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 bond holdings in Mexico. Monetary policy surprises are identified using intraday data on asset prices around monetary policy announcements. Asset prices and the bond holdings of domestic and foreign investors respond not only to unanticipated changes in the policy rate but to information about its future path communicated via statements. The ability to manage expectations about future policy via statements is thus not exclusive to central banks in advanced economies and does not require the zero lower bound to be binding.

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

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1 Introduction

Monetary policy in advanced economies influences financial markets through different types of information communicated by their central banks via policy statements, like interest rate policy, forward guidance and asset purchases. It is not yet clear, however, whether monetary policy in emerging markets also has multiple dimensions.[1] On the one hand, emerging market central banks convey information on their monetary policy actions, like changes in the policy rate, but they may not be willing to communicate information about future policy if the target rate is not constrained by the zero lower bound—as is generally the case in emerging markets. On the other hand, the adoption of inflation targeting and well-anchored inflation expectations allowed them to pursue more forward-looking policies. But even if they communicate different types of information via statements, financial markets may not respond to that information, in which case they would have less room to operate relative to their counterparts in advanced economies.

The underlying question behind this paper is whether monetary policy in an emerging economy has multiple dimensions as is the case for advanced economies. Mexico is a small open economy with a credible inflation targeting regime (De Pooter et al. 2014). The specific research question is whether its monetary policy is conducted exclusively through adjustments in the level of the policy rate. To address this question, I first construct a new dataset of intraday changes in swap rates around monetary policy announcements from 2011 to 2021,[2] and use it to identify monetary policy surprises following the methodology proposed by Gürkaynak et al. (2005).[3] I then characterize how asset prices and portfolio flows respond to those surprises. By considering the effects on portfolio flows along with those on asset prices, one can better understand the mechanisms behind the transmission of monetary policy.

The main finding of this paper is that the Mexican central bank, known as Banxico, conducts its monetary policy communicating two types of information via statements.

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

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

[3] That is, surprises are identified from changes in asset prices, no textual analysis is involved.

The first type relates to unanticipated changes in the target rate, and the second type captures guidance in statements about its future path; henceforth referred to as target and path surprises, respectively.[4] Therefore, path surprises are not only available but actually used by Banxico, which suggests that central banks in emerging markets indeed have the ability to manage expectations about the future path of the policy rate via statements, even if the zero lower bound is not binding.[5] The multidimensionality of monetary policy (Gürkaynak et al. 2005; Altavilla et al. 2019; Swanson 2021) is thus not exclusive to advanced economies. In this sense, emerging market central banks could deal with specific situations, like periods of high inflation and the spillover effects of monetary policy in advanced economies, better than previously thought by communicating information about the future path of their policy rates.

Target and path surprises from Banxico influence both asset prices and portfolio flows. I use intraday changes for the exchange rate and bond yields to quantify the effects on asset prices, and daily data collected by Banxico on holdings of Mexican bonds known as bonos (disaggregated by type of investor) to assess the effects on portfolio flows. The analysis uses an event study methodology and local projections to measure the contemporaneous effects of target and path surprises as well as their persistence in the days following a monetary policy announcement. Quantifying the effects of monetary policy is challenging because it is intrinsically endogenous as it reacts to different macroeconomic circumstances. By now, event studies with high-frequency data are a well-established approach in macro-finance to overcome endogeneity concerns (Gürkaynak and Wright 2013; Nakamura and Steinsson 2018). In particular, event studies overcome endogeneity by isolating the surprise component of monetary policy decisions.

The exchange rate only reacts to target surprises contemporaneously. A tightening in the policy rate appreciates the currency, in line with standard open economy models. But the lack of response to path surprises seems puzzling since rational and forward-looking

[4]Path surprises from emerging market central banks could also be considered as communication surprises or as a subtle form of forward guidance. Kuttner (2018) notes that although there is no clear divide in the literature of what constitutes forward guidance, the likely trajectory of the policy rate communicated when the zero lower bound binds is more explicit than under a conventional regime.

[5]Central banks in advanced economies also communicated information about future policy before the global financial crisis, when the zero lower bound was not binding (Gürkaynak et al. 2005).

investors would be expected to respond to them. In fact, the currencies of advanced economies do respond to path surprises (Rosa 2011; Ferrari et al. 2021). The relatively small variation of path surprises obtained with intraday relative to daily data partly explains the lack of response of the currency to path surprises, so the market may take time to process the information in statements. Future research could explore whether the weak link between the exchange rate and path surprises is characteristic of the Mexican peso given that, for example, emerging market currencies other than the Mexican peso respond to U.S. path surprises (Hausman and Wongswan 2011).[6]

The response of bond yields to target and path surprises is significant and persistent. A tightening of either surprise flattens the yield curve. However, medium- and long-term yields react more to path than to target surprises, consistent with the evidence for the U.S. when its policy rate was not constrained by the zero lower bound (Gürkaynak et al. 2005). In this sense, Banxico's path surprises improve the implementation of monetary policy in Mexico to the extent that medium- and long-term yields influence the spending decisions of households and firms. Furthermore, both types of surprises have a larger influence on the yield curve in Mexico than U.S. surprises have on the U.S. yield curve. This result reflects two non-mutually-exclusive channels according to the expectations hypothesis.[7] First, even though they are anchored (De Pooter et al. 2014), it is likely that long-term inflation expectations in Mexico are less firmly anchored than in the U.S. Second, the larger reaction of bond yields in Mexico can also reflect a larger effect of the surprises on term premia. According to Hanson and Stein (2015), a larger effect on the term premium could be explained by the presence of reach-for-yield investors. For instance, when the target rate decreases, these investors—in need of higher returns—would switch to long-term bonds lowering their yields. This paper shows that Mexican banks follow this pattern.

Investors rebalance their bonos portfolios in response to target and path surprises. Their bonos holdings change gradually in line with what is reported using bond yields

[6]For instance, Banxico's foreign exchange interventions to provide liquidity and to promote orderly market conditions may play a role in muting the response of the currency to path surprises.

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

and with the slow-moving capital explanation for the delayed response of bond yields to monetary policy in advanced economies (Brooks et al. 2019). Moreover, the rebalancing is done by both domestic and foreign investors. Domestic investors rebalance their portfolios based on their business model, and the rebalancing by foreign investors is important in the transmission of path surprises. The latter suggests that capital flows to emerging markets respond not only to the monetary policy of the home country, as shown in the existing literature, but also to the monetary policy of 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 role of path surprises beyond advanced economies. Moreover, the effects of target and path surprises are not only analyzed on asset prices but also on portfolio flows. The literature for advanced economies generally considers only the effects on prices (not quantities) and for emerging markets, it mostly focuses on target (not path) surprises (Kohlscheen 2014; Solís 2021a). Second, this paper takes the perspective of an emerging market economy to analyze the effects of its monetary policy on the portfolio flows of foreign investors. 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 abroad.[8]

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

2 Identification of Monetary Policy Surprises

This section summarizes institutional details relevant to measure the monetary policy surprises. It also describes the asset prices used in the analysis.

[8]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). 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 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 $\pm$ 1%. Before 2008, Banxico conducted monetary policy by setting a quantitative target for (non-borrowed) reserves and by expressing monetary conditions in basis points, after which it adopted the overnight interbank interest rate as its monetary policy instrument. Solís (2021a) discusses more 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 the 28-day interbank interest rate (TIIE28D), 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.[9] Banxico calculates the TIIE28D once a day based on quotes submitted by commercial banks. The 3-month swap of the TIIE28D is the main local derivative. Solís (2021a) uses this swap to capture surprises in the policy rate. This paper extends his analysis by considering a broader sense of monetary policy surprises. 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 and the Covid-19 crises, 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 policy path for longer periods. Moreover, using maturities up to one year is consistent with the approach of Gürkaynak et al. (2005) for the U.S. before the global financial crisis.[10]

[9]The average difference between the TIIE28D and the policy rate is around 30 basis points. Since this spread exhibits small variations, it essentially cancels out when computing changes in swap rates.

[10]Swanson (2021) argues for including maturities of more than one year out if the policy rate is constrained by the zero lower bound and the central bank uses unconventional monetary policy tools.

Asset price changes are calculated on intraday windows containing regular monetary policy announcements. The monetary policy surprises use intraday differences from 10 minutes before to 20 minutes after each announcement for swaps with maturities of 3, 6, 9 and 12 months.[11] To measure the effects of the surprises, intraday differences over the same windows are also calculated for the Mexican peso (MXN) per U.S. dollar (USD) exchange rate and for yields of fixed-rate bonds issued by the Mexican government with maturities of 2, 5, 10 and 30 years.[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 asset price information comes from Bloomberg. The data to calculate the intraday differences for the swap rates and the exchange rate are available since 2011, and since 2013 for bond yields other than the 5-year yield for which the sample starts in December 2014. The dataset covers up to the December 2021 announcement.[13] Between January 2011 and December 2021, there have been 87 regularly-scheduled monetary policy announcements. The four unscheduled announcements over the sample period, two of them in response to the Covid-19 crisis, are excluded because the mechanism driving asset prices on those dates is potentially different from the one driving them on conventional announcements.[14]

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 announcements move asset prices. The first factor is associated with surprises about the current policy rate and the other factor,

[11] When no information 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. Those cases only happen on a few days for some swaps.

[12] 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).

[13] 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.

[14] See Solís (2021a) for considerations about the timing of the announcements and details about the extraordinary meetings.

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 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 $(n - k_0)(n - k_0 + 1)/2 > n$.[15]

The test is performed for the exchange rate and bond yields to assess the number of factors that move asset prices, and for swaps with maturities up to one year to give a structural interpretation to the estimated factors. To satisfy the inference requirement of the test, k_0 can be at most 2 for the exchange rate and the yields (since $n = 5$) and 1 for the swaps (since $n = 4$). To check robustness to the frequency of the data and to 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 for which the data start in October 2006.[16]

Table 1 shows that two factors characterize the responses of asset prices to monetary policy in Mexico. The null hypothesis of no factors is strongly rejected in all cases; thus, asset prices in Mexico respond at least to one factor. Solís (2021a) shows that they do

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

[16] The sample with daily data can start in 2004 even though Banxico adopted its policy rate in 2008 because the swaps reference the TIIE28D not the policy rate.

respond to unanticipated changes in the current policy rate. The most interesting null hypotheses therefore involve one and two factors, $k_0 = 1, 2$. For the exchange rate and bond yields, the null hypothesis of one factor is rejected, but the null of two factors cannot be rejected even at the 10% significance level. This finding does not depend on the frequency of the data nor the sample period. The multidimensionality of monetary policy in advanced economies (Gürkaynak et al. 2005; Swanson 2021; Altavilla et al. 2019) is thus also observed in emerging markets.

[Insert Table 1 here.]

The test performed for swaps generates the same conclusion of two factors. In particular, the null of one factor is rejected at the 5% significance level, regardless of the data frequency or sample period. Asset prices in Mexico therefore react to information provided by Banxico other than adjustments in the current policy rate, but what additional information they react to? Section 3.3 relies on the result for swaps to interpret the two factors.

Lastly, two factors in Banxico's monetary policy is not a recent phenomenon. Asset prices in Mexico have responded to two factors in monetary policy even before Banxico adopted the overnight policy rate in 2008, since daily data go back to 2004. Again, this result holds when the test is performed for the exchange rate and bond yields as well as for swaps. This supports using statements before 2008 for the interpretation of the factors in section 3.3.

3.2 Estimating the Factors

Following Gürkaynak et al. (2005), 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 implied by the Cragg–Donald test 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. The factors, however, do not have a practical interpretation, which is needed to understand their effects on asset prices. Section 3.3 addresses this issue.

The two factors, F_1 and F_2, are estimated when X is comprised of swaps—instead of the exchange rate and bond yields—for interpretation purposes. 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 first three resctrictions require the rotated factors to be orthogonal to each other and to have unit variance. The final restriction is set so that only Z_1 mirrors the changes in the 3-month swap rate, what Solís (2021a) calls the policy rate surprises, thus the loading of the 3-month swap rate on Z_2 is zero.[17]

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 changes in the 3-month swap rate and Z_2 affects the 12-month swap rate in the same magnitude as Z_1 does. The rescaling is done using data since 2013, when intraday data for bond yields become available.[18] 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 12-month swap rate.

Figure 1 displays the estimated factors changing the sample period and the data frequency. The figure compares the time series of Z_1 (top panel) and Z_2 (bottom panel) obtained with intraday and daily data since 2011 as well as with daily data since 2004. Z_1 is less sensitive to changes in the sample period and the data frequency. For instance, the Z_1 factors correlate among themselves around 0.97, whereas the Z_2 factors about 0.73. Also, the standard deviation of Z_2 obtained with daily data doubles relative to when it is obtained with intraday data (4.83 vs. 2.16 basis points), whereas it is similar for Z_1

[17] 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).

[18] The rescaling does not affect the starting date of the factors.

(7.84 vs. 7.67 basis points). In any case, the standard deviation of Z_2 is smaller than Z_1, regardless of the data frequency. The intuition of this result is discussed in section 4.1.1.

The figure shows that two factors in Banxico's monetary policy is not a recent phenomenon, in line with table 1. Nevertheless, 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.

[Insert Figure 1 here.]

3.3 Interpreting the Factors

Gürkaynak et al. (2005) show that the first and second factors in the U.S. relate to changes in the policy rate and statements, respectively. For Mexico, Solís (2021a) shows that asset prices respond to policy rate surprises, but the second factor in principle might just capture a link to long-term yields without being related to communications by the central bank. The evidence, however, similarly supports its association with statements.

The factors Z_1 and Z_2 are henceforth referred to as the target and path factors or surprises. By definition, Z_1 moves with surprises in the 3-month swap rate, and Z_2 is aligned with surprises in the 12-month swap rate that are unrelated to changes in the 3-month swap rate.[19] Accordingly, Z_1 can be related to surprises in the *current* policy rate, it adequately captures the monetary stance in the short run—even though the 3-month swap might encompass more than one policy meeting ahead—while Z_2 can be associated with surprises about the *future* path of the policy rate. Figure 2 and table 2 provide evidence supporting this interpretation.

Figure 2 compares the estimated target and path surprises for relevant dates over the sample period. While the analysis in sections 4 and 5 uses target and path surprises obtained using intraday data for efficiency in the estimation, the factors plotted in figure 2 are obtained using daily data (solid line in figure 1) in order to explore longer series (since 2004) in the interpretation of path surprises in section 3.3.1. In the figure, target

[19] By construction, Z_1 is essentially the same as the policy rate surprises in Solís (2021a) the correlation coefficient between the two measures is 0.997. Meanwhile, the correlation between Z_2 and the residual of a regression of the change in the 12-month swap on the change in the 3-month swap is 0.85.

surprises are in the horizontal axis, and path surprises are in the vertical axis; the units in both cases are basis points.[20] A positive value in any of the two surprises represents a tightening in Banxico's monetary stance, and a negative value represents an easing.

Banxico has used all four possible combinations of target and path surprises. The first quadrant shows announcements in which there was a tightening in target as well as path surprises. Both surprises eased in the third quadrant. In the second and fourth quadrants, there was a tightening in one surprise and an easing in the other.

[Insert Figure 2 here.]

3.3.1 Statements and Path Surprises

Table 2 shows that Banxico communicates information about the future path of the policy rate via statements. Path surprises and Banxico's statements are therefore related. The table summarizes Banxico's policy statements on announcement days in which, according to figure 2, their content communicated important information in addition to the current policy rate. Central bank statements convey information intended to influence expectations about future monetary policy decisions and to reduce policy uncertainty. All the excerpts reported in table 2 contain clear references to the monetary stance in the future. The column labeled 'Path' indicates whether figure 2 associates the respective statement with a tighter (+) or looser (−) monetary stance going forward. Importantly, the excerpts and the signs are in line with each other.[21] In particular, the statements accompanying the announcements on October 2007, August 2008 and 2011, and June 2017 suggested looser financial conditions ahead, while the statements for the rest of the announcements signaled a tighter monetary stance going forward. Moreover, half of the announcements explicitly reference the future path of the policy rate.[22] Finally, notice that by plotting the monetary policy surprises obtained with daily (instead of intraday) data in figure 2, half of the announcements highlighted in table 2 are pre-2011 (i.e., be-

[20] Target and path surprises are orthogonal to each other by construction, so no correlation is to be expected between the dots in the figure.

[21] Remember that no textual analysis is used to obtain the surprises, they are identified exclusively from changes in asset prices.

[22] These statements are: April 2006, June 2009, March and October 2013, February and June 2017.

fore the start of the sample period with intraday data), which allows to assess the link between path surprises and statements over a longer period.

[Insert Table 2 here.]

The tightening cycle that started in mid-2016 due to rising inflation risks exemplifies the link between path surprises and the 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 Mexican government raised the minimum wage and ended gasoline subsidies in early-2017. By mid-2017, inflation had risen for 10 consecutive months. In that context, Banxico raised its policy rate by 50 basis points on June and September 2016, more than the market expected according to surveys, followed by six more consecutive tightenings, (three of 50 and three of 25 basis points). In the statement for the last hike on June 2017, Banxico dropped the reference to do 'the necessary tightenings ahead' from the previous statement and indicated that it expected inflation to peak in the near future. That 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. It is in fact the closest to a 'pure' path easing surprise in the sample.

Two other dates are also worth reviewing due to the relatively small path surprises. According to figure 2, the announcements on September 2013 and June 2014 generated 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 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, both delivered target with minimal path surprises.

These examples support the association of path surprises with unanticipated information about the future path of the policy rate communicated via statements.

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 quantifies the response of the exchange rate and the yield curve to those surprises. The next section extends the analysis by assessing their effects on portfolio flows.

4.1 Contemporaneous Effects

Given that the surprises are cleanly identified, the following event-study regression measures the on-impact effects of the two types of 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. $Target_t$ and $Path_t$ are the two types of surprises obtained using intraday data.[23] All the variables are expressed in basis points. Finally, the error term ε_t captures variations in the dependent variables unrelated to the two surprises.

Table 3 reports the results of the estimation. The first column for each dependent variable shows the coefficient estimates when the regression only includes target surprises as the independent variable, while the second column adds path surprises as a regressor. Focusing on the first column, a target tightening surprise appreciates the currency and flattens the YC. The estimated coefficients for the target surprises in table 3 are very

[23] As already mentioned, even though the surprises can also be obtained from daily data over a larger sample size, the analysis uses the surprises obtained with intraday data because there are gains in precision during the estimation and in terms of explanatory power.

similar to the ones reported by Solís (2021a, Table 2) for the responses of the exchange rate and bond yields to policy rate surprises.[24] This result is not surprising given that the target factor is rescaled so that it moves one-to-one with the change in the 3-month swap rate (see section 3.2). In fact, the target and the policy rate surprises are highly correlated (0.997).

[Insert Table 3 here.]

4.1.1 Response of the Exchange Rate

When Banxico increases the policy rate, the Mexican peso appreciates. A 25-basis-point target tightening surprise leads, on average, to an appreciation of the currency of more than 55 basis points. As a reference, the currencies of advanced economies also responded around two times the magnitude of a policy rate surprise before the global financial crisis (Rosa 2011), when monetary policy was not constrained by the zero lower bound.[25]

However, the exchange rate only responds to target but not to path surprises. This result 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 do respond to path surprises (Rosa 2011; Ferrari et al. 2021), and emerging market currencies other than the Mexican peso respond to U.S. path surprises (Hausman and Wongswan 2011).

One explaination for the lack of response of the peso to path surprises is the relatively small variation of path surprises obtained with intraday data. As mentioned in section 3.2, the standard deviation of path surprises more than doubles when using daily relative to intraday data, while it is similar for target surprises. In line with this explanation, table A.2 in the appendix shows that the currency responds to path surprises when they are obtained using daily data. Therefore, the foreign exchange market may take time to process the information in statements about the future path of the policy rate. Notwithstanding, the effect using daily data is only significant at the 10% significance

[24] Solís (2021a) defines the policy rate surprises as the intraday changes in the 3-month swap rate.

[25] After the global financial crisis, the currencies of advanced economies responded up to five times the magnitude of a policy rate surprise (Ferrari et al. 2021).

level. Remember that, in the data, the standard deviation of path surprises is smaller than target surprises, regardless of the data frequency (see section 3.2). Intuitively, since the possibility of reaching the zero lower bound has not been an issue in Mexico, the need of Banxico to rely on path surprises has been low.

An alternative explanation involves foreign exchange interventions. Although the peso operates under a flexible exchange rate regime, Banxico intervenes in the foreign exchange market to provide liquidity and to promote orderly conditions. Even though the interventions follow a rules-based approach (García-Verdú and Zerecero 2013),[26] they 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 (U.S.) path surprises.

A final explanation involves an information channel. Accordingly, if path surprises have opposite effects on the currency, the effects can offset among themselves. 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.

Future research can assess the relative importance of these potential explanations for the lack of response of the currency to path surprises.

4.1.2 Response of the Yield Curve

Unlike the exchange rate, the yield curve responds to both target and path surprises. In particular, a tightening of either surprise flattens the yield curve. But the effect of path surprises on the yield curve is especially strong. Table 3 shows that medium- and long-term yields respond more to path than to target surprises, consistent with the evidence for the U.S. when its policy rate was not constrained by the zero lower bound (Gürkaynak et al. 2005). Intuitively, information about the future path of the policy rate is expected to have relatively more weight on the middle to long end of the curve.

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

Moreover, comparing the R^2 statistic of the regressions with one and two factors reveals that path surprises explain more than 60, 25 and 40% of the variability in 5- 10- and 30-year yields, respectively.

The effects of path surprises on longer-term interest rates improves the implementation of monetary policy in emerging markets. To the extent that medium- and long-term yields influence the spending decisions of households and firms, monetary policy effectiveness increases with path surprises. In this sense, path surprises tighten the link between short- and long-term interest rates. In addition, emerging market central banks could deal with specific situations, like periods of high inflation and the spillover effects of monetary policy in advanced economies (which tend to be larger on long-term yields (Obstfeld 2015; Kearns et al. 2018)), better than previously thought by communicating information about the future path of their policy rates.

In terms of magnitude, the 2- 5- and 10-year yields in Mexico respond stronger to both types of surprises relative to the response of U.S. yields to the equivalent U.S. surprises constructed by Gürkaynak et al. (2005). On average, a 25-basis-point target tightening surprise in Mexico vs the U.S. raises the yields for those maturities by 17 vs 12, 11 vs 7, 11 vs 3 basis points, respectively; while a 10-basis-point path tightening surprise raises them by 10 vs 4, 10 vs 4, 8 vs 3 basis points. This result reflects two non-mutually-exclusive channels according to the expectations hypothesis.[27] First, even though they are anchored (De Pooter et al. 2014), it is likely that long-term inflation expectations in Mexico are less firmly anchored than in the U.S. Second, the larger reaction of bond yields in Mexico can also reflect a larger effect of monetary policy surprises on term premia, which could be explained by the presence of reach-for-yield investors (Hanson and Stein 2015). Section 5.3 shows that Mexican banks exhibit this type of reach-for-yield behavior.[28]

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

[28] Future research could provide more evidence on both channels. For instance, subject to data availability, one could assess the relevance of each channel by looking at the effects on real interest rates.

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 2021a). Unreported results confirm that the *daily* exchange rate returns do not respond to target nor path surprises in the days following Banxico's monetary policy announcements.

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 surprises (obtained with intraday data) on announcement days and zero otherwise. By construction, the factors are uncorrelated, but they are included simultaneously because the estimation is more efficient. The parameters of interest are β_h^1 and β_h^2 because they measure the average response of the yields to the surprises at horizon h. Finally, 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 essentially the same when no controls are included.[29] However, they are considered here for comparison with the analysis using portfolio flows in section 5 for which it might be reasonable to include 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

[29]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.

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.

Figure 3 shows the persistence of bond yields to target and path surprises. The top row shows the persistence of the yields to target surprises and the bottom row to path surprises. All responses are assessed relative to a one basis point tightening surprise. The contemporaneous effect (when $h = 0$) on the yields is indicated with an arrow next to the vertical axis.

[Insert Figure 3 here.]

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. Section 5.3 provides evidence supporting this interpretation for Mexico.

Three patterns emerge from the impulse responses. First, the effect of path surprises at all maturities more than doubles a few days after a surprise, which supports the view that financial markets may take some time to digest the implications of path surprises (Gürkaynak et al. 2005). Second, the yields respond stronger to path than to target surprises in the days following an announcement, but the effects of target surprises are more persistent. As mentioned in section 4.1.1, the need of Banxico to rely on path surprises has been low, but when they are used, they have a strong and somewhat persitent impact on yields. Lastly, the persistance of the effects 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.

Overall, Banxico's target and path surprises exert a strong impact on the yield curve that lasts days after an annoucement.

5 The Effects of Monetary Policy on Portfolio Flows

The previous section analyzes the responses of asset *prices* to target and path surprises. In fact, most studies involving high frequency identified monetary policy surprises focus only on the effects on prices. In contrast, this section studies how portfolio *flows* respond to those surprises to explore the mechanisms behind the transmission of monetary policy. Unlike previous studies that 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 itself to assess whether the monetary policy of emerging markets is able to influence those flows.

5.1 Daily Data on Portfolio Flows

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 following analysis focuses on bonos given the prominent role they play in the Mexican bond market (Abreu 2014).

The data on holdings collected by Banxico are unique because of its daily frequency. In fact, one challenge in analyzing the effects of monetary policy surprises on international financial flows is the frequency of the data. Cross-border capital flows—classified broadly as (bond and equity) portfolio flows, foreign direct investment, and banking flows—are reported quarterly, although some sources report portfolio flows monthly or even weekly. This section exploits the availability of daily data on bonos holdings to analyze how portfolio flows respond to target and path surprises.

The data contain the holdings of bonos by domestic and foreign investors. For reference, figure 4 compares the level of bonos and cetes holdings by residence from January 2011 to December 2021. Up to 2020, foreign investors were the main players in the bonos market,[30] their holdings increased substantially since bonos were included in the Citigroup's World Government Bond Index (WGBI) in 2010 (Abreu 2014), and the decline since 2020 is explained by their response to the Covid-19 crisis. Between late 2012 and early 2015, foreigners were also the main holders of cetes but rising hedging costs made short-term carry trade less attractive, which partly explains the decline since then.

[Insert Figure 4 here.]

Banxico categorizes domestic investors into banks, mutual funds, pension funds, insurers and non-financial investors (firms and households). Figure 5 displays the level of bonos holdings by domestic residents. Over the sample period, pension funds have been the biggest player in the market. In recent years, non-financial investors and banks started accumulating a larger share of bonos. On the other hand, insurers and mutual funds maintain the smallest share of bonos among the different types of investors. In Mexico, insurers usually hold bonos to maturity, and most of the mutual funds are shot-term debt funds with highly liquid investments.

[Insert Figure 5 here.]

The data need to be adjusted since 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

[30] Christensen et al. (2021) analyze the role of foreign investors in the liquidity of the bonos market.

Banxico.[31] 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. This information on net purchases is then used to analyze the effects of monetary policy on portfolio flows. Although the adjustment is far from perfect, it is reasonable given the available data; for instance, the average maturity data is not broken down by tenor or by type of investor. Fortunately, the adjusment does not alter the conclusions as the next section explains.

5.2 Contemporaneous Effects

Similar to the case of asset prices, the following event-study regression quantifies 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) by type of investor around monetary policy announcements. The rest is similar to equation (3). Table 4 reports the results.

[Insert Table 4 here.]

Most investors adjust their bonos holdings to at least one of the surprises on the day of a monetary policy announcement. Only insurers exhibit no reaction, which is not surprising given their small share of bonos holdings (see figure 5). For other investors, the responses are economically significant. For instance, pension funds buy about MXN 7 billion worth of bonos following a 25-basis-point target tightening surprise, while foreigners buy about MXN 23 billion worth of bonos after a 10-basis-point path tightening surprise. Those amounts represent a little more than 1.5% of the average value of the bonos holdings of each investor.[32] Therefore, in response to a decline in prices (or a rise

[31] 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 and $\mathrm{d}y$ is the change in the yield. Each day, the BFV yield closest to the average maturity is used to calculate D_{mod} and $\mathrm{d}y$. Banxico reports every month the average maturity (expressed in days) of the bonos outstanding. For the adjustment, the average maturity is expressed in years and rounded to the nearest integer; the same value is used for all the days in a month.

[32] Over the sample period, pension funds hold on average around MXN 395 billion and foreigners about MXN 1,415 billion worth of bonos.

in yields) due to a tightening in the monetary stance, as reported in table 3, two of the most important players in the bonos market increase their holdings.

Investors rebalance their bonos portfolios in response to a monetary policy surprise based on their business model. For instance, while other investors increase their holdings of bonos following a tightening in the monetary stance, banks sell them. With a tighter monetary stance, banks may no longer need to hold long-term bonds to receive a high yield; they can achieve it with shorter-term securities. Section 5.3 discusses this result in more detail. Notice that the magnitudes for the response to path surprises suggest that there are more buyers than sellers. In this case, the amount of bonos outstanding should increase to meet the demand. Table A.3 in the appendix supports this intuition.[33]

For robustness, table A.4 in the appendix reports the results of estimating equation (5) using the daily change in the value of bonos holdings with no valuation adjustment. In terms of magnitude, the adjustment makes little difference for domestic investors; for foreigners, although the effect of path surprises decreases, it is still statistically significant.

5.3 Persistence

As in section 4.2, 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 change in the holdings of bonos by type of investor over h days, $h = 0, 1, \ldots, 30$. The rest is similar to the case with asset prices in equation (4), including the vector of lagged variables z_{t-1} which now controls for potential drivers of the flows. The control variables are the same as for asset prices. The parameters of interest are again β_h^1 and β_h^2.

Figures 6 and 7 display the impulse responses for bonos flows.[34] As with asset prices, the contemporaneous effect (when $h = 0$) on portfolio flows is indicated with an arrow

[33] It is unlikely, however, that the government issues more bonos in response to path surprises. The central bank may be playing a role in this regard.

[34] For reference, figures A.1 and A.2 in the appendix show the impulse responses for cetes flows.

next to the vertical axis, and all responses are assessed relative to a one basis point tightening surprise. Portfolio flows above and below the horizintal axis indicate purchases and sales of bonos, respectively. The flows are expressed in billions of pesos.

[Insert Figure 6 here.]

[Insert Figure 7 here.]

The effects on bonos flows are in line with the results for yields. For instance, the responses by pension funds to a target surprise and by foreigners to a path surprise are persistent. This delayed adjustment in the bonos holdings of some investors aligns with the post-announcement drift displayed by the yields (see figure 3) and is consistent with the slow-moving capital explanation in which big players take time to respond to the surprises (see section 4.2).

Investors do rebalance their bonos portfolios in response to a monetary policy surprise based on their business model. For instance, while pension funds buy bonos in response to a target tightening surprise, banks sell them in the days following it, which reflects the different investment profiles of these two types of investors. In particular, the investment horizon of banks is shorter than that of pension funds. Specifically, the average maturity of the bonos held by banks is less than 5 years, while for pension funds it is more than 10 years (Abreu 2014).

Mexican banks exhibit a reach-for-yield behavior. The response of banks to target surprises (top left panel of figure 6) implies that they buy bonos a few days after a target easing surprise. This response supports the mechanism described by Hanson and Stein (2015). Accordingly, banks can offset the negative effects of a target easing surprise on their current income by rebalancing their portfolio toward long-term bonds, which would raise their price and hence lower long-term yields. A monetary easing would thus induce yield-oriented investors, like banks, to take on more interest rate risk and to push down the term premiums of bond yields. In this sense, Mexican banks boost the influence of Banxico's monetary policy on the term premium, which may partly explain why the yield curve in Mexico responds stronger to monetary policy surprises than the U.S. yield curve

(see section 4.1.2).[35]

Finally, foreign investors respond strongly and persistently to path surprises. In particular, they reallocate their portfolios toward bonos in the month following a tightening of the monetary stance going forward. Two implications derive from this result. First, the strong effect of path surprises on bond yields reported in section 4.1.2 is mainly driven by foreign investors. They are thus important players in the transmission of central bank communications about the future path of the policy rate. Second, 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 also to that of the destination country. The response of foreign investors can therefore be relevant for central banks in emerging markets to deal, for instance, with the spillover effects from policies implemented abroad.

In summary, domestic and foreign investors rebalance their bonos portfolios in response to target and path surprises.

6 Concluding Remarks

This paper uses a new high-frequency dataset to identify monetary policy surprises in an emerging economy. The evidence shows that the central bank conducts monetary policy by adjusting its current policy rate and by managing expectations about its future path via statements, both of which influence asset prices and portfolio flows. The multidimensionality of monetary policy is therefore not exclusive to central banks in advanced economies and does not require the zero lower bound to be binding.

Having the ability to manage market expectations about the future path of the policy rate via statements improves the implementation of monetary policy by central banks in emerging markets. For instance, they can better influence medium- and long-term interest rates, which are relevant for the spending decisions of households and businesses. In addition, they have more room than previously thought to deal with periods of high inflation as well as with the spillover effects from policies implemented by central banks

[35]This result does not discard that the larger reaction of bond yields in Mexico can also be due to long-term inflation expectations in Mexico being less firmly anchored than in the U.S.

in advanced economies.

Given the importance of statements documented here, central banks in 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.[36]

The results in this paper can be extended in several directions. For instance, additional evidence supporting the effect of Banxico's monetary policy on the term premium can use the decomposition proposed by Solís (2021b) for the bond yields of emerging markets. In addition, the destination-country perspective for portfolio flows seems relevant for emerging markets in connection with macroprudential policies. Given how foreign investors rebalance their portfolios in response to local monetary policy surprises, policymakers could be interested in the interaction of target and path surprises with different macroprudential policies, including capital controls. Finally, more research is needed to assess the extent to which the results reported here apply to other emerging markets.

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[36] On this regard, Banxico committed to issue clear and concise statements and made its guidelines publicly available in February 2020. The press release is available at `https://www.banxico.org.mx/publicaciones-y-prensa/miscelaneos/%7B4C09D772-2CDF-8BD6-3F04-65DE03CA6212%7D.pdf`.

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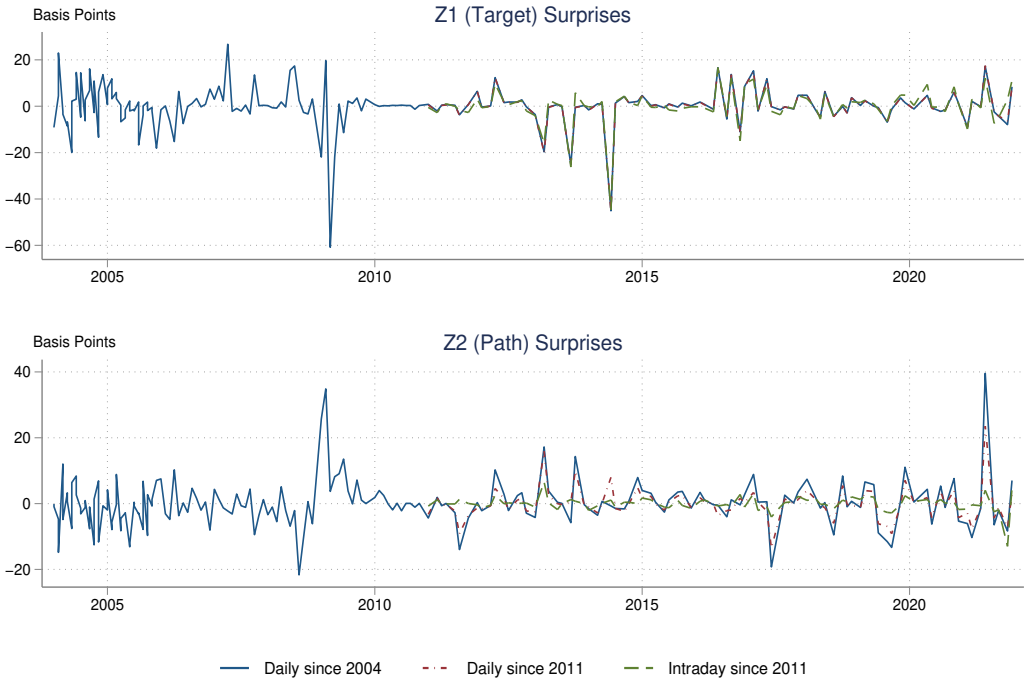
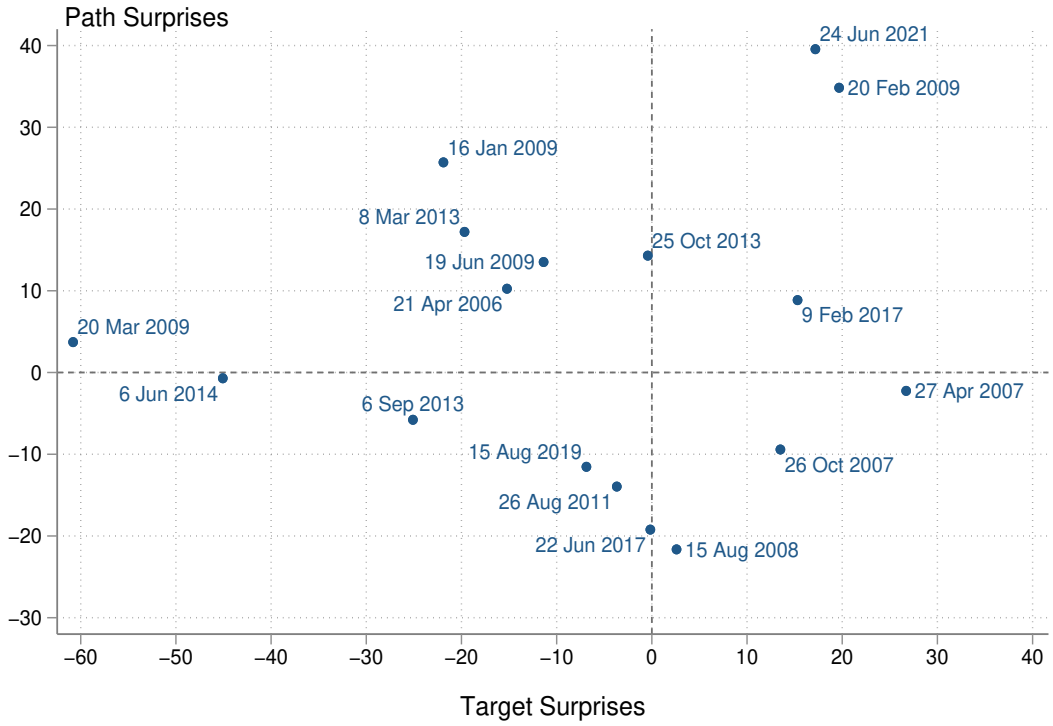
Figure 1. Monetary Policy Surprises in Mexico: Intraday vs. Daily Data



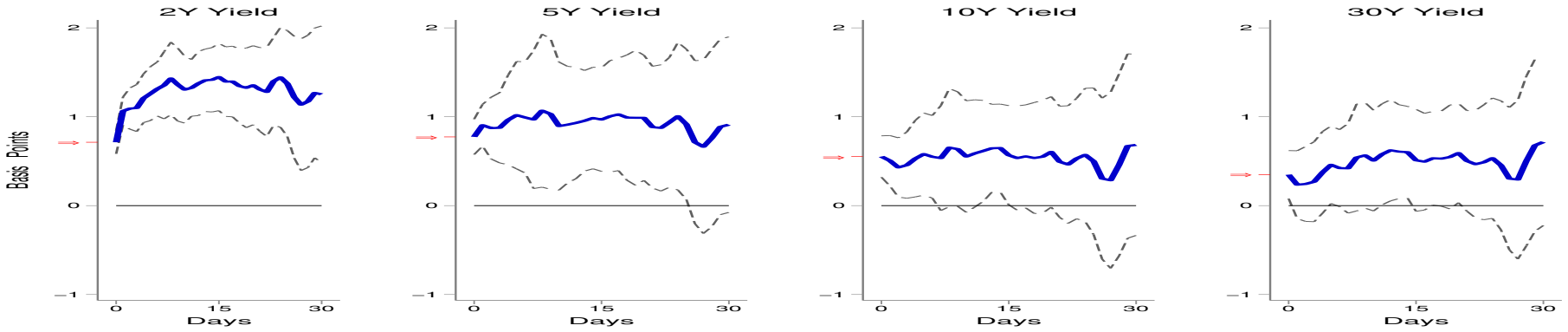
Notes: This figure compares the evolution of the Z_1 (target) and Z_2 (path) surprises obtained with daily data since 2004 (solid line) and 2011 (dash-dotted line), and with intraday data since 2011 (dashed line). The sample includes all regular monetary policy announcements up to December 2021.

Figure 2. Monetary Policy Dimensions

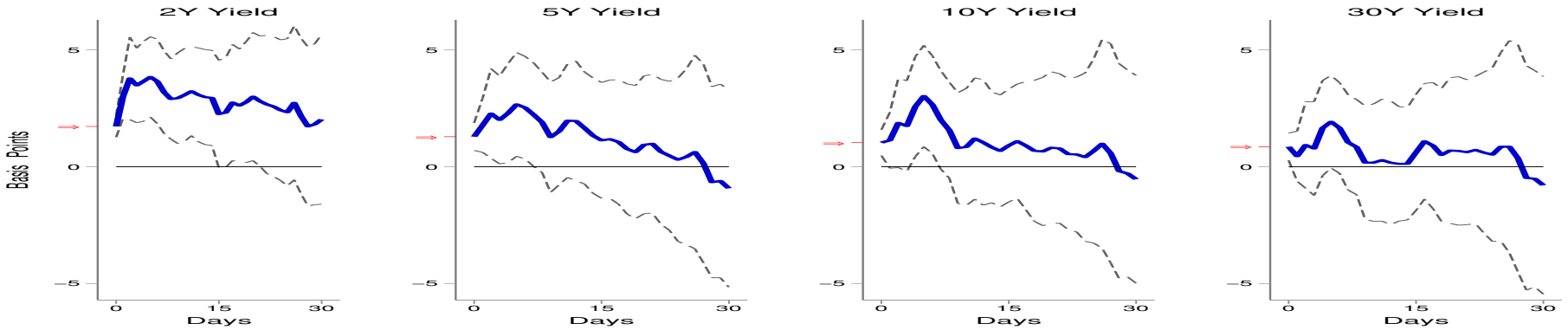


Notes: This figure plots the largest estimated target and path surprises obtained from daily data, as explained in the main text. The sample includes all regular monetary policy announcements from January 2004 to December 2021.

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



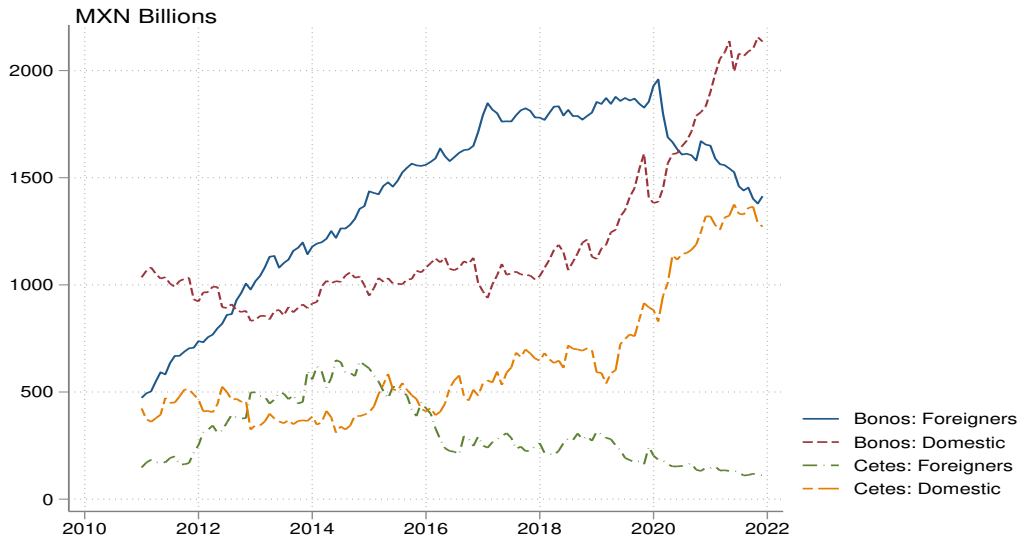
(a) Target Surprises



(b) Path Surprises

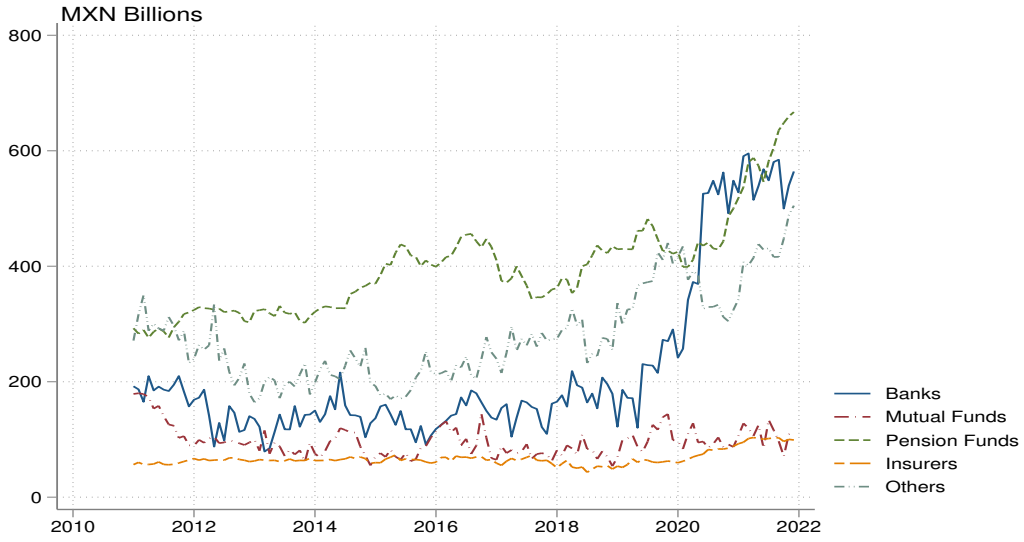
Notes: This figure plots the coefficient estimates and 95% confidence intervals for 1 basis point target and path tightening surprises for yield changes from close of day $t-1$ to day $t+h$, where t is a day with a monetary policy announcement and $h = 0, 1, \ldots, 30$. An arrow in the vertical axis indicates the contemporaneous effect (when $h = 0$). The surprises are equal to the target and path surprises (obtained with intraday data) on announcement days and zero otherwise. The sample includes all regular monetary policy announcements from January 2011 to December 2021. The 95% confidence bands are based on robust standard errors.

Figure 4. Holdings of Cetes and Bonos by Nationality



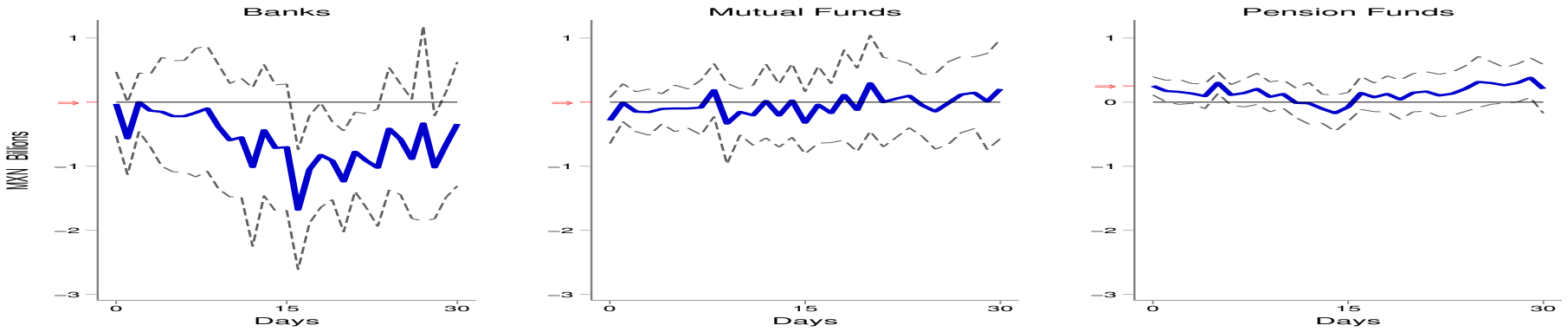
Notes: This figure shows the net holdings of Mexican Treasury bills (cetes) and fixed-rate sovereign bonds (bonos) by investor nationality from January 2011 to December 2021.

Figure 5. Holdings of Bonos by Type of Investor

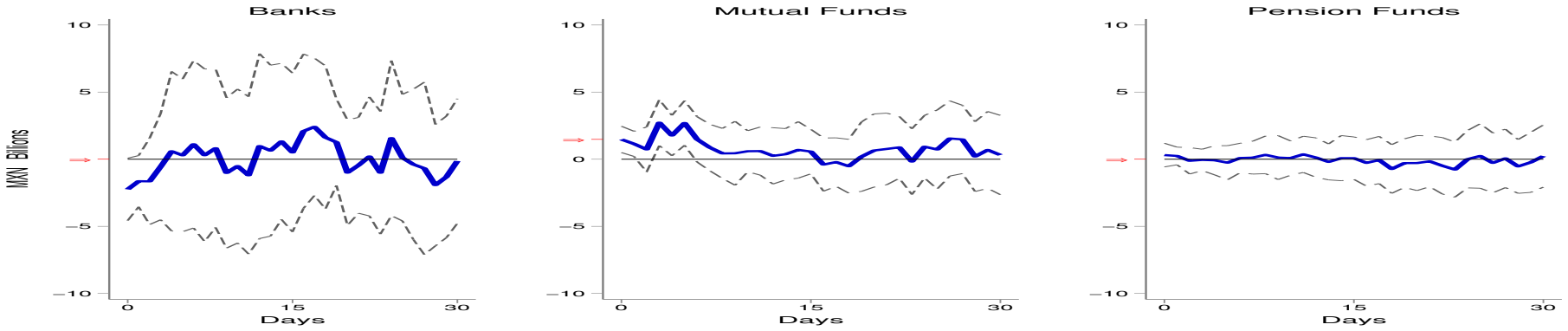


Notes: This figure shows the net holdings of fixed-rate Mexican sovereign bonds (bonos) by type of domestic investor from January 2011 to December 2021.

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



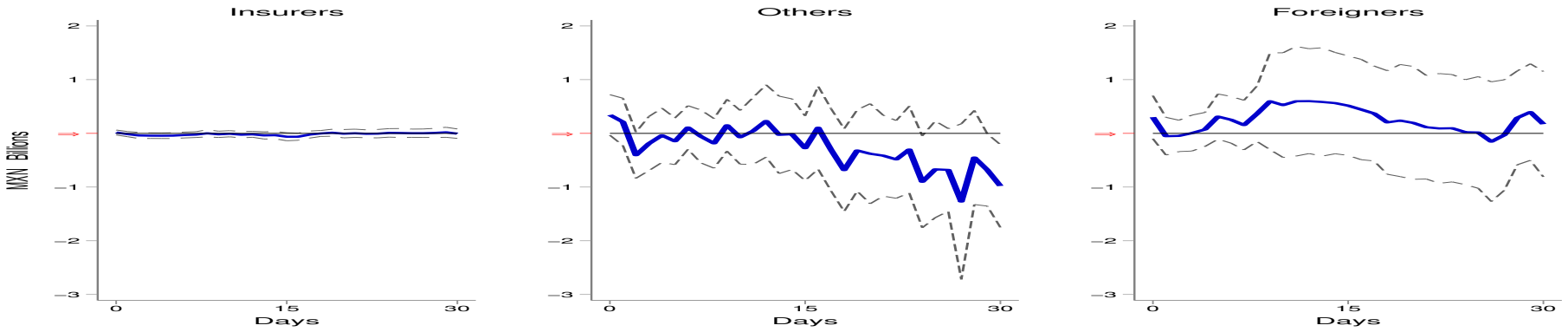
(a) Target Surprise



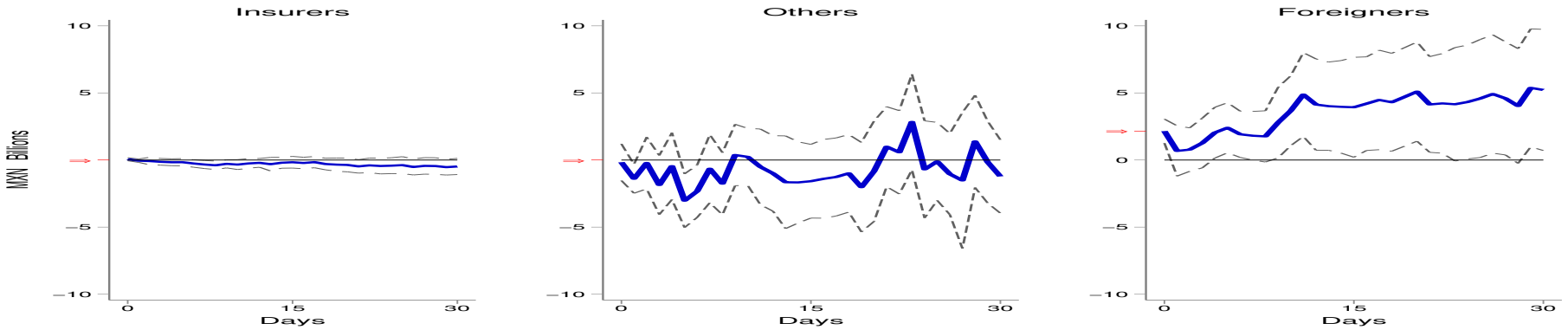
(b) Path Surprise

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 in the vertical axis indicates the contemporaneous effect (when $h = 0$). The surprises are equal to the target and path surprises (obtained with intraday data) on announcement days and zero otherwise. The sample includes all regular monetary policy announcements from January 2011 to December 2021. 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 in the vertical axis indicates the contemporaneous effect (when $h = 0$). The surprises are equal to the target and path surprises (obtained with intraday data) on announcement days and zero otherwise. The sample includes all regular monetary policy announcements from January 2011 to December 2021. 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	29.56	10	0.001	56
		1	10.07	5	0.073	56
		2	1.14	1	0.285	56
	Daily	0	40.20	10	0.000	135
		1	18.93	5	0.002	135
		2	0.00	1	0.978	135
Swaps	Intraday	0	28.30	6	0.000	87
		1	7.21	2	0.027	87
	Daily	0	33.06	6	0.000	190
		1	9.35	2	0.009	190

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 includes monetary policy announcements until December 2021, the starting date varies based on data availability: for the exchange rate and the yield curve with intraday data, it 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, it is January 2011 and with daily data is January 2004. The yield curve includes 2- 5- 10- and 30-year bonds. Swaps have maturities of 3, 6, 9 and 12 months.

Table 2. Summary of Statements in Selected Dates

Date	Path	Description
21-Apr-2006	+	Statement announces an easing of monetary conditions but notes that 'for the foreseeable future there is no space available for further easing.'
26-Oct-2007	−	Statement indicates that the risk that the sharp decline in the U.S. real estate market weakens the U.S. economy, affecting economic activity in Mexico, has increased.
15-Aug-2008	−	Statement highlights that global inflationary pressures continue to rise but an improvement is foreseen in the medium term due to the prospects for lower global growth. Downside risks to the local economy have increased.
16-Jan-2009	+	Statement notes 'a higher than expected upward trend in inflation in the last quarter' and that 'instability in financial markets continues to be a risk factor for the inflationary trend.'
20-Feb-2009	+	Statement indicates that 'the strong financial turmoil represents a risk to the expected inflation path, even considering the greater contraction in demand and the reduction in commodities prices.'
19-Jun-2009	+	Statement indicates that 'the Board considers that its easing cycle is close to an end.'
26-Aug-2011	−	Statement notes that the current monetary policy stance is considered adequate but if it turns in an unnecessary tightening, the Board will reflect on the need to adjust it.
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.'
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.
24-Jun-2021	+	Statement highlights additional shocks to those expected in headline and core inflation, and notes that their expected paths in the following quarters are higher than previously estimated.

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

	FX Returns		Δ 2Y Yield		Δ 5Y Yield		Δ 10Y Yield		Δ 30Y Yield	
Target	-2.31***	-2.31***	0.67***	0.68***	0.52***	0.43***	0.44***	0.44***	0.30***	0.30***
	(0.82)	(0.79)	(0.080)	(0.083)	(0.13)	(0.099)	(0.073)	(0.072)	(0.071)	(0.072)
Path		-2.12		0.95***		1.00***		0.78***		0.69***
		(1.57)		(0.17)		(0.21)		(0.16)		(0.19)
Constant	-9.17***	-9.17***	-0.32	-0.29	-0.56	-0.35	-0.60	-0.57*	-0.79**	-0.76**
	(3.21)	(3.19)	(0.42)	(0.32)	(0.47)	(0.37)	(0.40)	(0.33)	(0.39)	(0.34)
Obs.	87	87	71	71	56	56	71	71	71	71
R^2	0.26	0.28	0.72	0.84	0.39	0.64	0.55	0.69	0.37	0.53

Notes: The first column for each dependent variable shows the coefficient estimates in regressions of intraday yield changes or exchange rate (FX) returns 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 includes all regular monetary policy announcements starting on January 2011 for the exchange rate, on January 2013 for 2- 10- and 30-year yields, and on December 2014 for 5-year yields; the sample ends on December 2021 in all cases. Figures are expressed in basis points. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

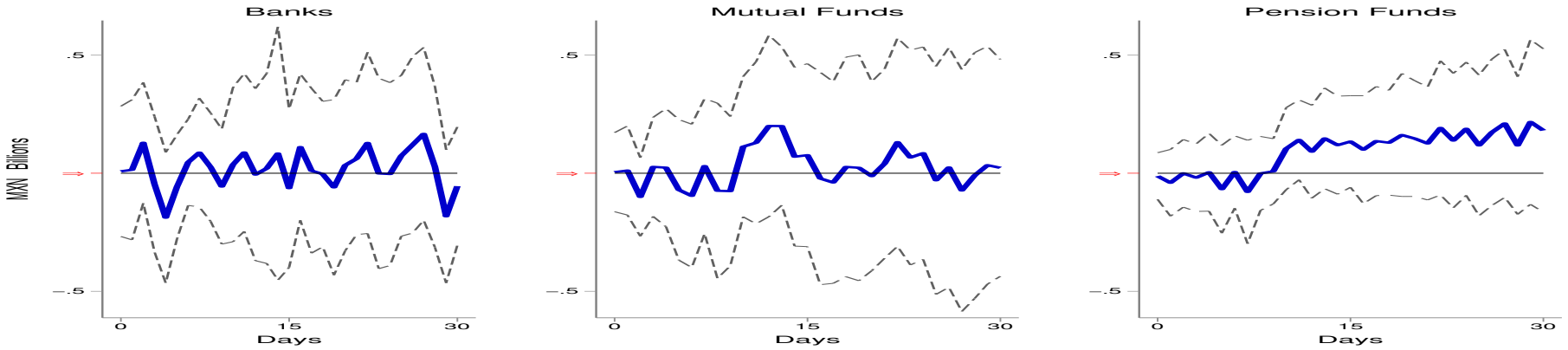
Table 4. Response of Daily Bonos Holdings to Target and Path Surprises

	Banks	Mutual	Pension	Insurers	Others	Foreigners
Target	-0.078	-0.26	0.26***	0.016	0.36*	0.26
	(0.27)	(0.20)	(0.076)	(0.024)	(0.18)	(0.20)
Path	-2.08*	1.89***	0.45	0.079	-0.14	2.26***
	(1.12)	(0.58)	(0.49)	(0.057)	(0.71)	(0.43)
Obs.	87	87	87	87	87	87
R^2	0.04	0.11	0.09	0.02	0.02	0.21

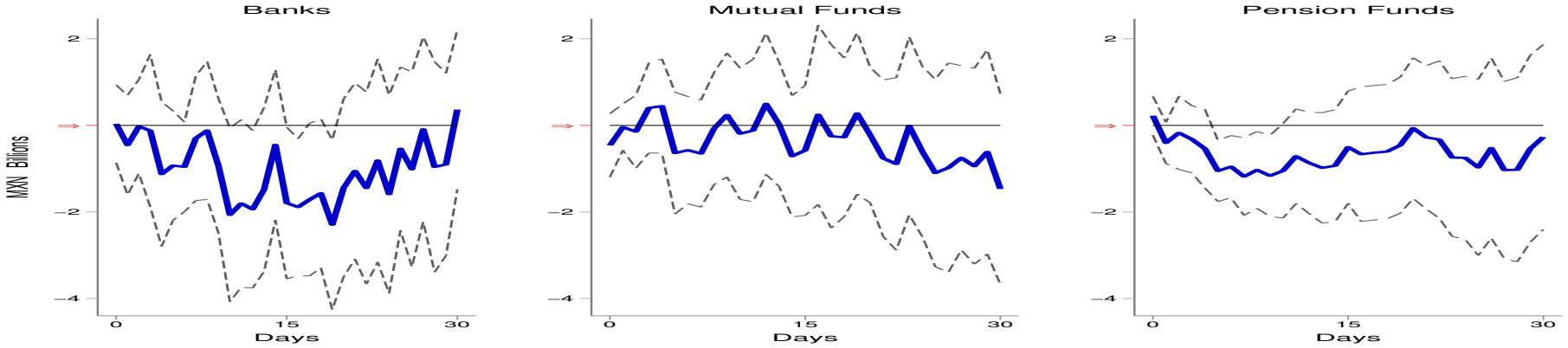
Notes: This table shows the coefficient estimates in regressions of different categories of bonos inflows on target and path surprises. Inflows are obtained as the daily change in the holdings of bonos. All flows are expressed in billions of Mexican pesos. Target and path surprises are obtained from intraday data, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2021. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.

Appendix

Figure A.1. Response of Cetes Flows to Target and Path Surprises



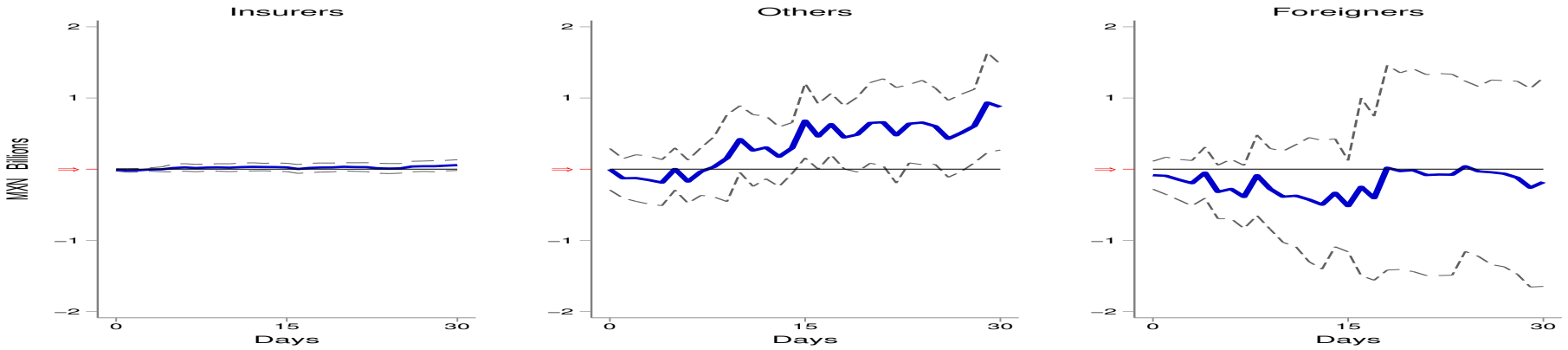
(a) Target Surprise



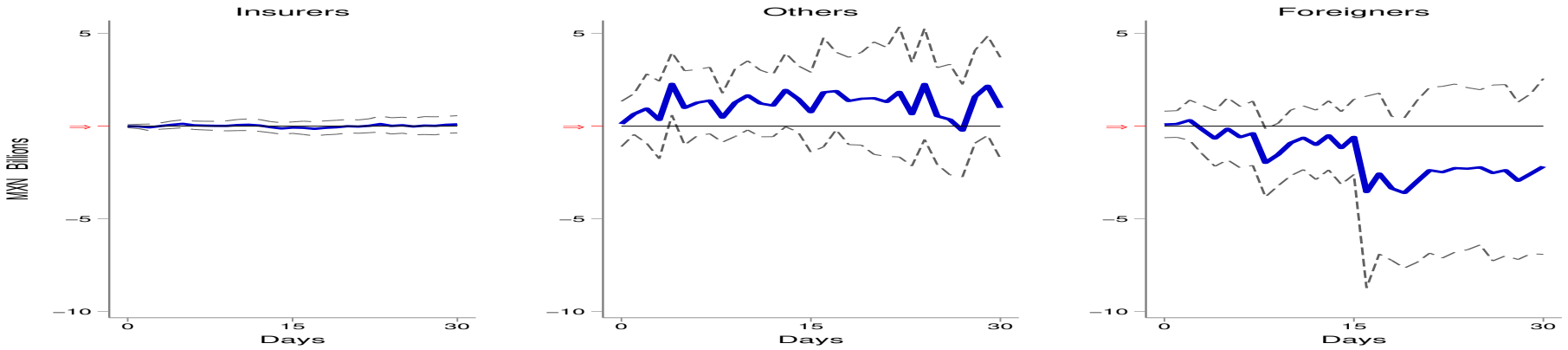
(b) Path Surprise

Notes: This figure plots the coefficient estimates and 95% confidence intervals for 1 basis point target and path tightening surprises for cetes 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 in the vertical axis indicates the contemporaneous effect (when $h = 0$). The surprises are equal to the target and path surprises (obtained with intraday data) on announcement days and zero otherwise. The sample includes all regular monetary policy announcements from January 2011 to December 2021. The 95% confidence bands are based on robust standard errors.

Figure A.2. Response of Cetes Flows to Target and Path Surprises (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 cetes 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 in the vertical axis indicates the contemporaneous effect (when $h = 0$). The surprises are equal to the target and path surprises (obtained with intraday data) on announcement days and zero otherwise. The sample includes all regular monetary policy announcements from January 2011 to December 2021. The 95% confidence bands are based on robust standard errors.

Table A.1. Response of Swap Rates to Z_1 and Z_2 Factors

	3M-Swap				12M-Swap			
	Intraday		Daily		Intraday		Daily	
Intraday Z_1 Factor	0.998***	0.998***			1.080***	1.080***		
	(0.011)	(0.011)			(0.066)	(0.037)		
Intraday Z_2 Factor		–0.000				1.140***		
		(0.089)				(0.400)		
Daily Z_1 Factor			1.000***	1.000***			0.974***	0.974***
			(0.007)	(0.007)			(0.075)	(0.014)
Daily Z_2 Factor				–0.000				0.887***
				(0.012)				(0.024)
Constant	–0.205***	–0.205***	–0.326***	–0.326***	0.091	0.091	–0.375	–0.375***
	(0.062)	(0.063)	(0.062)	(0.062)	(0.362)	(0.247)	(0.488)	(0.139)
Obs.	87	87	190	190	87	87	190	190
R^2	0.994	0.994	0.992	0.992	0.859	0.935	0.641	0.971

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 Z_1 and Z_2 factors obtained from intraday and daily data, as explained in the main text. Similarly for the 12-month 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 includes all regular monetary policy announcements until December 2021; the sample starts in January 2011 with intraday data, and in January 2004 with daily data. 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 Asset Prices to Daily Target and Path Surprises

	FX Returns		Δ 2Y Yield		Δ 5Y Yield		Δ 10Y Yield		Δ 30Y Yield	
Target	-2.16***	-2.16***	0.68***	0.68***	0.55***	0.36***	0.42***	0.42***	0.29***	0.29***
	(0.76)	(0.68)	(0.082)	(0.090)	(0.14)	(0.077)	(0.080)	(0.088)	(0.076)	(0.085)
Path		-1.37*		0.23**		0.52***		0.28***		0.29***
		(0.71)		(0.12)		(0.070)		(0.11)		(0.093)
Constant	-9.17***	-9.17***	-0.21	-0.26	-0.63	-0.33	-0.54	-0.60	-0.74*	-0.81**
	(3.25)	(3.19)	(0.39)	(0.36)	(0.46)	(0.38)	(0.41)	(0.37)	(0.40)	(0.36)
Obs.	87	87	71	71	56	56	71	71	71	71
R^2	0.24	0.28	0.75	0.78	0.43	0.67	0.52	0.60	0.35	0.48

Notes: The first column for each dependent variable shows the coefficient estimates in regressions of intraday yield changes or exchange rate (FX) returns on target surprises; the second column adds path surprises as a regressor. Target and path surprises are obtained from daily data. Intraday changes are calculated starting 10 minutes before to 20 minutes after a monetary policy announcement. The sample includes all regular monetary policy announcements starting on January 2011 for the exchange rate, on January 2013 for 2- 10- and 30-year yields, and on December 2014 for 5-year yields; the sample ends on December 2021 in all cases. Figures 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.3. Response of Daily Total Holdings to Target and Path Surprises

	Cetes	Bonos
Target	0.15	0.44
	(0.18)	(0.32)
Path	-0.038	3.42***
	(0.80)	(0.80)
Obs.	87	87
R^2	0.00	0.15

Notes: This table shows the coefficient estimates in regressions of changes in cetes and bonos holdings on target and path surprises. The changes are expressed in billions of Mexican pesos. Target and path surprises are obtained from intraday data, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2021. 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 Daily Bonos Holdings to Target and Path Surprises: No Valuation Adjustment

	Banks	Mutual	Pension	Insurers	Others	Foreigners
Target	-0.13	-0.29	0.16**	-0.0016	0.29	-0.11
	(0.27)	(0.21)	(0.073)	(0.022)	(0.18)	(0.12)
Path	-2.47**	1.79***	-0.14	-0.012	-0.59	0.59**
	(1.12)	(0.58)	(0.46)	(0.055)	(0.74)	(0.24)
Obs.	87	87	87	87	87	87
R^2	0.05	0.10	0.03	0.00	0.02	0.06

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 daily change in the holdings of bonos without making a valuation adjustment. All flows are expressed in billions of Mexican pesos. Target and path surprises are obtained from intraday data, as explained in the main text. The sample includes all regular monetary policy announcements from January 2011 to December 2021. All regressions include a constant. Robust standard errors are shown in parentheses. *, **, *** asterisks respectively indicate significance at the 10%, 5% and 1% level.