be forecast on average in the full information rational expectation model), and a coefficient that depend on idiosyncratic expectation formation of the firm, that can be tied to its characteristics, such as experience. That term contains the interaction of that bias with the firm characteristic. In particular, as π_{t+h} is common to all firms, we can run the following regression:

$$E_{i,t}\pi_{t+h} = \gamma_t + \frac{\beta}{1+\beta}E_{i,t-1}\pi_{t+h} + \varepsilon_{it}, \tag{6}$$

where γ_t is a time fixed effect. With this equation, we can consider all the common

[9]For example, if firms round their answers, it would produce an error term that is time and firm specific, therefore, it would bias the estimate of β.

information that the firms have, and check how the idiosyncratic bias interact with the time shock. By estimating β we can infer how much weight firms put on current information and how much weight they attach to the past. In particular, we can run this regression with different forecasting errors (lags in the right hand side expectations) and different h or horizons with the actual value. Table 1 shows the results:

Table 1: Estimation of Over- or Under-Reaction Parameter

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$E_{i,t-1}\pi_{t+h}$	0.853***	0.745***	0.757***	0.619***	0.798***	0.654***	0.660***	0.591***
	(0.020)	(0.032)	(0.059)	(0.048)	(0.050)	(0.055)	(0.037)	(0.053)
π_{t+h}	0.134***	0.395***	0.151***	0.431***				
	(0.024)	(0.027)	(0.049)	(0.080)				
Constant	0.335	-0.910***						
	(0.203)	(0.212)						
β	5.787***	2.927***	3.119***	1.621***	3.980***	1.890***	1.941***	1.445***
	(0.897)	(0.496)	(1.005)	(0.330)	(1.225)	(0.459)	(0.320)	(0.317)
Month	Jun	Sep	Jun	Sep	Jun	Sep	Jun	Sep
Time FE	✗	✗	✗	✗	✓	✓	✓	✓
Firm FE	✗	✗	✓	✓	✗	✗	✓	✓
Observations	2,984	3,108	2,938	3,055	3,440	3,495	3,440	3,495
R-squared	0.715	0.724	0.762	0.777	0.748	0.745	0.790	0.798

Note: Table show results from regressions (5) and (6). For each of them, we use 3 lags for the independent variable. We estimate β as presented in the equations. Standard errors of that variable are estimated using delta method. Column (1) an (2) have standard errors at the firm level. Columns (3)-(8) have standard errors clustered at the firm and time level.

We can see a positive coefficient consistent with firms under-reacting to available information. The sign is the same independently of looking at the expectations in June or September, i.e., two or one quarter before the final release of annual inflation. Moreover, in Figure 22 in Appendix F we estimate β for all the possible combinations of lags and revisions. The coefficient is always positive, suggesting under-reaction independently of the forecast horizon. Thus, the results suggest that firms tend to under-react to news, putting some non-negligible weight on their past expectations. This finding is consistent with the aggregate results in

Coibion and Gorodnichenko (2015), and in general, with models of sluggish reactions of expectations, as discussed by Angeletos, Huo, and Sastry (2021).

As discussed by Malmendier and Nagel (2016) and Bordalo et al. (2023), memory and experience play an important role in the expectation formation process of economic agents. After testing this feature, Pedemonte, Toma, and Vertugo (2023) study the implications of incorporating memory within a New Keynesian model. In particular, controlling by common information, they assess the role of memory and find that it is also relevant for the expectation formation of consumers. Our result also suggests that firms have an information process that is consistent with memory playing a role, in line with costly information processes, or the use of heuristic (Tversky and Kahneman (1973)). In that sense, firms use information from the past to, on average, infer that a shock in the US MP would imply a price decline, as it used to be in Uruguay under the previous policy rule. The finding that firms under-react to new information is consistent with an information process in which firms weigh new information with what they thought in the past, slowly incorporating that new information in their forecast.

Building on these results, we incorporate this evidence within a simple open economy New Keynesian model in the next section. In particular, we will model information frictions as firms believing that the domestic economy stayed in the former policy framework when the Uruguayan Central Bank intervened in the exchange market to attenuate the exchange rate fluctuations.

4.2 A model of misspecified beliefs

Circling back to our main results, there seems to be a misalignment between expectations and the dynamic responses of macroeconomic variables in Uruguay. The effect of a US MP shock ultimately depends on how policy accommodates and responds to it. For example, in the context of a New Keynesian model and dominant currency pricing, Nispi-Landi and Flaccadoro (2022) find that the effect of a dominant country's MP shock is disciplined by

the policy framework in the local economy. In particular, when the small open economy is under a currency peg, the CPI inflation decreases, as the local central bank will raise the policy rate to maintain the nominal exchange rate parity. This policy reaction produces a bigger contraction in local economic activity.

While Uruguay was in a flexible exchange rate regime in the period studied, firms seem to have reacted as if the central bank was in the previous regime, when the value of the peso was protected by the monetary authority, expecting a decrease in prices when the actual effect on prices was neutral. As discussed in Section 3.1, this reaction could come from the recent history of a currency peg in the country or skepticism about the policy framework. In fact, firms seem to pay special attention to the US dollar when thinking about inflation. In the survey, firms can justify their inflation expectations answer openly. We show in Appendix B that answers related to the US dollar largely dominate the share of responses.

The way local firms perceive the shock and the future depreciation of the local currency is therefore relevant to understand the effects of a monetary policy shock abroad. Additionally, as shown in Table 1, firms tend to under-react to news and put higher weight on their past forecasts when forming expectations. Through this evidence, in this section we explore a possible mechanism that can rationalize firms' observed reaction to the international shock.[10] The mechanism builds on a *perceived* policy rule. While the Central Bank has a flexible regime, firms might attach some non-negligible probability that the central bank will eventually intervene the exchange rate. Hence after a depreciation, firms expect a stronger reaction by the central bank to maintain the currency's value, producing a stronger fall in inflation. With this information, we rely on the empirical evidence about the expectation formation process of firms presented in Section 4.1 to discipline a reduced-form model of expectations and assess the macroeconomic implications of such bias.

We start with a very simple departure from the full information rational expectation model, in line with Bordalo et al. (2020), L'Huillier, Singh, and Yoo (2023) or Pedemonte,

[10]Firms react in line with the aggregate data reaction to a local monetary policy shock, as shown in Appendix D.

Toma, and Vertugo (2023). Expectations about a variable in the economy are modeled as:

$$E_t x_{t+1} = E_t^{FIRE} x_{t+1} - \zeta \left(E_t^{FIRE} x_{t+1} - E_{f,t}^{Reference} x_{t+1} \right), \tag{7}$$

In this case, we use $E_{f,t}^{Reference}$ as the expectations from a model version with a policy rule that maintains the exchange rate value or pegged regime. This equation has a direct mapping with equation (6), where $\zeta = \frac{\beta}{1+\beta}$, so we can input the bias using the data. As done by L'Huillier, Singh, and Yoo (2023) and Pedemonte, Toma, and Vertugo (2023), we embed the bias into a very stylized small open economy general equilibrium model, as in Gali and Monacelli (2005). There is a large world economy, which we model with a simple three-equation New Keynesian model with Calvo pricing.[11] Specific details of the model are presented in Appendix H. The following IS curve characterizes the large economy:

$$y_t^* = -\frac{1}{\gamma}(i_t^* - E_t \Pi_{t+1}^*) + E_t y_{t+1}^*, \tag{8}$$

a Phillips curve

$$\Pi_t^* = \beta E_t \Pi_{t+1}^* + \kappa(\alpha + \gamma) y_t^*, \tag{9}$$

and a Taylor rule

$$i_t^* = \phi_\pi \Pi_t^* + y_t^* + \epsilon_t, \tag{10}$$

where y_t^* is output, i_t^* the interest rate, and Π_t^* is inflation in the price of the good in the large economy. The parameter γ is the intertemporal elasticity of substitution, β the intertemporal discount factor, $\kappa = \frac{(1-\theta)(1-\theta\beta)}{\theta}$, where θ is the Calvo parameter, α is the inverse of the labor supply elasticity and, ϕ_π is how much the central bank penalizes inflation from its rule. Finally, ϵ_t is the monetary policy shock, where $\epsilon_t = \rho\epsilon_{t-1} + \varepsilon_t$, with ε_t an iid

[11] The small open economy, on the other hand, does not play a role since it is of mass zero.

shock with mean zero and standard deviation equal to one.

We introduce a reduced-form departure from rational expectations to allow for misperceived beliefs. In line with the previous discussion, while the central bank declares a flexible exchange rate policy, it used a more active exchange rate intervention policy in the past. Therefore, some agents might not fully understand the new policy regime and expect the monetary authority to intervene under a strong depreciation of the local currency. Thus, we model an economy where firms think that the central bank tries to peg the exchange rate to the US dollar with some probability ζ, although the central bank actually follows a Taylor rule. Then, firms' expectations about any variable are:

$$E_{f,t}x_{t+1} = \zeta E^{peg}_{f,t}x_{t+1} + (1-\zeta)E^{FIRE}_{f,t}x_{t+1}, \tag{11}$$

where $E^{peg}_{f,t}$ is the expectations operator that agents in the economy would have in the peg regime. According to that operator, the firm sees the state variables and the shock and weights them in the same way as in the version of the model with a peg regime to form expectations. In that sense, firms use all available information at all periods of time, but have a wrong idea of the policy rule, which depends on ζ. $E^{FIRE}_{f,t}$ is the full information rational expectations operator and ζ represents the firm bias. When $\zeta = 0$ al the agents in the economy have full information rational expectations in a model with a flexible exchange rate.

As discussed in Section 3.1, the Central Bank of Uruguay has a recent history of interventions in the exchange rate market. Firms might take time to learn about the floating regime in the considered expectations formation process. Coibion et al. (2023) argue that agents do not pay much attention to monetary news, as US consumers were unaware of the new policy regime that the Federal Reserve made in 2020. In addition, Binder and Makridis (2022) find that consumers adjust expectations and their expected reaction to shocks considering their individual past experiences. In this context, we interpret equation (11) as a reduced-form

way to capture uncertainty about the actual underlying policy regime or firms anticipating an exchange rate intervention, given the past policy framework in Uruguay. Moreover, equation (11) maps to (6), where $\zeta = \frac{\beta}{1+\beta}$. We will then calibrate the model with the estimated value of ζ reported in Table 1.

The log-linearized[12] Phillips curve is characterized by:

$$\check{\pi}_t = \beta E_{f,t}\check{\pi}_{t+1} + \kappa \check{mc}_t, \tag{12}$$

where $E_{f,t}$ is the expectation term for the local firm and $\check{mc}_t$ the marginal cost, with $\check{mc}_t = \check{w}_t - \check{p}_t$

In addition, the log-linearized risk-sharing condition is:

$$-\gamma\check{c}_t + \gamma\check{y}^*_t = \check{P}^*_t - \check{P}_t - e_t \tag{13}$$

where e_t is the log-linearized exchange rate. In addition, the uncovered interest rate parity is

$$\check{i}_t - \check{i}^*_t = e_{t+1} - e_t \tag{14}$$

Following the market clearing condition of the local economy, as in Gali and Monacelli (2005), we have

$$\check{y}_t = \check{y}^*_t + (1/\sigma_a) * (\check{P}^*_t + \check{e}_t - \check{p}_t),$$

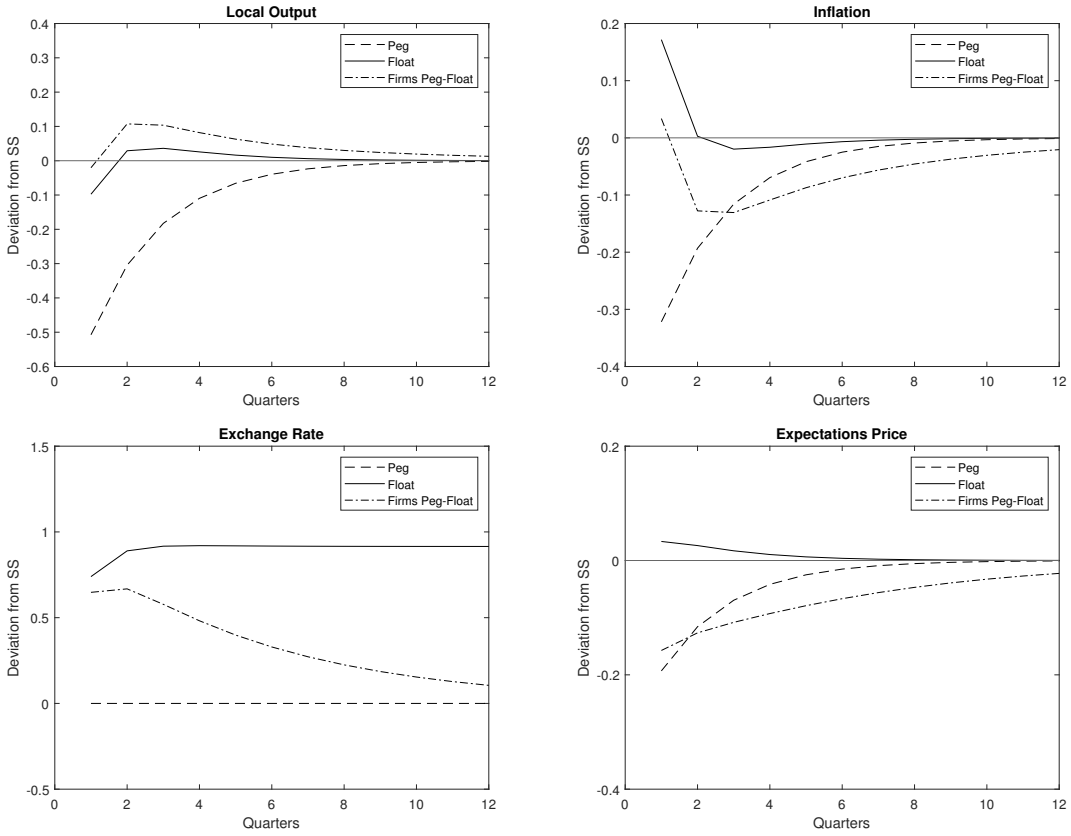
with $\sigma_a = \frac{\gamma}{\phi+(1-\phi)\omega}$ and $\omega = (\gamma\eta + \phi(\gamma\sigma - 1))$. Finally, the central bank in the small open economy follows two rules. When there is a floating regime, it follows $\check{i}_t = \sigma_\pi\check{\pi}_t + \check{y}_t$ and when there is a peg it follows $e_t = 0$.

We use the calibrated values of Gali and Monacelli (2005), that is: $\phi = 0.6$, $\gamma = 0.6$, $\alpha = 2$, $\eta = 1$, $\sigma = 1$, and $\theta = 0.75$. We also use $\rho = 0.6$, and $\sigma_\pi = 1.5$. We use $\zeta = 0.6255$,

[12] with $\check{x} = \frac{x_t - \bar{x}}{\bar{x}}$

consistent with the average result that we find in Table 1, columns (7) and (8). With our model, we compute the dynamic reaction of local outcome, local inflation, the exchange rate and firms' own price inflation expectations to a monetary policy shock in the large economy. Figure 6 shows the results.

Figure 6: Impulse response functions for selected variables



Note: The figure shows impulse response functions to a 100 basis point foreign interest rate shock for a regime where the central bank pegs the exchange rate (Peg), follows a Taylor rule (Float), and one where it follows a Taylor rule, but the firms have expectations of a Peg (Firms Peg-Float).

In our scenario where firms form wrong expectations about the current regime, we can see that while inflation increases initially, firms' inflation expectations adjust downward, consistent with what would happen under the peg regime. Moreover, based on the simulated evolution of the variables, firms' expectations remain negative for an extended period. The depreciation of the local currency leads firms to think that the central bank will intervene, so

they perceive the shock as contractionary for a prolonged period. This effect on expectations produces a lower impact on aggregate prices and a long-lasting depreciation, consistent with what we observed in the data. We also see an initial decline in output, consistent with the data.

While we focus on uncertainty about the policy regime in this section, other theories can explain the effect, which would work similarly. For example, firms could have uncertainty about the nature of the shock, thinking that depreciation is actually the response to a negative local shock, which would make them believe that it is associated with a lower inflation rate scenario. This could happen, for example, with a negative demand shock. In that case, it would work similarly to the previously modeled scenario, where there is a price reduction and a local currency depreciation. In any case, given the response of firms to local shocks and the history of policy in Uruguay, it seems likely that the uncertainty is about the policy regime. This effect is expected to be transitory in the absence of interventions, as firms should eventually learn about the policy regime.

5 Conclusion

Expectations matter for economic decisions. How expectations affect firms' decisions have been largely studied in the context of closed economies and local shocks. In this paper, we explore how external shocks propagate to firms' domestic expectations. Moreover, we show that a monetary policy surprise in the US will indeed affect firms' inflation and cost expectations in the short and middle run. Our results are relevant since they add another source of expectations instability the local central bank must deal with. Besides the direct effect on firms' expectations, we argue that firms' exposure to the US economy matters significantly since it results in different responses to the shock in terms of both sign and persistence.

We interpret our results by studying the expectation formation process of firms *and*

through a DSGE model where we allow firms to have misperceived beliefs. Our empirical results suggest that firms tend to under-react to available information, a feature that, we argue, is consistent with past experience playing a prominent role in shaping firms' beliefs. Moreover, with the model, we show that the empirical responses are consistent with a setting where firms anticipate a different reaction to an international shock, in line with the historical response that the monetary authority has followed in the past.

These results introduce a novel mechanism by which US monetary policy can affect small open economies abroad through the expectation channel. Although this channel has not been explored, it can have important implications for understanding extensions of international financial cycles. This channel also extends to other contexts where economic agents have not fully incorporated changes in the policy framework, as shown in the case of the US by Coibion et al. (2023). In addition, it highlights further avenues through which local monetary authorities can lose sovereignty over their nominal variables, other than the one exposed by Rey (2015) and Ilzetzki, Reinhart, and Rogoff (2019). Since the effects described in this paper are related to forward-looking variables, a combination of policy action and communication from local economic authorities becomes central in addressing the effects of external shocks on the local economy, especially in the context of uncertainty or inattention about the policy regime.

References

Acosta, Miguel. 2022. "The perceived causes of monetary policy surprises." *Published Manuscript* URL https://www1.columbia.edu/~jma2241/papers/acosta_jmp.pdf.

Angeletos, George-Marios, Zhen Huo, and Karthik A Sastry. 2021. "Imperfect macroeconomic expectations: Evidence and theory." *NBER Macroeconomics Annual* 35 (1):1–86.

Auerbach, Alan J. and Yuriy Gorodnichenko. 2012. "Fiscal multipliers in recession and expansion." In *Fiscal Policy after the Financial Crisis*, edited by Alberto Alesina and Francesco Giavazzi. National Bureau of Economic Research, 63–98. URL https://www.nber.org/chapters/c12634.

Bachmann, Rüdiger and Steffen Elstner. 2015. "Firm optimism and pessimism." *European Economic Review* 79:297–325. URL https://doi.org/10.1016/j.euroecorev.2015.07.017.

Baek, ChaeWon and Byoungchan Lee. 2021. "A guide to autoregressive distributed lag models for impulse response estimations." *Oxford Bulletin of Economics and Statistics* 84 (5):1101–1122. URL https://doi.org/10.1111/obes.12494.

Basal, Jorge, Patricia Carballo, Fernanda Cuitiño, Serafín Frache, Gerardo Licandro, José Mourelle, Helena Rodríguez, Verónica Rodriguez, and Leonardo Vicente. 2016. "Un modelo estocástico de equilibrio general para la economía Uruguaya." Documento de trabajo 2016002, Banco Central del Uruguay. URL https://ideas.repec.org/p/bku/doctra/2021006.html.

Bergman, Nittai, David A. Matsa, and Michael Weber. 2022. "Inclusive Monetary Policy: How Tight Labor Markets Facilitate Broad-Based Employment Growth." Working paper 29651, National Bureau of Economic Research. URL https://doi.org/10.3386/w29651.

Binder, Carola and Christos Makridis. 2022. "Stuck in the seventies: gas prices and consumer sentiment." *Review of Economics and Statistics* 104 (2):293–305.

Bordalo, Pedro, John J Conlon, Nicola Gennaioli, Spencer Y Kwon, and Andrei Shleifer. 2023. "Memory and probability." *The Quarterly Journal of Economics* 138 (1):265–311.

Bordalo, Pedro, Nicola Gennaioli, Yueran Ma, and Andrei Shleifer. 2020. "Overreaction in macroeconomic expectations." *American Economic Review* 110 (9):2748–82. URL https://doi.org/10.1257/aer.20181219.

Born, Benjamin, Zeno Enders, Gernot J. Müller, and Knut Niemann. 2021. "Chapter 15 - Firm expectations about production and prices: facts, determinants, and effects." In *Handbook of Economic Expectations*, chap. 15. URL https://www.uni-heidelberg.de/md/awi/professuren/wipol/bemn_2022_chap15_firmexp.pdf.

Bu, Chunya, John Rogers, and Wenbin Wu. 2021. "A unified measure of Fed monetary policy shocks." *Journal of Monetary Economics* 118:331–349. URL https://doi.org/10.1016/j.jmoneco.2020.11.002.

Calvo, Guillermo A. and Carmen M. Reinhart. 2002. "Fear of floating." *The Quarterly Journal of Economics* 117 (2):379–408. URL http://www.jstor.org/stable/2696430.

Candia, Bernardo and Mathieu Pedemonte. 2021. "Export-led decay: The trade channel in the gold standard era." .

Cloyne, James, Oscar Jorda, and Alan Taylor. 2020. "Decomposing the fiscal multiplier." Working Paper 2020-12, Federal Reserve Bank of San Francisco. URL https://doi.org/10.24148/wp2020-12.

Coibion, Olivier and Yuriy Gorodnichenko. 2015. "Information rigidity and the expectations formation process: A simple framework and new facts." *American Economic Review* 105 (8):2644–78. URL https://www.doi.org/10.1257/aer.20110306.

Coibion, Olivier, Yuriy Gorodnichenko, Edward Knotek, and Raphael Schoenle. 2023. "Average inflation targeting and household expectations." *Journal of Political Economy Macroeconomics* .

Coibion, Olivier, Yuriy Gorodnichenko, and Saten Kumar. 2018. "How do firms form their expectations? New survey evidence." *American Economic Review* 108 (9):2671–2713. URL https://doi.org/10.1257/aer.20151299.

Coibion, Olivier, Yuriy Gorodnichenko, Saten Kumar, and Mathieu Pedemonte. 2020. "Inflation expectations as a policy tool?" *Journal of International Economics* 124:103297. URL https://doi.org/10.1016/j.jinteco.2020.103297.

Coibion, Olivier, Yuriy Gorodnichenko, and Tiziano Ropele. 2020. "Inflation expectations and firm decisions: new causal evidence." *The Quarterly Journal of Economics* 135 (1):165–219. URL https://doi.org/10.1093/qje/qjz029.

D'Acunto, Francesco, Ulrike Malmendier, Juan Ospina, and Michael Weber. 2021. "Exposure to grocery prices and inflation expectations." *Journal of Political Economy* 129 (5):1615–1639. URL https://doi.org/10.1086/713192.

de Bruin, Wandi Bruine, Wilbert van der Klaauw, Giorgio Topa, Julie S. Downs, Baruch Fischhoff, and Olivier Armantier. 2012. "The effect of question wording on consumersâ€™ reported inflation expectations." *Journal of Economic Psychology* 33 (4):749 – 757. URL http://www.sciencedirect.com/science/article/pii/S0167487012000244.

Degasperi, Riccardo, Seokki Hong, and Giovanni Ricco. 2020. "The global transmission of US monetary policy." Discussion paper DP14533, CEPR. URL https://ideas.repec.org/p/cpr/ceprdp/14533.html.

Egorov, Konstantin and Dmitry Mukhin. 2021. "Optimal policy under dollar pricing." URL https://www.lse.ac.uk/CFM/assets/pdf/CFM-Discussion-Papers-2021/CFMDP2021-24-Paper.pdf. Manuscript.

Frache, Serafin and Rodrigo Lluberas. 2019. "New information and inflation expectations among firms." BIS Working Papers 781. URL https://ideas.repec.org/p/bis/biswps/781.html.

Frache, Serafin, Rodrigo Lluberas, and Javier Turen. 2021. "Belief-dependent pricing decisions." Documentos de trabajo 2021007, Banco Central del Uruguay. URL https://ideas.repec.org/p/bku/doctra/2021007.html.

Gali, Jordi and Tommaso Monacelli. 2005. "Monetary policy and exchange rate volatility in a small open economy." *The Review of Economic Studies* 72 (3):707–734. URL https://doi.org/10.1111/j.1467-937X.2005.00349.x.

Gertler, Mark and Peter Karadi. 2015. "Monetary policy surprises, credit costs, and economic activity." *American Economic Journal: Macroeconomics* 7 (1):44–76. URL https://doi.org/10.1257/mac.20130329.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. "Dominant currency paradigm." *American Economic Review* 110 (3):677–719. URL https://doi.org/10.1257/aer.20171201.

Gürkaynak, Refet S., Brian P. Sack, and Eric T. Swanson. 2005. "Do actions speak louder than words? The response of asset prices to monetary policy actions and statements." *International Journal of Central Banking* URL https://www.ijcb.org/journal/ijcb05q2a2.htm.

Herreño, Juan and Mathieu Pedemonte. 2022. "The geographic effects of monetary policy." Working paper 22-15, Federal Reserve Bank of Cleveland. URL https://doi.org/10.26509/frbc-wp-202215.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. "Exchange arrangements entering the twenty-first century: which anchor will hold?" *The Quarterly Journal of Economics* 134 (2):599–646. URL https://doi.org/10.1093/qje/qjy033.

Jarociński, Marek and Peter Karadi. 2020. "Deconstructing monetary policy surprises—the role of information shocks." *American Economic Journal: Macroeconomics* 12 (2):1–43. URL https://doi.org/10.1257/mac.20180090.

Jordà, Òscar. 2005. "Estimation and inference of impulse responses by local projections." *American Economic Review* 95 (1):161–182. URL https://doi.org/10.1257/0002828053828518.

Kozlowski, Julian, Laura Veldkamp, and Venky Venkateswaran. 2020. "The tail that wags the economy: Beliefs and persistent stagnation." *Journal of Political Economy* 128 (8):2839–2879.

L'Huillier, Jean-Paul, Sanjay R. Singh, and Donghoon Yoo. 2023. "Incorporating Diagnostic Expectations into the New Keynesian Framework." *Review of Economic Studies* .

Malmendier, Ulrike and Stefan Nagel. 2016. "Learning from inflation experiences." *Quarterly Journal of Economics* 131 (1):53–87. URL https://doi.org/10.1093/qje/qjv037.

Miranda-Agrippino and Hélene Rey. 2022. "The global financial cycle." In *Handbook of International Economics*, vol. 6, edited by Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, chap. 1. 1–43. URL https://doi.org/10.1016/bs.hesint.2022.02.008.

Miranda-Agrippino, Silvia and Hélene Rey. 2020. "US monetary policy and the global financial cycle." *The Review of Economic Studies* 87 (6):2754–2776. URL https://doi.org/10.1093/restud/rdaa019.

Nakamura, Emi and Jón Steinsson. 2018. "High-frequency identification of monetary non-neutrality: the information effect." *The Quarterly Journal of Economics* 133 (3):1283–1330. URL https://doi.org/10.1093/qje/qjy004.

Nispi-Landi, Valerio and Marco Flaccadoro. 2022. "Foreign monetary policy and domestic inflation in emerging markets." Temi di Discussione (Working Paper) 1365, Banca

D'Italia. URL https://www.bancaditalia.it/pubblicazioni/temi-discussione/2022/2022-1365/en_tema_1365.pdf.

Pedemonte, Mathieu, Hiroshi Toma, and Esteban Vertugo. 2023. "Aggregate Implications of Heterogeneous Inflation Expectations: The Role of Individual Experience." Working paper 23-04, Federal Reserve Bank of Cleveland. URL https://doi.org/10.26509/frbc-wp-202304.

Puppo, Pablo and Juan Francisco Gari. 2009. "Intervenciones del Banco Central en el mercado de cambios." *Tesis de grado. Universidad de la República (Uruguay), Facultad de Ciencias Económicas y de Administración* URL https://hdl.handle.net/20.500.12008/126.

Rey, Hélène. 2015. "Dilemma not trilemma: the global financial cycle and monetary policy independence." Working paper 21162, National Bureau of Economic Research. URL https://doi.org/10.3386/w21162.

Romer, Christina D and David H Romer. 2004. "A new measure of monetary shocks: derivation and implications." *American Economic Review* 94 (4):1055–1084. URL https://doi.org/10.1257/0002828042002651.

Ropele, Tiziano, Yuriy Gorodnichenko, and Olivier Coibion. 2022. "Inflation Expectations and Corporate Borrowing Decisions: New Causal Evidence." (30537). URL http://www.nber.org/papers/w30537.

Tversky, Amos and Daniel Kahneman. 1973. "Availability: A heuristic for judging frequency and probability." *Cognitive psychology* 5 (2):207–232.

Weber, Michael, Bernardo Candia, Tiziano Ropele, Rodrigo Lluberas, Serafin Frache, Brent H Meyer, Saten Kumar, Yuriy Gorodnichenko, Dimitris Georgarakos, Olivier Coibion et al. 2023. "Tell Me Something I Don't Already Know: Learning in Low and High-Inflation Settings." Tech. rep., National Bureau of Economic Research.

A Firms' data: further details

As already noted, the expectations survey used in the empirical application is representative of firms with more than 50 employees in all the sectors of the economy with the exception of financial, agricultural and public sectors. Table 2 shows the proportion of firms in each sector for the whole sample period used in the analysis of this paper together with a comparison with the sectoral composition of the population of firms with 100 or more employees. There are no substantial differences in the sectoral structure of the sample vis-a-vis the population of firms in Uruguay.

Table 2: Proportion of firms by sector: sample and population (in %)

	Sample	Population
Manufacturing	30.9	25.0
Electricity, gas and water supply	0.1	3.0
Construction	1.8	2.3
Trade	20.5	16.2
Hotels and restaurants	3.0	2.3
Transport, storage and communications	9.0	12.8
Real estate, renting and business activities	16.3	17.4
Education	11.1	10.2
Health and social work	7.4	10.9

Note: The table shows the share of respondents by secntor. The column "Sample" shows the share of respondents for the survey sample and the share "Population" is the share of firms with 100 employees or more in each sector in the Uruguayan Economy.

Firms are asked about their expected annual change in the Consumer Price Index (CPI) for the current year, for the next 12 months, and for the monetary policy horizon, which was 18 months until July 2013 and has been 24 months since then. The specific wording of the

question is: *What do you believe is going to be the change in the CPI?* [13]. From the wording of the question we interpret that firms are asked about their expectations about the general CPI and not their specific prices [14].

Firms are also asked about the expected change of their own costs for the same time horizons. The exact questions are: *What do you believe is going to be the average change in your firm's costs in local currency?* [15]

The person answering the survey is supposed to be the one in charge of firm's pricing decisions. In March 2016, we asked the respondents about their role within the firm and found that 42% were directors, general managers, or area managers; 19% economic analysts; 12% consultants; and 28% had different roles within the firm.

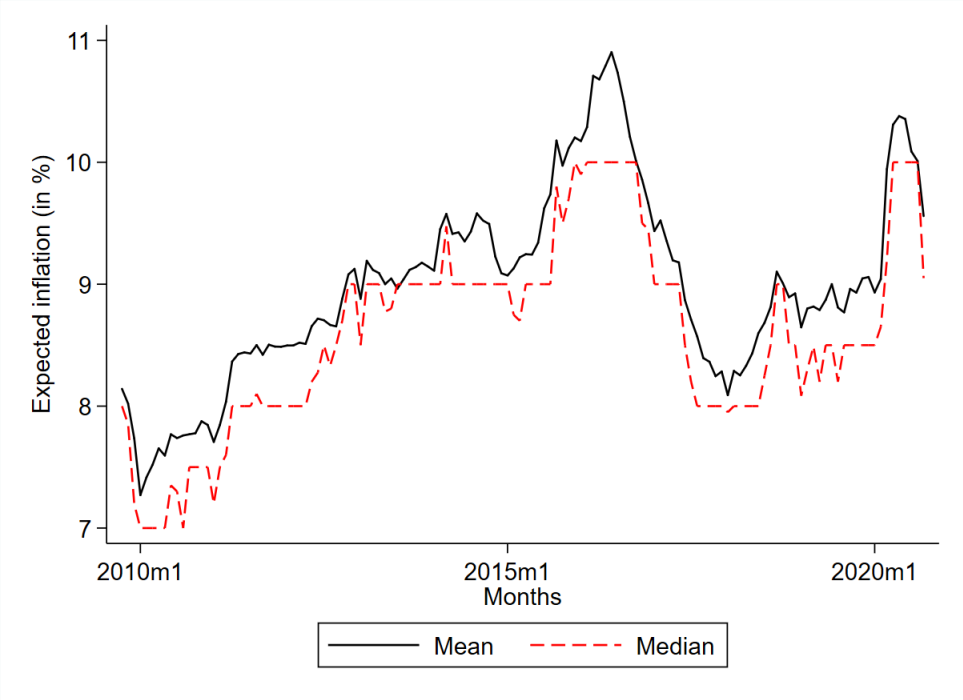
Figure 7 shows the evolution of the mean and median 12-month ahead inflation expectations together with actual inflation, observed 12 months later. In general, firms' inflation expectations are not far from actual inflation, but there are some periods in which inflation expectations depart from observed inflation.

[13] In Spanish, the original wording is: *¿Cuál cree usted que será la variación del IPC (Indice de Precios al Consumo)?*.

[14] The wording of the questions is important. For instance, de Bruin et al. (2012) find that expectations were lower and there was less disagreement if households in the Michigan Survey of Consumers are asked about "inflation" instead of "prices in general" or "prices you pay". On the other hand, Coibion, Gorodnichenko, and Kumar (2018) find no difference in expectations if firms in New Zealand are asked about "changes in prices" or directly "inflation".

[15] In Spanish, the original wording is: *¿Cuál cree usted que será la variación promedio de los costs de su empresa en pesos uruguayos?*.

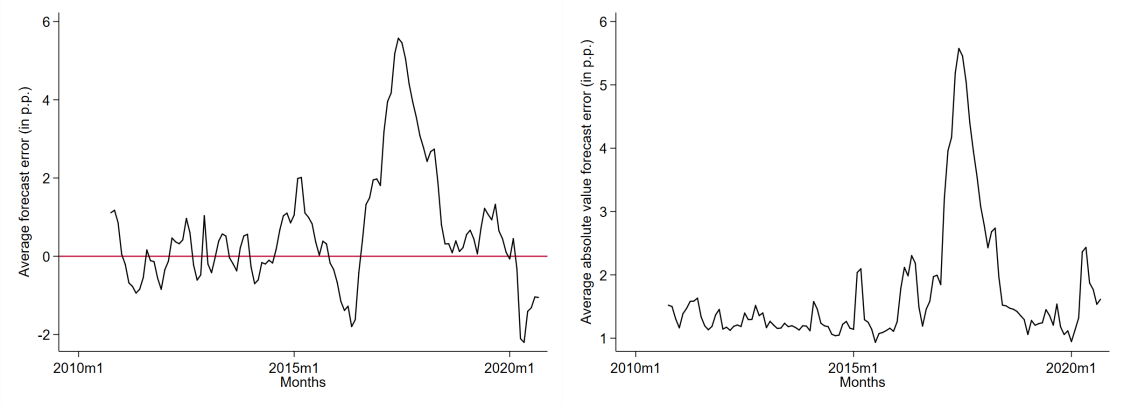
Figure 7: Mean and median inflation expectations: next 12 months



Note: The figure shows the simple average and mean for the sample of firms in the survey to 12 months inflation expectations. We use all observations available.

Figure 8 shows the mean forecast error for 12-month ahead inflation expectations. Firms in Uruguay are better forecasters than firms in New Zealand. Whilst the forecast error for the average 12 months-ahead inflation is 0.6 percentage points among Uruguayan firms, it is between 2.3 and 3.9 percentage points among firms in New Zealand. The absolute value of firms' average forecast error in Uruguay is 1.7 percentage points on an average inflation of more than 8% during the sample period.

Figure 8: Average forecast error (in p.p.)



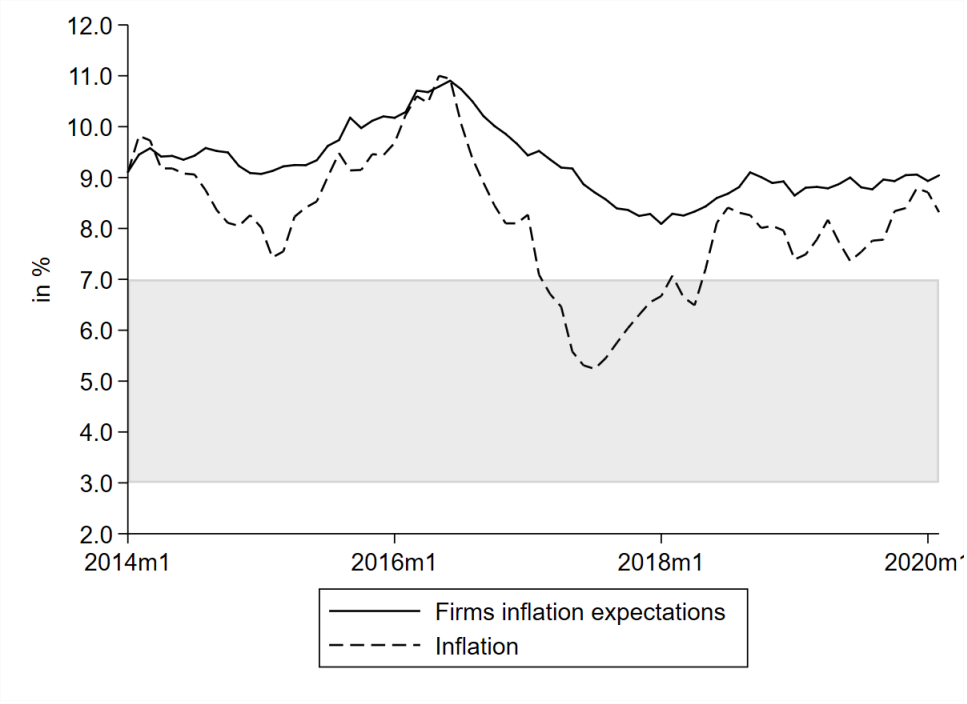
Forecast Error | Absolute value forecast error

Note: The left panel shows the average forecasting error for the sample of firms. The forecasting error is computed as the difference between the point forecast over 12 months and the realized inflation 12 months after. The right panel shows the average of the the absolute value for the sample measure.

Figure 9 shows the evolution of inflation and firms' average inflation expectations between January 2014 and February 2020. The gray area represents the inflation target range during that period. As we can see from the graph, inflation most of the time was above the upper bound of the target range. On the other hand, on average, firms' inflation expectations were never within that range. Despite this, observed and expected inflation in our sample period were relatively stable, with a mean of 8.2 percent and 9.3 percent, respectively.

More details about the expectations survey can be found in Frache and Lluberas (2019).

Figure 9: Inflation and inflation expectations in Uruguay



Note:The figure shows the 12 months inflation expectations of the firms for each period of time and the current CPI inflation. The solid black line is the average 12 month inflation expectations of firms and the dashed black line is the CPI annual inflation. The shaded are shows the Uruguayan Central Bank inflation target, that goes from 3.00 percent to 7.00 percent.

B Exchange rate: Firms and Central Bank text analysis

To elicit the firm's concerns during the analyzed period and have some understanding of how relevant the exchange rate is from the firm's perspective, we exploit an open question in the Uruguayan survey on firms' expectations. Every month at the end of the questionnaire, there is a free text, not compulsory question, asking about the reasons behind the answers and expectations. We have access to these comments between June 2012 and February 2020; the average response rate is 46

To build the word cloud we exhibit in Figure 10, we preprocess the answers transforming all words into lower-case, correct misspelled words, remove words with no meaning. Finally, we group them into category-specific terms according to their topic based on specific keywords

or associated ones. The terms appearing more than one thousand times, with the number of appearances reported in brackets, are inflation (6,616), dollar (4,891), wages (3,959), costs (3,524), company (2,432), macroeconomics (1,604) and market (1,328).

Figure 10: Category-specific terms answered by the firms

Note: The figure shows the words that firms use in the open question where they have to justify their numerical expectation forecast. The size of the words indicate the relative importance of each answer in terms of the share of the total words used.

The category "inflation" appears as the main word when firms have the option to explain the motives behind their forecast and expectations reported in the survey. Not surprisingly, for a dollarized economy like Uruguay, the exchange rate value appears immediately after, even before wages, costs, or aggregate or idiosyncratic elements. This evidence shows how relevant is the price of the US currency for the firms in the domestic economy.

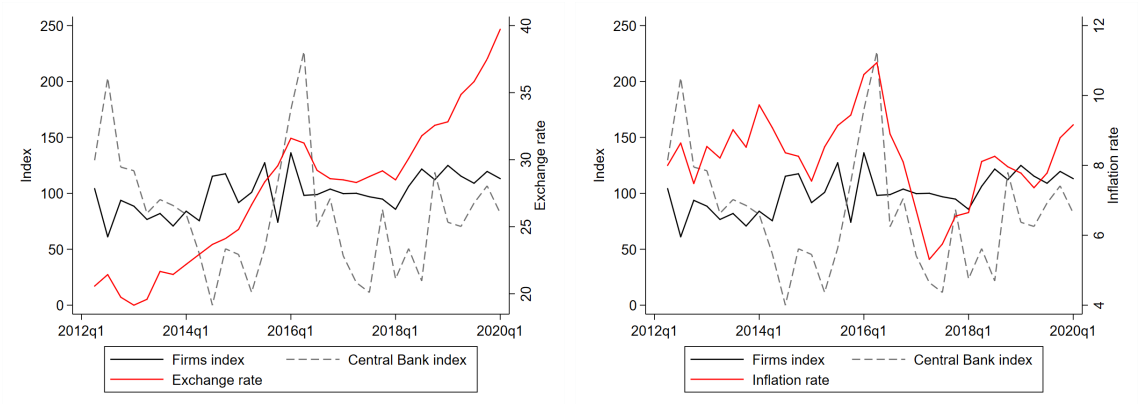
To provide further evidence of the relevance of the exchange rate for the Uruguayan economy, we construct an index that captures the relative concern about the dollar for the analyzed period. Apart from building this index for the firms using the above-explained question, we do it for the Monetary Policy Committee memo [16] , which is released quarterly.

[16]They are available at https://www.bcu.gub.uy/Ingles/Paginas/Copom.aspx

We do the following steps to capture the relative importance of the exchange rate on the firms' comments or the Monetary Policy Committee communique. First, we count the number of phrases in which any of the following words related to the exchange rate appear: dollar/s, currency/ies, exchange rate, devaluation, depreciation, foreign currency, USD, US$, U$S. Secondly, we divide those sentences over the total amount of sentences answered by the firms, or appear in the Central Bank document. Thirdly, we aggregate the monthly firms' frequency into quarterly. Next, we stantardize each index to unit standard deviation. Finally we normalize each index to its mean and multiply by 100.

The mean frequency of the sentences with the dollar concept is 31.3% and 2.9% for the firms and the central bank, respectively. At first, the evidence suggests firms exhibit more relative importance to the exchange rate than the central bank, particularly during the first two-thirds of the sample, as seen in Figure 11.

Figure 11: Text index capturing the exchange rate relative importance



Note: The figure shows the time series of an index that shows how important is the exchange rate relative to the rest of the words used in a open question where firms are asked to justify their numerical expectation response. The index is constructed as the total number of words related to exchange rate divided by the the total amounts of words use by each firms. We do the same index for the Monetary Policy Committee memo of the Central Bank. In both left and right panel the solid line is the firms' index and the dashed line Central Bank index. In the left panel, the solid red line is the exchange rate value. In the right panel, the solid red line is the CPI inflation.

An interesting point emerges when we compare the evolution of the indices with the exchange rate or inflation, which we report in Figure 11. Firm's concerns about the exchange

rate and the actual local price of the US currency exhibit a positive correlation of 0.61, reinforcing the idea of how relevant this issue is for the companies. On the contrary, the index from the monetary policy meetings' report seems uncorrelated with the dollar price in pesos, as the correlation is -0.03. This evidence reverses when we compute the correlation of the indices with inflation. The firm's answers index correlates 0.04 with inflation, but in the case of the index from the Central Bank, the correlation is 0.56.

In sum, firms express concern with the exchange rate when the Uruguayan peso depreciates, but the Central Bank does not. Remarkably, mention of the exchange rate in the monetary authority communication seems to appear and co-move with inflation. This evidence suggests that when movements in the exchange rate may potentially be behind changes in inflation, the central bank considers that in their monetary policy communication. For instance, during the first semester of 2016 when the peso depreciated around a fifth of its value, this sentence appeared in the first and second report of the year: "Should the volatile situation in the international financial markets persist, with the consequent repercussions on the domestic exchange market, the combination of available instruments will be used to smooth excessive exchange rate movements."

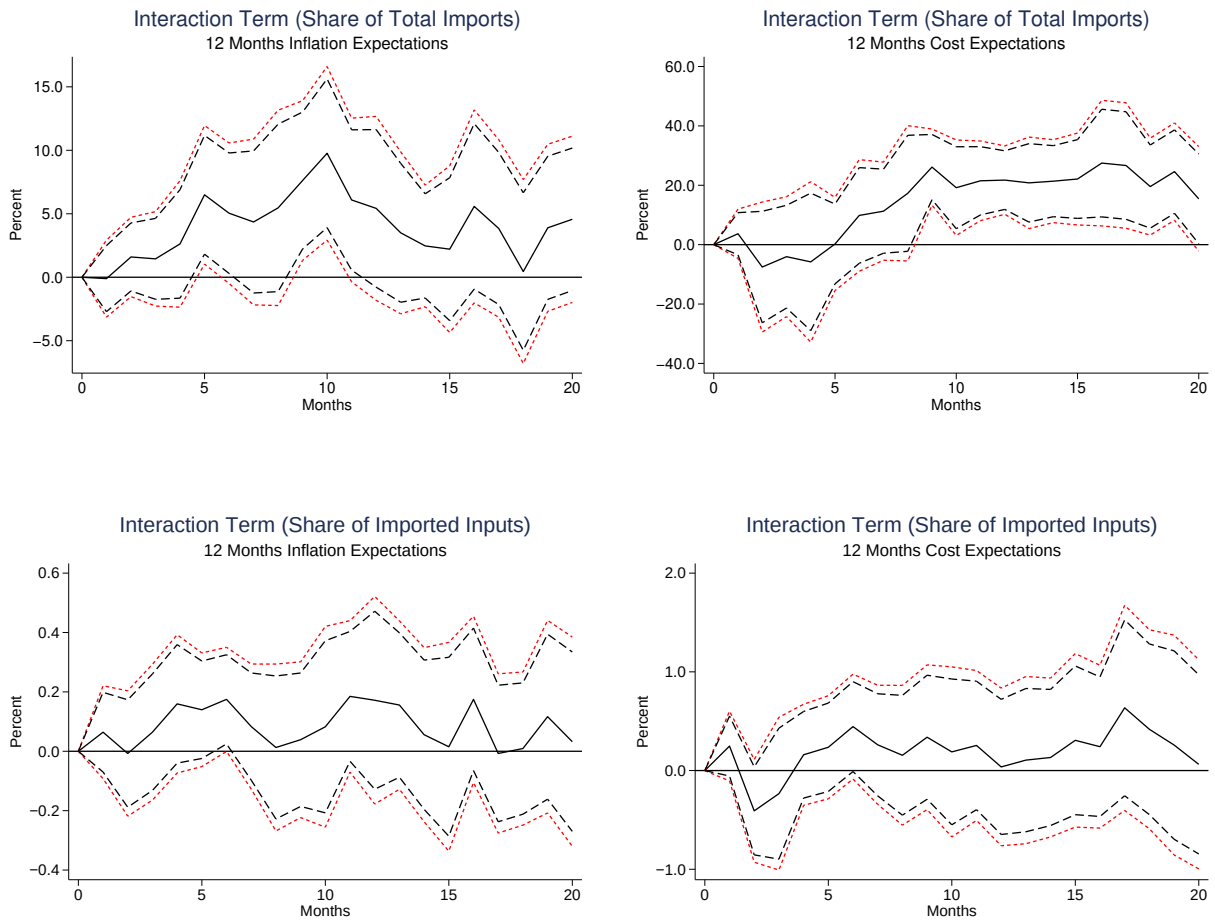
C International shocks and exposure to imported goods

Besides the debt position in external currency, the share of imported goods at the firm level could also play a crucial role in the transmission of external MP shocks to firms' expectations. We allow for two distinctions to measure imported goods in the data. On the one hand, we start by focusing on firms' total imported goods at a monthly frequency, including both inputs and final goods sold directly to customers. We measure total imports as a function of firms' annual sales. On the other hand, we tackle the importance of imported goods with respect to the production function of the firm by controlling only for the share of imported inputs. In this latter case, we measure total imported inputs as a function of total imports.

Following the same approach as in equation (3), we instead control for the relevance of imported goods instead of focusing on debt. In particular, we interact each measure of imported goods (one at a time) with our measure of MP shocks and assess the response to expectations. Figure 12 presents the results.

Interestingly, in this case there is a mild significant reaction across firms that import either their inputs or their final goods. Consistent with the intuition, both expectations for this group of firms are revised upward after the international MP shock and the upcoming depreciation in the nominal exchange rate. Similar to the results discussed in Section 3.4.1 the degree of exposure to the US economy and particularly to the US dollar matters in order to understand the reaction of firms' expectations. Finally, focusing on the share of imported inputs only, we observe no significant reaction of expectations.

Figure 12: Response of importers' expectations to MP shocks



Inflation Expectations | Cost Expectations

Note: This figure shows the effect of a monetary policy shock on firms' expectations, exploiting their level of exposure to imports, using specification (3). The upper panels plot $\gamma^{h,0}$, or the effect on firms that import. The lower panels plot the same coefficient, but for firms that import their inputs. The dependent variable is the firms' inflation expectations (left) and cost expectations (right). We include a firm fixed effect. We use $J = 12$ and robust standard errors. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

D Effects of a Uruguayan MP shock

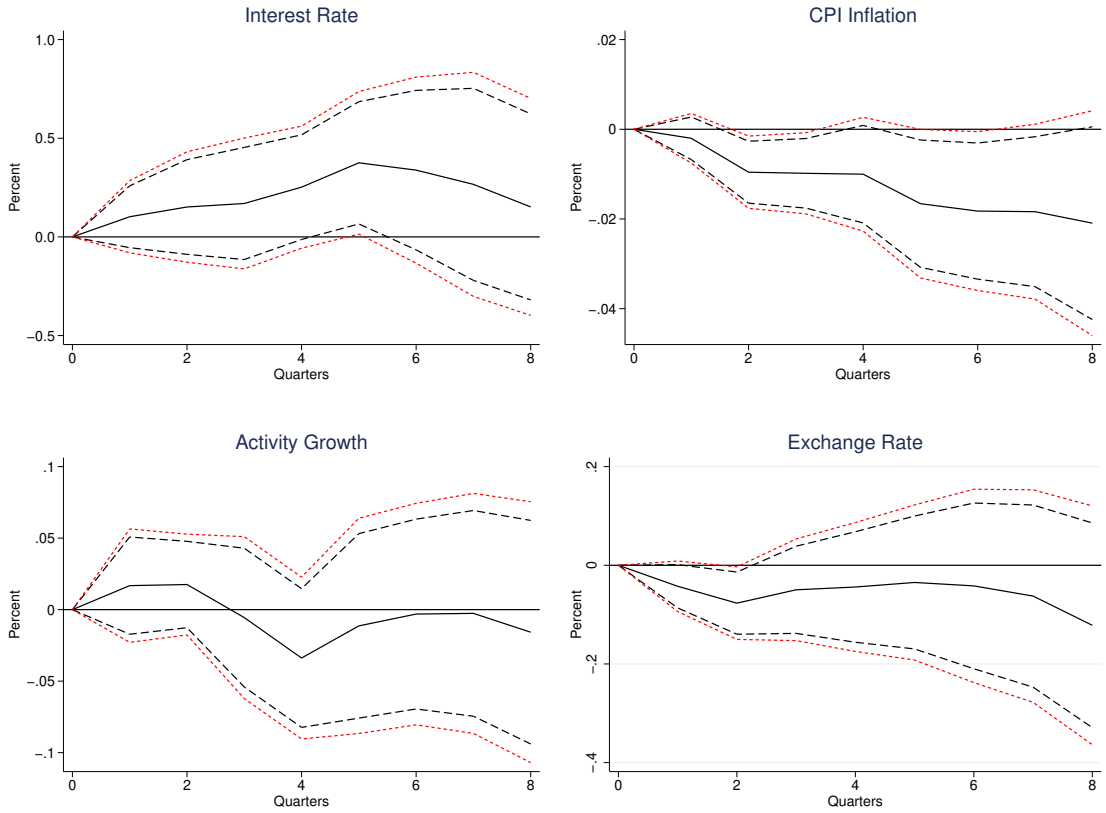
We discuss the effects of a Uruguayan MP shock on local macroeconomic variables and also the response of both inflation and cost expectations across firms. To do so, we collect a

monetary policy shocks using the DSGE model in Basal et al. (2016). The model is calibrated at a quarterly frequency so we adjust the estimation accordingly.

D.1 Effects of MP shock on local economy

Figure 13 below shows the response of inflation, a short-term interest rate, and the nominal exchange rate after a local MP tightening. Approximately after six quarters, inflation drops by 2 percent after a positive MP shock. The effect is significant even if we focus solely on a 95 percent confidence interval. As expected, the reaction of short-term rates is also positive and significant. The reaction of the nominal exchange rate is mildly significant right after a shock but then the effect dies out after the second quarter.

Figure 13: Effect of Uruguayan MP shocks on the domestic economy

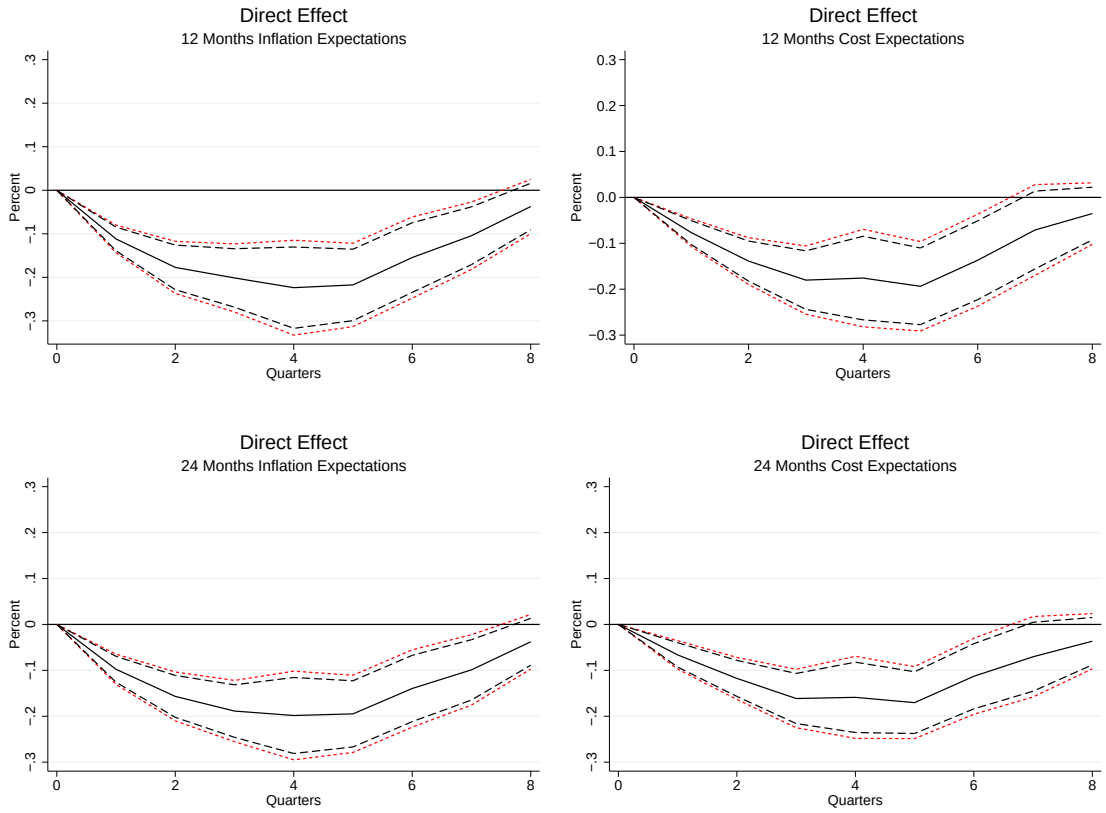


Note: The Figure shows the effect of a monetary shock in Uruguay on interest rate (upper-left pannel), CPI inflation (upper-right), economic activity (lower-left) and exchange rate (lower-right). We use $J = 4$ quarters and robust standard error. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

D.2 Direct effect on expectations of Uruguayan MP shock

As shown in the previous section a local MP shock induces a drop in current prices in Uruguay. Now, we assess the response of inflation and cost expectations. This is shown in Figure 14. In line with a recessionary shock, firms revise both expectations downwards at both 12 months and 24 months. Hence, firms anticipate a reduction in activity and demand that will bring a possible drop in their input costs as well as in overall prices. As the direct effect on expectations of the two shocks is observationally equivalent, we now study whether such an effect is indeed heterogeneous depending on the degree of exposure to the US economy.

Figure 14: Effect of Uruguayan MP shocks on the firms' expectations

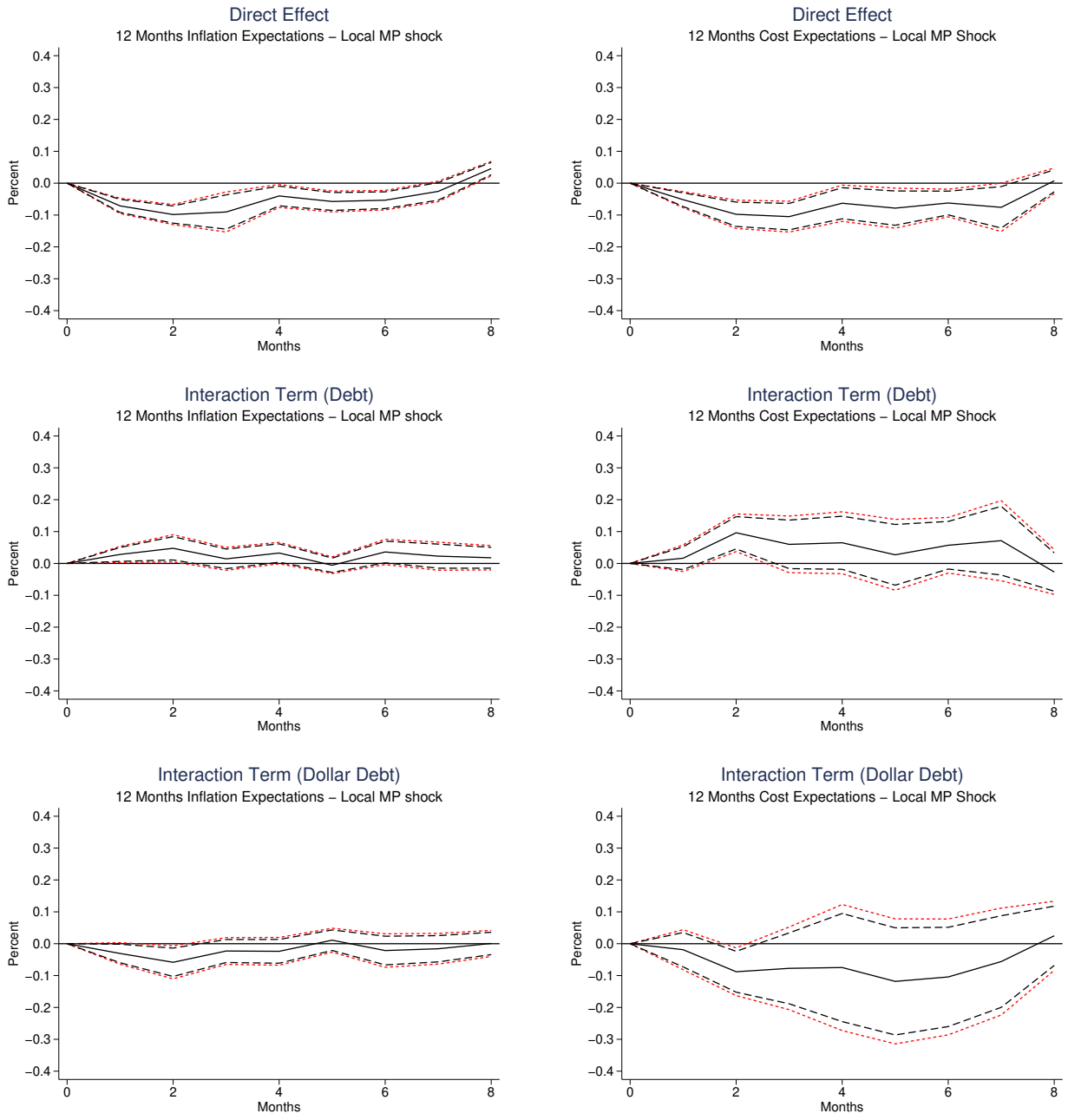


Note: This figure shows the effect of a monetary policy shock in Uruguay on firms' 12-month cost expectations (upper right), 12-month inflation expectations (upper left), 24-months cost expectations (lower right) and 24-months inflation expectations (lower left). The results come from estimating 2, were the dependent variable is the firms specific percentage change between the base period and H. We use $J = 4$. Standard errors are clustered at the time and firm level. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

D.3 Interactions' effect on expectations of Uruguayan MP shock

Even though the direct effect of a local MP shock is similar to that of an external shock, and in line with our transmission intuition, we expect no heterogeneous reaction to a local shock when we control for the level of exposure to the US economy. Figure 15 shows the responses to the local shock when we interact such a shock with our "debt" dummy variable which reflects whether or not the firm has debt or not and our "dollar" variable, which computes the share of debt denominated in US dollars.

Figure 15: Adjustment of expectations to a local MP shock



Inflation Expectations | Cost Expectations

Note: This figure shows the effect of a monetary policy shock on firms' expectations, exploiting their level of exposure to debt and debt in US dollar, using specification (3). The upper panels show the direct effect ($\beta^{h,0}$) or the effect for firms without debt. The middle panels plot $\gamma^{h,0}$, or the effect on firms with debt in Uruguayan pesos. The lower panels plot $\zeta^{h,0}$, or the effect on firms with debt in US Dollar. The dependent variable is the firms' inflation expectations (left) and cost expectations (right). We include a firm fixed effect. We use $J = 4$ and robust standard errors. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

As expected, and in line with our intuition, the result show no meaningful reaction across the subset of firms more heavily exposed to the US dollar. Although the dynamics of the response suggest a slight positive reaction, none of the specifications deliver significant results.

D.4 Interactions' effect on expectations of US MP shock - Accuracy

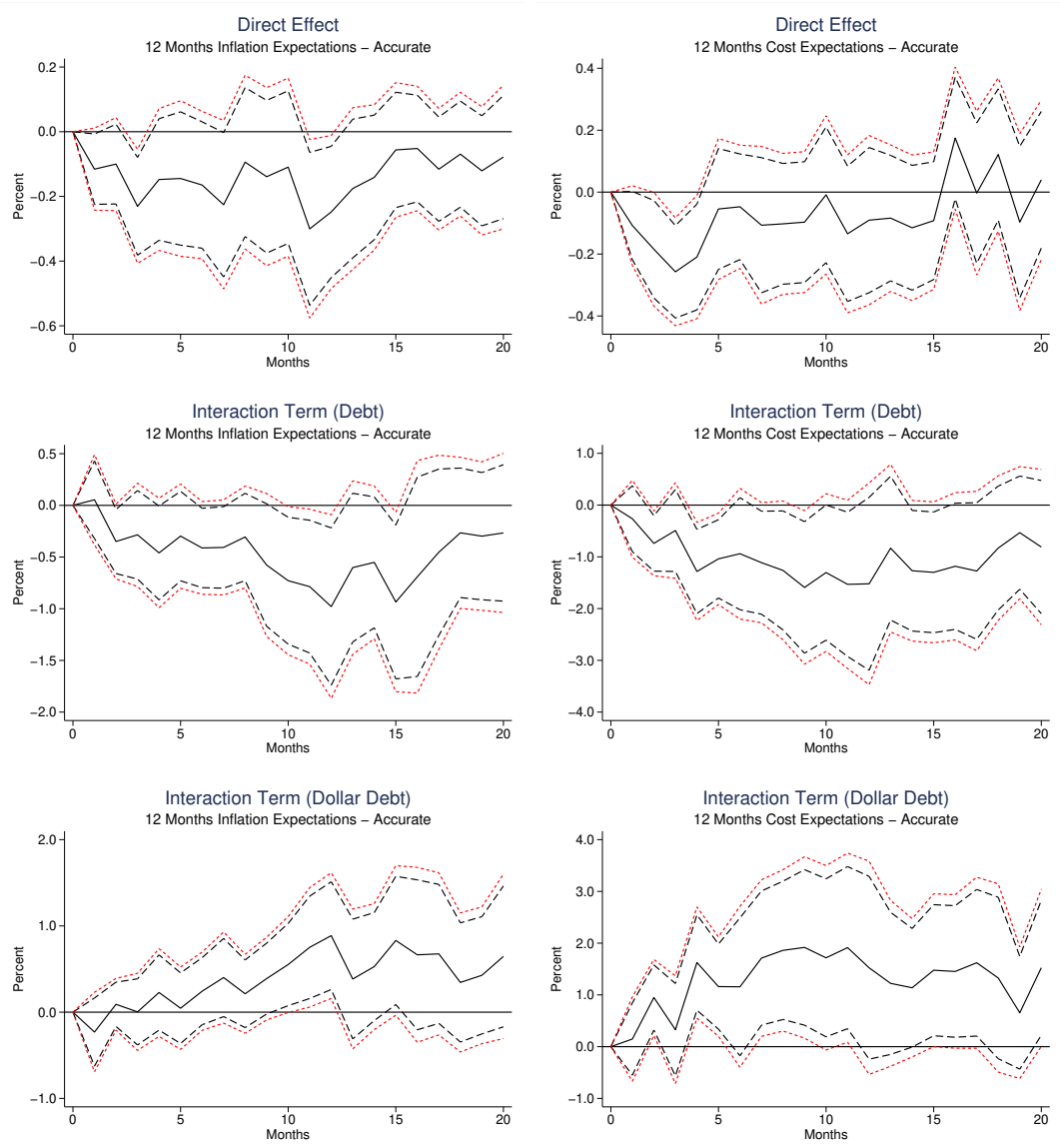
In this section, we split the firms in terms of their ex-post accuracy. While we do not have specific information about costs, we can compare their predictions for inflation to its actual outcome. The idea is to assess whether part of the significant reaction of expectations to the external shock is driven by the "quality" of expectations. In particular, it could be that firms that are reacting to the shock are precisely those that are more informed and are tracking overall economic conditions more closely.

We compute the forecast error $FE_{i,t}$ for inflation expectations as the difference between the predicted inflation at time t and its $t+12$ actual realization. Following Bachmann and Elstner (2015) we then run firm-level regressions of the forecast errors on a constant, and given the sign of the estimated constant, we classify firms as: "Accurate" and "Non-Accurate." Accurate firms correspond to the ones whose estimated constant is not statistically different from zero at the 95 percent confidence level, i.e., on average, their forecast error is zero. Non-accurate corresponds to firms whose constant is statistically either positive or negative.[17] In Figure 16 we repeat the estimation, controlling for the level of exposure to the US economy, but also conditioning on Accurate and Non-accurate firms.

Overall, the results are roughly similar to those of the baseline estimation. Both the direct and the interacted effects show similar dynamics after we control for the degree of accuracy of expectations. Focusing on the reaction for the group of exposed firms, the positive response of both inflation and cost expectations is particularly significant for the subset of accurate firms. Thus, it seems that the level of information or attentiveness across firms, coupled with the level exposure to the US, is also relevant for determining the response of expectations to an international shock.

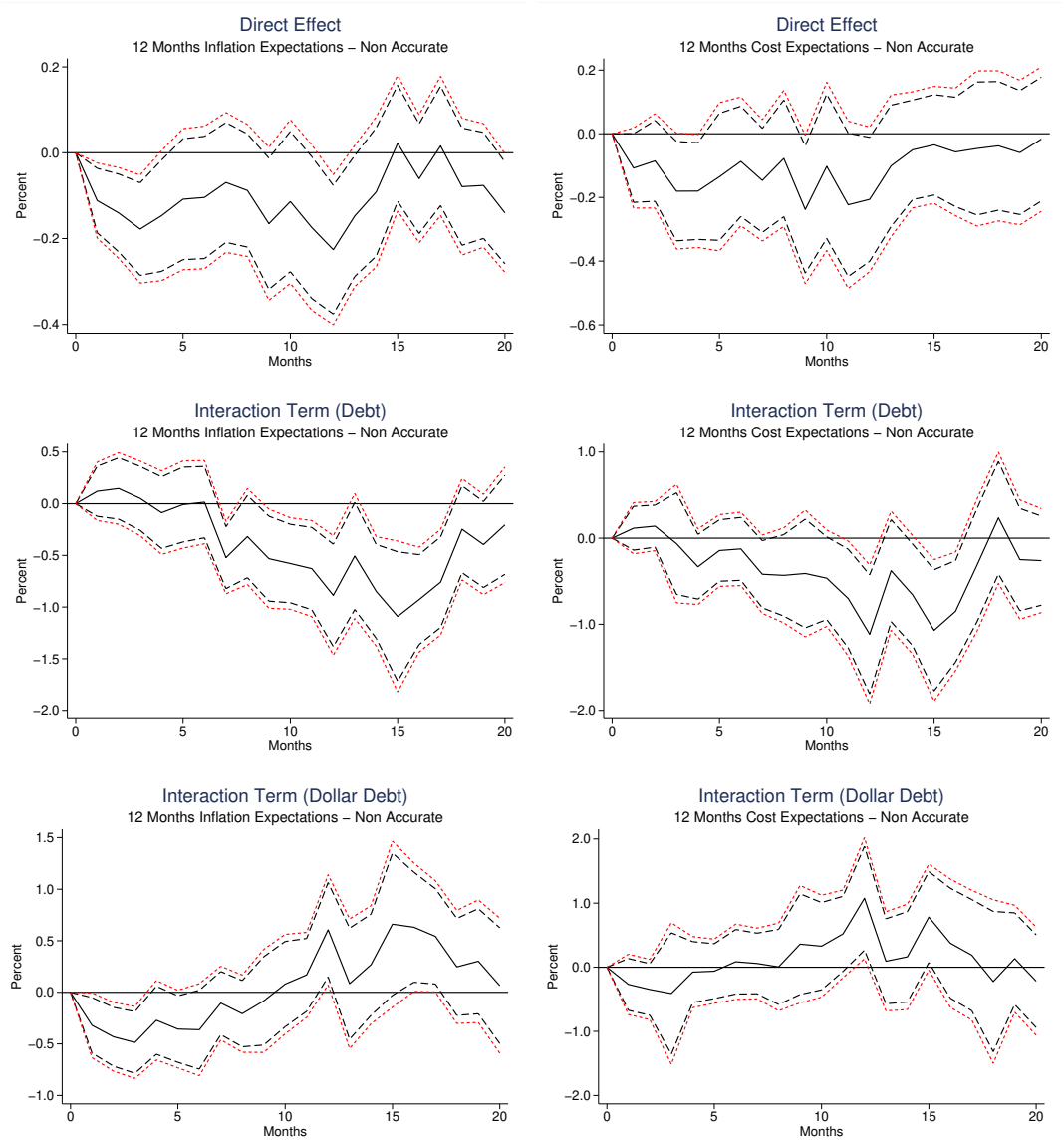
[17] Strictly speaking, Bachmann and Elstner (2015) propose three categories of accuracy: "Realists," "Optimists" and "Pessimists." Realists correspond to firms whose estimated constant is not statistically different from zero at the 95% confidence level. The Optimists group includes firms with a negative average for the error, i.e., those that expect lower than realized cost changes over the next year. Finally, the Pessimists group is composed of firms that expect higher than observed costs.

Figure 16: Adjustment of expectations in response to MP shock



Note: This figure shows the effect of a monetary policy shock on firms' expectations, exploiting their level of exposure to debt and debt in US dollar, using specification (3). The upper panels show the direct effect ($\beta^{h,0}$) or the effect on firms without debt. The middle panels plot $\gamma^{h,0}$, or the effect on firms with debt in Uruguayan pesos. The lower panels plot $\zeta^{h,0}$, or the effect on firms with debt in US dollar. The dependent variable is the firms' inflation expectations (left) and cost expectations (right). We include a firm fixed effect. We use $J = 12$ and robust standard errors. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

Figure 17: Adjustment of expectations in response to MP shocks

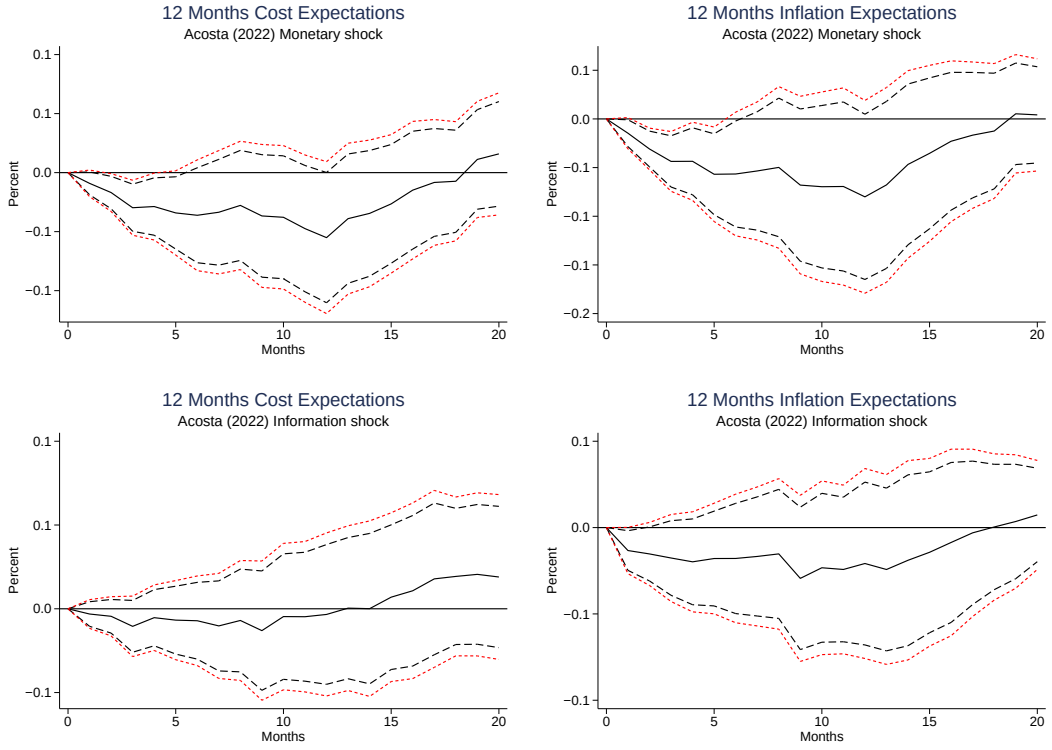


Note: This figure shows the effect of a monetary policy shock on firms' expectations, exploiting their level of exposure to debt and debt in US dollar, using specification (3). The upper panels show the direct effect ($\beta^{h,0}$) or the effect on firms without debt. The middle panels plot $\gamma^{h,0}$, or the effect on firms with debt in Uruguayan pesos. The lower panels plot $\zeta^{h,0}$, or the effect on firms with debt in US dollar. The dependent variable is the firms' inflation expectations (left) and cost expectations (right). We include a firm fixed effect. We use $J = 12$ and robust standard errors. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals.

E Robustness with alternative shocks

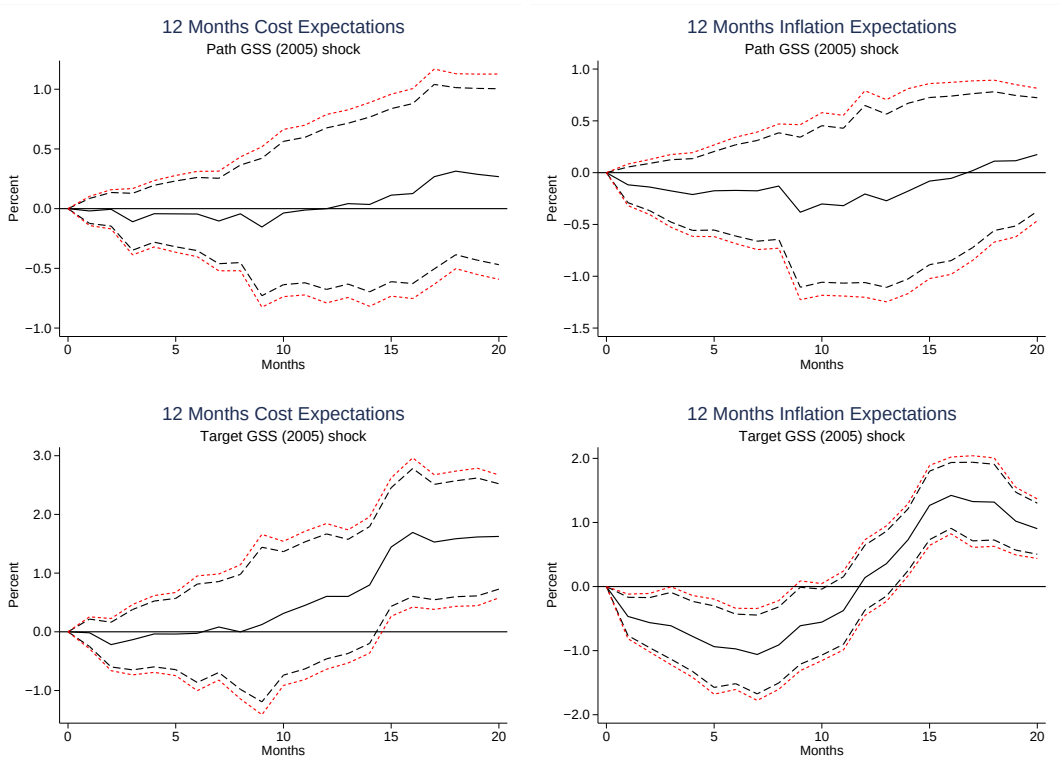
Our main results use a monetary policy shock in the US developed by Bu, Rogers, and Wu (2021). While this shock eliminates the information effect of the monetary policy shock, there are other shocks that aim to have a similar effect. In this section we evaluate the effect on expectations of information and monetary policy shocks and compare it with the main results. Using the extensions of Acosta (2022), we evaluate the shock of Nakamura and Steinsson (2018), Gürkaynak, Sack, and Swanson (2005), and Acosta (2022) and policy surprises in a 30 minute window. These shocks are separated by information and monetary policy shocks. Figure 18 19 and 20 show the results.

Figure 18: Effect of response to MP shocks on firms' expectations (according to Acosta (2022))



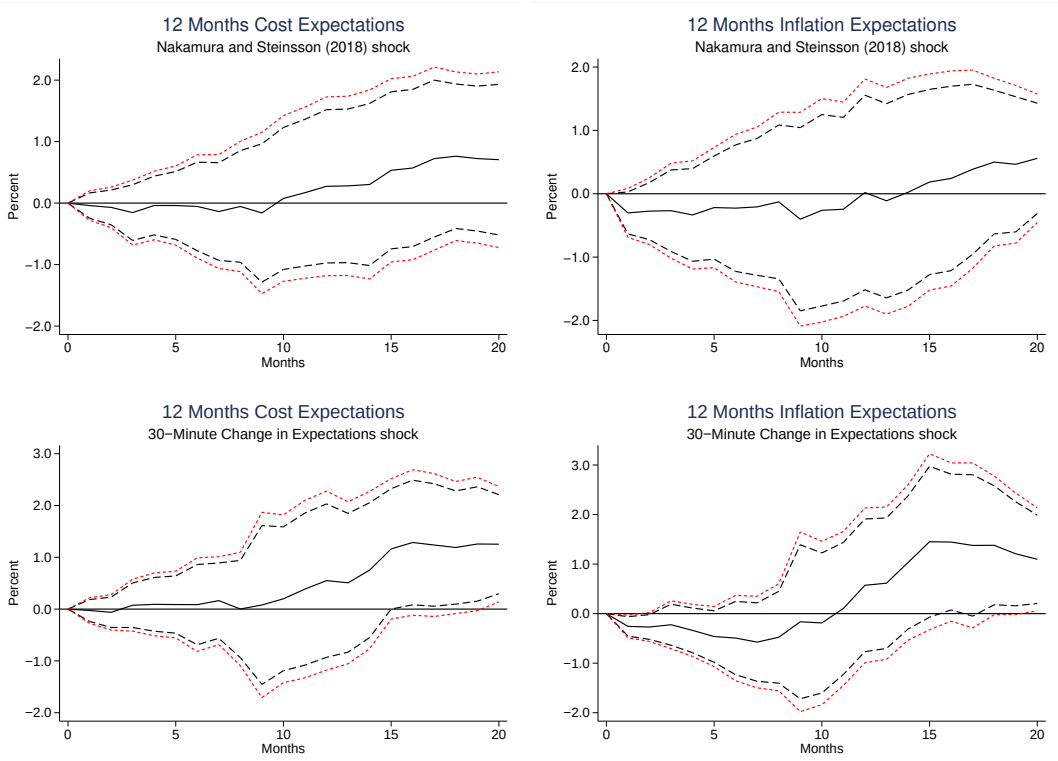
Note: Figures show how a 1 percentage point monetary policy shock according to Acosta (2022) changes the percentage change in Uruguayan firms' inflation and cost expectations. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals. Standard errors are clustered at the time level.

Figure 19: Effect of response to MP shocks on firms' expectations (according to Gurkaynak, Sack and Swanson (2005))



Note: Figures show how a 1 percentage point monetary policy shock according to Gürkaynak, Sack, and Swanson (2005) changes the percentage change in Uruguayan firms' inflation and cost expectations. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals. Standard errors are clustered at the time level.

Figure 20: Effect of response to MP shocks on firms' expectations (according to Nakamura and Steinson (2018))



Note: Figures show how a 1 percentage point monetary policy shock according to Nakamura and Steinsson (2018) and 30-minute changes in expectations change the percentage change in Uruguayan firms' inflation and cost expectations. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals. Standard errors are clustered at the time level.

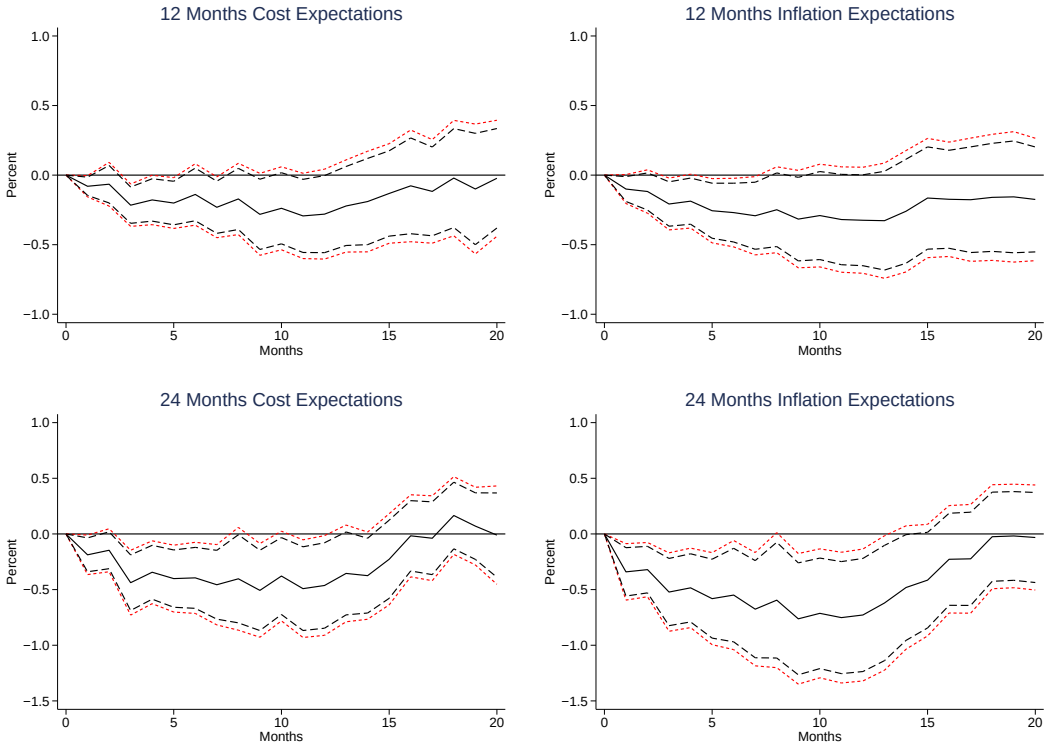
We can see that monetary policy shocks not related to the information channel confirm our results. This is because the information channel is associated with a expansionary demand shock as shown by Jarociński and Karadi (2020).

F Results since 2009

Our main specification uses data from January 2014 to February 2020, as it overlaps with the sample size that we have for other data sources. In addition, that period of time is characterized by policy normalization in the US after a prolonged period with the policy rate at the effective zero lower bound. Since the shocks of Bu, Rogers, and Wu (2021)

include the whole term of the rates, they construct shocks for the period of the zero lower bound. In this appendix, we extend our results to a sample from October 2009, when the survey starts, to February 2020, prior to the COVID-19 pandemic. Figure 21 shows the results of our main specification.

Figure 21: Effect of response to MP shocks on firms' expectations for sample starting in 2009

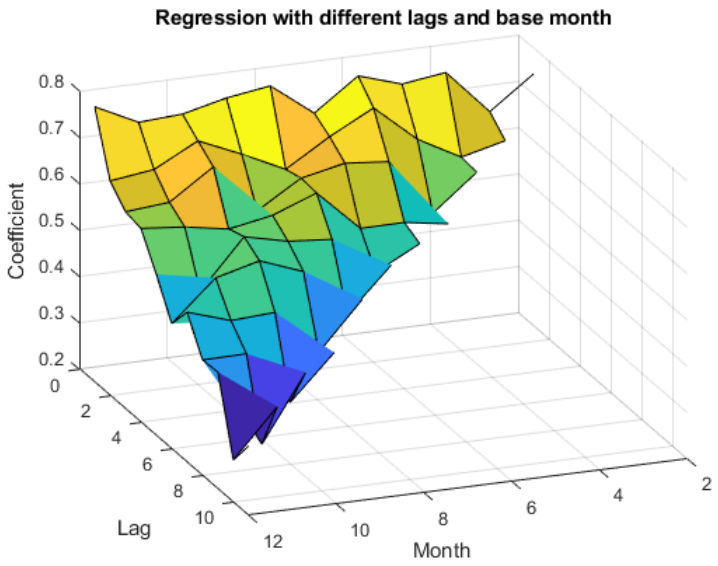


Note: Figures show how a 1 percentage point monetary policy shock according to Bu, Rogers, and Wu (2021) changes the percentage change on Uruguayan firms' inflation and cost expectations. The long dashed black lines represent 90% confidence intervals, while the short dashed red lines represent 95% confidence intervals. Standard errors are clustered at the time level.

We can see that the results show a similar pattern and a similar effect. After a contractionary monetary policy shock, expectations of inflation and costs at 12 and 24 months are adjusted downward as in our main results.

G Other Figures

Figure 22



Note: Figure shows results of regression 6, changing the number of lags of the previous forecast and the month of the year that the regression is run. All coefficient are statistically different from zero at the 99 percent confidence interval and al regressions have standard errors clustered at the time and firm level.

H Model Details

We use a simple small open economy model as in Gali and Monacelli (2005). The large economy has the same preferences as the small open economy.

The small open economy consumes local and foreign goods and has similar parameters. The consumers maximize:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma} - \frac{L_t^{1+\alpha}}{1+\alpha}, \tag{15}$$

subject to

$$P_t C_t + (1+i_t) B_t = B_{t+1} + W_t L_t + \Pi_t^f, \tag{16}$$

with

$$C_t = \left[\phi c_{H,t}^{\frac{\sigma-1}{\sigma}} + (1-\phi) c_{F,t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{17}$$

where C_t is the consumption basket formed by home ($c_{H,t}$) and foreign goods ($c_{F,t}$), σ is the elasticity of substitution between local and foreign goods and ϕ are the preferences for the local good. When $\phi > 0.5$ there is home bias. Goods are produced by a continuum of firms with elasticity of substitution η, as $c_{i,t} = \int_0^1 c_{i,t}(z)dz$. Π_t^f are local firms' profits, and W_t are local wages. Local consumers buy foreign goods paying an exchange rate E_t. The price index is:

$$P_t = \left[\phi P_{H,t}^{1-\sigma} + (1-\phi)\left(E_t P_{F,t}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \tag{18}$$

The only departure is the expectations formation of the firms $E_{f,t}$. In order to compute those expectations, we first run the model in the peg version. Then we obtain the reaction function and next we construct the auxiliary expectations of the firm. To do so, we construct an auxiliary variable that is equal to the firm's own price expectations of the form $\pi_{H,t}^{aux} = \pi_{H,t+1}$. Then, the model policy function would depend on the following state variables: the lag in the price of the small open economy firm, the lag price in the large economy firm, the lag in the price index of the small economy, and the monetary policy shock variable. Finally, $E_{f,t}^{peg}$ is defined by

$$E_{f,t}^{peg}\pi_{H,t+1} = \phi_\varepsilon * \varepsilon_t + \phi_{P_H}\check{p}_{H,t-1} + \phi_{P^*}\check{P}_{t-1}^* + \phi_\epsilon \epsilon_{t-1} + \phi_P \check{P}_{t-1},$$

With that variable, we compute $E_{f,t}$ in the model.

The log-linearized model equations are:

$$\Pi_t^* = \kappa(\alpha+\gamma))y_t^* + \beta E_t \Pi_{t+1}^*$$

$$c_t^* = -(1/\gamma)(i_t^* - \Pi_{t+1}) + E_t c_{t+1}^*$$

$$i_t^* = \sigma_\pi \Pi_t^* + y_t^* + \epsilon_t$$

$$c_t^* = y_t^*$$

$$\Pi_t^* = P_t^* - P_{t-1}^*$$

$$i_t - i_t^* = E_t e_{t+1} - e_t$$

$$\pi_t = \kappa * mc_t + \beta * \pi_t^{aux}$$

$$-\gamma * c_t + \gamma * c_t^* = P_t - P_t^* - e_t$$

$$P_t = \phi p_t + (1-\phi)(P_t^* + e_t)$$

$$\Pi_t = P_t - P_{t-1}$$

$$\pi_t = p_t - p_{t-1}$$

$$mc_t = \alpha y_t + (\gamma - (1/\sigma))c_t + ((1/\sigma)) * c_{H,t}$$

$$-c_{F,t} + c_{H,t} = \sigma(P_t^* + e_t - p_t)$$

$$c_t = \phi c_{H,t} + (1-\phi)c_{F,t}$$

$$y_t = y_t^* + (1/\sigma_a) * (P_t^* + e_t - p_t)$$

$$\epsilon_{t-1} = \rho \epsilon_{t-1} + \varepsilon_t$$

Expectations of the firms could be either

$$\pi_t^{aux} = E_t \pi_{t+1}$$

or

$$\pi_t^{aux} = E_{f,t}\pi_{t+1}$$

Then, the two policy regimes for the local economy are:

$$e_t = 0$$

$$i_t = \sigma_\pi \Pi_t + y_t$$