Price and Quantity Effects of Monetary Policy Actions and Statements in an Emerging Economy [†]

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Abstract

This paper studies the effects of monetary policy actions and statements on the exchange rate, the yield curve and portfolio flows in Mexico. Surprises about the current policy rate and about its future path communicated via statements are identified using a new dataset of intraday changes in asset prices around monetary policy announcements. I show that bond yields and portfolio flows respond significantly to both types of surprises. Domestic and foreign investors rebalance their portfolios over time following monetary policy decisions; for domestic investors, the rebalancing depends on their business model. Meanwhile, the exchange rate only reacts to surprises about the current policy rate and the effect is not persistent.

Keywords: Monetary policy surprises, exchange rate, yield curve, portfolio flows, high-frequency data, event study.

JEL Classification: E52, E58, E43, F31, G14.

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1 Introduction

Monetary policy in advanced economies has more than one dimension since financial markets react to different types of information (e.g. changes in the policy rate, news about the future path of the policy rate, adjustments in asset purchase programs) communicated by central banks via policy statements. However, it is not yet clear whether monetary policy in emerging markets also has more than one dimension.[1] A lack of response of financial markets to the different types of information communicated by emerging market central banks would mean that they have less room to operate relative to their counterparts in advanced economies.

This paper studies whether asset prices and portfolio flows respond not only to changes in the policy rate but to information about its future path communicated via policy statements by Banxico, the Mexican central bank. Monetary policy surprises are identified following the methodology proposed by Gürkaynak et al. (2005) and using a new dataset of intraday changes in swap rates around monetary policy announcements from 2011 to 2019.[2] Surprises in the policy rate and about its future path are henceforth referred to as target and path surprises, respectively. To measure the effects on asset prices, intraday changes over the same windows are also calculated for the exchange rate and bond yields. To assess the effects on portfolio flows, the analysis looks at holdings of Mexican government securities disaggregated by type of investor available daily and at U.S.-Mexico portfolio flows available monthly. The analysis quantifies the contemporaneous effects as well as their persistence in the days following a monetary policy announcement using an event study methodology and local projections, respectively. By now, event studies with high-frequency data are a well-established approach in macro-finance to overcome endogeneity concerns. Monetary policy is intrinsically endogenous, it reacts to different macroeconomic circumstances, and so quantifying its effects is challenging. Event studies overcome this by isolating the surprise component of policy decisions.[3]

[1] Blinder et al. (2008) review the literature documenting the influence of central bank communications on financial markets mainly for advanced economies. Some evidence exists for emerging markets. Su et al. (2019) use content analysis to classify those communications but it is prone to subjectivity.

[2] The swaps reference an interbank interest rate that closely follows the policy rate.

[3] Nakamura and Steinsson (2018) review approaches to measure the effects of monetary policy.

The main finding in this paper is that path as well as target surprises are relevant for asset prices and portfolio flows in Mexico. This means that, in addition to changes in the policy rate, central banks in emerging markets also have the ability to manage expectations via statements. Three implications are worth highlighting. First, the multidimensionality of monetary policy (Gürkaynak et al., 2005; Swanson, 2018; Altavilla et al., 2019) is not exclusive to advanced economies. Second, by communicating information about the future path of the policy rate, emerging market central banks can better tame the spillover effects of monetary policy in advanced economies, which tend to be larger on long-term yields (Obstfeld, 2015; Kearns et al., 2018). Third, central banks in emerging markets would still have room to conduct monetary policy in case their policy rate were to be constrained by the zero lower bound.[4]

The exchange rate only reacts to target surprises and the effect is not persistent. The lack of response to path surprises seems characteristic of the Mexican peso because the currencies of advanced economies do respond to path surprises (Rosa, 2011; Ferrari et al., 2017), and emerging market currencies other than the Mexican peso respond to path surprises in the U.S. (Hausman and Wongswan, 2011). Future research can explore the extent to which Banxico's foreign exchange interventions to provide liquidity and to promote orderly market conditions mute the response of the currency to path surprises.

Bond yields respond significantly to target and path surprises. In particular, medium- and long-term yields react more to path than to target surprises, consistent with the evidence for the U.S. reported by Gürkaynak et al. (2005) for a period when the U.S. policy rate was not constrained by the zero lower bound. In this sense, Banxico's influence over longer-term yields improves the implementation of monetary policy in Mexico given that medium- and long-term yields are more relevant to the spending decisions of households and firms. Moreover, both type of surprises have a larger influence on the yield curve in Mexico than U.S. surprises have on the U.S. yield curve. According to the expectations hypothesis, this result suggests that long-term inflation expectations in Mexico are less

[4] Gürkaynak et al. (2005) reach a similar conclusion for the U.S. before the global financial crisis. When the zero lower bound is binding, forward guidance about the policy rate is more explicit than under a conventional approach (Kuttner, 2018). When other unconventional monetary policies are implemented (e.g. quantitative easing), financial markets respond to other types of information (Swanson, 2018).

firmly anchored than in the U.S.;[5] even though inflation expectations in Mexico are anchored (De Pooter et al., 2014), it is likely that they are not as well anchored as in the U.S. In addition, the larger reaction in Mexico can also reflect a larger effect of surprises on term premia, which could be explained by the response of reach-for-yield investors (Hanson and Stein, 2015); Mexican banks indeed exhibit this behavior as explained next.

Daily portfolio flows respond to both target and path surprises. Banxico collects daily data on holdings of different types of Mexican government securities disaggregated by type of investor. The most relevant type of bonds in Mexico are the long-term fixed-rate ones known as bonos. The analysis shows that domestic and foreign investors rebalance their portfolios of bonos following monetary policy decisions. Moreover, the rebalancing done by domestic investors depends on their business model. For instance, banks exhibit reach-for-yield behavior, they increase their purchases of bonos a few days after a target easing surprise; their response supports the mechanism described by Hanson and Stein (2015), in which monetary policy affects term premia due to yield-oriented investors. More broadly, holdings data provides a broader picture of the effects of monetary policy. Target and path surprises influence bond yields days after an announcement, which is in line with gradual changes in bonos holdings. Indeed, pension funds and foreign investors take time to respond to the surprises. This evidence is consistent with the slow-moving capital explanation proposed by Brooks et al. (2019) for how the yields respond to monetary policy in advanced economies.

Some portfolio flows between Mexico and the U.S. also react to target and path surprises. Inflows into non-U.S. stocks increase following a target easing surprise. This means that the central bank in the destination country can trigger a reach-for-yield behavior in U.S. investors. Meanwhile, inflows into U.S. agency bonds decrease after a path easing surprise, which suggests that local investors use non-Mexican securities to rebalance their portfolios in response to monetary policy decisions in Mexico. Lastly, the evidence suggests that foreign non-U.S. investors are important players in the bonos market. These results show that capital flows to emerging markets respond to the monetary policy of

[5]Since prices are flexible in the long run, long-term expected real interest rates would not be affected.

both the home and the destination country.

This paper contributes to the literature in two respects. First, it extends the analysis in Gürkaynak et al. (2005) to an emerging economy in order to assess the extent to which its path surprises impact, and for how long, not only asset prices but also portfolio flows. The study of the effects of monetary policy in emerging markets generally focuses on target surprises (Kohlscheen, 2014; Solís, 2021b). Second, this paper takes the perspective of an emerging market economy to analyze the effects of its monetary policy on the portfolio flows it faces. In contrast, the traditional approach in the literature takes the perspective of the home country to study, for instance, the spillover effects of its monetary policies. The literature based on the traditional approach documents significant inflows into financial assets in emerging markets after the global financial crisis (Fratzscher et al., 2018).[6] Hausman and Wongswan (2011) show that stock prices respond more to U.S. target surprises, whereas exchange rates and long-term yields respond more to U.S. path surprises; meanwhile, short-term yields respond to both types of surprises. Bowman et al. (2015) and Fischer (2020) show that the effect of U.S. monetary policy surprises is particularly relevant for local-currency sovereign yields.

The rest of the paper is structured as follows. The next section describes how monetary policy surprises are measured. Section 3 tests the number of monetary policy factors and discusses their interpretation. Sections 4 and 5 respectively analyze how asset prices and portfolio flows respond to the factors. The last section concludes.

2 Identification of Monetary Policy Surprises

The Bank of Mexico, also known as Banxico, conducts monetary policy through a Governing Board comprised by the governor—who acts as the chair of the Board—and four deputy governors. Banxico became an independent central bank in 1994 and adopted an inflation targeting regime in 2001. The official inflation target is 3% with a range of ± 1%. Before 2008, Banxico conducted monetary policy using something akin to a

[6] Curcuru et al. (2015) argues that this is due to allocations of new savings (a wealth effect) rather than a reallocation toward assets in those countries since portfolio flows did not surge disproportionately to emerging markets in response to unconventional monetary policies in advanced economies.

target for non-borrowed reserves, and in 2008 it adopted the overnight interbank interest rate as its monetary policy instrument. Solís (2021b) discusses institutional details about Banxico's monetary policy and provides the dates and times of its announcements.

This paper uses swap rates to measure surprises in monetary policy decisions. The swaps market in Mexico references an interbank interest rate denominated in local currency that serves as a benchmark for banking loans in the country and that closely follows the policy rate, the 28-day interbank interest rate or TIIE28D.[7] Banxico calculates the TIIE28D once a day based on quotes submitted by commercial banks. The TIIE28D 3-month swap is the main local derivative. Solís (2021b) uses this swap to capture surprises in the policy rate. This paper extends his analysis by considering a broader sense of monetary policy surprises given that the adoption of inflation targeting and well-anchored inflation expectations arguably allowed Banxico to pursue more forward-looking policies.

I consider swaps with maturities up to one year. Like other central banks, Banxico communicates information about its monetary policy outlook via statements. This information might influence market expectations about future policy actions. Unlike in many advanced economies after the global financial crisis, the policy rate in Mexico has so far not been constrained by the zero lower bound. As a consequence, Banxico's monetary policy statements include information about future policy actions within a year out at most, it does not need to commit to a predetermined path for the policy rate for longer periods. Using swaps with maturities up to one year is consistent with the approach of Gürkaynak et al. (2005) for the U.S. before the Great Recession.[8]

Monetary policy surprises are obtained as the difference in swap rates around windows containing policy announcements.[9] Intraday differences from 10 minutes before to 20 minutes after each announcement are calculated for swaps of 3, 6 and 9 months as well as of 1 year.[10] To measure the effects of the surprises, intraday differences over the same

[7] The average difference between the TIIE28D and the overnight policy rate is around 30 basis points.

[8] Swanson (2018) argues for including maturities of more than one year out when the policy rate is constrained by the zero lower bound and the central bank uses unconventional monetary policy tools.

[9] See Solís (2021b) for considerations about the timing of the announcements.

[10] When no data is available at any of those times, the next available quote is used to compute the changes. In extreme cases, in which there are no quotes in wider windows for a day, the open and close quotes are used to compute the differences. This only happens on a few days for some swaps.

windows are also calculated for the Mexican peso (MXN) per U.S. dollar (USD) exchange rate and for yields of bonds issued by the Mexican government with maturities of 2, 5, 10 and 30 years.[11] [12] For yields, the change is calculated directly using quotes before and after the announcements; for the exchange rate, 100 times log differences are used to approximate the percentage change (or return) over the window. All the information for the analysis comes from Bloomberg. The information to calculate the intraday differences for the swap rates and the exchange rate is available since 2011, and since 2013 for bond yields other than the 5-year yield for which the sample starts in December 2014.

3 Monetary Policy Dimensions

This section applies the methodology proposed by Gürkaynak et al. (2005) to Mexico and shows that two factors in monetary policy decisions move asset prices. One factor can be associated with surprises about the current policy rate and the other factor with surprises about its future path communicated via policy statements. Subsequent sections analyze how asset prices and portfolio flows respond to these factors.

3.1 Assessing the Number of Factors

The number of factors influencing asset prices is assessed using the matrix rank test developed by Cragg and Donald (1997). Let X be a $T \times n$ matrix of asset price changes around monetary policy announcements with T observations and n asset prices, and with a factor structure given by:

$$X = F\Lambda + \zeta, \tag{1}$$

in which F is a $T \times k$ matrix with k unobserved factors, Λ is a $k \times n$ matrix of factor loadings and ζ is white noise. For a given number of variables n, the Cragg–Donald test assesses the null hypothesis that k_0 factors ($k_0 < n$) explain most of the variability

[11] The Mexican government issued 10- 20- and 30-year fixed-rate local-currency bonds for the first time in 2001, 2003 and 2006, respectively, following the implementation of a debt management strategy to develop its debt market that started in 2000 (Jeanneau and Tovar, 2008; Abreu, 2014).

[12] All the results discussed below using tight 30-minute windows remain using wider 50-minute windows, starting 20 minutes before and ending 30 minutes after each monetary policy announcement.

observed in the data. The test minimizes the distance between the covariance matrix of the observed data and that obtained from all the possible models with k_0 factors. The test is a Wald statistic with an asymptotic χ^2 distribution with $(n-k_0)(n-k_0+1)/2-n$ degrees of freedom. Inference based on it requires that $(n-k_0)(n-k_0+1)/2 > n$.[13]

In addition to conducting the test for the exchange rate and bond yields, the test is also performed for swaps with maturities up to one year because later on that helps to give a structural interpretation to the estimated factors. Since $n = 5$ for the exchange rate and the yields while $n = 4$ for swaps, k_0 can be at most 2 and 1, respectively, to satisfy the requirements of the test. To check robustness to the frequency of the data and the sample period, the test is also performed using daily—besides intraday—changes in asset prices around the announcements. Daily changes for all asset prices are calculated since 2004, except for the 30-year yield which starts in October 2006.

Table 1 shows that two factors characterize the responses of asset prices in Mexico. The null hypothesis of no factors is strongly rejected in all cases. Solís (2021b) indeed shows that asset prices in Mexico respond at least to unanticipated changes in the current policy rate. The most interesting null hypotheses, however, involve one and two factors, $k_0 = 1, 2$. When the test is performed for the exchange rate and bond yields, the null hypothesis of one factor is rejected at the 5% significance level, but the null of two factors cannot be rejected even at the 10% level. This finding does not depend on the frequency of the data nor the sample period. Therefore, asset prices in Mexico react to more than just surprises about the current policy rate, they react to additional information Banxico is providing. And they have done so even before Banxico adopted the overnight policy rate in 2008, since daily data goes back to 2004. The multidimensionality of monetary policy in advanced economies (Gürkaynak et al., 2005; Swanson, 2018; Altavilla et al., 2019) is thus also observed in emerging markets.

[Insert Table 1 here.]

The same conclusion is reached when the test is performed for swaps. The null of one factor is also rejected at the 5% significance level, regardless of the data frequency.

[13] See Cragg and Donald (1997) and the appendix in Gürkaynak et al. (2005) for further details.

Section 3.3 exploits this for interpreting the two factors.

3.2 Estimating the Factors

The factors F, as well as their loadings Λ, in equation (1) are estimated by applying principal components to the matrix of asset price changes X. The two factors will be the first two principal components of X. These factors are orthogonal to each other and are linear combinations of the variables included in X. Yet the factors do not have a practical interpretation, which is needed to understand their effects on asset prices.

For interpretation purposes, X is comprised of swaps—instead of the exchange rate and bond yields—when estimating the two factors, F_1 and F_2. The factors are normalized to have unit standard deviation and then rotated to give them a structural interpretation.

Let U be a 2×2 rotation matrix for F such that

$$Z = F\,U, \tag{2}$$

in which Z denotes the rotated factors, Z_1 and Z_2. Four restrictions are imposed on U to uniquely identify it and being able to give an interpretation to the factors. The rotated factors are required to be orthogonal to each other and to have unit variance. The final restriction is set so that only Z_1 mirrors the change in the 3-month swap rate, i.e. the policy rate surprise, thus the loading of the 3-month swap rate on Z_2 is zero.[14]

To further ease the interpretation and to be able to compare the magnitudes of the factors, they are rescaled so that Z_1 moves one-to-one with the change in the 3-month swap rate and Z_2 affects the 1-year swap rate in the same magnitude as Z_1 does. The rescaling is done using data since 2013, when intraday data for bond yields becomes available.[15] Table A.1 in the appendix verifies that changes in the 3-month swap rate move (one-to-one) with Z_1, whereas Z_2 has considerable explanatory power for changes in the 1-year swap rate.

Figure 1 shows that the estimation of the factors is not sensitive to the sample size,

[14] The loadings on Z_1 and Z_2 for all four swaps can be expressed in terms of the parameters in U and the factor loadings Λ. To see this, substitute F from equation (2) into (1). The last restriction, however, only uses the two loadings in Λ for the 3-month swap. See the appendix in Gürkaynak et al. (2005).

[15] The rescaling does not affect the starting date of the factors, the first observation starts in 2011.

the sample period nor data frequency. The figure compares the time series of Z_1 and Z_2 obtained with intraday and daily data since 2011 as well as with daily data since 2004. The Z_1 factors correlate among themselves around 0.98, whereas the Z_2 factors around 0.74. Even though daily data yields longer time series, the core of the analysis relies on the factors identified with intraday data because there are gains in precision during the estimation and in terms of explanatory power, plus the effects on the exchange rate can only be detected with intraday data (Solís, 2021b).

[Insert Figure 1 here.]

3.3 Interpreting the Factors

The factors Z_1 and Z_2 are henceforth referred to as the target and path factors or surprises, respectively. By definition, Z_1 moves with surprises in the 3-month swap rate, and Z_2 is aligned with surprises in the 1-year swap rate that are unrelated to changes in the 3-month swap rate.[16] Accordingly, Z_1 can be related to surprises in the *current* policy rate, while Z_2 can be associated with surprises about the *future* path of the policy rate. The evidence presented below supports this interpretation.

Figure 2 compares the estimated target and path surprises for relevant dates over the sample period. Even if there is no change in the policy rate, there can still be target surprises if market participants expected a change. For instance, on April 27, 2012, the average rate from survey expectations was lower than the existing level indicating that some market participants expected a cut in the rate. Banxico, however, left the policy rate unchanged, which was interpreted as a target tightening surprise as the figure shows.

[Insert Figure 2 here.]

3.3.1 Statements and Path Surprises

Statements convey information intended to influence expectations about future monetary policy decisions and to reduce policy uncertainty. Table 2 summarizes Banxico's

[16] By construction, Z_1 is essentially the same as the policy rate surprises in Solís (2021b), the correlation coefficient between the two measures is 0.998. Meanwhile, the correlation between Z_2 and the residual of a regression of the change in the 1-year swap on the change in the 3-month swap is 0.993.

policy statements on announcement days in which, according to figure 2, their content communicated important information about the future path of the policy rate.

[Insert Table 2 here.]

The excerpts reported in table 2 are in line with figure 2. The announcements on June 2017 and August 2019 suggested loose financial conditions ahead, while the statements for the rest of the announcements signaled a tighter monetary stance going forward. Moreover, the announcements on March and October 2013, January 2015 and June 2017 are noteworthy because of their explicit reference to the future path of the policy rate.

Consider the tightening cycle that started in mid-2016 due to rising inflation risks as an example of the association of path surprises with information contained in statements. The 2016 U.S. presidential election generated uncertainty about the bilateral relation of the two countries. Between early-November 2016 and mid-January 2017, the peso depreciated by more than 14%. In addition, the minimum wage was raised and gasoline subsidies ended in early-2017. By mid-2017, inflation had risen for 10 consecutive months. On June and September 2016, Banxico raised its policy rate by 50 basis points, more than had been expected according to surveys. These increases were followed by 6 consecutive tightenings, three of 50 basis points followed by three of 25 basis points.[17] In the statement for the last hike on June 2017, Banxico indicated that it expected inflation to peak in the near future, in addition to what is reported in table 2. This statement is relevant because the hike was mostly anticipated by the market, so there was essentially no target surprise, but the wording suggested the end of the tightening cycle, which can be interpreted as a path easing surprise. In fact, the closest to a 'pure' path surprise in the sample.

Two dates are also worth reviewing due to the 'lack' of path surprises. According to figure 2, the announcements on September 2013 and June 2014 contained large easing surprises in the target but not in the path factor. A closer look at the statements for those dates supports this interpretation. Contrary to survey expectations of no change in the monetary policy stance, on September 6, 2013, Banxico announced a 25 basis point cut in the policy rate but indicated that with 'the lower policy rate, the monetary stance is in line

[17]The beginning of the tightening cycle might be dated as of November 2016 according to table 2.

with inflation converging to the target.' Similarly, while survey expectations indicated no policy change on June 6, 2014, Banxico cut the policy rate by 50 basis points adding that 'no further reductions in the policy rate are expected in the foreseeable future.' In both decisions the policy rate was cut unexpectedly, but the statements portrayed them as one-off cuts by signaling that no further movements in the rate were to be expected. That is, they were both target but not path surprises.

These examples support the association of path surprises with unanticipated information about the future path of the policy rate communicated via statements. Notice, however, that the magnitude of the path surprises is lower than that of target surprises. The largest path surprises in Mexico are also lower compared to the largest path surprises for the U.S. reported by Gürkaynak et al. (2005), see their table 4. Two potential reasons might explain this. First, international developments play a relevant role in the monetary policy considerations of small open economies, and Mexico is no exception. In this sense, it is harder to commit to a future path of the policy rate for extended periods of time when there is high uncertainty abroad. Second, and most importantly, the possibility of reaching the zero lower bound has not been an issue in Mexico, and so the need of Banxico to rely on path surprises has been low.

4 The Effects of Monetary Policy on Asset Prices

The previous section shows that target and path surprises capture the responses of asset prices to monetary policy decisions. This section documents the response of the exchange rate and the yield curve to those surprises. The next section extends the analysis and assess their effects on portfolio flows.

4.1 Contemporaneous Effects

The following event-study regression is used to measure the on-impact effects of the two monetary policy surprises on the exchange rate and the yield curve:

$$\Delta y_t = \beta_0 + \beta_1 Target_t + \beta_2 Path_t + \varepsilon_t, \tag{3}$$

in which Δy_t is the intraday change in asset prices around monetary policy announcements, as described in section 2. The changes are expressed in basis points. $Target_t$ and $Path_t$ are the two factors described in section 3.3. Positive values in either factor indicate a tightening of the monetary stance and negative values represent an easing. Finally, the error term ε_t captures variations in the dependent variables unrelated to the two factors.

Table 3 reports the results. Since the target surprises in this paper are highly correlated with policy rate surprises in Solís (2021b), the estimated coefficients for target surprises in table 3 align closely with the responses of the exchange rate and the yield curve reported by Solís (2021b).

[Insert Table 3 here.]

4.1.1 Response of the Exchange Rate

Table 3 indicates that the exchange rate only responds to target but not to path surprises. This seems puzzling since rational and forward-looking investors are expected to respond to changes in the future path of the policy rate. In fact, the currencies of advanced economies respond stronger to path than to target surprises (Rosa, 2011; Ferrari et al., 2017). The lack of response to path surprises seems characteristic of the Mexican peso, however. For instance, other emerging market currencies respond to U.S. path surprises, whereas the peso only reacts to U.S. target surprises (Hausman and Wongswan, 2011).

Two reasons might explain the lack of response of the currency to path surprises. First, although the peso operates under a flexible regime, Banxico intervenes in the foreign exchange market to provide liquidity and to promote orderly conditions. Even though Banxico intervenes following a rules-based approach (García-Verdú and Zerecero, 2013),[18] the interventions might unintendedly be muting the response of the currency to path surprises. Consistent with this, Hausman and Wongswan (2011) find that the currencies of countries with a more flexible exchange rate regime respond more to path surprises (in the U.S.).

An alternative explanation involves an information channel, according to which path

[18]For instance, Banxico intervenes following a 2% intraday depreciation threshold.

surprises have different effects on the currency that offset each other. For instance, a path tightening surprise would appreciate the currency due to a higher policy rate in the future but could, at the same time, depreciate it if the surprise signals higher future inflation. Gürkaynak et al. (2005) provide a similar explanation for the lack of reaction of the stock market to path surprises.

4.1.2 Response of the Yield Curve

Table 3 shows that, unlike the exchange rate, the yield curve responds to target and path surprises. Information about the future path of the policy rate is expected to have relatively more weight on the middle to long end of the yield curve.[19] Indeed, table 3 shows that medium- and long-term yields respond more to path than to target surprises. Moreover, comparing the R^2 statistic of the regressions with one and two factors reveals that path surprises explain 60, 25 and 40% of the variability in 5- 10- and 30-year yields, respectively. The relevance of path surprises for medium- and long-term yields further supports its association with policy statements.

The effects of path surprises on longer-term interest rates improves the implementation of monetary policy. First of all, medium- and long-term yields are more relevant to the spending decisions of households and firms. In addition, since the spillover effects of monetary policy in advanced economies tend to be larger on long-term yields than on short-therm ones (Obstfeld, 2015; Kearns et al., 2018), Banxico can better tame them by communicating information about the future path of its policy rate.

In terms of magnitude, the 2- 5- and 10-year yields in Mexico respond stronger to both surprises than U.S. yields do to the surprises constructed by Gürkaynak et al. (2005). On average, a 25 basis point target tightening surprise in Mexico vs the U.S. rises the yields for those maturities by 17 vs 12, 7 vs 7, 11 vs 3 basis points, respectively; while a 10 basis point path tightening surprise rises them by 5 vs 4, 7 vs 4, 6 vs 3 basis points.

[19] By providing guidance about the future path of the policy rate, statements might be revealing central bank's information about the future course of output and inflation. For instance, a positive path surprise might suggest that the central bank sees greater inflation ahead than previously expected, which would lead to revisions in private forecasts. In relation to this, de Mendonça and de Deus (2019) show that private forecasters in emerging markets update their expectations based on central bank forecasts.

According to the expectations hypothesis, this result suggests that long-term inflation expectations in Mexico are less firmly anchored than in the U.S.;[20] even though inflation expectations in Mexico are anchored (De Pooter et al., 2014), it is likely that they are not as well anchored as in the U.S. In addition, the larger reaction in Mexico can also reflect a larger effect of surprises on term premia, which could be explained by the response of yield-oriented investors (Hanson and Stein, 2015); Mexican banks indeed exhibit this type of reach-for-yield behavior as explained section 5.1.2.

4.2 Persistence

Monetary policymakers are not only interested in the initial reaction to the surprises but on how persistent they are. While event studies capture the response to the surprises on the day of a surprise, their persistence over subsequent days is assessed using local projections. Jordà (2005) proposes using local projections instead of vector autoregressions to generate impulse responses that are robust to misspecification.

This exercise is only done for the yield curve because it involves daily frequencies. Daily returns of the currencies of emerging markets do not react to surprises about the policy rate (Kohlscheen, 2014) because daily exchange rate returns are noisy, so the response can only be detected using intraday data (Solís, 2021b). Unreported results confirm that the daily exchange rate returns do not respond to target nor path surprises.

I run the following local projections for the daily changes in the yields:

$$y_{t+h} - y_{t-1} = \alpha_h + \beta_h^1 \, Target_t + \beta_h^2 \, Path_t + \eta_h^{'} z_{t-1} + u_{t+h}, \tag{4}$$

in which h indicates the horizon in days with $h = 0, 1, \ldots, 30$. $Target_t$ and $Path_t$ are equal to the target and path factors on announcement days and zero otherwise. By construction, the factors are uncorrelated, but they are included simultaneously because the estimation is more efficient. z_{t-1} is a vector of lagged variables to control for potential drivers of the yields one day before an announcement. Since the factors are indeed surprises, there is no need to control for other variables. In fact, all the results are

[20] Since prices are flexible in the long run, long-term expected real interest rates would not be affected.

essentially the same when no controls are included.[21] However, they are considered here for comparison with the analysis in section 5.2 because it involves monthly data for which it is reasonable to include the controls.

The controls included are the exchange rate, the daily return on the MSCI Mexico stock market index, the 10-year U.S. Treasury yield from the Federal Reserve's H.15 dataset to account for global financial conditions, the Cboe's volatility index (VIX) as a measure of risk aversion and economic uncertainty, the J.P. Morgan Emerging Market Bond Index (EMBI) to capture developments in emerging market sovereign bonds, the West Texas Intermediate (WTI) crude oil price given that the budget of the Mexican government is closely tied to it as an oil exporter country, the rate on the 5-year credit default swap (CDS) for Mexico to account for sovereign default risk, and the TED spread as an indicator of credit risk in the global financial sector as well as the local version calculated as the difference between the one-month interbank rate (TIIE28D) and the one-month Mexican Treasury bill rate. These controls are similar to the ones considered by Christensen et al. (2021) who study the liquidity premium in the Mexican bond market.

The parameters of interest are β_h^1 and β_h^2. They measure the average response of the yields to the factors at horizon h. The contemporaneous effect (when $h = 0$) on the yields is indicated with an arrow in the figures below. All responses are assessed relative to a one basis point tightening surprise.

Figure 3 shows the persistence of bond yields to target and path surprises. First, the effects on the yields last days after an announcement. This post-announcement drift has been identified in advanced economies and has been attributed to slow-moving capital (Brooks et al., 2019). Big players like pension funds and foreign investors might take time to respond to the surprises, as discussed in section 5.1. Second, the persistence of the effect decreases with the maturity of the bond. Traditionally, central banks exert relatively more control over the short end of the yield curve with conventional monetary policies. Lastly, the effect of the path factor at all maturities more than doubles a few days after a surprise. Gürkaynak et al. (2005) argue that financial markets may take

[21] The results reported from event studies do not include the controls given the relatively small number of observations but when they are included (unreported), some effects are even stronger.

some time to digest the implications of path surprises. Figure 3 supports this view.

[Insert Figure 3 here.]

5 The Effects of Monetary Policy on Portfolio Flows

The previous section analyzes the responses of asset *prices* to target and path surprises. This section studies how portfolio *flows* respond. While previous studies look at the (spillover) effects of monetary policy in advanced economies on portfolio flows to emerging markets, this section takes the perspective of the destination country. The evidence shows that both target and path surprises are relevant for portfolio flows.

5.1 Daily Flows

This section exploits the availability of daily data on bonos holdings to analyze how they respond to target and path surprises. Banxico collects daily data on the value of holdings of different types of Mexican government securities: Treasury bills (cetes), fixed-rate bonds (bonos), floating-rate bonds (bondes), inflation-protected bonds (udibonos) and bonds issued by the deposit insurer (bpas). The analysis focuses on the bonos given the prominent role they play in the Mexican bond market (Abreu, 2014),

The data contains the holdings of bonos by domestic and foreign investors. Figure 4 compares the level of bonos holdings by residence along with the level of cetes holdings for reference over the period from January 2011 to December 2019. Foreign investors are the main players in the bonos market, their holdings increased substantially since bonos were included in the Citigroup's World Government Bond Index (WGBI) in 2010 (Abreu, 2014). Christensen et al. (2021) document the role of foreign investors in the liquidity of the bonos market. Between late 2012 and early 2015, foreigners were also the main holders of cetes but their share declined since then.

[Insert Figure 4 here.]

Banxico categorizes domestic investors into banks, mutual funds, pension funds, insurers and other or non-financial investors (firms and households). Figure 5 displays the

level of bonos holdings by domestic residents over the same period. As can be seen, pension funds are the biggest player in the market. Recently, non-financial investors and banks started accumulating a larger share of bonos. Meanwhile, insurers maintain the smallest and most stable share of bonos among the different types of investors.

[Insert Figure 5 here.]

Changes in the nominal value of bonos holdings can reflect either a change in the amount of bonos and/or a change in the value of the bonos. To adjust for valuation effects, I deflate the nominal value of bonos holdings with a rate equal to the percentage change in the price. The daily percentage change in the price of the bonos is approximated as minus the duration times the daily change in the yield. The duration of the bonos is calculated using the par yields from the Bloomberg Fair Value (BFV) curve for Mexico and the average maturity of the bonos reported by Banxico.[22] In this way, a change in the deflated value of bonos holdings only reflects a change in the amount of bonos regardless of price movements. The adjustment makes little difference in the results though.

5.1.1 Contemporaneous Effects

Similar to the case of asset prices, the following event-study regression measures the on-impact effects of target and path surprises on the flows of bonos:

$$\Delta H_t = \beta_0 + \beta_1 Target_t + \beta_2 Path_t + \varepsilon_t, \tag{5}$$

in which ΔH_t is the daily change in the (deflated) value of bonos holdings, i.e. the flows into bonos, around monetary policy announcements. The rest is similar to equation (3). The model is estimated for each category of investor. Table 4 reports the results.

[Insert Table 4 here.]

[22] Every month, Banxico reports the average maturity of government securities outstanding, expressed in days. For the calculation, the average maturity of bonos is expressed in years and rounded to the nearest integer; the same value is used for all the days in a month. The change in the log price of the bond, $\mathrm{d}\log(P)$, is approximately equal to $-D_{mod}\,\mathrm{d}y$, in which D_{mod} is the modified duration. Each day, the BFV yield closest to the average maturity is used to calculate D_{mod} and the change in the yield.

Mutual funds, pensions funds, non-financial investors and foreigners adjust their bonos holdings to at least one of the surprises on the day of a monetary policy announcement; only banks and insurers exhibit no reaction. The responses are economically significant. The most noteworthy ones are those displayed by pension funds to a target surprise and by foreigners to a path surprise. Pension funds buy about MXN 8 billion worth of bonos following a 25 basis point target tightening surprise, while foreigners buy about MXN 10 billion worth of bonos after a 10 basis point path tightening surprise. Therefore, in response to a decline in prices (or a rise in yields) due to a tightening in the monetary stance, as reported in table 3, the two most important players in the bonos market increase their holdings.

5.1.2 Persistence

As before, I use local projections to analyze the persistence of the effects. Specifically, I run the following regressions:

$$H_{t+h} - H_{t-1} = \alpha_h + \beta_h^1 \, Target_t + \beta_h^2 \, Path_t + \eta_h^{'} z_{t-1} + u_{t+h}, \tag{6}$$

in which the dependent variable is the daily changes in the holdings of bonos. The rest is similar to equation (4). Figures 6 and 7 display the impulse responses for bonos flows.

[Insert Figure 6 here.]

[Insert Figure 7 here.]

As can be seen, the responses by pension funds to a target surprise and by foreigners to a path surprise are persistent. The delayed adjustment in the bonos holdings of these investors aligns with the post-announcement drift displayed by the yields in figure 3 and supports the slow-moving capital explanation discussed in section 4.2.

Banks also exhibit a delayed response to target surprises but in the opposite direction to that of pension funds. These two types of investors have different investment profiles. The average maturity of the bonos held by banks is less than 5 years relative to the more than 10 years for pension funds (Abreu, 2014). The top left panel in figure 7 indeed suggests that Mexican banks see bonos as riskier assets. The response is consistent

with a reach-for-yield behavior by banks, they buy bonos a few days after a target easing surprise. Banks' response supports the mechanism described by Hanson and Stein (2015), in which monetary policy affects term premia due to yield-oriented investors.

5.2 Monthly Flows

A related research question is whether Banxico's monetary policy also influences cross-border portfolio flows, in addition to the effects it has on the changes of bonos holdings of different investors.

The data on holdings collected by Banxico is unique because of its daily frequency. In fact, one challenge in analyzing the effect of monetary policy surprises on international financial flows is the frequency of the data. Cross-border capital flows can be classified broadly as (bond and equity) portfolio flows, foreign direct investment, and banking flows; sometimes international reserves are included as another category. All those flows are reported quarterly, the same frequency of the balance of payments accounts from which they are obtained. However, other sources report portfolio flows more frequently.

5.2.1 Data

The U.S. Treasury International Capital (TIC) system is a monthly database of cross-border securities transactions involving a U.S. counterparty, and is used as an input to calculate the balance of payments accounts for the U.S.[23] TIC data contains disaggregated portfolio flows by country. For many emerging markets, including Mexico, portfolio flows from and to the U.S. are among the most relevant ones. In the case of Mexico, inflows represent sales of securities by Mexican to U.S. investors, and outflows constitute purchases of securities by Mexican from U.S. investors. Inflows and outflows are categorized into six categories each: (1) U.S. Treasury bonds and notes,[24] (2) U.S. government agency bonds,[25] (3) U.S. corporate bonds, (4) U.S. corporate stocks, (5) non-U.S. bonds, (6) non-U.S. stocks. Although it does not hold exactly, non-U.S. bonds and stocks can

[23]EPFR collects weekly and daily flows data from mutual funds and exchange-traded funds but it is not as comprehensive as the balance of payments data and is not publicly available.

[24]Notes have maturities between 2 and 10 years, while bonds have maturities between 10 and 30 years.

[25]Bonds issued by U.S. government agencies are not guaranteed by the U.S. Treasury.

broadly be considered as local (or Mexican) securities. Finally, net flows are obtained by subtracting outflows to inflows in each of the six categories.

Table 5 provides summary statistics for the different categories of TIC flows. The sample starts in January 2011 and ends in December 2019. Transactions involving non-U.S. bonds and Treasury-issued securities stand out as the most significant ones followed by transactions on non-U.S. stocks and U.S. agency bonds.

[Insert Table 5 here.]

To compare the effects on cross-border flows, changes in bonos holdings are calculated at the monthly frequency. Table 6 summarizes those monthly flows. As mentioned before, foreign investors are the main players in the bonos market; the two most important domestic investors are pension funds and the non-financial sector.

[Insert Table 6 here.]

5.2.2 Effects on Monthly Portfolio Flows

For each flow category, the following model is used to analyze the effects of target and path surprises on portfolio flows at the monthly frequency:

$$w_t = \beta_0 + \beta_1 Target_t + \beta_2 Path_t + \sum_{j=1}^{p} \gamma_j w_{t-j} + \eta^{'} z_{t-1} + \nu_t, \tag{7}$$

in which w_t denotes the respective portfolio flow, and the lags w_{t-j} up to order p capture the persistence in flow data; the lag order for each flow category is selected using the Bayesian information criterion. $Target_t$ and $Path_t$ are equal to the target and path surprises identified with intraday data if there is a monetary policy announcement in the respective month and zero otherwise.[26] The control variables are the same as for equation (3), with their value taken at the last day of the month and the return on the MSCI Mexico stock market index computed monthly.

Tables 7 and 8 respectively show that portfolio inflows and outflows between Mexico and the U.S. do respond to target and path surprises. Nevertheless, the effects on net

[26] In the few cases in which there is more than one announcement during a month, the monthly surprises are equal to the sum of the values in the month.

flows are not significant (see Table A.4 in the appendix).

[Insert Table 7 here.]

[Insert Table 8 here.]

The most significant effects of a target surprise are seen on non-U.S. stocks. A target easing surprise increases inflows into non-U.S. stocks, which likely reflects more willingness of U.S. investors to hold risky local assets. Relatedly, but from a home-country perspective, Chen et al. (2014) find that easing surprises in the U.S. are associated with higher portfolio equity flows into emerging markets. Tables 7 therefore suggests that the central bank in the destination country can trigger a reach-for-yield behavior in U.S. investors. Tables 8 shows that domestic investors also increase their purchases of non-U.S. stocks owned by U.S. investors but in smaller magnitude, so net inflows into non-U.S. stocks increase following a target easing surprise; the effect on net inflows, however, is not significant (see Table A.4 in the appendix).

Tables 8 indicates that inflows into U.S. agency bonds respond to path surprises. They decline following a path easing surprise. This is better understood from the perspective of Mexican investors. According to the results in section 4, a path easing surprise reduces sovereign bond yields in Mexico so, ceteris paribus, the spread between bonos and the yield of U.S. agency bonds changes making the latter more attractive. Mexican investors rebalance their portfolios by lowering their sales of agency bonds to U.S. investors. This result suggests that local investors use non-Mexican securities to rebalance their portfolios in response to Banxico's monetary policy decisions.

In contrast to the results involving daily flows of bonos by foreign investors, the bilateral flows on non-U.S. bonds do not respond to Banxico's monetary policy. Two potential reasons can explain this result. First, non-U.S. bonds could include corporate Mexican bonds or even non-Mexican bonds. These other types of bonds might be less sensible to target and path surprises. Nevertheless, even if that category exclusively comprises bonds issued by the Mexican government, it mixes together at least cetes and bonos. Tables A.2 and A.3 in the appendix show that cetes flows by foreign investors do not respond to target nor path surprises. Second, the results in section 5.1 refer

to non-Mexican investors, while the TIC data captures transactions involving a U.S. counterparty. The evidence thus suggests that foreign non-U.S. investors are important players in the bonos market.

Table 9 reports the effects of target and path surprises on the monthly bonos flows. Unlike the results with daily flows reported in table 4, significant effects are harder to detect with monthly data. Even so, the effects on the bonos flows by foreigners to a target surprise remain. This makes the results using TIC data more promising since, with access to better data, there might be more significant effects than the ones reported in tables 7 and 8. Data on cross-border portfolio flows at higher frequencies (e.g. weekly, daily), categorized by type of instrument and/or disaggregated by maturity could help to better characterize the effects of Banxico's monetary policy on cross-border capital flows.

[Insert Table 9 here.]

Summing up, portfolio flows, even cross-border ones, react to target and path surprises. This means that capital flows to emerging markets respond not only to the monetary policy of advanced economies (Chen et al., 2014; Curcuru et al., 2015; Fischer, 2020) but to that of the destination country.

6 Concluding Remarks

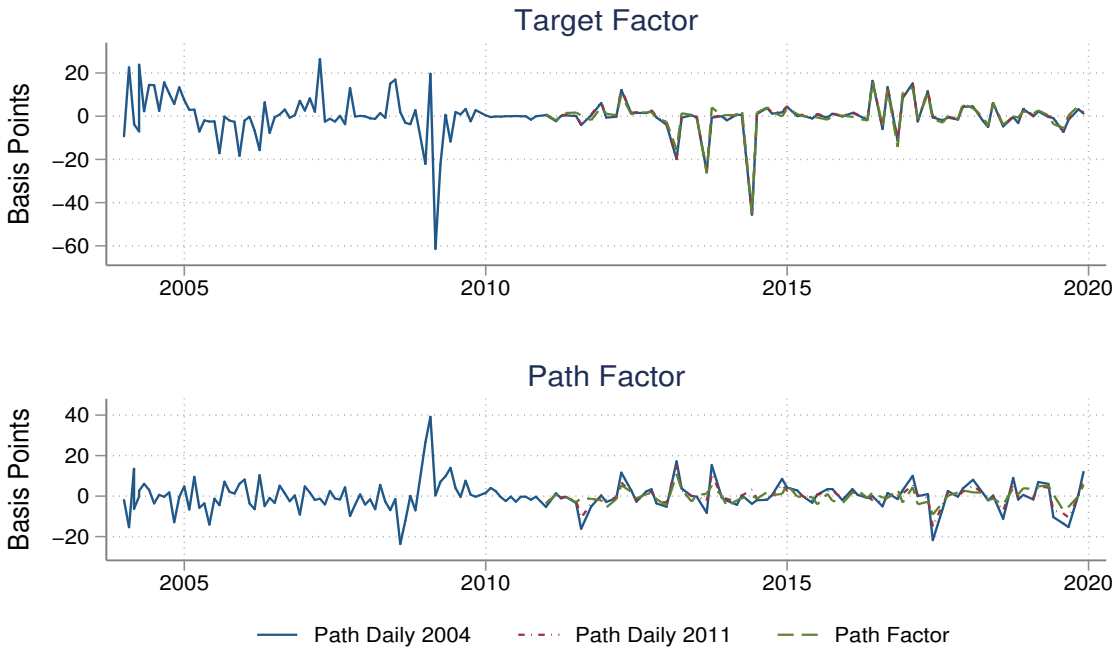
This paper uses a new dataset to identify monetary policy surprises in an emerging economy. The evidence indicates that surprises in the policy rate and about its future path are relevant for both asset prices and portfolio flows. The multidimensionality of monetary policy is therefore not restricted to advanced economies. By having the ability to alter market expectations about the future path of the policy rate via statements, central banks in emerging markets can influence medium and long-term interest rates, which are the ones that ultimately transmit to the broader economy. Furthermore, they have room to deal with the spillover effects from the policies implemented by central banks in advanced economies as well as to conduct monetary policy in case their policy rate were to be constrained by the zero lower bound.

Given the importance of statements documented here, emerging markets should consider best practices in monetary policy communications, including brief, clear and concise language without compromising the main message. References to non-monetary policy issues (e.g. structural reforms) in statements should be assessed on a case-by-case basis. On this regard, Banxico committed to issue clear and concise statements and made its guidelines publicly available in February 2020.[27]

The results in this paper can be extended in several directions. For instance, to further understand how bond yields respond to monetary policy, one can analyze how target and path surprises transmit to the expected future short rate and the term premium in bond yields; the decomposition proposed by Solís (2021a) for the yields of emerging markets is relevant to address this issue. In addition, the destination-country perspective can be relevant for emerging markets in connection with macroprudential policies. One could study, for instance, the interaction of target and path surprises with different macroprudential policies, including capital controls given the response of portfolio flows to target and path surprises documented here. Finally, more research is needed to assess the extent to which the results reported here apply to other emerging markets.

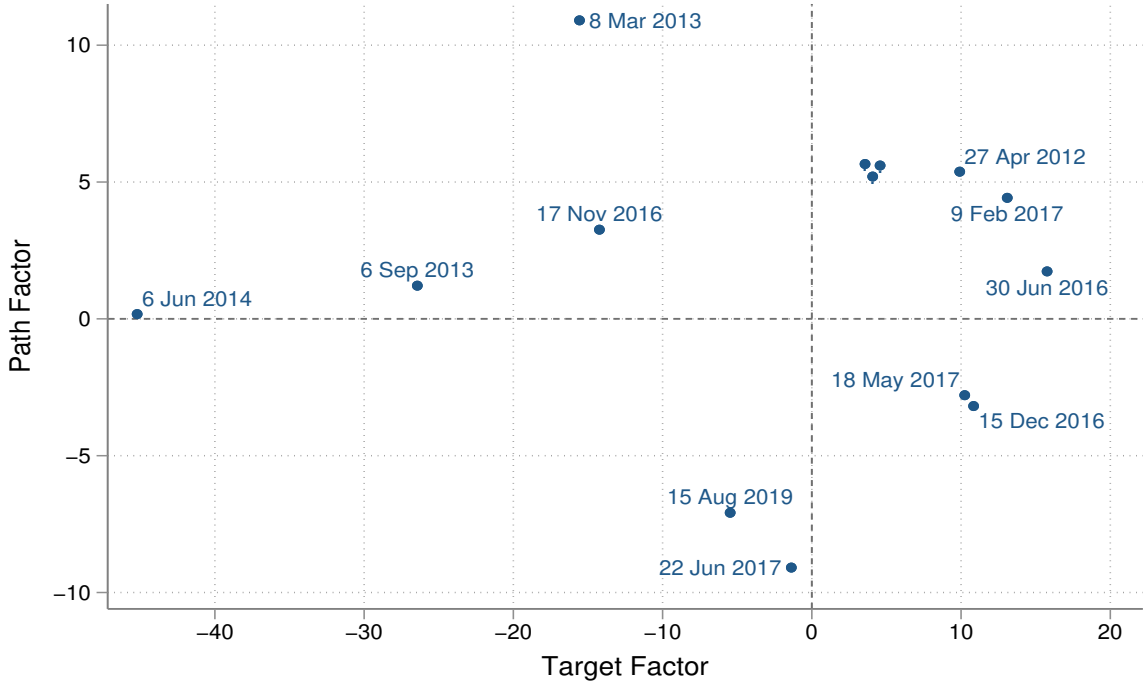
[27]The press release is available at https://www.banxico.org.mx/publicaciones-y-prensa/miscelaneos/%7B4C09D772-2CDF-8BD6-3F04-65DE03CA6212%7D.pdf.

Figure 1. Monetary Policy Surprises in Mexico: Intraday and Daily Data



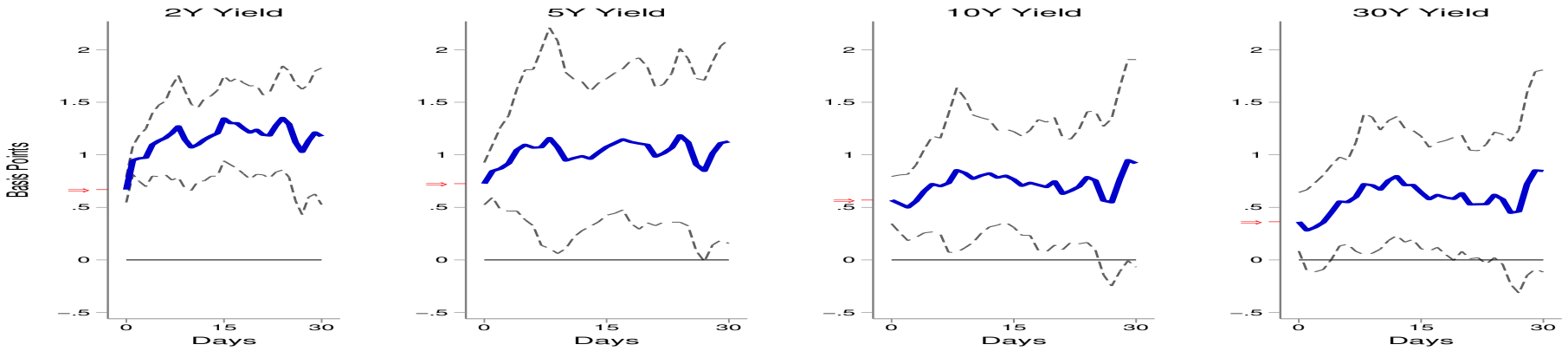
Notes: This figure compares the evolution of the target and path factors obtained with intraday and daily data. The solid lines are obtained with daily data from 2004 to 2019. The dash-dotted lines are obtained with daily data from 2011 to 2019. The dashed lines are obtained with intraday data from 2011 to 2019.

Figure 2. Monetary Policy Dimensions

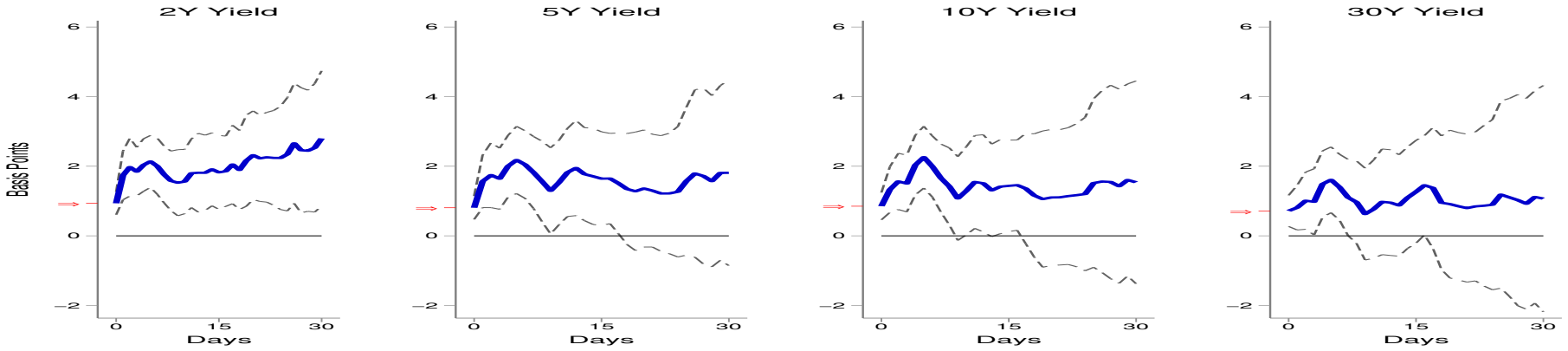


Notes: This figure plots the largest estimated target and path factors obtained from intraday data, as explained in the main text. The sample is all regular monetary policy announcements from January 2011 to December 2019. The dates of the three unlabeled dots in the first quadrant are 25 Oct 2013 (bottom), 29 Jan 2015 (left) and 19 Dec 2019 (right).

Figure 3. Response of the Yield Curve to Target and Path Surprises



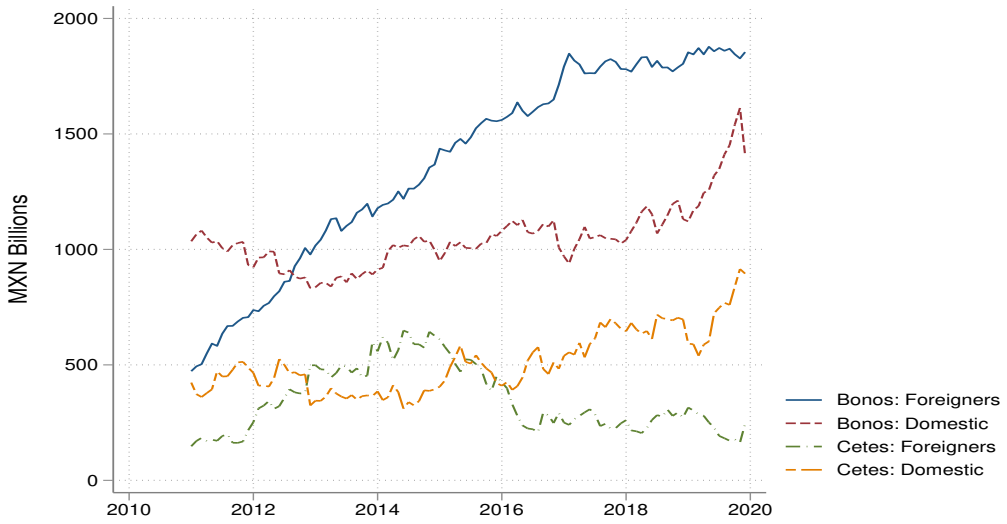
(a) Target Surprise



(b) Path Surprise

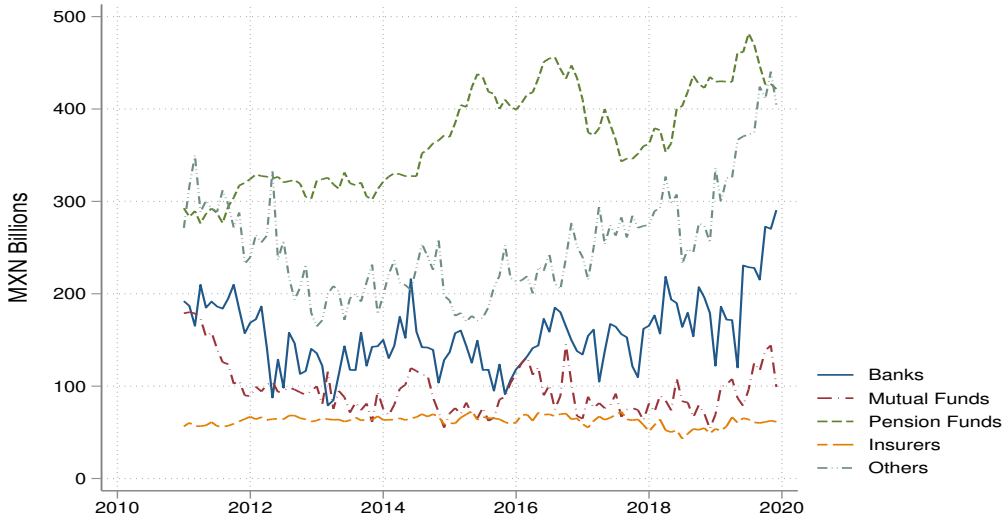
Notes: This figure plots the coefficient estimates and 95% confidence intervals for 1 basis point target and path tightening surprises for yield changes from close of day $t-1$ to day $t+h$, where t is a day with a monetary policy announcement and $h = 0, 1, \ldots, 30$. An arrow indicates the contemporaneous effect (when $h = 0$). The surprises are identified using intraday data around monetary policy announcements, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2019. The 95% confidence bands are based on robust standard errors.

Figure 4. Holdings of Cetes and Bonos by Nationality



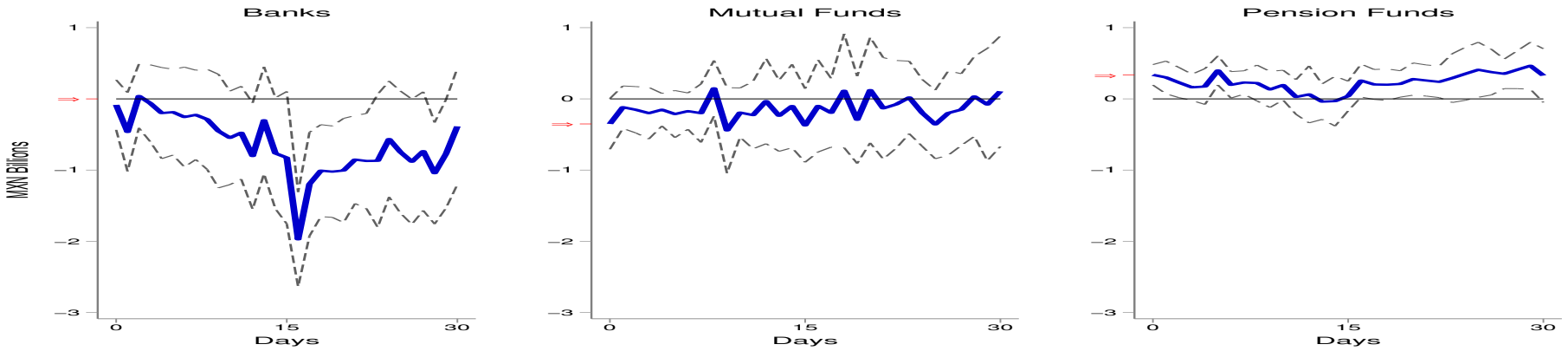
Notes: This figure shows the net holdings of Mexican Treasury bills (cetes) and fixed-rate sovereign bonds (bonos) by the nationality of the investor from January 2011 to December 2019.

Figure 5. Holdings of Bonos by Type of Investor

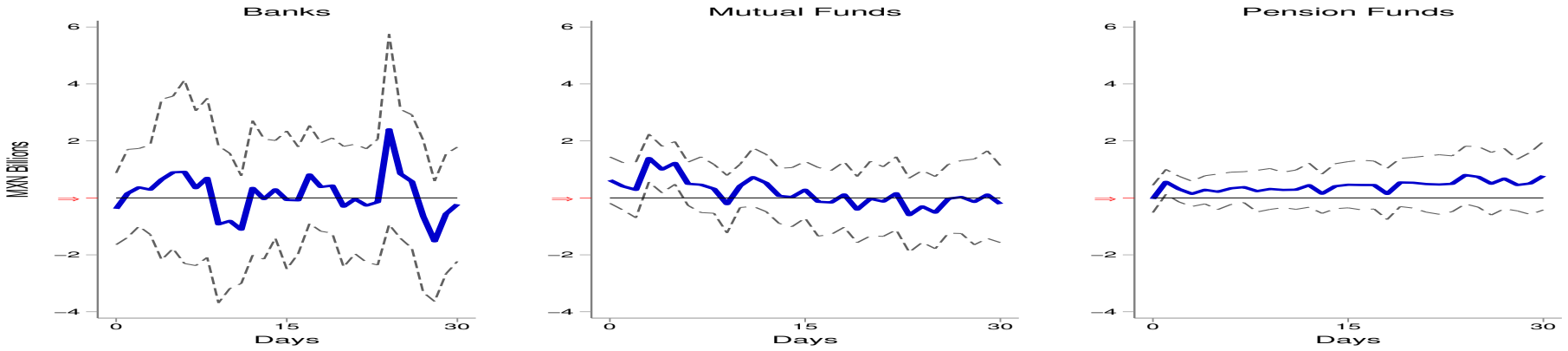


Notes: This figure shows the net holdings of fixed-rate Mexican sovereign bonds (bonos) by type of investor from January 2011 to December 2019.

Figure 6. Response of Bonos Flows to Target and Path Surprises



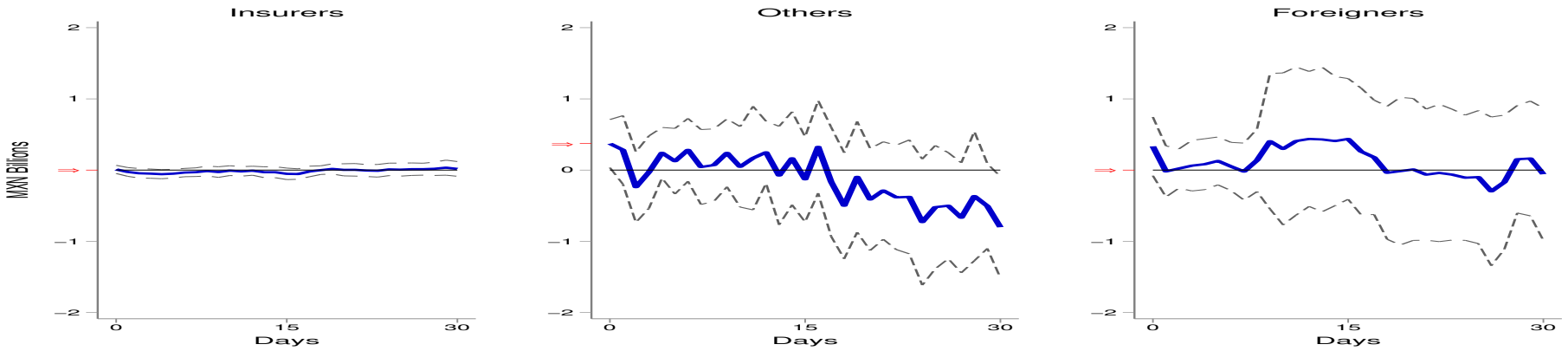
(a) Target Surprise



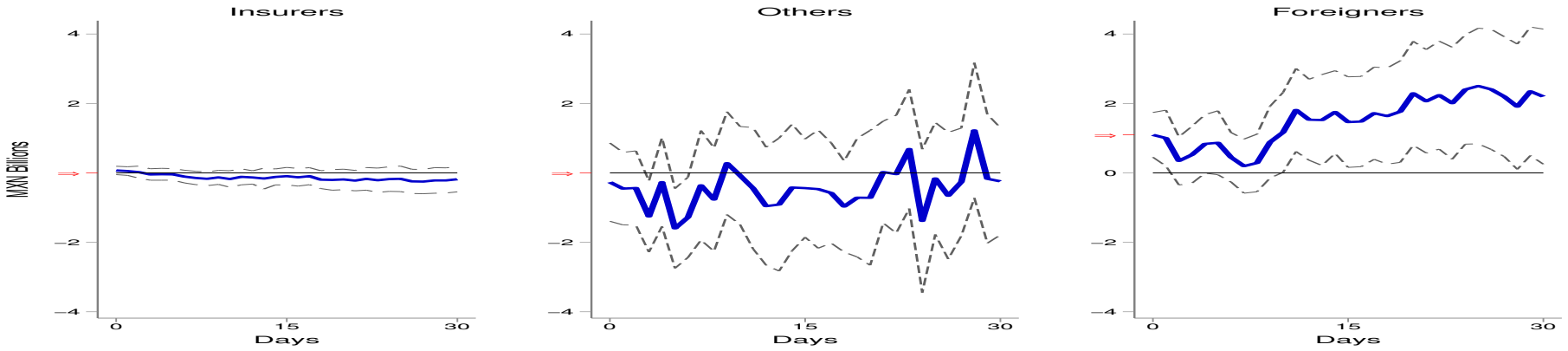
(b) Path Surprise

Notes: This figure plots the coefficient estimates and 95% confidence intervals for 1 basis point target and path tightening surprises for bonos flows from day $t-1$ to day $t+h$, where t is a day with a monetary policy announcement and $h = 0, 1, \ldots, 30$. An arrow indicates the contemporaneous effect (when $h = 0$). The surprises are identified using intraday data around monetary policy announcements, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2019. The 95% confidence bands are based on robust standard errors.

Figure 7. Response of Bonos Flows to Target and Path Factors (cont.)



(a) Target Surprise



(b) Path Surprise

Notes: This figure plots the coefficient estimates and 95% confidence intervals for 1 basis point target and path tightening surprises for bonos flows from day $t-1$ to day $t+h$, where t is a day with a monetary policy announcement and $h = 0, 1, \ldots, 30$. An arrow indicates the contemporaneous effect (when $h = 0$). The surprises are identified using intraday data around monetary policy announcements, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2019. The 95% confidence bands are based on robust standard errors.

Table 1. Tests of the Number of Factors in Monetary Policy Surprises

	Frequency	$H_0 : k = k_0$	Wald Statistic	Degrees of Freedom	p-value	Observations
Exchange Rate & Yield Curve	Intraday	0	36.55	10	0.000	41
		1	11.62	5	0.040	41
		2	0.04	1	0.851	41
	Daily	0	35.24	10	0.000	120
		1	14.60	5	0.012	120
		2	0.01	1	0.933	120
Swaps	Intraday	0	26.47	6	0.000	72
		1	7.47	2	0.024	72
	Daily	0	25.57	6	0.000	155
		1	9.49	2	0.009	155

Notes: This table reports the results from the Cragg–Donald test. H_0 is the null hypothesis of $k = k_0$ factors against the alternative of $k > k_0$ factors, where $k_0 = 0, 1, 2$. The sample is all regular monetary policy announcements until December 2019, the starting date varies based on data availability: for the exchange rate and the yield curve with intraday data is December 2014 (due to the 5-year yield) and with daily data is October 2006 (due to the 30-year yield); for swaps with intraday data is January 2011 and with daily data is January 2004. The yield curve includes 2- 5- 10- and 30-year bonds. Swaps include 3- 6- 9-month and 1-year swaps.

Table 2. Summary of Statements in Selected Dates

Date	Description
27-Apr-2012	Statement indicates that the balance of risks for economic growth has improved.
08-Mar-2013	Statement makes clear that the 50 basis point reduction in the policy rate 'does not represent the beginning of an easing cycle'.
25-Oct-2013	Statement highlights that 'no further cuts in the policy rate are appropriate in the foreseeable future'.
29-Jan-2015	Statement notes the recent depreciation of the peso is an upward risk to inflation; the Board will monitor U.S. monetary policy and exchange rate dynamics 'to be able to take the necessary measures'.
17-Nov-2016	Statement announces that the balance of risks for inflation has deteriorated and removes 'this increment in the policy rate is not the beginning of a tightening cycle' from the previous statement.
09-Feb-2017	Statement highlights the effects of the tightenings in 2016 and 'the ones required in 2017' to counteract inflationary pressures.
22-Jun-2017	Statement drops reference to do 'the necessary tightenings ahead' from the previous statement; the balance of risks for inflation has shifted from moderately deteriorated to neutral.
15-Aug-2019	Statement notes that the negative output gap increased more than expected.
19-Dec-2019	Statement notes that headline and core inflation for 2020 might be 'slightly higher' than previously expected due to a recent increase in minimum wages.

Table 3. Response of Asset Prices to Target and Path Surprises

	FX		2Y Yield		5Y Yield		10Y Yield		30Y Yield	
Target	-1.89**	-1.89**	0.67***	0.68***	0.35***	0.27***	0.42***	0.42***	0.30***	0.30***
	(0.77)	(0.78)	(0.086)	(0.081)	(0.10)	(0.094)	(0.086)	(0.081)	(0.079)	(0.075)
Path		-0.14		0.48***		0.69***		0.56***		0.59***
		(1.19)		(0.089)		(0.16)		(0.12)		(0.12)
Obs.	72	72	56	56	41	41	56	56	56	56
R^2	0.20	0.20	0.80	0.86	0.24	0.60	0.53	0.69	0.35	0.59

Notes: The first column for each dependent variable shows the coefficient estimates in regressions of intraday yield changes or exchange rate returns (FX) on target surprises; the second column adds path surprises as a regressor. Target and path surprises are obtained from intraday data, as explained in the main text. Intraday changes are calculated starting 10 minutes before to 20 minutes after a monetary policy announcement. The sample for the exchange rate is all regular monetary policy announcements from January 2011 to December 2019; for 2- 10- and 30-year yields, from January 2013 to December 2019; and for 5-year yields, from December 2014 to December 2019. Figures expressed in basis points. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table 4. Response of Daily Bonos Flows to Target and Path Surprises

	Banks	Mutual	Pension	Insurers	Others	Foreign
Target	-0.065	-0.34*	0.32***	0.0088	0.31*	0.32
	(0.18)	(0.19)	(0.086)	(0.030)	(0.17)	(0.21)
Path	-0.29	0.90*	-0.089	0.074	-0.36	1.03***
	(0.53)	(0.48)	(0.24)	(0.061)	(0.56)	(0.35)
No. of Obs.	72	72	72	72	72	72
R^2	0.01	0.09	0.12	0.03	0.03	0.18

Notes: This table shows the coefficient estimates in regressions of different categories of bonos inflows on target and path surprises. Inflows are obtained as the change in the holdings of Mexican bonds. All flows are expressed in billions of Mexican pesos. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period is January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table 5. Summary Statistics for Portfolios Flows Between Mexico and the U.S.

	Mean	Std. Dev.	Minimum	Maximum	Observations
Net Flows: T-Bonds, T-notes	-0.02	2.87	-9.26	6.84	108
Net Flows: U.S. Agency Bonds	0.13	1.09	-2.73	6.15	108
Net Flows: U.S. Corp. Bonds	0.01	0.31	-0.98	2.05	108
Net Flows: U.S. Corp. Stocks	-0.09	0.46	-0.95	1.38	108
Net Flows: Non-U.S. Bonds	0.88	2.08	-4.67	9.50	108
Net Flows: Non-U.S. Stocks	-0.07	0.30	-0.71	0.73	108
Inflows: T-Bonds, T-notes	3.80	3.13	0.19	17.23	108
Inflows: U.S. Agency Bonds	1.63	1.07	0.08	7.97	108
Inflows: U.S. Corp. Bonds	0.28	0.30	0.07	2.24	108
Inflows: U.S. Corp. Stocks	2.76	0.63	1.30	4.49	108
Inflows: Non-U.S. Bonds	5.28	2.34	1.52	14.17	108
Inflows: Non-U.S. Stocks	2.62	0.74	1.43	5.12	108
Outflows: T-Bonds, T-notes	3.82	2.89	0.10	18.29	108
Outflows: U.S. Agency Bonds	1.50	0.63	0.36	3.76	108
Outflows: U.S. Corp. Bonds	0.27	0.21	0.07	1.37	108
Outflows: U.S. Corp. Stocks	2.84	0.60	1.72	4.98	108
Outflows: Non-U.S. Bonds	4.40	2.09	1.12	10.70	108
Outflows: Non-U.S. Stocks	2.69	0.74	1.47	4.95	108

Notes: Amounts expressed in billions of U.S. dollars. The sample period goes from January 2011 to December 2019. Net flows are inflows minus outflows. Inflows are sales of securities by Mexican to U.S. investors. Outflows are purchases of securities by Mexican from U.S. investors.

Table 6. Summary Statistics for Cetes and Bonos Flows

	Mean	Std. Dev.	Minimum	Maximum	Observations
Cetes: Banks	0.47	18.42	-47.19	41.15	108
Cetes: Mutual Funds	0.24	19.02	-50.42	58.72	108
Cetes: Pension Funds	1.85	10.53	-28.03	53.81	108
Cetes: Insurers	0.30	3.52	-7.70	9.29	108
Cetes: Others	0.81	24.04	-59.52	57.62	108
Cetes: Foreigners	1.34	37.64	-75.63	145.17	108
Bonos: Banks	0.31	29.79	-65.72	108.77	108
Bonos: Mutual Funds	-0.25	17.78	-44.88	55.60	108
Bonos: Pension Funds	1.19	12.06	-32.72	37.27	108
Bonos: Insurers	0.04	3.97	-11.45	9.75	108
Bonos: Others	1.54	29.11	-96.72	79.79	108
Bonos: Foreigners	12.89	28.46	-69.32	76.12	108

Notes: This table shows summary statistics for the monthly flows of cetes and bonos by different groups of investors. The flows are equal to the change in the value of holdings of government securities. The value is net of valuation effects, as explained in the main text. Foreigners refer to holdings by non-Mexican investors. Amounts expressed in billions of Mexican pesos. The sample period goes from January 2011 to December 2019.

Table 7. Response of Portfolio Inflows to Target and Path Surprises

	T-Notes/Bonds	Agency Bonds	U.S. Corp. Bonds	U.S. Corp. Stocks	Non-U.S. Bonds	Non-U.S. Stocks
Target	-0.062	0.0055	-0.0036	-0.0014	-0.042	-0.019***
	(0.054)	(0.017)	(0.0042)	(0.0058)	(0.038)	(0.0040)
Path	0.13	0.073**	0.012	-0.015	0.091	0.0092
	(0.17)	(0.036)	(0.010)	(0.020)	(0.10)	(0.014)
Lags	0	1	3	2	1	3
Obs.	108	108	108	108	108	108
R^2	0.15	0.27	0.36	0.30	0.26	0.67

Notes: This table shows the coefficient estimates in regressions of different categories of portfolio inflows on target and path surprises. Inflows are sales of securities by Mexican to U.S. investors. All flows are expressed in billions of U.S. dollars. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period goes from January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table 8. Response of Portfolio Outflows to Target and Path Surprises

	T-Notes/Bonds	Agency Bonds	U.S. Corp. Bonds	U.S. Corp. Stocks	Non-U.S. Bonds	Non-U.S. Stocks
Target	-0.017	0.0079	0.0035*	-0.0048	-0.024	-0.013***
	(0.032)	(0.0085)	(0.0021)	(0.0093)	(0.030)	(0.0047)
Path	0.20	0.020	0.0021	-0.0080	0.0031	0.010
	(0.13)	(0.018)	(0.0056)	(0.016)	(0.055)	(0.016)
Lags	0	3	2	2	3	3
Obs.	108	108	108	108	108	108
R^2	0.13	0.33	0.54	0.26	0.38	0.69

Notes: This table shows the coefficient estimates in regressions of different categories of portfolio outflows on target and path surprises. Outflows are purchases of securities by Mexican from U.S. investors. All flows are expressed in billions of U.S. dollars. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period goes from January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table 9. Response of Monthly Bonos Flows to Target and Path Surprises

	Banks	Mutual	Pension	Insurers	Others	Foreign
Target	-0.86*	-0.34	0.053	0.00021	-0.43	0.36
	(0.47)	(0.25)	(0.15)	(0.039)	(0.34)	(0.52)
Path	-0.89	0.19	0.22	-0.17	0.38	1.90**
	(0.92)	(0.70)	(0.46)	(0.12)	(0.81)	(0.93)
Lags	3	1	0	2	1	0
Obs.	108	108	108	108	108	108
R^2	0.33	0.17	0.12	0.15	0.23	0.12

Notes: This table shows the coefficient estimates in regressions of different categories of Mexican bond inflows on target and path surprises. Inflows are obtained as the change in the holdings of Mexican bonds. All flows are expressed in billions of Mexican pesos. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period goes from January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

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Appendix

A Supplementary Tables

Table A.1. The Response of Swap Rates to the Target and Path Factors

	3M-Swap				1Y-Swap			
	Intraday		Daily		Intraday		Daily	
Intraday Target Factor	0.999***	0.999***			0.983***	0.983***		
	(0.008)	(0.008)			(0.046)	(0.013)		
Intraday Path Factor		0.000				1.050***		
		(0.022)				(0.038)		
Daily Target Factor			1.001***	1.001***			0.942***	0.942***
			(0.007)	(0.007)			(0.065)	(0.011)
Daily Path Factor				0.000				0.816***
				(0.011)				(0.019)
Constant	-0.480***	-0.480***	-0.083	-0.083	-0.286	-0.286***	0.062	0.062
	(0.061)	(0.062)	(0.061)	(0.061)	(0.435)	(0.104)	(0.501)	(0.115)
Observations	72	72	155	155	72	72	155	155
R-squared	0.996	0.996	0.994	0.994	0.819	0.990	0.691	0.984

Notes: For the 3-month swap rate, the table shows the coefficient estimates in regressions of intraday and daily changes in the 3-month swap rate on the target and path factors obtained from intraday and daily data, as explained in the main text. Similarly for the 1-year swap rate. Daily changes are calculated around monetary policy announcements; intraday changes are calculated starting 10 minutes before to 20 minutes after a monetary policy announcement. The sample is all regular monetary policy announcements until December 2019, with intraday data the sample starts in January 2011 and with daily data it starts in January 2004. All variables are expressed in basis points. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table A.2. Response of Daily Cetes Flows to Target and Path Surprises

	Banks	Mutual	Pension	Insurers	Others	Foreign
Target	0.019	-0.067	-0.027	-0.0066	0.069	-0.090
	(0.12)	(0.11)	(0.051)	(0.0083)	(0.15)	(0.12)
Path	0.087	-0.35	0.091	0.029	0.19	0.10
	(0.38)	(0.23)	(0.20)	(0.044)	(0.55)	(0.35)
No. of Obs.	72	72	72	72	72	72
R^2	0.00	0.04	0.01	0.01	0.01	0.01

Notes: This table shows the coefficient estimates in regressions of different categories of Cetes inflows on target and path surprises. The inflows are obtained as the change in the holdings of cetes. All flows are expressed in billions of Mexican pesos. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period is January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table A.3. Response of Monthly Cetes Flows to Target and Path Surprises

	Banks	Mutual	Pension	Insurers	Others	Foreign
Target	0.21	-0.14	0.076	0.026	0.25	-0.37
	(0.22)	(0.23)	(0.11)	(0.032)	(0.32)	(0.65)
Path	-0.011	-0.61	-0.90***	-0.031	0.68	-0.97
	(0.52)	(0.51)	(0.30)	(0.14)	(0.69)	(1.00)
Lags	1	0	0	0	1	0
Obs.	108	108	108	108	108	108
R^2	0.29	0.12	0.19	0.09	0.13	0.22

Notes: This table shows the coefficient estimates in regressions of different categories of Cetes inflows on target and path surprises. The inflows are obtained as the change in the holdings of cetes. All flows are expressed in billions of Mexican pesos. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period goes from January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Table A.4. Response of Portfolio Net Flows to Target and Path Surprises

	T-Notes/Bonds	Agency Bonds	U.S. Corp. Bonds	U.S. Corp. Stocks	Non-U.S. Bonds	Non-U.S. Stocks
Target	-0.051	-0.0031	-0.0076	0.0043	-0.014	-0.0055
	(0.037)	(0.017)	(0.0053)	(0.0065)	(0.024)	(0.0033)
Path	-0.073	0.063	0.011	-0.0072	0.10	0.0017
	(0.11)	(0.045)	(0.011)	(0.016)	(0.10)	(0.0080)
Lags	1	1	0	0	0	2
Obs.	108	108	108	108	108	108
R^2	0.25	0.18	0.13	0.16	0.14	0.29

Notes: This table shows the coefficient estimates in regressions of different categories of portfolio net flows on target and path surprises. Net flows are inflows minus outflows. Inflows are sales of securities by Mexican to U.S. investors. Outflows are purchases of securities by Mexican from U.S. investors. All flows are expressed in billions of U.S. dollars. The surprises are equal to the estimated value (as explained in the main text) if there was a monetary policy announcement in the respective month and zero otherwise. The lag order for each flow category is selected using the Bayesian information criterion. The sample period goes from January 2011 to December 2019. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.