



HAL
open science

**The impact of monetary surprises on exchange rates:
insights from a textual analysis approach on a panel of
countries. LEO Working Paper 2024-10**

Jean-Charles Bricongne, Louis Marolleau

► **To cite this version:**

Jean-Charles Bricongne, Louis Marolleau. The impact of monetary surprises on exchange rates: insights from a textual analysis approach on a panel of countries. LEO Working Paper 2024-10. 2024. hal-04637996

HAL Id: hal-04637996

<https://univ-orleans.hal.science/hal-04637996v1>

Preprint submitted on 8 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Document de Recherche du Laboratoire d'Économie d'Orléans

*Working Paper Series, Economic Research Department of the University of Orléans, University Of Tours
and University Clermont-Auvergne, France*

DR LEO 2024-07



The impact of monetary surprises on exchange rates: insights from a textual analysis approach on a panel of countries

Jean-Charles Bricongne, Louis Marolleau

MISE EN LIGNE / ONLINE | 04/06/2024

Laboratoire d'Économie d'Orléans
Collegium DEG
Rue de Blois - BP 26739
45067 ORLÉANS Cedex 2

TÉL | (33) (0)2 38 41 70 37
MAIL | leo@univ-orleans.fr
www.leo-univ-orleans.fr

The impact of monetary surprises on exchange rates: insights from a textual analysis approach on a panel of countries

Jean-Charles Bricongne¹, Louis Marolleau²

Abstract:

We investigate the impact of monetary policy surprises on the exchange rates by detecting them with a text indicator. A textual analysis method is applied on 236 business press articles and 510 online briefing notes. A database of monetary policy decisions is thus created. It contains 11 countries from 2018 to 2023 and 510 monetary decisions including 72 surprises. To identify a causal effect, the impact of surprising decisions on exchange rates is analyzed at the precise minute the decision is made. The exchange rate amplitudes of variation for surprises are compared with the decisions qualified as “expected”. In this way, surprises form a treatment group, while non-surprising decisions constitute a control one. Results indicate that monetary surprises are associated with larger currencies growth rates. They are on average 1.5‰ higher for surprises compared to non-surprising decisions. Still, they may be exceeded by other events, depending on periods and countries.

JEL codes: E52, E58, E43

Keywords: monetary policy decision surprise, text analysis, exchange rate, interest rate parity.

Acknowledgments: we thank Jean-Luc Ntamakuliro-Inema for his useful inputs on the identification of monetary surprises at the start of the project. Olivier de Bandt, Marwan Mena

¹ Banque de France, Paris I University and LEO (Laboratory of Economics of Orléans).

² Previously Banque de France. Corresponding author

Acknowledgements

We would like to thank **Dr Davide Furceri** for taking the time to review our paper. We thank him for the very interesting and fruitful discussion during the presentation seminar at the Banque de France (April 2024) and for the advice to improve our work.

Thanks to **Professor Refet S. Gürkanyak** for the advice given during the Workshop on the transmission of monetary policy at the European Central Bank (April 2024). Thanks also to **Dr Xin Zhang** for his advice on using AI to detect surprises in newspapers (ECB Workshop April 2024).

We thank **Professor Jean-Paul Renne** for his advice.

We would also like to warmly thank **Professor Christophe Hurlin** and **Professor Matthieu Picault** for their interactions in a seminar at the Laboratory of Economics in Orleans (LEO).

I. Introduction

Most central banks have recently tried to make their decisions as predictable as possible to avoid taking financial markets by surprise. Many reasons can support that. A predictable monetary policy enables to maintain credibility and to influence expectations. The decisions of central banks are also awaited by specialists to carry out macroeconomic analysis and forecasts.

A monetary policy decision is said to be “surprising” if it is unexpected or contradicts previous announcements about the future direction of monetary policy. If that kind of surprising decision is made, it is expected to have a sizeable impact on real and financial variables. Among these, exchange rates are supposed to react strongly and immediately when an unexpected decision is taken, following the logic of the interest rate parity³.

To qualify a monetary decision as “surprising” or “unexpected”, several methods have been used up to now in the literature. A first method mobilizes derivatives markets on interest rates to see whether financial variables react when the decision is made public. Another method uses surveys among economists to gather their bets and the consensus on the future stance of interest rates. A third one is based on the final outcome, by analyzing the impact of the decision on financial variables. In that case, if there is a strong impact, say, on exchange rates, the decision is qualified as surprising.

Still, all these methods have some limits. The first two methods suppose that derivative markets and surveys among economists on monetary policy decisions exist, which is not always the case. The central banks that can be covered could be quite limited (typically the Fed or the ECB), and sources are not always available over a long period. What’s more, consensus forecasts may not be updated frequently enough to get the real consensus when the decision is released. The third method also implies to determine a threshold over which the decision is qualified as surprising. This may give misleading conclusions. For instance, there is no *a priori* causal relationship between the size of the relative change in the exchange rate and the presence of a surprise. Strong variations can very well occur for decisions without surprises.

The goal of this paper is to identify monetary policy decisions containing surprises by textual analysis, and to look at the up-to-the-minute impact of these surprises on the relative variation in the exchange rate. A treatment group is then formed. It is compared to a control one made

³ According to interest rates parity, with i_h the interest rate in the home country, i_f the interest rate in a given foreign country, S_0 and F_0 respectively the spot and forward exchange rates between these two countries (one unit of foreign currency = X units of home currency), the following relation holds: $1+i_h = (1+i_f)*F_0/S_0$ and thus, supposing F_0 does not move, an unexpected change in i_h has a direct impact on S_0 .

up of monetary policy decisions containing no surprises. We use business press articles to qualify surprises *ex post*. This qualifying method has many advantages. There is no need to make strong methodological assumptions. Instead, the only one made is that the press article has to be trustable enough to get the right qualification of the expectedness of a decision. In that case, journalists make the synthesis of the consensus about a given decision. The method can be applied to many countries and over a large period, as long as an article from a reliable source has been written on the corresponding monetary policy decision.

Once surprising and expected decisions are identified, their impact can be analyzed. Exchange rate growth over one minute has been chosen as a dependent variable for many reasons. First, exchange rates are commonly available, except for a few countries that have adopted other countries' currencies (Ecuador, Panama). Besides, they are often available with high-frequency, typically on a minute-by-minute basis. That said, it is possible to identify a causal effect by targeting the precise time of the delivery of the monetary policy decision. The likelihood that another important event takes place exactly at the same minute as a given monetary decision is very low.

Different vectors of communication, as press releases and conferences, are considered. We will see that monetary surprises lead to greater relative variations in exchange rates at the time of the decision, compared with those without surprises. To this end, we check that journalists identify these latter as expected.

The next section examines the different methods and results from the literature in the field of monetary policy surprises. The third section explains the construction of the database. The fourth section displays the econometric method and results, with robustness checks and discussion on results in the fifth section. The sixth section concludes.

II. Literature Review

Textual analysis is frequently used to study the impact of uncertainty or surprises on macroeconomic variables. We draw on textual analysis methods available in the literature. Using a textual indicator created from reading 12,000 press articles, Baker et al. (2016) build an overall uncertainty index. Based on the occurrence of given words on press articles, it takes into account fiscal, monetary, trade, healthcare, national security, and regulatory policy uncertainties from 1900 to 2015. Using monthly and quarterly data, the authors show that “policy uncertainty raises stock price volatility and reduces investment and employment in policy-sensitive sectors like defense, healthcare, and infrastructure construction”. Many papers examine the macroeconomic effects of monetary policy uncertainty using textual analysis methods. Husted et al. (2020) create monetary policy uncertainty indexes, based on the paper of Baker et al. (2016). This motivates us to implement this type of methodology on press articles related to monetary policy.

A paper by Gürkanyak et al. (2005) pioneered the effect of monetary surprises on asset prices using intraday and high-frequency data. The authors show that US monetary policy decisions have an impact on asset prices through two factors: a “current federal funds rate target” factor, and a “future path of policy” factor. The latter is directly linked to the communication on the future path of monetary policy at the time of the decision. The authors show that surprises do have a significant impact on financial assets, by introducing these two factors to improve their regression analysis.

Rosa & Verga (2008) examine the effect of the European Central Bank's communication on Euribor futures prices. They use high-frequency intraday data on the days of monetary policy decisions. Like Gürkanyak et al. (2005), the authors show that both the rate decision and the ECB's explanation of its monetary policy stance affect financial markets at the time of the decision. Tick-by-tick data are used, i.e., data collected for each logical unit of information. Referring to fixed and documented times for the European Central Bank on decision days (1:45 pm and 2:15 pm CET), the authors show that the unanticipated component of the monetary policy decision has effects on futures prices.

Altavilla et al. (2019) create a Euro Area Monetary Policy Event-Study Database, studying sovereign yields, exchange rates and stock prices.

To qualify a monetary decision as a surprise, different methods are possible. The first one is to use Overnight Index Swap (OIS) data and to check to what extent OIS react after a

monetary policy event. Enders et al. (2019) employ high-frequency changes in OIS interest rates around monetary policy events and use a decomposition of monetary policy surprises à la Jarociński & Karadi (2020). In this latter paper, it is underlined that central bank announcements simultaneously convey information about monetary policy and the central bank's assessment of the economic outlook. This paper disentangles these two components and studies their effect on the economy using a structural vector auto-regression. It relies on the information inherent in high-frequency co-movement of interest rates and stock prices around policy announcements. A surprise policy tightening raises interest rates and reduces stock prices, while the complementary positive central bank information shock raises both. Nonetheless, OIS data are not equally available and trustable across countries, which is a problem.

Studying the case of Russia, Evstigneeva et al. (2022) show that “in emerging market economies, the analysis of surprises is complicated due to the lack of a developed and highly liquid derivatives market on the interbank loan rate”. So, the authors use ROISfix indicative rate for interest rate swap operations on the RUONIA rate (from 1 week to 6 months). This indicator is formulated by the National Financial Association on the basis of quotes announced by the participants in fixing – several of the largest Russian banks. The 1 week to 6-month rates have been available since 2011. In this way the authors capture the fluctuations in the short-term rates.

A second approach to qualify a surprise is based on the forecasts of experts on a future monetary policy decision. It is for example the case of the “Bloomberg consensus”. Forecasts are then compared with the realized values of interest rates set by the corresponding central bank. Not all countries have this kind of consensus of economists, and the results of this panel need to be updated until the final decision is taken.

An interesting alternative to qualify surprises is to identify the expectations of stakeholders on the central bank's policy rates using machine-learning methods. Andhika, Zulen & Wibisono (2018) do it for Indonesia. They extract the expectations from news, around two weeks before the Board of Governor's meeting. Their index has a correlation close to 80% with the one generated from Bloomberg's monthly survey. These Machine-Learning methods are based on purely *ex ante* information. Conversely, Masciandaro et al. (2023) contrast *ex ante* and *ex post* information. In their paper, they use machine learning tools to identify Twitter messages related to monetary policy in a short-time window around the release of policy decisions for three major central banks, namely the ECB, the US Fed and the Bank of England. They build an hourly measure of similarity between tweets about monetary policy and the written policy announcements. This measure can be used to evaluate both the ex-ante predictability and the

ex-post credibility of the policy. They show that large differences in similarity are associated with a higher stock market and sovereign yield volatility, particularly around ECB press conferences. In our study, only *ex post* information is used, namely press articles commenting on the surprising dimension of monetary policy decisions.

Another approach to qualify surprises is to identify them by checking for strong changes in the exchange rates after a monetary policy release. Albogatchiev et al. (2018) do it for the Bank of Canada. Namely, they examine press releases that have the largest five-minute changes in the US/Canadian dollar exchange rate. They get a list of the eight largest monetary surprises between April 2006 and November 2017. Results show an increase in volatility following these releases, but the effect is short-lived and dissipates after a few hours. The size of the effect is similar to what is observed after Federal Open Market Committee (FOMC) press releases and releases of new economic data, like those for inflation or economic growth. In line with our approach, they focus on exchange rates, as they play an essential role in the transmission of monetary policy (see Feunou et al. (2017)).

Analysis of monetary policy announcements impacts are extended to other central banks as the ECB. Until recently, most papers dealing with monetary surprises have mostly focused on a few developed countries, whereas U.S. (Romer and Romer (2004); Gürkaynak et al. (2005); Gertler and Karadi (2015); Jarocinski and Karadi (2020); Bauer and Swanson (2023)), euro area (Jarocinski and Karadi (2020)), U.K. (Miranda-Agrippino and Ricco (2021)) or Canada (Champagne and Sekkel (2018)).

In the same approach comparing what was forecasted *ex ante* and what happened *ex post*, Deb et al. (2023) build a panel of monetary surprises for 33 advanced and emerging market economies during the period 1991Q2-2023Q2. To identify monetary policy surprises, they compare realized short-term interest rates with forecasted interest rates from the Consensus Forecasts. Among other articles dealing with a panel of countries, Furceri et al. (2018) construct annual monetary policy shocks for 32 advanced and emerging countries. Their study is based on a measure of unanticipated changes in policy rates, defined as the difference between the actual policy rates and the rate expected by analysts from Consensus Economics. Choi et al. (2023) cover 105 countries using a mix of different methods, among others high-frequency studies, changes in swap yields, changes in short-term government bond yields, surveys of financial market participants. What's more, Brandão-Marques et al. (2020) cover emerging countries. In this latter case, deviations from the Taylor-type rules are supposed to capture the non-systematic and unexpected part of monetary policy actions.

Decision releases are not the only events that matter. Press conferences have some additional impact on financial markets, as suggested by Duarte and Rosa (2013). As for the ECB, Leombroni et al. (2021) show that communication outside regular monetary policy days may also have an important impact on bonds yields. Pescatori (2018) analyzes the case of the communication by the Central Bank of Chile, studying the impact of policy meetings' statements, minutes and monetary policy reports on equity prices and exchange rates. Still, releases decisions are the events which are most commonly available and commented across countries.

III. Database setting up and descriptive statistics

Identification of monetary policy surprises

A database of press articles from January 2018 to November 2023 is our main source. Monetary surprises are identified by textual analysis of press articles, looking for root character strings such as "surpris" or "unexpect". They are joint with the name of at least one central bank (see Table S8 for a more precise list of keywords used in the Factiva request).

Surprises are also identified by human reading and by understanding the context. We use *Factiva*, a professional solution supplied by Dow Jones & Company, for extracting and analyzing information. We also use focus-economics⁴, a website offering macroeconomic analyses and forecasts based on expert analysis. For *Factiva*, the article sources can be diverse, such as *Reuters* or *Bloomberg*. By automatically reading the root words, or by natural human reading, we extract the sequences relating to monetary surprises.

Monetary policy decision calendar

The fact that a press article on monetary policy decisions is published on a given date in no way means that the decision took place on the same day. Thus, we need to retrieve the exact days of the monetary policy decisions. Therefore we retrieve the days from the central banks' monetary policy decision calendar. We use the website *Investing.com*, which draws its sources from central bank websites, to retrieve days of monetary policy decisions more

⁴ Focus-economics is also known to produce the consensus forecasts, based on the inputs by chief economists, which gives credit to Focus-economics as being able to produce a trustable evaluation of market anticipations concerning forthcoming monetary policy decisions.

efficiently and systematically. The content of the press articles is compared with the calendar. Corrections are made to the dates, to check that the surprises indeed refer to an exact date in the monetary policy calendar. We are able to create a database of monetary policy decision days, containing monetary surprises (and also decisions that are qualified as expected, to fuel the control group of non-surprises).

Choice of exchange rates as a dependent variable

The exchange rate is used as the main dependent variable. It is considered as relative variations from one minute to the next. This allows us to normalize bilateral exchange rates on the same percentage basis and to make comparisons, irrespective of the currency parities. The choice of the relative variation is motivated by looking graphically at the exchange rates movements on decision days, with or without surprises. For example, in Turkey on 24 September 2020, "the Central Bank's Monetary Policy Committee (MPC) took market analysts by surprise and raised the one-week repo rate by 200 basis points to 10.25% from 8.25%", in particular to fight inflation, according to *FocusEconomics*. The effects of this decision on the USD/TRY exchange rate are shown in Figure S1 in the Appendix. The figure shows that the Turkish lira appreciated within minutes of the announcement being made.

Figure S1 to be inserted here.

Figure S2 shows the evolution of the exchange rate on a Fed policy decision day, on 30 January 2019. There was no surprise on that day. However, we can see a clear appreciation of the euro against the US dollar. We can therefore see that it is not enough to have a sharp relative change at the time of the decision to call it a surprise.

Figure S2 to be inserted here.

Exchange rates are expressed as the number of domestic currency units per US dollar (USD), because USD is the reference currency on international markets. The exchange rates in the database are considered with the foreign currency, namely the US dollar being the reference country (1 USD=X units of domestic currency). An increase means a depreciation of a given currency vis-à-vis the US dollar. When considering the US, the bilateral exchange rate is expressed vis-à-vis the euro, with the same convention using the foreign currency as the reference.

Table S1 shows the mean, median, quantiles, minimum and maximum relative variations of exchange rates for the currencies in our database (one-minute scale). On average, the

magnitude order of relative variations are 10^{-8} or 10^{-7} . The magnitude order of standard deviation is 10^{-4} . For 99-percentile, 99.9-percentile, 1-percentile, 0.1-percentile, the magnitude orders are 10^{-4} or 10^{-3} . The magnitude order of minimums and maximums are 10^{-2} (one percent over one minute). Relative variations of the order of a per thousand, or even a percent, are therefore rare.

Table S1 to be inserted here.

A 1‰ variation could have huge effects on exchange rates, if accumulated over several hours. For instance, a relative change in the exchange rate by 3‰ on a one-minute scale, over 24 hours, would lead to a more than 4-fold increase in parity. Absolute values of relative variations of the order of 1‰, on a one-minute scale, are rare. For example, a relative minute-to-minute variation of the order of 1‰ for the Australian dollar occurs in average less than 4 times a day only, apart from days when monetary policy decisions are made. A relative variation of 1% for the same currency would occur on average only 3 times per million minutes (corresponding roughly to a 2-year period). As a result, if we measure amplitudes in the per thousand or percent range at the time of monetary policy decisions, this means that it has a strong impact on the exchange rate.

We set relative variations to absolute values in order to measure the impact of surprises on the amplitude of variation.

From now on, we use the term "amplitude of variation" to refer to the "absolute value of the relative variation on a one-minute scale". We use the terms "amplitude of variation" or "absolute values of relative variations on a one-minute scale" interchangeably.

Data matching

Exchange rates on a minute-by-minute basis are matched to surprising/non-surprising decisions deduced from press articles. Free Forex data from *histdata.com* are used, defined in EST time as the number of foreign currency units for one US dollar. Table S1 gives the number of observations for up-to-the-minute exchange rates for all currency pairs over the period January 2018-November 2023.

We recover the maximum amplitude of variation over the days of decision. Ideally, we would have had access to the exact hour and minute of the decision. However, although some websites such as *Investing.com* track this information, we were not certain of their veracity on a one-minute scale. It is also difficult to get them for all central banks. Moreover, a decision may be made at 2:00 pm for example, and the markets may react a few minutes later. Thus, as far as possible, we look at the exact moment when the monetary policy announcement is made. If not, we at least check that the time of maximum amplitude of variation correspond to

office hours for the country. We check that the moment we find is consistent with a standard hour for a decision (typically 2:00 pm or a few minutes later). In this case, we can at least ensure that the time is consistent.

Once we identify the time when the amplitude of variation is at its maximum on the decision day, we keep only that minute, for a given decision day. This gives us a synthetic database for monetary policy decisions.

Data processing

The statistical unit is one minute to one day of monetary policy decision for a currency pair. The database initially contained 648 days of monetary policy decisions, 92 decision days with surprises, and 14 countries. We initially had Japan, Poland and South Africa in our database. However, we were not certain that we had retrieved the exact decision times for these countries to carry out the causal inference. Indeed, Figures S14 to S24 show the hours and minutes for which we have the maximum amplitudes of variation on decision days, for 11 countries. It can be seen that the statistical distribution mode is systematically based on the exact time of the monetary policy announcement for the 11 central banks. That was not the case for Japan, Poland and South Africa. That is why we have removed them.

We hand-check the remaining decisions. We use *FocusEconomics* to verify that the days labeled as "surprise" really are, and to make sure we have not missed any decisions with surprises. We also check that other decision days are described as "non surprising" or "as expected". In this way, we are able to create two very distinct surprise/non-surprise groups.

A data panel indexed to the country and month in which the decision is made (measured to the minute) is created. Adjustments are necessary to define the panel, to introduce lagged variables and to avoid unevenly time series. It is necessary to have evenly ones in order to apply standard econometric methods and get unbiased estimators. A geoscience research article by Rehfeld et al. (2011) shows for instance that irregular sampling of time series can make these standard methods inapplicable. Thus we assume that most monetary policy decisions are monthly. If two decisions take place in the same month, then we keep the one that possibly contain a surprise. If several decisions take place in the same month but do not contain a surprise, we select the data on a case-by-case basis. Using this method, 8 observations are removed for econometrics, so that there are no duplicates. The unexpected decisions in March 2020 to tackle the urgent situation linked to the Covid19 crisis are considered as surprises. Thus the panel database is unbalanced with 510 days of decisions, 11 countries and 72 days with surprises (see Table S9).

Table S9 to be inserted here.

The period considered is from January 2018 to November 2023, for Australia, Canada, the Euro Zone, the Czech Republic, Hungary, Mexico, New Zealand, Sweden, Turkey, the United Kingdom and the United States of America. We have been constrained by the number of currencies available in Open Data on *HistData.com* to carry out this study, as well as by the time required to verify the surprises. That is why the coverage remains somewhat limited.

Distribution of relative variations

Figure S3 shows the distribution of relative variations on a one-minute scale. These distributions are computed for positive and negative values and for the surprise and decision groups. The coloured bands correspond to the confidence interval at the 95% level. It can be seen that for the no-surprise decision group, 95% of the relative variations fall within the interval [-0.005; 0.005]. For the surprise groups, 95% of the values fall within the interval [-0.010; 0.012]. So the confidence interval is almost twice as large for surprises as for expected decisions. Furthermore, we can see the presence of extreme values for the not-surprising decisions group, with relative variations of -2.3% and 2.5%. However, the surprises group have extreme relative variations of around -4% and 3%. Surprises therefore appear to have higher normal and extreme values than expected decisions.

Figure S3 to be inserted here.

Distributions of the amplitudes of variation for the two groups are compared in Figure S4. We can see that the two distributions deviate from the median, and that the distribution of surprises has a larger tail. The 95-percentile is twice as high for the surprise group compared with the no-surprise decision groups.

Figure S4 to be inserted here.

Figures S5 and S6 show that the means of the no-surprise and surprise decision groups are not the same. They are equal to 2.4‰ and 5.6‰ respectively (See Table S2, Appendix).

Figures S5, S6 and Table S2 to be inserted here.

A Wilcoxon test between the two groups is performed, which we display on a comparison of boxplots in Figure S7. This test is used because of the smaller number of observations for surprises compared with normal decisions. The amplitudes of variation are also not independently and identically distributed as a Gaussian. We reject H_0 for the Wilcoxon test: the means are different between the two groups. Surprises have higher amplitudes of variation than decisions without surprises, with a higher median value for surprises. Yet, we can see

that even the decision days with no surprises have extreme values around 2.5% (although the highest values for surprises are 3% and 4%).

Figure S7 to be inserted here.

Among the countries in our database, Turkey stands out for its high relative exchange rate variations. Figures S8 to S10 show plots of the relative variations for each country, with mean, standard deviation, interquartile range and shape of the distribution. They are presented in positive, negative and absolute values. We can see that most of the countries have average relative variations between -5‰ and 5‰, except for Turkey, which has an average variation amplitude of 7.4‰ (See Table S2). Turkey appears to have extreme amplitudes of variation (Figure S10), due to its very long distribution tail, with values as high as 4.6%. If Turkey is removed, Figure S11 shows that the countries have relatively homogeneous distributions of amplitudes of variation. Most of the mean values are in the range [0.0018; 0.0040], except for New Zealand, which has a mean amplitude of 4.6‰ (See Table S2).

Figures S8 to S11 to be inserted here.

It appears that the exchanges rates amplitudes of variation for surprises are, on average and in extreme values, greater than for expected decisions. Turkey in particular stands out for its very high values. Since the groups of surprises and expected decisions are quite distinct by design, and since the effect of the monetary policy decision is measured to the minute, it is possible to make a causal inference. The probability that another event takes place at the same moment is almost null and there is no risk of reverse causality.

In the spirit of propensity score matching, the figure S31 also displays ratios of amplitudes for surprises versus non surprises closest neighbours, excluding Turkey.

Table 31 to be inserted here.

For each monetary surprise, a ratio is calculated. It divides its amplitude of variation by the average of the ones for the two non-surprises closest neighbors. This average is computed before and after the date of the monetary surprise for the same country (or alternatively the two before if none after). A ratio above 1 highlights that the impact of a monetary surprise on exchange rate growth is higher for the surprise compared to the expected decisions. When excluding Turkey, most ratios are above 1 (43 over 53). The average ratio is equal to 2 and the median to 1.7.

When comparing the impact of monetary surprises on exchange rates to other events, it seems that surprises indeed have a strong impact. Other events may also play an ever bigger

role, depending on countries and periods. If monetary surprises have the biggest impact for the period under review for Turkey, it is not the case for most other countries. They come 3rd for the Swedish crown, 4th for the Canadian dollar, 6th for the Czech crown and the New Zealand dollar, 7th for the Australian dollar, but only 21st for the Hungarian Forint, 35th for the Mexican peso and 37th for the British pound.

In the next section, an econometric model is set up to study the causal effect of surprises on the amplitude of variation. Surprises and expected decisions are compared. We run regressions with and without Turkey due to atypical exchange rates variations of this country. Regressions according to the period under consideration are implemented: over the whole period, before Covid19 crisis (2018-2019), during Covid19 crisis (2020-2021) and after the peak of the pandemic (2022-2023).

IV. Econometric model and results

Econometric model

We draw on the papers by Rosa & Verga (2008) and Gürkanyak et al. (2005) for the econometric specification. The relationship described between the amplitude of variations and the surprise indicator is causal, provided that the exact moment of the decision is identified. Following Rosa & Verga (2008), we include a dummy for surprises.

An AR(2) process is considered. We make the hypothesis that having strong relative variations at the two previous decisions may increase the probability of having a strong relative variation at the current decision. In a way, we want to check if there is a learning effect following previous decisions. Figures S25 and S26 show the autocorrelation and partial autocorrelation of the amplitude of variation time series from our database. Figure S26 shows two peaks at lags 1 and 2, which differ in magnitude. Figure S25 shows a geometric decrease in autocorrelation. This motivates us to choose an AR(2) process for the modelling.

Figures S25 and S26 to be included here.

A measure of standard deviation on the considered day excluding the decision minute, is added. If volatility is high during the day, then that would qualify the presence of a high relative variation at the time of the decision.

The econometric specification is therefore:

$$Y_{i,t'} = \beta_0 + \beta_1 * 1_{SURPRISE} + \beta_2 * Y_{i,t'-1} + \beta_3 * Y_{i,t'-2} + \beta_4 * sd(Y_{i,t \neq t'})_{i,t'} + \epsilon_{i,t'}$$

With i a bilateral exchange rate; t' the exact minute of decision for a decision day; t one minute of exchange rate valuation during a decision day; $Y_{i,t'}$ the amplitude of variation at the time of the decision; $1_{SURPRISE}$ a dummy variable equal to 1 if the decision contains a surprise, 0 otherwise; $Y_{i,t'-1}$ the amplitude of variation on the previous decision; $Y_{i,t'-2}$ the amplitude of variation on the decision lagged by two periods; $sd(Y_{i,t \neq t'})_{i,t'}$ a measure of the standard deviation on the decision day excluding the decision minute for the concerned country and $\epsilon_{i,t'}$ the error term. As we count decision days over the period for each country, $t'-k$ should be understood as the k -th previous decision at the exact minute.

We have initially sought to use a monthly fixed-effect time indicator to take into account the intrinsic effect of the month. Unfortunately, this approach has proved inconclusive. We therefore run the regressions on sub-databases. One over the period 2018-2019, one over the period 2020-2021 (Covid19 crisis), and one over the period 2022-2023 (monetary policy normalization for most of the world's central banks). This choice is all the more justified given that before the Covid19 crisis, rates were rather low in developed countries. The Covid19 crisis led to a global recession by 3.1% in 2020, while the world economy grew again by 6.2% in 2021 (see The World Bank data, GDP Growth annual %). Global demand for goods and services has returned faster to pre-Covid levels than supply. Supply chains have been challenged during this crisis (see for example Bacchetta et al. (2021)). This shock, combined with the consequences of the war in Ukraine on raw materials and energy prices, has contributed to a sharp rise in inflation (Caldara et al. (2022)) and to shifts in monetary policies around the world. We therefore considered as important to distinguish between these three periods, besides regressions performed over the whole period.

Two sets of regressions are run. One set with Turkey, one without. This enables us to check that the surprise effect is not carried by Turkey alone, which has atypical amplitudes compared with the others. Each regression set contains OLS and panel regressions. The OLS regressions are for the entire period, and then for 2018-2019, 2020-2021 and 2022-2023 ones. For the panel regressions, we run random models, within models over the entire period, and within models over the same sub-periods as for the OLS.

Results

Three types of models are implemented: fixed-effects models, random-effects models and OLS models with country factors. Fixed-effect models are within models. This allows us to

take into account the average value of the amplitude of variation for each country over time and to integrate it for each country as a fixed effect. Random effects models introduce random effects time-independent and not directly measured. These models introduce idiosyncratic effects, specific to each country. Their use is justified when modelling exchange rate variations, as many macroeconomic or microeconomic factors can affect them. Within and random models are compared to OLS one with country factors. If a country such as Turkey, for example, has high amplitudes, it will be possible to control them.

Tables S3 to S6 show the results of the various econometric estimates according to the models. All the models are significant at the 5% level, with significant parameters in most cases for the surprise indicator and the standard deviation variable. When Turkey is taken into account, the adjusted R2 of the models are between 40% and 74%, except for the models for the 2022-2023 period. For the regressions without Turkey, the R2 are between 40% and 61%, except for the within model over the entire period and for the regressions over the 2022-2023 period. The OLS regression over the 2018-2019 period with Turkey stands out for its high adjusted R2 of 74%. This linear model explains 74% of the variations observed.

Tables S3 to S6 to be inserted here.

The dummy variable for surprises should be interpreted as follows. If the decision contains a surprise, then it increases the amplitude of variation by x percentage points (pp.). The lagged variables and the standard deviation variable outside the decision minute are less straightforward to interpret. The standard deviation variable is a control one. Yet it can be said that increasing a lagged amplitude of variation by 1% must increase the amplitude of variation at the current decision by x. The standard deviation variable outside the decision minute is systemically significant. The one-period lagged variable is significant with Turkey for the following models: within (whole period), random, within (period 2018-2019), OLS (whole period), OLS (period 2018-2019 and 2020-2021). The same variable is significant without Turkey for the following models: within (whole period), random, within (period 2018-2019), OLS (whole period).

We look at the parameters of the surprise indicator. Table S7 displays the parameters obtained for the surprise variable according to the method used.

Table S7 to be inserted here.

Overall, the significant parameters range from 1‰ to 3.1‰. However, we see for Turkey a stronger effect between 2018 and 2019, both in the OLS model with 3‰ and in the within model with 3.1‰. If Turkey is removed, the effect over 2018-2019 is 1.5‰ in the OLS model

and 1.8‰ in the within model. Those are fairly close to the parameters obtained over the whole period for the two methods. In the within model as in the OLS model, with and without Turkey, the effect over the 2020-2021 period is weaker than over the 2018-2019 period. The effect for these two methods with and without Turkey over the period 2022-2023 is even weaker than over the period 2020-2021, and often insignificant. Over the whole period with Turkey, the surprise parameter is 1.6‰ for the within and OLS models. Over the whole period without Turkey, the surprise parameter is 1.3‰ for the within model and 1.5‰ for the OLS model. The parameter with Turkey over the whole period with the random model is 1.8‰. The parameter without Turkey over the whole period with the random model is 1.5‰.

Figures S27 to S30 show the analysis of the residuals of an OLS regression over the whole period with Turkey.

Figures S27 to S30 to be inserted here.

In Figure 27, we can clearly see the presence of heteroscedasticity, which is confirmed by a Breusch-Pagan test: null hypothesis is rejected. The residuals are not independently and identically distributed. Indeed, there are extreme values, as can be seen in Figure S27 for the Turkish decisions in the 7th, 9th and 46th months. It should be remembered that Turkey has extreme values that are likely to affect the regressions, which explains why we choose to repeat the regressions without this country. Figures 28 and 29 also show that the distribution of residuals is not consistent with a normal distribution, with the presence of the outliers mentioned above. Figure S30 shows that the three outliers mentioned above have very high leverage. They are therefore extremely far from the average and can significantly increase it. In the database, it is found that the amplitudes of variation for these outliers are greater than 2% on a one-minute scale, which is extremely high.

OLS regressions with country factors show that Canada, the Czech Republic, New Zealand and Turkey have intrinsic effects. In the OLS regressions with Turkey (Table S4), during the Covid19 crisis in 2020-2021, the amplitude of variation is on average 1.5‰ stronger at the time of the decision for New Zealand and 1.4‰ stronger at the time of the decision for Turkey. It is 1.8‰ smaller for the Czech Republic in 2022-2023.

Table S4 to be inserted here.

Removing Turkey from the panel (Table S6), the amplitude of variation is 1.4‰ stronger for Canada in 2018-2019 and 2.2‰ stronger for the Czech Republic. The amplitude is 1.5‰ stronger for New Zealand in 2020-2021 and 1.8‰ weaker for the Czech Republic in 2022-2023.

Table S6 to be inserted here.

These various elements can be summed up. If we retain the whole period, the random model seems to be the most appropriate, with parameters of 1.8‰ with Turkey and 1.5‰ without Turkey. If we run sub-regressions by couple of years, the OLS and within models account for a stronger effect before and during Covid19 crisis. Monetary surprises have little effect on the amplitude of variation over the post-pandemic 2022-2023 period, marked by the normalization of monetary policy. Over the whole period and removing some countries with extreme amplitudes (such as Turkey), the effect of monetary surprises on the amplitude of exchange rate variation varies between 1.5‰ and 2‰.

V. Improving results with ChatGPT4

As a robustness check, and also to explore a text analysis technics based on LLM (large language models) ChatGPT 4 has been used to tag texts related to monetary decisions. To avoid incorrect tagging, the prompt explicitly considers the case in which ChatGPT 4 does not have the answer. The question asked is as follows: “Tell me if the following articles signal that the central bank has taken a monetary decision that is surprising or not. Tell me also if there a source of surprise coming from the central bank that is not connected to the current monetary decision but to something else (quantitative easing, future stance of monetary policy for example). If the text does not give enough information to conclude, please say that you do not have enough information. Before your explanations, answer by saying "yes", "no" or "I don't know" if there has been a surprise on the setting of key interest rates. Answer by saying "yes", "no" or "I don't know" if there has been a surprise on other elements than the setting of key interest rates. For each decision, give some justifications to justify your answers.”

In the whole, results are robust and even improved compared to the initial “human” tagging. Around 450 texts from Focus Economics have been tagged by ChatGPT 4. When compared with our initial tagging, there are 35 differences: 26 have led to change the classification as a “surprise” of our initial tagging among 510 observations. Hence around 95% of initial tagging is confirmed. Econometric results are also slightly improved thanks to these changes and ChatGPT 4 thus seems to be a reliable source. For example, the corrections made by ChatGPT4 improve the surprise parameter for a random model with Turkey. Before the

ChatGPT4 corrections, the parameter was 1.8‰ for this model, compared with 2‰ afterwards, with an overall quality (in terms of significance, R^2 ...) that is somewhat improved (results available upon request).

Chat GPT 4 also Enables the construction of a cleaner control group. Indeed, ChatGPT 4 has also tagged surprises which are not related to the setting of interest rates. Hence another cleaner control group can be constructed with two conditions: no surprise on the setting of interest rates and on other elements of monetary policy. We calculate the ratio between the exchange rate growth of surprises on the setting of interest rates and:

1. the one of the previous decisions, for the same country, without any surprise (whether on interest rates or on other dimensions)
2. the median value of growth rates of meetings for the same country, without any surprise (whether on interest rates or on other dimensions)

The median value of the ratio is equal to 2.5 (ratio 1.) and 2.2 (ratio 2.) and the average is around 3.2 in both cases.

The figure S32 displays the ratios of amplitudes of surprises vs. median of pure non-surprises (ratios 2.) and also signals, in red, monetary surprises on both interest rates and other aspects of monetary decisions. As expected, the three biggest ratios cumulate both surprises.

Figure S32 to be inserted here.

VI. Robustness checks and discussion on results

Beyond alternative regressions performed in section IV, other robustness checks may be implemented. For these, countries with atypical variations such as Turkey can be included or not. All countries may be deleted from the sample one by one, to check that results are robust and are not dependent on a given country.

Alternative calculations can be made varying the nature of surprises. Interest rate hikes or cuts, quantitative easing, or future stance of monetary policy can be considered for instance. It would require to have enough details in the business press articles. This kind of information is specifically detailed in online brief notes of *FocusEconomics.com*. Those materials could be integrated into the econometric specification. It could even be done using Natural Language Processing (NLP) methodologies to save time. NLP can be a tool to automatize the process

implemented on the current sample, mixing automatic text analysis and human reading and judgement. In this way, ChatGPT4 could be used to tag other texts related to monetary decisions, to cover more central banks and a longer period, being given that the tagging was comparable and even slightly better than spontaneous human tagging. After that, a very large database could be built.

Another robustness check may be performed using a different time pace for the calculation of variation amplitudes. 5 minutes could be chosen for instance rather than 1. The choice of this very short time span enables to clearly state a causal effect, with almost no risk of another event influence.

The panel used may still be enlarged further. This extension would depend on the access to other bilateral exchange rates series available on a minute-by-minute frequency. It would enable to cover more emerging countries (Brazil, Argentina...). In this way, more stylized facts and results on the impact of surprises on these countries compared to developed ones can be obtained.

The method used in this article, based on text analysis, is simple and enables to build a large database. It covers developed, emerging and developing countries, over potentially a long period of time. A more systematic comparison with surprises identified with other methods may be made to check how consistent this new method is with previous ones. Other methods are derivative markets on interest rates, consensus predictions and magnitude of exchange rates on the moment of a decision. A first preliminary result is that using the magnitude of exchange rates variations on the moment of a decision as a qualifier for monetary surprises may not work all the time. Some decisions qualified as "expected" may go hand in hand with quite large amplitudes of variation, still. This may be the case when the expected decision is accompanied with another information that may also have an impact.

VII. Conclusion

We study the impact of monetary surprises on exchange rates at the precise moments of monetary policy decisions. A database of monetary policy surprises is built on a panel of 11 countries over 2018-2023. To identify surprises, we implement a textual analysis methodology on business press articles. We compare surprises and expected decisions amplitudes of variation to get a causal effect. As predicted by interest rates parity, unexpected monetary policy decisions are associated with larger exchange rate growth (on average 1.5 per thousand higher). Still, though quite high, this magnitude may be exceeded by other events (economic, geopolitical...), depending on periods and countries.

This paper demonstrates the relevance of using a text indicator to analyze unanticipated monetary policy decisions. It can be extended by implementing Natural Language Processing methods to study larger databases of monetary policy decisions, with more countries and over a longer period. The results obtained with ChatGPT 4, which are consistent with the initial tagging and even improve it, confirm that this LLM (large language model) source may be used to extend the database.

Apart from the impact of monetary surprises on exchange rates movements, other consequences may be analyzed, depending on the availability of high-frequency series or financial data, as bond spreads or stock exchange variations.

References

Research papers

Albogatchiev A., Fontaine J.-S., Sandhu J. & Xie R. (2018), The Impact of Surprising Monetary Policy Announcements on Exchange Rate Volatility, Bank of Canada Staff Analytical Note, No. 2018-39, December.

Altavilla C., Brugnolini L., Gürkaynak R. S., Motto R. & Ragusa G. (2019), Measuring euro area monetary policy, *Journal of Monetary Economics*, Vol. 108(C), 162-179.

Andhika Zulen A. & Wibisono O. (2018), Measuring stakeholders' expectations for the central bank's policy rate, BIS / Irving Fisher Committee – Bank of Indonesia Workshop and Seminar on “Big Data for Central Bank Policies / Building Pathways for Policy Making with Big Data”, July.

Bacchetta M., Bekkers E., Piermartini R., Rubinova S., Stolzenburg V. & Xu A. (2021), COVID-19 and global value chains : A discussion of arguments on value chain organization and the role of WTO, WTO Staff Working Paper No. ERSD-2021-3.

Baker S. R., Bloom N. & Davis S. J. (2016), Measuring economic policy uncertainty, *The Quarterly Journal of Economics*, Oxford University Press, Vol.131, 1593-1636, March.

Bauer M. D. & Swanson E. T. (2023), An Alternative Explanation for the «Fed Information Effect», *American Economic Review*, 113 (3), 664-700.

Brandão-Marques L., Gelos G., Harjes T., Sahay R. & Xue Y. (2020), Monetary policy transmission in emerging markets and developing economies, IMF Working Paper, No. WP 2020/35, February.

Caldara D., Conlisk S., Iacoviello M. & Penn M. (2022), The Effect of the War in Ukraine on Global Activity and Inflation, FEDS Notes. Washington: Board of Governors of the Federal Reserve System, May 27.

Champagne J. & Sekkel R. (2018), Changes in monetary regimes and the identification of monetary policy shocks: Narrative evidence from Canada, *Journal of Monetary Economics*, 99, 72-87.

Choi S., Willems T. & Yong Yoo S. (2022), Revisiting the monetary transmission mechanism through an industry-level differential approach, *IMF Working Paper*, No. WP 22/17, January.

Deb P., Estefania-Flores J., Firat M., Furceri D. & Kothari S. (2023), Monetary Policy Transmission Heterogeneity: Cross-Country Evidence, *IMF Working Paper*, No. WP 23/204.

Duarte F. M. & Rosa C. (2013), *A Way With Words : The Economics of the Fed's Press Conference*, Liberty Street Economics, Federal Reserve Bank of New York, November 25.

Enders Z., Hünnekes F. & Müller G. J. (2019), Monetary policy announcements and expectations: Evidence from German firms, *Journal of Monetary Economics*, Vol. 108, 45-63.

Evstigneeva A., Shchadilova Y. & Sidorovskiy M. (2022), The Role of Communication and Information in the Emergence of Surprises in Bank of Russia Monetary Policy, *Bank of Russia Working Paper*, No. 99, August.

Gertler M. & Karadi (2015), Monetary policy surprises, credit costs, and economic activity, *American Economic Journal: Macroeconomics*, 7, No. 1, 44-76.

Gürkanyak R. S., Sack B. & Swanson E. (2005), Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements, *International Journal of Central Banking*, Vol.1, May.

Feunou, B., Garriott C., Kyeong J. & Leiderman R. (2017), The Impacts of Monetary Policy Statements, *Bank of Canada Staff Analytical Note*, No. 2017-22, November.

Furceri D., Loungani P. & Zdzienicka A. (2018), The effects of monetary policy shocks on inequality, *Journal of International Money and Finance*, 85, 168-186.

Husted L., Rogers J. & Sun B. (2020), Monetary policy uncertainty, *Journal of Monetary Economics*, Vol. 115, 20-36, November.

Jarociński, M. & Karadi P. (2020), Deconstructing monetary policy surprises—the role of information shocks, *American Economic Journal: Macroeconomics*, Vol. 12(2), 1-43.

Leombroni M., Vedolin A., Venter G. & Whelan P. (2021), Central bank communication and the yield curve, *Journal of Financial Economics*, Vol. 141, Issue 3, 860-880, September.

Masciandaro D., Romelli D. & Rubera G. (2023), Monetary policy and financial markets: evidence from Twitter traffic, *Trinity Economic Papers (TEP)*, Working Paper No. 1023, June.

Miranda-Agrippino S. & Ricco G. (2021), The transmission of monetary policy shocks, *American Economic Journal: Macroeconomics*, 13, No. 3, 74-107.

Pescatori A. (2018), Central Bank Communication and Monetary Policy Surprises in Chile, *IMF Working Paper*, WP/18/156, July.

Rehfeld K., Marwan N, Heitzig J., Kurths J., Comparison of correlation analysis techniques for irregularly sampled time series, *Nonlinear Processes in Geophysics*, 23 June 2011, Volume 18, Issue 3

Rosa C. & Verga G. (2008), The Impact of Central Bank Announcements on Asset Prices in Real Time, *International Journal of Central Banking*, Vol.4, 175-217, June.

Romer C. D. & Romer D. H. (2004), A new measure of monetary shocks: Derivation and implications, *American Economic Review*, No. 4, 1055-1084.

Websites

Bank of Canada, Policy interest rate, <https://www.bankofcanada.ca/core-functions/monetary-policy/key-interest-rate/>

Bank of England, Monetary policy summary and minutes, <https://www.bankofengland.co.uk/monetary-policy-summary-and-minutes/monetary-policy-summary-and-minutes>

Banco de México, Minutes of the Governing Board meetings regarding monetary policy decisions, <https://www.banxico.org.mx/publications-and-press/minutes-of-the-board-of-governors-meetings-regardi/minutes-regarding-monetary-po.html>

Czech National Bank, Bank Board Decisions, <https://www.cnb.cz/en/monetary-policy/bank-board-decisions/>

European Central Bank, Eurosystem, Monetary policy decisions, <https://www.ecb.europa.eu/press/quivdec/mopo/html/index.en.html>

Factiva, Dow Jones, <https://www.dowjones.com/professional/fr/factiva/>

Federal Reserve, Federal Open Market Committee, Meeting calendars, statements and minutes (2018-2024), <https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm>

FocusEconomics, <https://www.focus-economics.com/>

focus-economics.com. 2020. "Turkey Monetary Policy September 2020", by "Jan", <https://www.focus-economics.com/countries/turkey/news/monetary-policy/central-bank-unexpectedly-raises-interest-rate-in-september/>

HistData.com, Free Forex Historical Data, <https://www.histdata.com/download-free-forex-data/?/metatrader/1-minute-bar-quotes>

Hungarian National Bank, The Monetary Council, <https://www.mnb.hu/en/monetary-policy/the-monetary-council>

Investing.com, Australia Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-171>

Investing.com, Canada Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-166>

Investing.com, Czech Republic Interest Rate Decision, <https://www.investing.com/economic-calendar/czech-interest-rate-decision-457>

Investing.com, Eurozone Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-164>

Investing.com, Hungary Interest Rate Decision, <https://www.investing.com/economic-calendar/hungarian-interest-rate-decision-452>

Investing.com, Mexico Interest Rate Decision, <https://www.investing.com/economic-calendar/mexican-interest-rate-decision-423>

Investing.com, New Zealand Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-167>

Investing.com, Sweden Interest Rate Decision, <https://www.investing.com/economic-calendar/swedish-interest-rate-decision-427>

Investing.com, Turkey Interest Rate Decision, <https://www.investing.com/economic-calendar/turkish-one-week-repo-rate-409>

Investing.com, United Kingdom Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-170>

Investing.com, United States of America Interest Rate Decision, <https://www.investing.com/economic-calendar/interest-rate-decision-168>

Reserve Bank of Australia, Schedule of All Releases, <https://www.rba.gov.au/schedules-events/schedule.html>

Reserve Bank of New Zealand, Events Calendar, Past Events, [https://www.rbnz.govt.nz/news-and-events/events/past-events#first=20&sort=%40eventstart%20descending&f:@hierarchicalz95xs120xatopicagnames=\[Monetary%20policy\]](https://www.rbnz.govt.nz/news-and-events/events/past-events#first=20&sort=%40eventstart%20descending&f:@hierarchicalz95xs120xatopicagnames=[Monetary%20policy])

Sveriges Riksbank, Press & published, <https://www.riksbank.se/en-gb/press-and-published/>

The World Bank Data, GDP growth (annual %), <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

Appendix

Choice of dependent variable

Relative variations in exchange rates expressed as the value of foreign currencies to the dollar: We adopt a convention expressing the value of domestic currency for one dollar (1 USD=X units of domestic currency). For the dollar itself, its value for one euro is retained. Since relative variations are much smaller than 1 on a minute-by-minute basis, they are equivalent to the difference in the logarithms of the exchange rates on a one-minute scale, knowing that logarithm differences are indicators of asset denominated performances.

Graphs of exchange rate movements over decision days

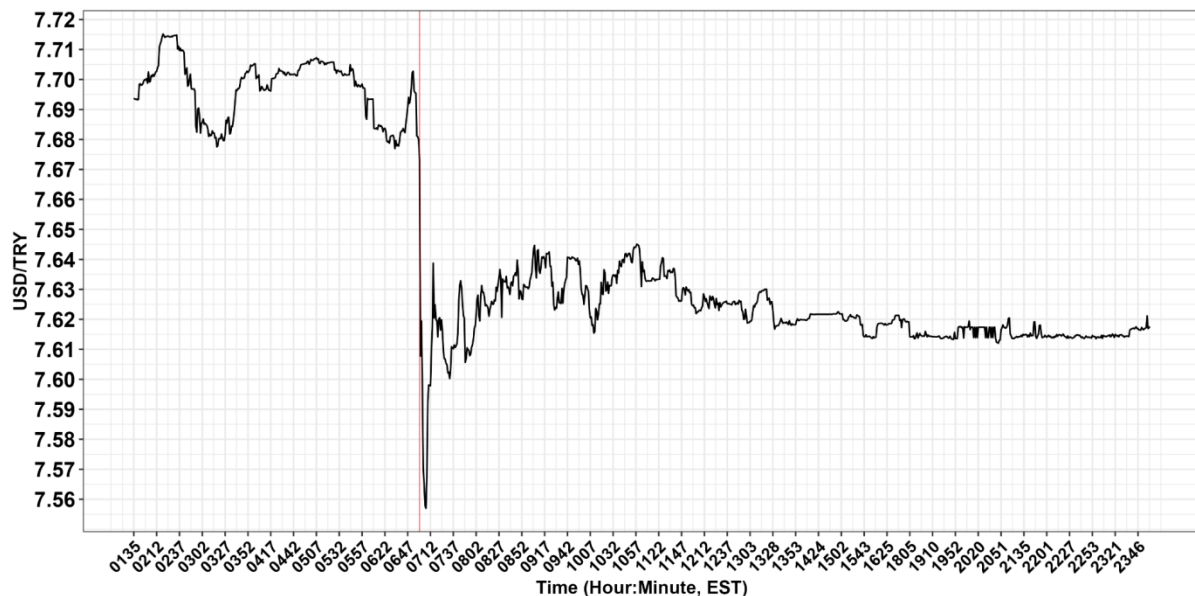


Figure S1: Turkish lira against 1 US dollar (1 USD= x TRY) on 24 September 2020: the Turkish Central Bank's monetary policy decision contained a surprise.

Source: Free Forex Data (HistData.com), Central bank websites, FocusEconomics.com, Reuters.com

The red line shows a very strong relative variation from 07:00 AM to 07:01 AM EST, i.e., from 03:00 PM to 03:01 PM in Turkish time. It must correspond to the minute when a monetary policy decision is announced. The time in our database is Eastern Time USA. There is an 8-hour time difference between the US east coast and Turkey. Expressed in UTC time, the strong relative variation occurs at 12:00 pm. In the space of ten minutes or so, the Turkish currency has appreciated by 1.8%.



Figure S2: US dollar against 1 Euro (1 Euro = x USD) on 30 January 2019: the Fed's monetary policy decision did not contain a surprise.

Source: Free Forex Data (HistData.com), Central bank websites, FocusEconomics.com, Reuters.com

This figure should be read in the same way as figure S1. Despite the fact that the decision came as no surprise, the dollar appreciated sharply in the space of a few minutes at the time of the decision. However, the amplitude of variation is smaller than in figure S1, with an appreciation of 3.9%.

Pair	Minimum	0.1-percentile	1-percentile	99-percentile	99.9-percentile	Maximum	Mean	Standard Deviation	nb obs.
USD/AUD	$-1.4 \cdot 10^{-2}$	$-1.1 \cdot 10^{-3}$	$-5.0 \cdot 10^{-4}$	$5.0 \cdot 10^{-4}$	$1.1 \cdot 10^{-3}$	$1.8 \cdot 10^{-2}$	$6.6 \cdot 10^{-8}$	$1.9 \cdot 10^{-4}$	2 134 534
USD/CAD	$-7.6 \cdot 10^{-3}$	$-7.1 \cdot 10^{-4}$	$-3.4 \cdot 10^{-4}$	$3.4 \cdot 10^{-4}$	$6.9 \cdot 10^{-4}$	$9.1 \cdot 10^{-3}$	$-5.0 \cdot 10^{-8}$	$1.3 \cdot 10^{-4}$	2 132 656
USD/CZK	$-1.1 \cdot 10^{-2}$	$-1.4 \cdot 10^{-3}$	$-5.7 \cdot 10^{-4}$	$5.5 \cdot 10^{-4}$	$1.1 \cdot 10^{-3}$	$2.2 \cdot 10^{-2}$	$4.6 \cdot 10^{-8}$	$2.0 \cdot 10^{-4}$	2 090 922
USD/GBP	$-1.2 \cdot 10^{-2}$	$-9.9 \cdot 10^{-4}$	$-4.5 \cdot 10^{-4}$	$4.5 \cdot 10^{-4}$	$9.8 \cdot 10^{-4}$	$1.6 \cdot 10^{-2}$	$2.3 \cdot 10^{-8}$	$1.7 \cdot 10^{-4}$	2 140 865
USD/HUF	$-1.4 \cdot 10^{-2}$	$-1.6 \cdot 10^{-3}$	$-6.6 \cdot 10^{-4}$	$6.4 \cdot 10^{-4}$	$1.4 \cdot 10^{-3}$	$2.1 \cdot 10^{-2}$	$1.8 \cdot 10^{-7}$	$2.3 \cdot 10^{-4}$	1 952 172
USD/MXN	$-1.9 \cdot 10^{-2}$	$-1.5 \cdot 10^{-3}$	$-6.7 \cdot 10^{-4}$	$6.6 \cdot 10^{-4}$	$1.4 \cdot 10^{-3}$	$2.2 \cdot 10^{-2}$	$-3.5 \cdot 10^{-8}$	$2.4 \cdot 10^{-4}$	2 085 470
USD/NZD	$-1.6 \cdot 10^{-2}$	$-1.1 \cdot 10^{-3}$	$-5.0 \cdot 10^{-4}$	$5.0 \cdot 10^{-4}$	$1.1 \cdot 10^{-3}$	$1.5 \cdot 10^{-2}$	$6.1 \cdot 10^{-8}$	$1.9 \cdot 10^{-4}$	2 131 854
USD/SEK	$-1.3 \cdot 10^{-2}$	$-1.4 \cdot 10^{-3}$	$-5.9 \cdot 10^{-4}$	$5.8 \cdot 10^{-4}$	$1.2 \cdot 10^{-3}$	$2.2 \cdot 10^{-2}$	$1.4 \cdot 10^{-7}$	$2.1 \cdot 10^{-4}$	2 122 857
USD/TRY	$-9.1 \cdot 10^{-2}$	$-3.5 \cdot 10^{-3}$	$-1.1 \cdot 10^{-4}$	$1.0 \cdot 10^{-3}$	$3.2 \cdot 10^{-3}$	$4.8 \cdot 10^{-2}$	$1.2 \cdot 10^{-6}$	$4.5 \cdot 10^{-4}$	1 796 598
USD/EUR	$-1.2 \cdot 10^{-2}$	$-9.9 \cdot 10^{-4}$	$-4.5 \cdot 10^{-4}$	$4.5 \cdot 10^{-4}$	$9.8 \cdot 10^{-4}$	$1.6 \cdot 10^{-2}$	$2.3 \cdot 10^{-8}$	$1.7 \cdot 10^{-4}$	2 140 865

Table S1: Distribution of relative variations on a one-minute scale for the different pairs of the database: quantiles, mean, standard deviation, number of observations

Source: Free Forex Data (HistData.com), Period: January 2018 - November 2023

Country	Decisions without surprises		Decisions with surprises		All decisions	
	Average amplitude of variation	Number of decisions	Average amplitude of variation	Number of decisions	Average amplitude of variation	Number of decisions
Australia	1.7*10 ⁻³	56	4.8*10 ⁻³	4	1.9*10 ⁻³	60
Canada	2.3*10 ⁻³	42	4.5*10 ⁻³	4	2.5*10 ⁻³	46
Czech Republic	1.6*10 ⁻³	38	3.9*10 ⁻³	8	2.1*10 ⁻³	46
Euro Zone	1.8*10 ⁻³	39	1.7*10 ⁻³	2	1.8*10 ⁻³	41
Hungary	2.3*10 ⁻³	65	3.1*10 ⁻³	4	2.3*10 ⁻³	69
Mexico	2.0*10 ⁻³	42	3.5*10 ⁻³	4	2.1*10 ⁻³	46
New-Zealand	3.6*10 ⁻³	28	6.7*10 ⁻³	13	4.6*10 ⁻³	41
Sweden	3.1*10 ⁻³	25	5.8*10 ⁻³	5	3.6*10 ⁻³	30
Turkey	6.3*10 ⁻³	24	8.6*10 ⁻³	19	7.4*10 ⁻³	43
United-Kingdom	2.5*10 ⁻³	37	2.9*10 ⁻³	7	2.6*10 ⁻³	44
United States of America	1.9*10 ⁻³	42	1.9*10 ⁻³	2	1.9*10 ⁻³	44
Total	2.4*10 ⁻³	438	5.6*10 ⁻³	72	2.7*10 ⁻³	510

Table S2: Average amplitude of variation (one-minute scale) for decisions with and without surprises, by country

Source: Free Forex Data (HistData.com), Period: January 2018 - November 2023

	Dependent variable :				
	Amplitude of variation (one-minute scale): $Y_{i,t}$				
	(1) within	(2) random	(3) within: before Covid19 (2018-2019)	(4) within: during Covid19 (2020-2021)	(5) within: after Covid19 (2022-2023)
<i>Constant</i>		-0.0006***			
$1_{SURPRISE}$	0.0016***	0.0018***	0.0030***	0.0011*	0.0008
$Y_{i,t-1}$	0.1435***	0.1705***	0.1501*	-0.1174	0.1045
$Y_{i,t-2}$	0.0719	0.0958**	0.0672	0.0900	-0.0587
<i>sd</i>	16.40***	15.92***	27.44***	14.75***	13.10***
<u>Effects:</u> <i>Idiosyncratic</i> (<i>sd,share</i>):		($2.35 \cdot 10^{-3}, 1$)			
Observations	473	488	149	177	139
R2	0.44	0.55	0.65	0.57	0.23
Adjusted R2	0.43	0.54	0.64	0.55	0.19
Statistics	F: 94.74***	Chi sq: 584.404***	F: 70.47***	F: 58.25***	F: 10.188***

Table S3: Panel data econometric estimation of the impact of surprises on the amplitude of exchange rate variation (one-minute scale)

Note : *p<0.1 ; **p<0.05 ; ***p<0.01

	Dependent variable:			
	Amplitude of variation (one-minute scale): $Y_{i,t}$			
	(1) OLS	(4) OLS : before Covid19 (2018-2019)	(5) OLS : during Covid19 (2020-2021)	(6) OLS : after Covid19 (2022-2023)
<i>Constant</i>	-0.0005	-0.0019**	-0.0002	0.0010
$1_{SURPRISE}$	0.0016***	0.0031***	0.0010*	0.0008
$Y_{i,t-1}$	0.1435***	0.1434*	-0.1480*	0.0866
$Y_{i,t-2}$	0.0719	0.0983	0.0064	-0.0689
<i>sd</i>	16.40***	30.53***	14.63**	14.71***
<i>Factor country</i> Czech-Republic New-Zealand Turkey	YES	YES	YES 0.0015* 0.0014*	YES -0.0018**
Observations	473	142	170	131
R2	0.56	0.76	0.60	0.36
Adjusted R2	0.55	0.74	0.57	0.30
Statistics	F: 43.71***	F: 31.98***	F: 18.36***	F: 5.35***

Table S4: Ordinary Least Square econometric estimation of the impact of surprises on the amplitude of exchange rate variation (one-minute scale), countries factor

Note: *p<0.1 ; **p<0.05 ; ***p<0.01

	Dependent variable :				
	Amplitude of variation (one-minute scale): $Y_{i,t}$				
	(2) within	(3) random	(4) within: before Covid19 (2018-2019)	(5) within: during Covid19 (2020-2021)	(6) within: after Covid19 (2022-2023)
<i>Constant</i>		-0.0001			
$1_{SURPRISE}$	0.0013***	0.0015***	0.0018***	0.0015***	0.0018*
$Y_{i,t-1}$	0.0929*	0.16.66***	0.1818*	0.0582	0.1335
$Y_{i,t-2}$	0.0644	0.1385***	0.2225**	0.0075	0.0672
<i>sd</i>	12.66***	11.47***	21.27***	10.96***	13.70***
<u>Effects:</u> <i>Idiosyncratic</i> (<i>sd,share</i>):		($1.50 \cdot 10^{-3}, 1$)			
Observations	447	447	142	154	136
R2	0.36	0.41	0.40	0.61	0.24
Adjusted R2	0.34	0.41	0.37	0.59	0.21
Statistics	F: 31.3616***	Chi sq: 310.479***	F: 22.3848***	F: 59.1317***	F: 11.0168

Table S5: Panel data econometric estimation of the impact of surprises on the amplitude of exchange rate variation (one-minute scale), without Turkey

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

	Dependent variable :			
	Amplitude of variation (one-minute scale): $Y_{i,t}$			
	(1) OLS	(4) OLS : before Covid19 (2018-2019)	(5) OLS : during Covid19 (2020-2021)	(6) OLS : after Covid19 (2022-2023)
<i>Constant</i>	-0.0001	-0.0010*	0.0002	0.0010
$1_{SURPRISE}$	0.0015***	0.0015***	0.0013***	0.0008
$Y_{i,t-1}$	0.1666***	0.0677	-0.0031	0.0361
$Y_{i,t-2}$	0.1385***	0.1257	-0.0051	-0.0396
<i>sd</i>	11.47***	24.13***	11.23***	14.83***
<i>Factor country</i> <i>Canada</i> <i>Czech Republic</i> <i>New-Zealand</i>	YES	YES 0.0014* 0.0022**	YES 0.0015***	YES -0.0018**
Observations	442	128	148	129
R2	0.41	0.56	0.64	0.36
Adjusted R2	0.41	0.51	0.61	0.29
Statistics	F: 77.62***	F: 12.41***	F: 20.58***	F: 5.49***

Table S6: Ordinary Least Square econometric estimation of the impact of surprises on the amplitude of exchange rate variation (one-minute scale), countries factor, without Turkey

Note: *p<0.1 ; **p<0.05 ; ***p<0.01

	With Turkey	Without Turkey
OLS, whole period	0.0016***	0.0015***
OLS, before Covid19 (2018-2019)	0.0031***	0.0015***
OLS, during Covid19 (2020-2021)	0.0010*	0.0013***
OLS, after Covid19 (2022-2023)	0.0008	0.0008
Within, whole period	0.0016***	0.0013***
Within, before Covid19 (2018-2019)	0.0030***	0.0018***
Within, during Covid19 (2020-2021)	0.0011*	0.0015***
Within, after Covid19 (2022-2023)	0.0008	0.0018*
Random	0.0018***	0.0015***

Table S7: Summary of the parameters obtained for the surprise variable using the different methods

Keywords used to capture monetary surprises and decisions	“central” or “surpris” or “decision” or “markets” or “bank” or “rate” or “expect” or “hawkish” or “dovish” or «unexpected»
List of keywords used to get central banks	“Fed” or “Buba” or “ECB” or “European Central Bank” or “Central Republican Bank” or “Gosbank” or “National Bank of South Ossetia” or “ Administration of the Patrimony of the Apostolic See ” or “ Autoridade Monetária de Região Administrativa Especial de Macau ” or “ Bangko Sentral ng Pilipinas ” or “ Bangladesh Bank ” or “ Bank of Albania ” or “ Bank of Algeria ” or “ Bank of Botswana ” or “ Bank of Canada ” or “ Bank of Cape Verde ” or “ Bank of Central African States” or “ Bank of England ” or “ Bank of Eritrea ” or “ Bank of Estonia ” or “ Bank of Finland ” or “ Bank of France ” or “ Bank of Ghana ” or “ Bank of Greece ” or “ Bank of Guatemala ” or “ Bank of Guyana ” or “ Bank of Indonesia ” or “ Bank of Israel ” or “ Bank of Italy ” or “ Bank of Jamaica ” or “ Bank of Japan ” or “ Bank of Korea ” or “ Bank of Latvia ” or “ Bank of Lithuania ” or “ Bank of Mauritius ” or “ Bank of Mexico ” or “ Bank of Mongolia ” or “ Bank of Mozambique ” or “ Bank of Namibia ” or “ Bank of Papua New Guinea ” or “ Bank of Portugal ” or “ Bank of Sierra Leone ” or “ Bank of Slovenia ” or “ Bank of Somaliland ” or “ Bank of South Sudan ” or “ Bank of Spain ”

or " Bank of Tanzania " or " Bank of Thailand " or " Bank of the Lao People's Democratic Republic " or " Bank of the Republic of Burundi " or " Bank of the Republic of Haiti " or " Bank of the Republic " or " Bank of Uganda " or " Bank of Zambia " or " Banque du Liban " or " Bermuda Monetary Authority " or " Bulgarian National Bank " or " Cayman Islands Monetary Authority " or " Central Bank of Argentina " or " Central Bank of Armenia " or " Central Bank of Aruba " or " Central Bank of Azerbaijan " or " Central Bank of Bahrain " or " Central Bank of Barbados " or " Central Bank of Belize " or " Central Bank of Bolivia " or " Central Bank of Bosnia and Herzegovina " or " Central Bank of Brazil " or " Central Bank of Chile " or " Central Bank of Costa Rica " or " Central Bank of Cuba " or " Central Bank of Curaçao and Sint Maarten " or " Central Bank of Curaçao and Sint Maarten " or " Central Bank of Cyprus " or " Central Bank of Djibouti " or " Central Bank of Ecuador " or " Central Bank of Egypt " or " Central Bank of Eswatini " or " Central Bank of Honduras " or " Central Bank of Iceland " or " Central Bank of Iraq " or " Central Bank of Ireland " or " Central Bank of Jordan " or " Central Bank of Kenya " or " Central Bank of Kosovo " or " Central Bank of Kuwait " or " Central Bank of Lesotho " or " Central Bank of Liberia " or " Central Bank of Libya " or " Central Bank of Luxembourg " or " Central Bank of Madagascar " or " Central Bank of Malaysia " or " Central Bank of Malta " or " Central Bank of Mauritania " or " Central Bank of Montenegro " or " Central Bank of Myanmar " or " Central Bank of Nicaragua " or " Central Bank of Nigeria " or " Central Bank of Oman " or " Central Bank of Paraguay " or " Central Bank of Russia " or " Central Bank of Samoa " or " Central Bank of São Tomé and Príncipe " or " Central Bank of Seychelles " or " Central Bank of Solomon Islands " or " Central Bank of Somalia " or " Central Bank of Sri Lanka " or " Central Bank of Sudan " or " Central Bank of Suriname " or " Central Bank of Syria " or " Central Bank of The Bahamas " or " Central Bank of the Comoros " or " Central Bank of the Congo " or " Central Bank of the Democratic People's Republic of Korea " or " Central Bank of the Dominican Republic " or " Central Bank of The Gambia " or " Central Bank of the Islamic Republic of Iran " or " Central Bank of the Republic of China" or " Central Bank of the Republic of Guinea " or " Central Bank of the Republic of San Marino " or " Central Bank of the Republic of Turkey " or " Central Bank of the Republic of Uzbekistan " or " Central Bank of the Turkish Republic of Northern Cyprus " or " Central Bank of the United Arab Emirates " or " Central Bank of Trinidad and Tobago " or " Central Bank of Tunisia " or " Central Bank of Turkmenistan " or " Central Bank of Uruguay " or " Central Bank of Venezuela " or " Central Bank of West African States" or " Central Bank of West African States" or " Central Bank of Yemen " or " Central Reserve Bank of El Salvador " or " Central Reserve Bank of Peru " or " Croatian National Bank " or " Czech National Bank " or " Da Afghanistan Bank " or " Danmarks Nationalbank " or " De Nederlandsche Bank " or " East Timor Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Eastern Caribbean Central Bank " or " Federal Reserve " or " Hong Kong Monetary Authority " or " Hungarian National Bank " or " Maldives Monetary Authority " or " Monetary Authority of Brunei Darussalam " or " Monetary Authority

	of Singapore " or " National Bank of Angola " or " National Bank of Belgium " or " National Bank of Cambodia " or " National Bank of Ethiopia " or " National Bank of Georgia " or " National Bank of Kazakhstan " or " National Bank of Liechtenstein " or " National Bank of Moldova " or " National Bank of North Macedonia " or " National Bank of Poland " or " National Bank of Romania " or " National Bank of Rwanda " or " National Bank of Serbia " or " National Bank of Slovakia " or " National Bank of Tajikistan " or " National Bank of the Kyrgyz Republic " or " National Bank of the Republic of Abkhazia " or " National Bank of the Republic of Belarus " or " National Bank of Ukraine " or " National Reserve Bank of Tonga " or " Nepal Rastra Bank " or " Norges Bank " or " Oesterreichische Nationalbank " or " Overseas Issuing Institute " or " Palestine Monetary Authority " or " People's Bank of China " or " Qatar Central Bank " or " Reserve Bank of Australia " or " Reserve Bank of Fiji " or " Reserve Bank of India " or " Reserve Bank of Malawi " or " Reserve Bank of New Zealand " or " Reserve Bank of Vanuatu " or " Reserve Bank of Zimbabwe " or " Royal Monetary Authority of Bhutan " or " Saudi Central Bank " or " South African Reserve Bank " or " State Bank of Pakistan " or " State Bank of Vietnam " or " Sveriges Riksbank " or " Swiss National Bank " or " Transnistrian Republican Bank " or "Bank Al-Maghrib" or "Bundesbank " or "Central Bank of the Philippines" or "CFP" or "Communauté Financière du Pacifique "
--	--

Table S8: keywords used in the Factiva request and in focus-economics.com web pages to get monetary surprises for central banks worldwide

Pairs of currencies	Date and time retained for the surprise	Growth rate absolute value (%)
AUD_USD	01/07/2019 18:28	0,046
AUD_USD	18/03/2020 20:58	1,088
AUD_USD	01/02/2021 22:31	0,125
AUD_USD	03/10/2022 23:31	0,673
CAD_USD	30/05/2018 10:01	0,630
CAD_USD	13/03/2020 13:09	0,374
CAD_USD	27/10/2021 10:01	0,548
CAD_USD	07/06/2023 11:00	0,241
CZK_USD	27/06/2018 07:01	0,500
CZK_USD	06/02/2020 08:01	0,224
CZK_USD	16/03/2020 04:24	0,788
CZK_USD	07/05/2020 09:46	0,220
CZK_USD	30/09/2021 08:31	0,579
CZK_USD	04/11/2021 08:31	0,331
CZK_USD	22/12/2021 17:52	0,185
CZK_USD	03/02/2022 08:31	0,259
GBP_USD	10/05/2018 07:03	0,188
GBP_USD	07/11/2019 07:01	0,208
GBP_USD	19/03/2020 07:53	0,477
GBP_USD	04/11/2021 07:01	0,356

GBP_USD	16/12/2021 07:01	0,448
GBP_USD	21/09/2023 07:01	0,263
GBP_USD	02/11/2023 07:01	0,106
HUF_USD	26/03/2019 09:28	0,142
HUF_USD	28/04/2020 09:49	0,164
HUF_USD	23/06/2020 08:01	0,316
HUF_USD	27/09/2022 09:01	0,628
MXN_USD	15/08/2019 14:01	0,281
MXN_USD	12/11/2020 14:01	0,209
MXN_USD	24/06/2021 14:02	0,610
MXN_USD	09/02/2023 14:03	0,316
NZD_USD	09/05/2018 17:01	0,384
NZD_USD	08/08/2018 17:01	0,313
NZD_USD	26/03/2019 20:01	1,133
NZD_USD	06/08/2019 22:01	1,002
NZD_USD	12/11/2019 20:01	1,186
NZD_USD	15/03/2020 16:10	1,157
NZD_USD	12/05/2020 22:02	0,638
NZD_USD	11/08/2020 22:01	0,624
NZD_USD	25/05/2021 22:01	0,297
NZD_USD	13/07/2021 08:31	0,413
NZD_USD	12/04/2022 08:31	0,336
NZD_USD	12/07/2022 22:04	0,285
NZD_USD	04/04/2023 22:01	0,927
SEK_USD	20/12/2018 03:31	1,002
SEK_USD	05/09/2019 03:31	0,461
SEK_USD	24/10/2019 03:31	0,206
SEK_USD	28/04/2022 03:31	0,782
SEK_USD	20/09/2022 03:31	0,451
TRY_USD	25/04/2018 07:01	1,012
TRY_USD	07/06/2018 07:01	1,463
TRY_USD	24/07/2018 07:01	3,033
TRY_USD	13/09/2018 07:01	4,023
TRY_USD	06/03/2019 07:37	0,209
TRY_USD	12/09/2019 07:01	0,809
TRY_USD	24/10/2019 07:01	0,538
TRY_USD	12/12/2019 00:07	0,163
TRY_USD	16/01/2020 06:01	0,204
TRY_USD	17/03/2020 09:23	0,214
TRY_USD	22/04/2020 01:36	0,148
TRY_USD	25/06/2020 07:19	0,138
TRY_USD	24/09/2020 07:01	0,852
TRY_USD	22/10/2020 07:01	1,105
TRY_USD	24/12/2020 06:00	0,537
TRY_USD	18/03/2021 06:01	0,877
TRY_USD	18/08/2022 07:01	0,596

TRY_USD	22/09/2022 19:50	0,135
TRY_USD	20/07/2023 01:16	0,373
EUR_USD	08/03/2018 14:50	0,171
EUR_USD	21/07/2022 08:17	0,162
USD_EUR	19/12/2018 14:01	0,209
USD_EUR	03/03/2020 10:01	0,181

Table S9: list of monetary policy surprises, by pairs of currencies, date and time, and magnitude of the surprise (growth rate of bilateral exchange rate over one minute, in %)

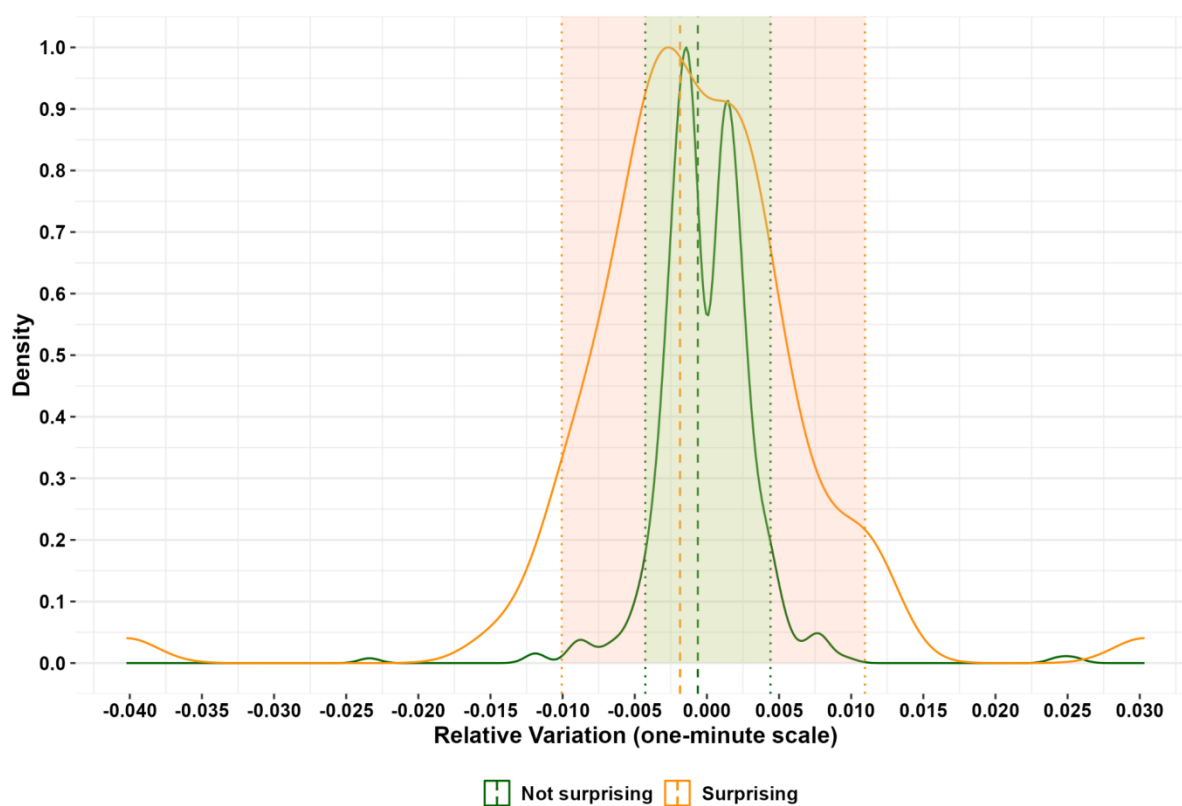


Figure S3: Densities of exchange rates relative variations (one-minute scale) for surprising and non-surprising decisions

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

Notes: The dashed lines represent the means, the dotted lines represent the 5-percentiles and 95-percentiles

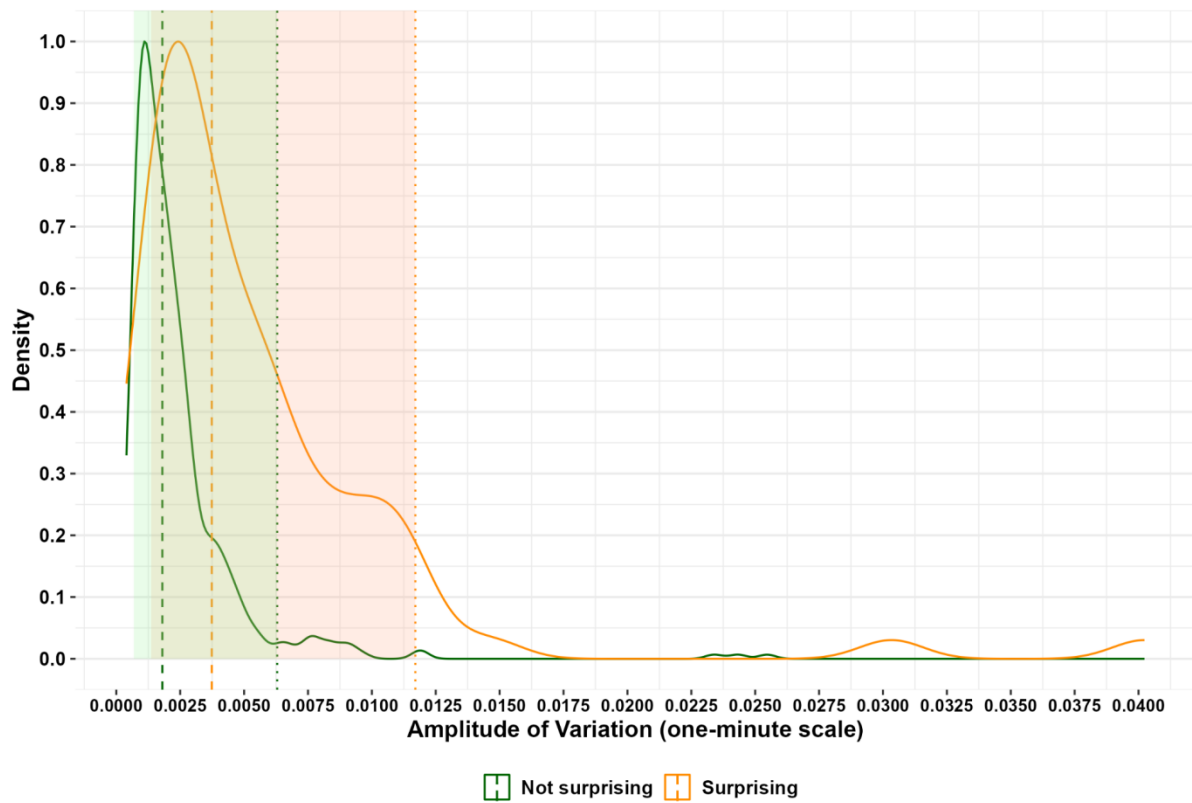


Figure S4: Density of exchange rates amplitude of variations (one-minute scale) for surprising and non-surprising decisions

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

Notes: The dashed lines represent the medians, the dotted lines represent the 95-percentiles

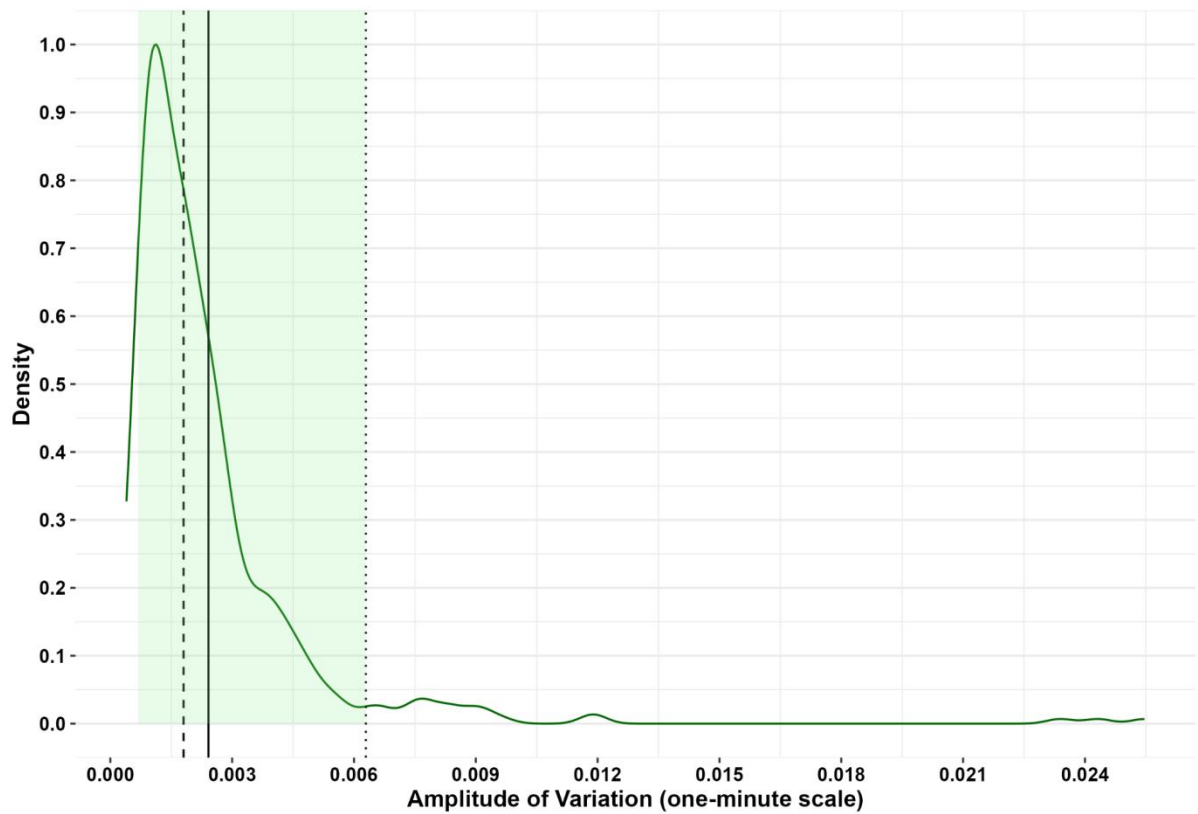


Figure S5: Density of exchange rates amplitude of variations (one-minute scale) for non-surprising decisions

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

Notes: The solid line represents the mean, the dashed line represents the median, the dotted line represents the 95-percentile

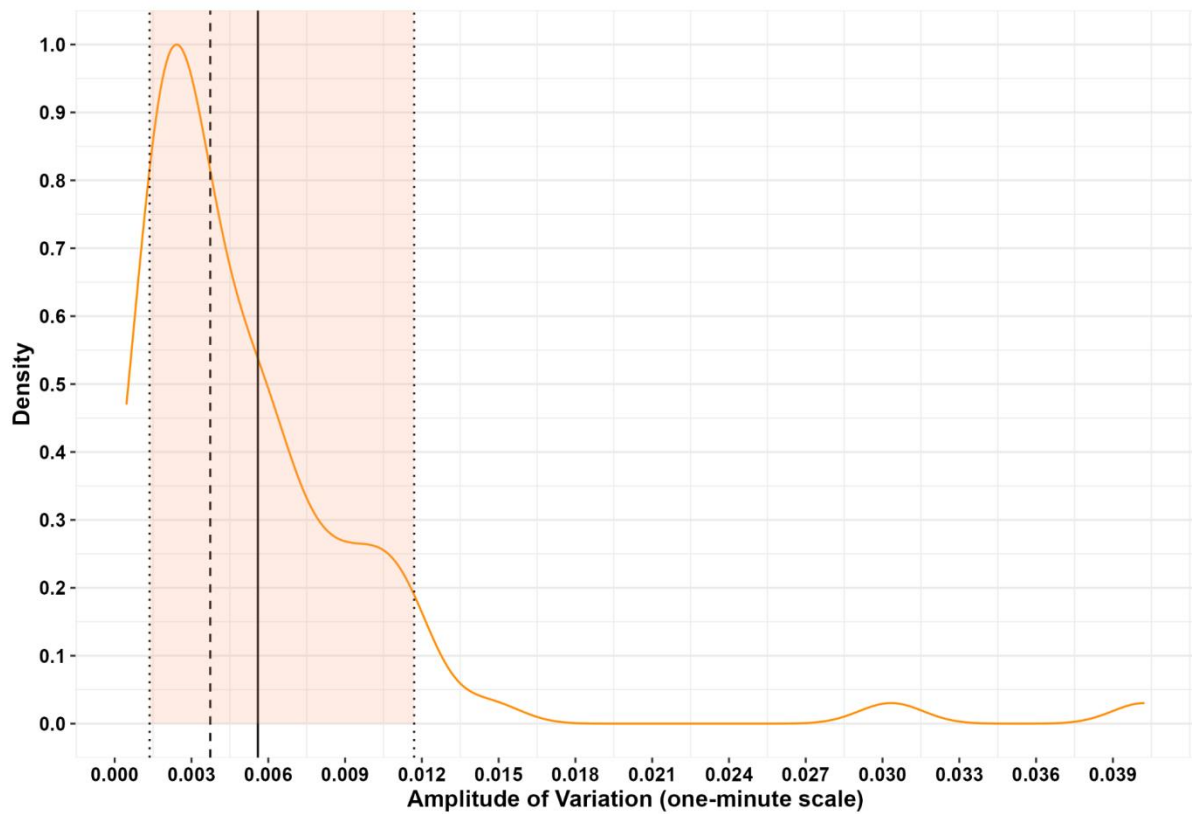


Figure S6: Density of exchange rates amplitude of variations (one-minute scale) for surprising decisions

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

Notes: The solid line represents the mean, the dashed line represents the median, the dotted lines represent the 5-percentile and the 95-percentile

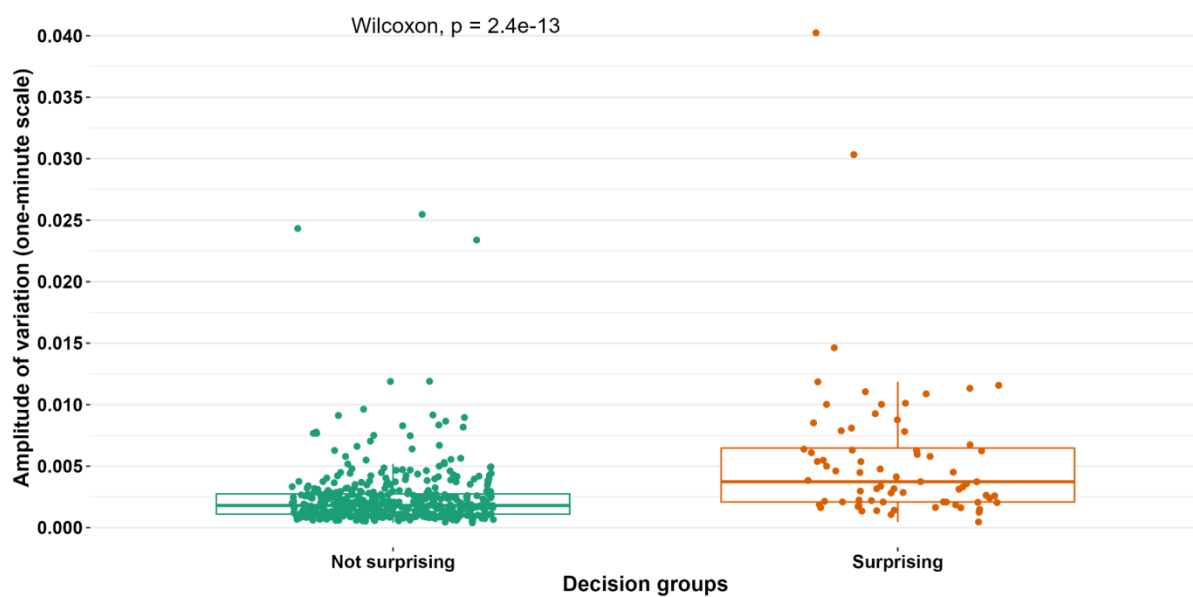


Figure S7: Boxplots and Wilcoxon test for surprising and non-surprising decision groups, exchange rates amplitude of variations (one-minute scale)

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

Notes: The boxplot lines represent the medians and interquartile ranges

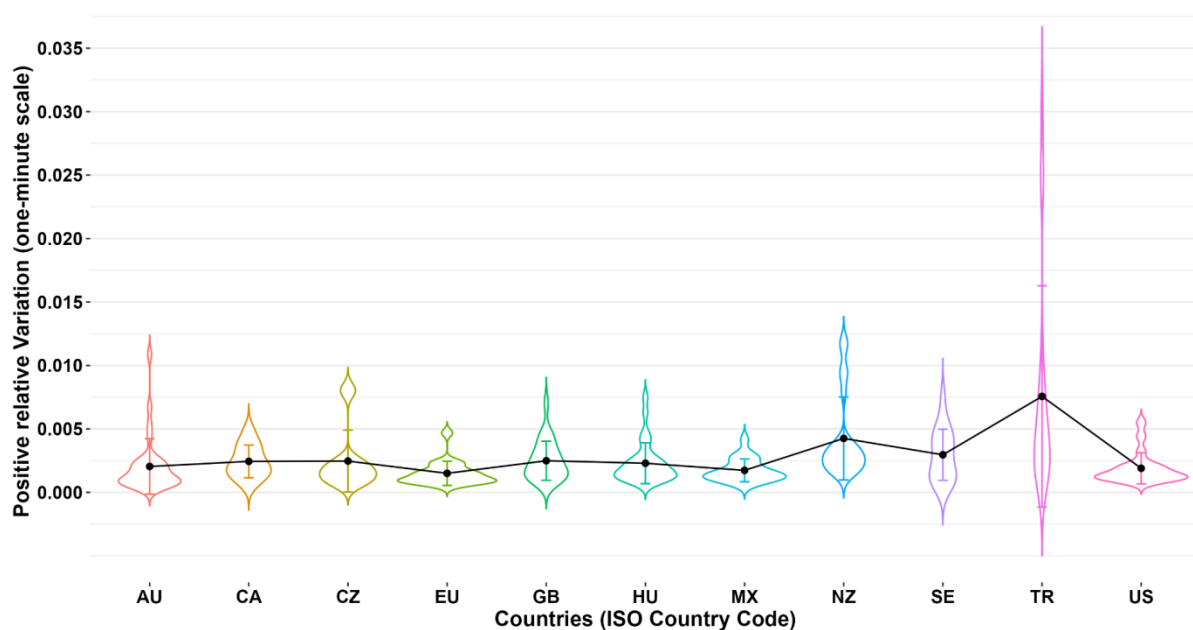


Figure S8: Mean, standard deviation, interquartile range and distribution of relative variations across countries: positive relative variations (one-minute scale), all decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

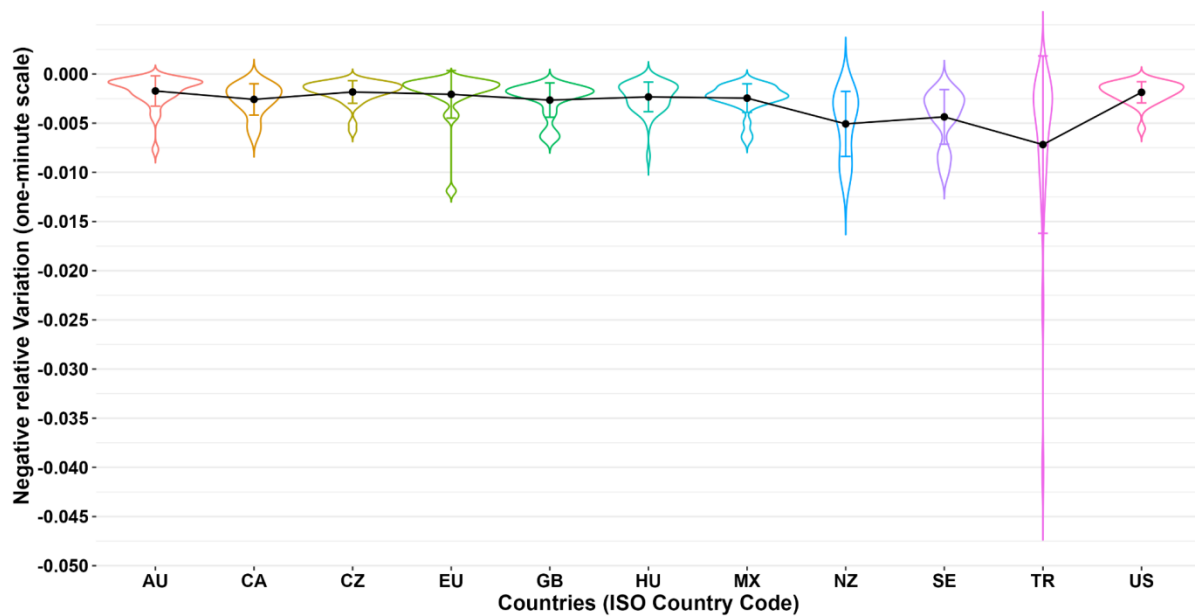


Figure S9: Mean, standard deviation, interquartile range and distribution of relative variations across countries: negative relative variations (one-minute scale), all decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

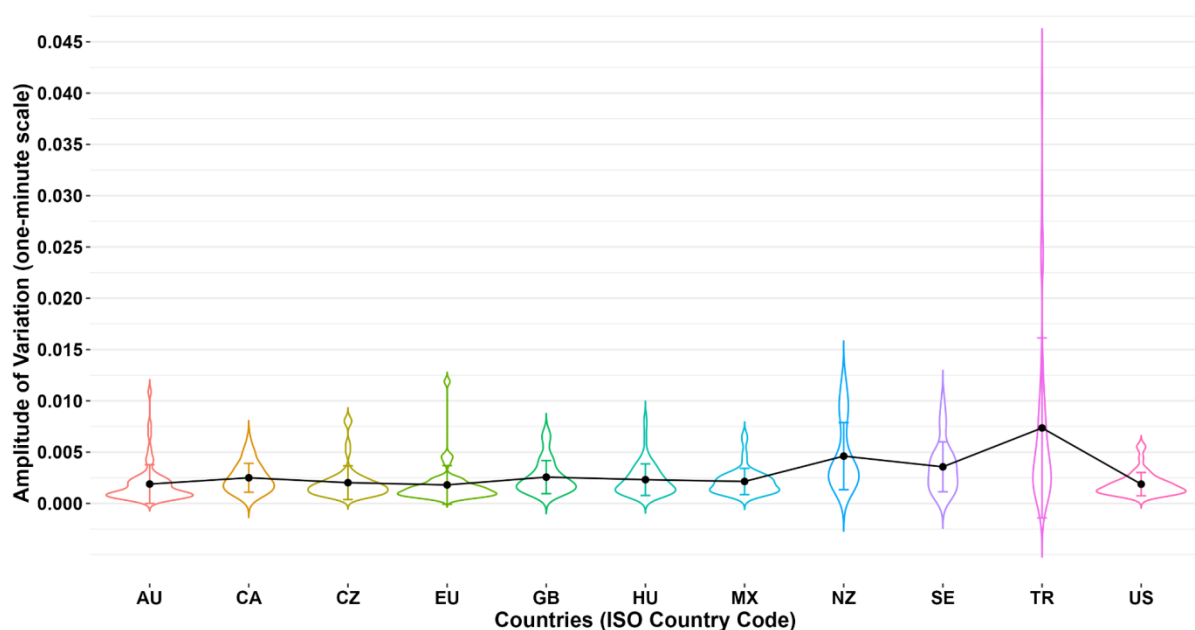


Figure S10: Mean, standard deviation, interquartile range and distribution of relative variations across countries: amplitude of variations (one-minute scale), all decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

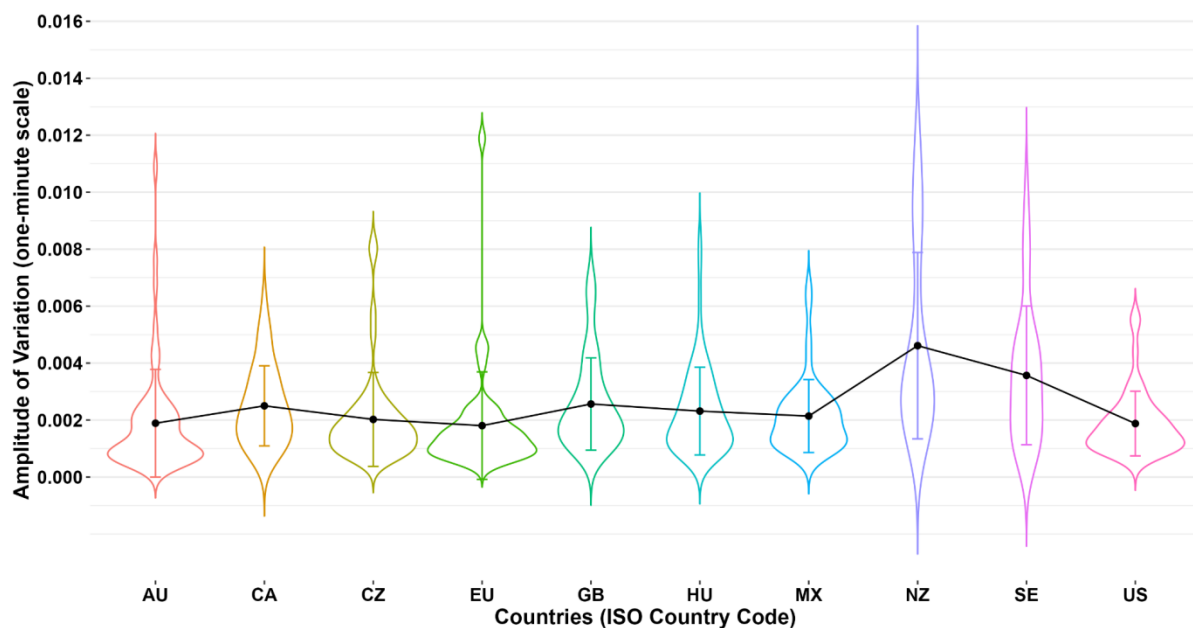


Figure S11: Mean, standard deviation, interquartile range and distribution of relative variations across countries: absolute values of relative variations (one-minute scale), without Turkey, all decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

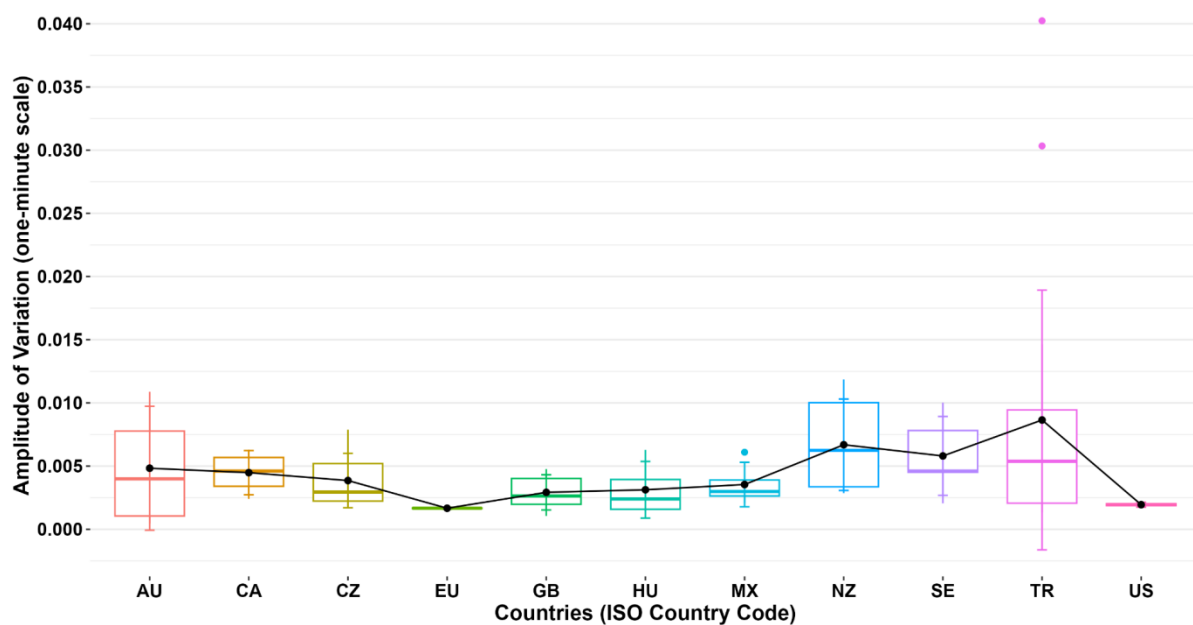


Figure S12: Mean, standard deviation, interquartile range and boxplots of relative variations across countries: absolute values of relative variations (one-minute scale), surprising decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

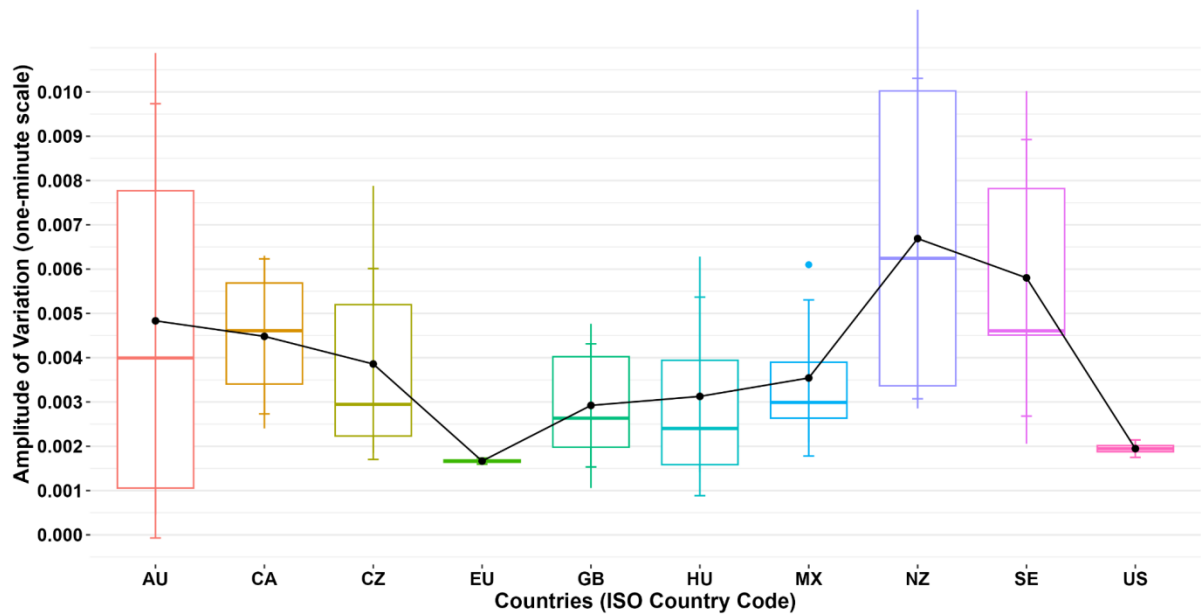


Figure S13: Mean, standard deviation, interquartile range and boxplots of relative variations across countries: absolute values of relative variations (one-minute scale), surprising decision days, without Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

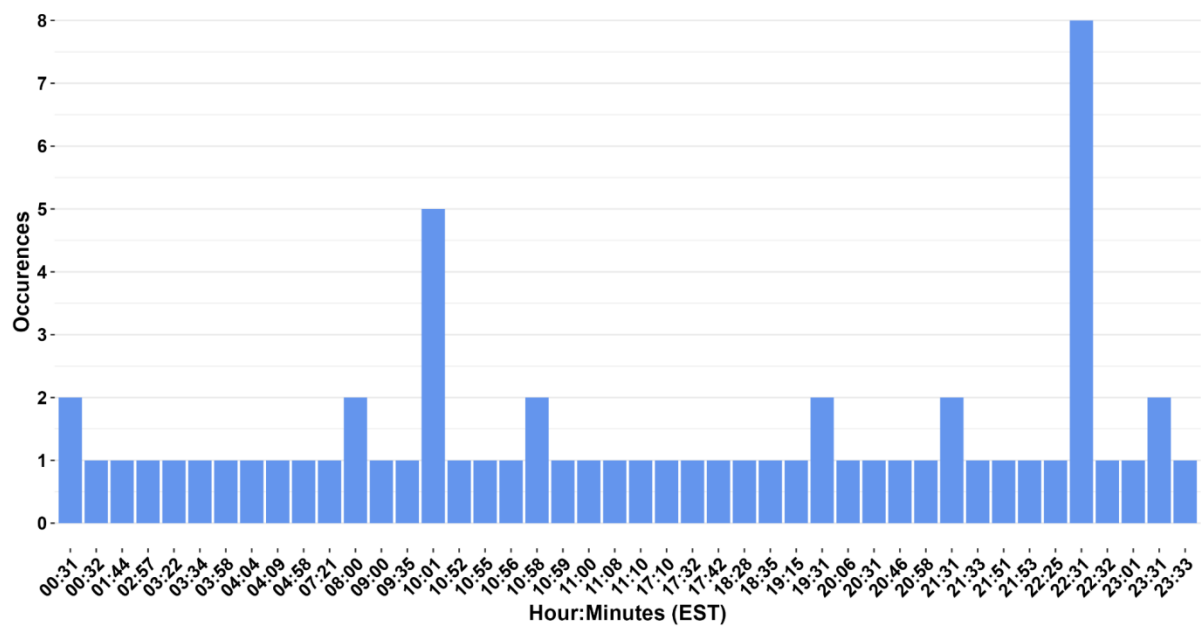


Figure S14: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Australia

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

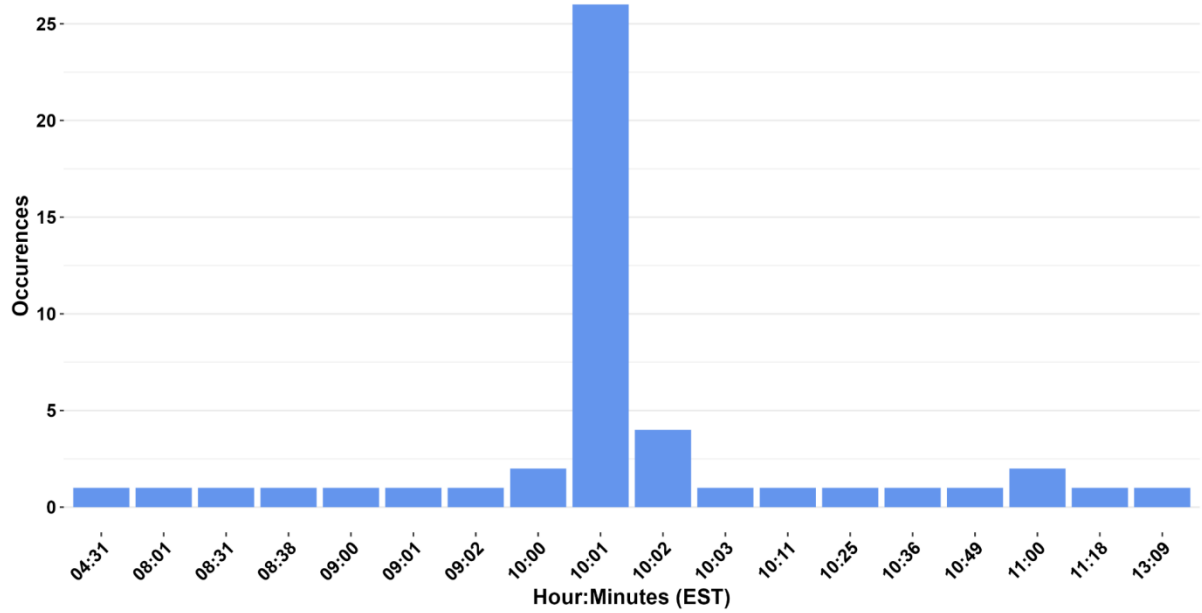


Figure S15: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Canada

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

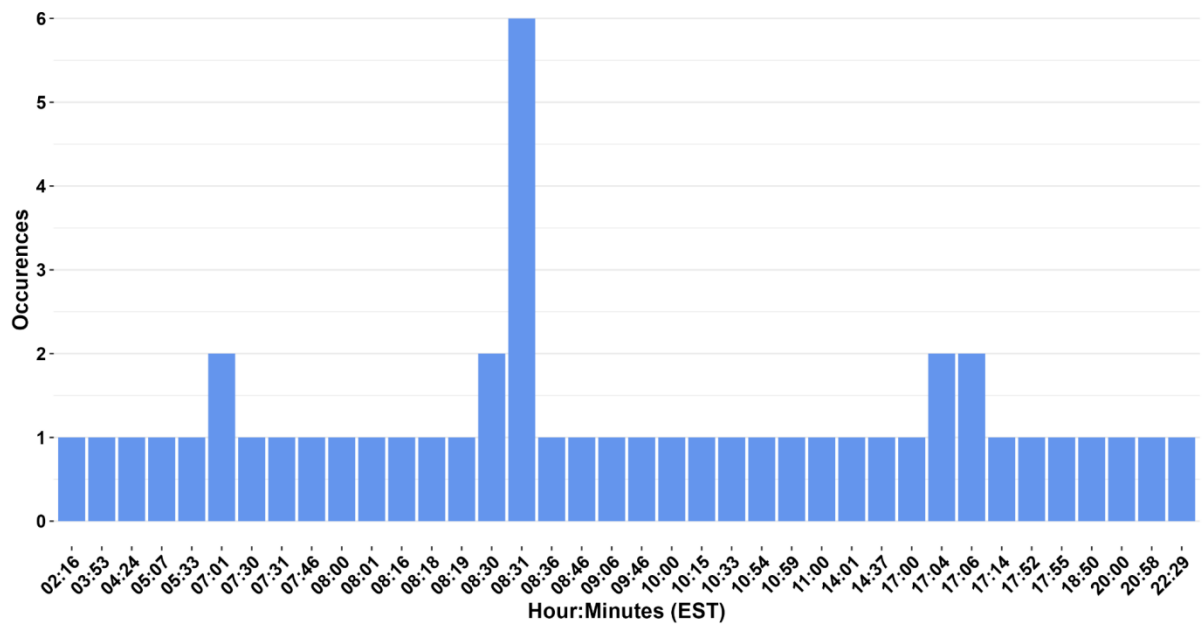


Figure S16: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Czech Republic

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

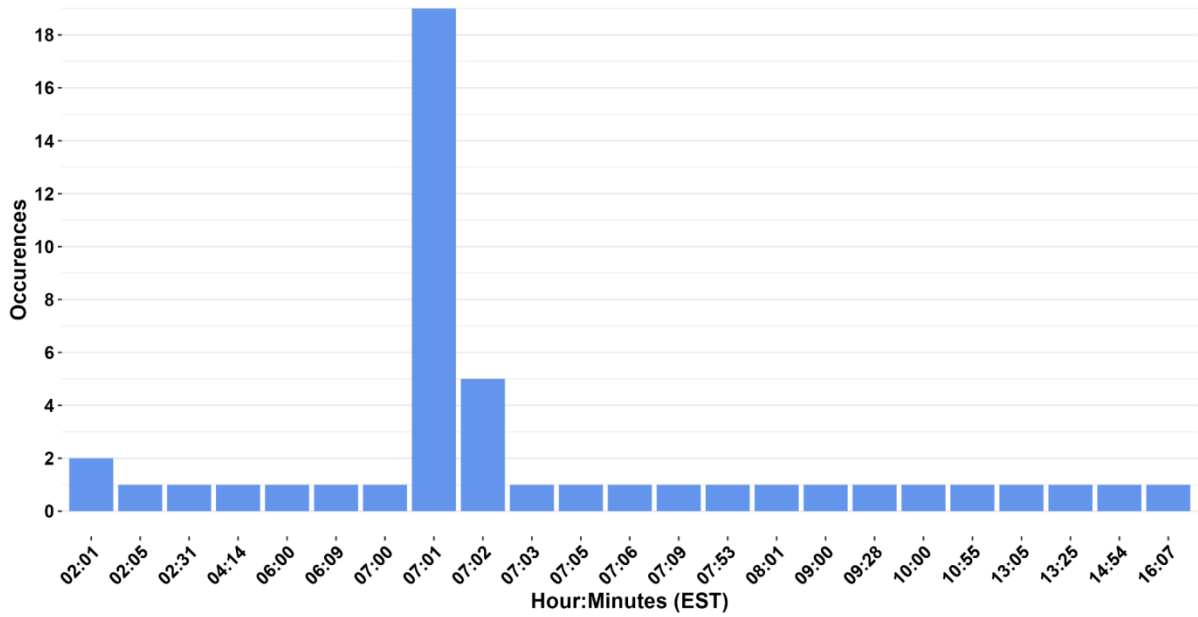


Figure S17: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: United-Kingdom

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

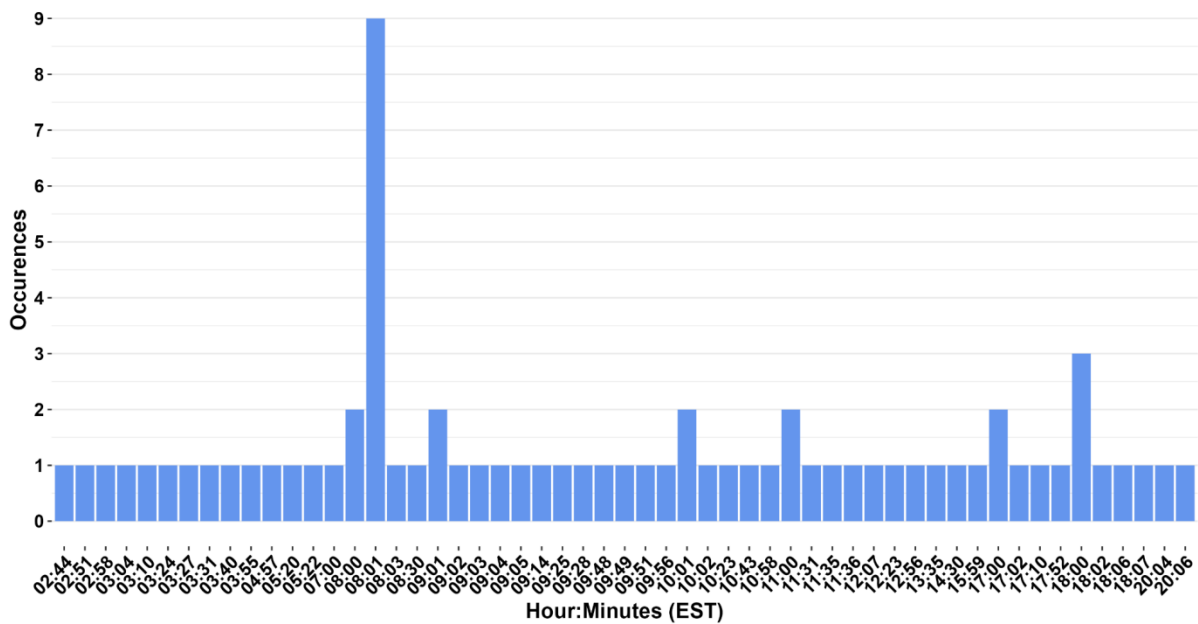


Figure S18: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Hungary

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

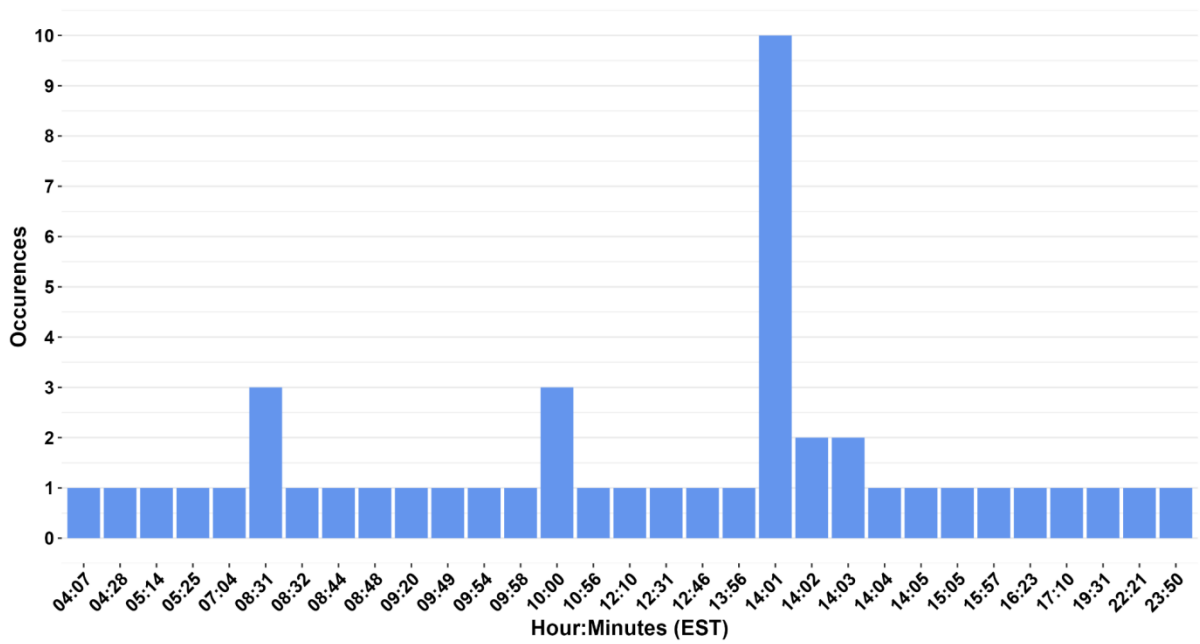


Figure S19: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Mexico

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

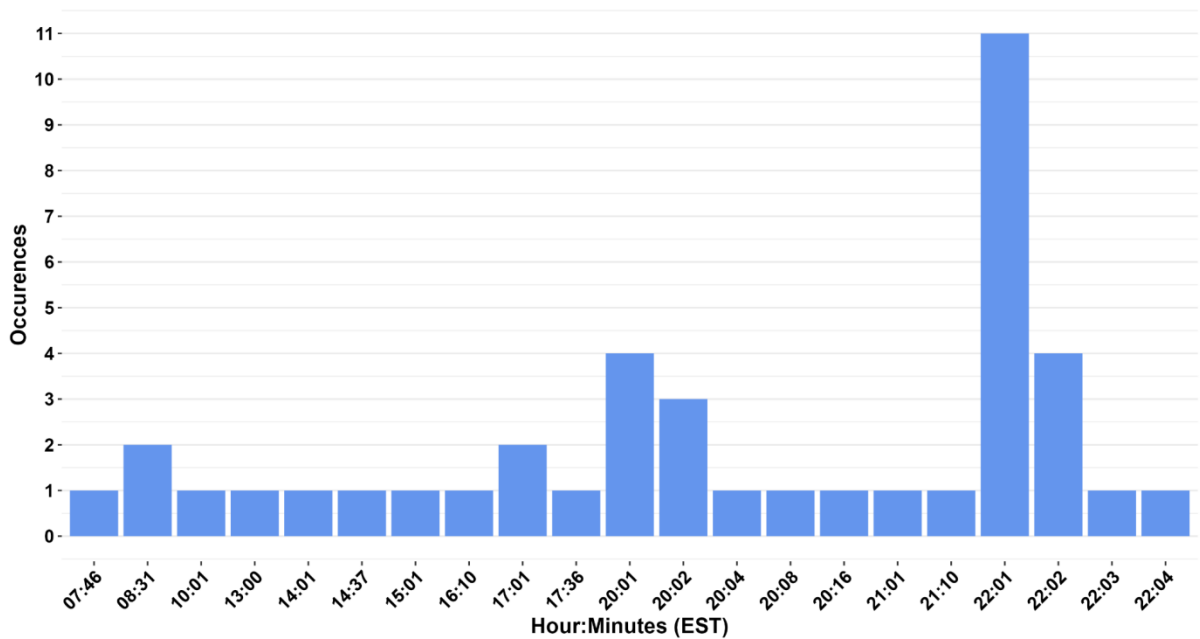


Figure S20: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: New-Zealand

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

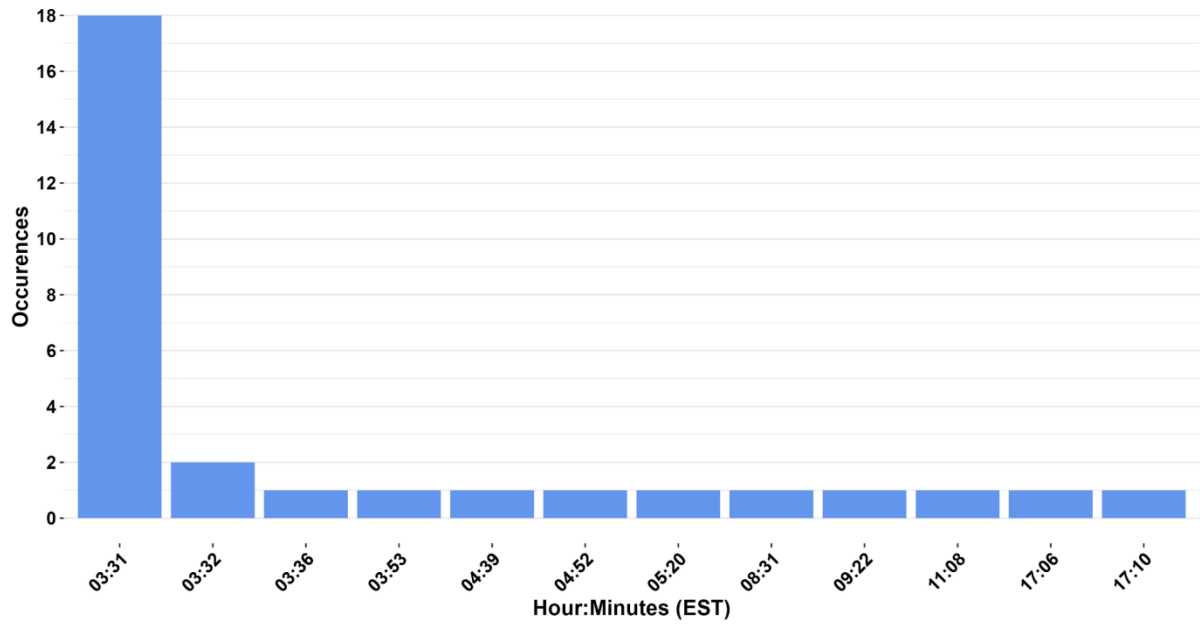


Figure S21: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Sweden

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

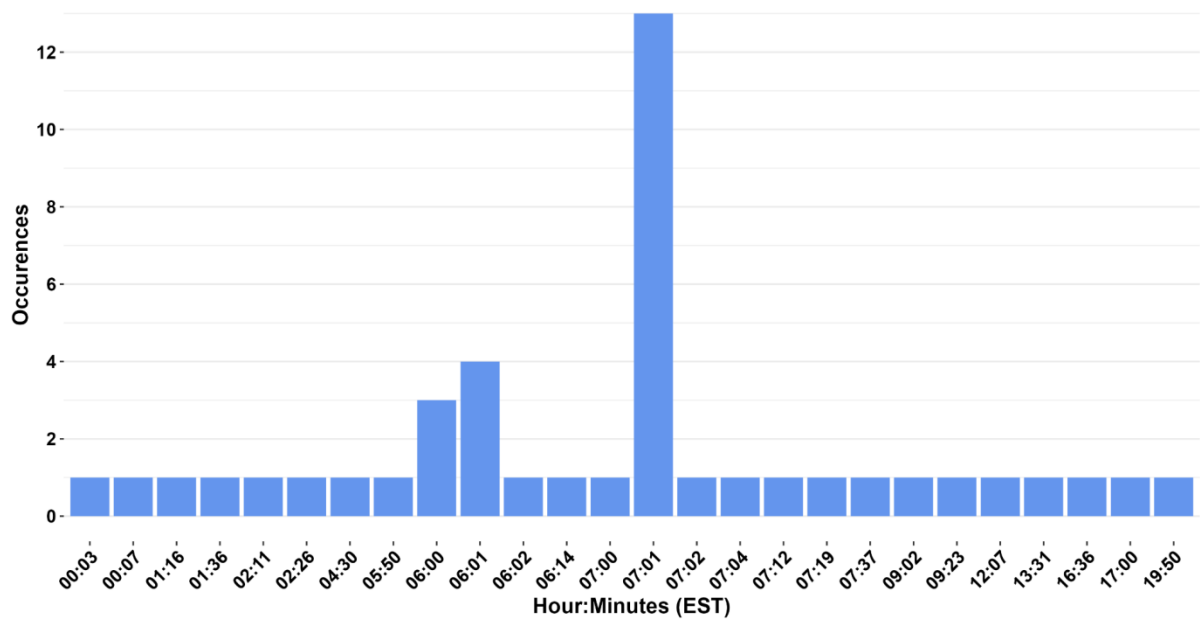


Figure S22: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

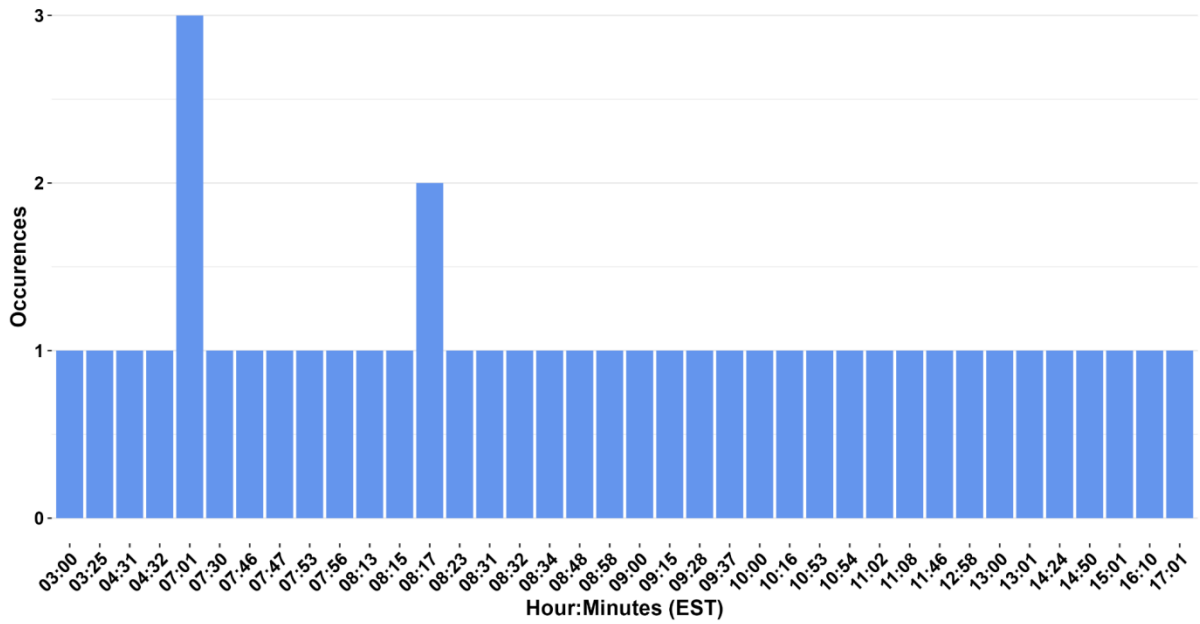


Figure S23: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: Euro Zone

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

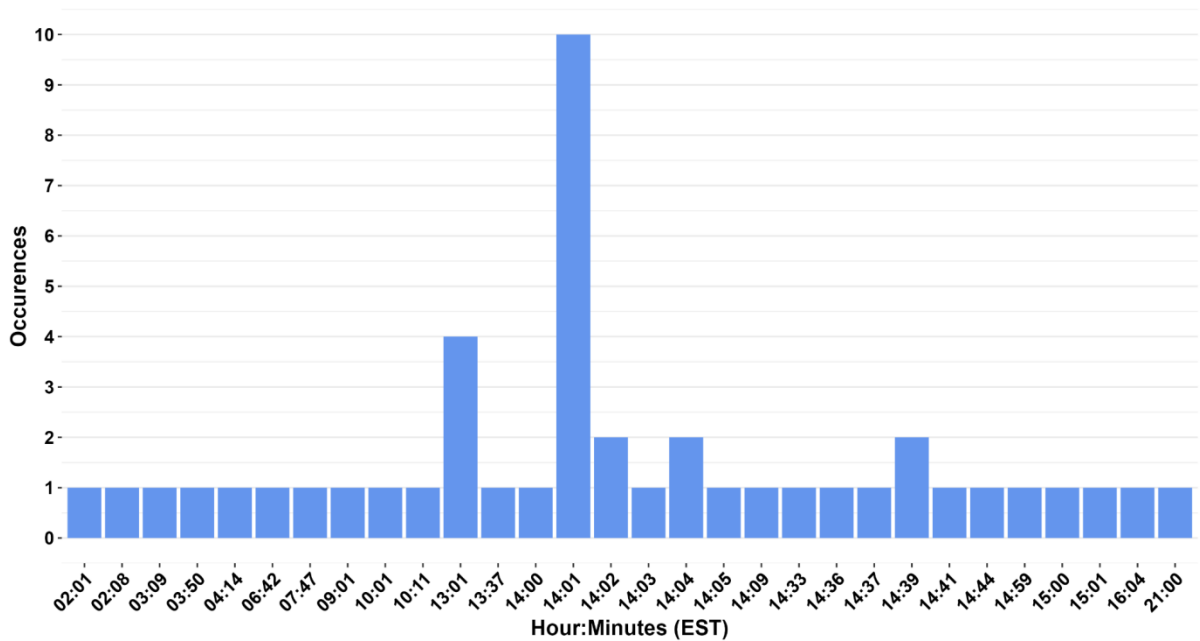


Figure S24: Time occurrences of amplitude of variation maximums (one-minute scale) on decision days: United States of America

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

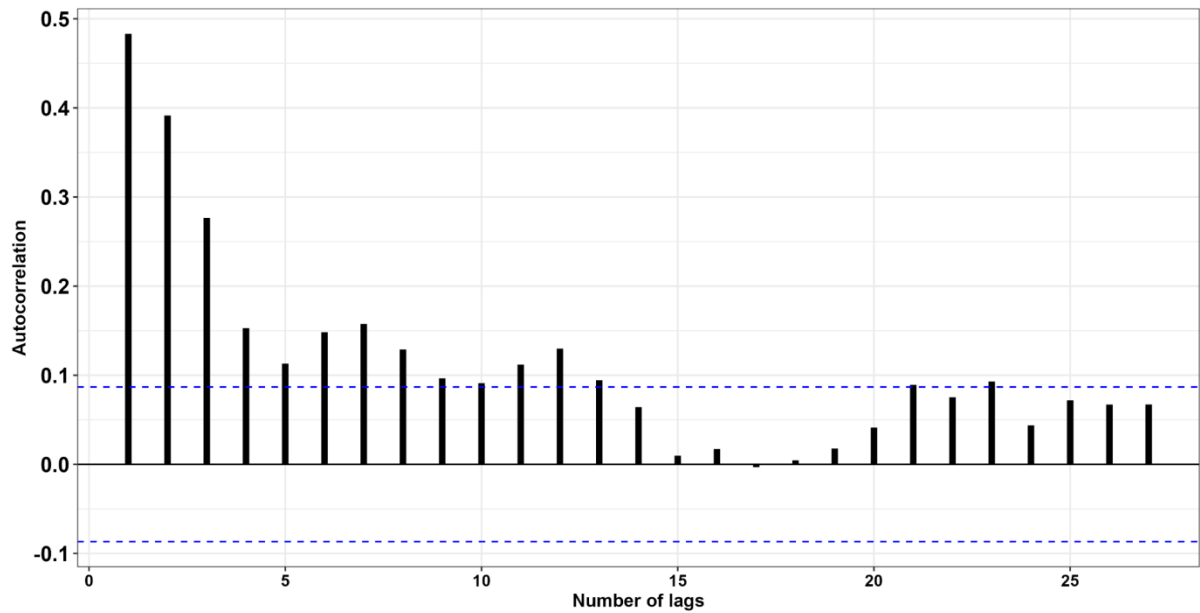


Figure S25: Autocorrelation function applied to the database of decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

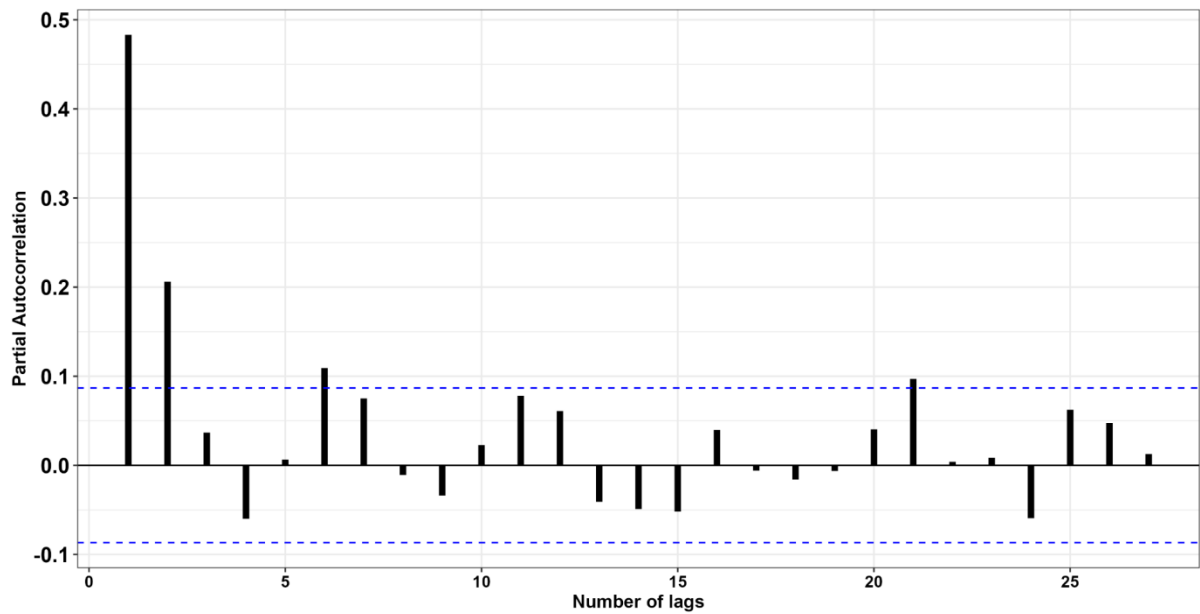


Figure S26: Partial autocorrelation function applied to the database of decision days

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

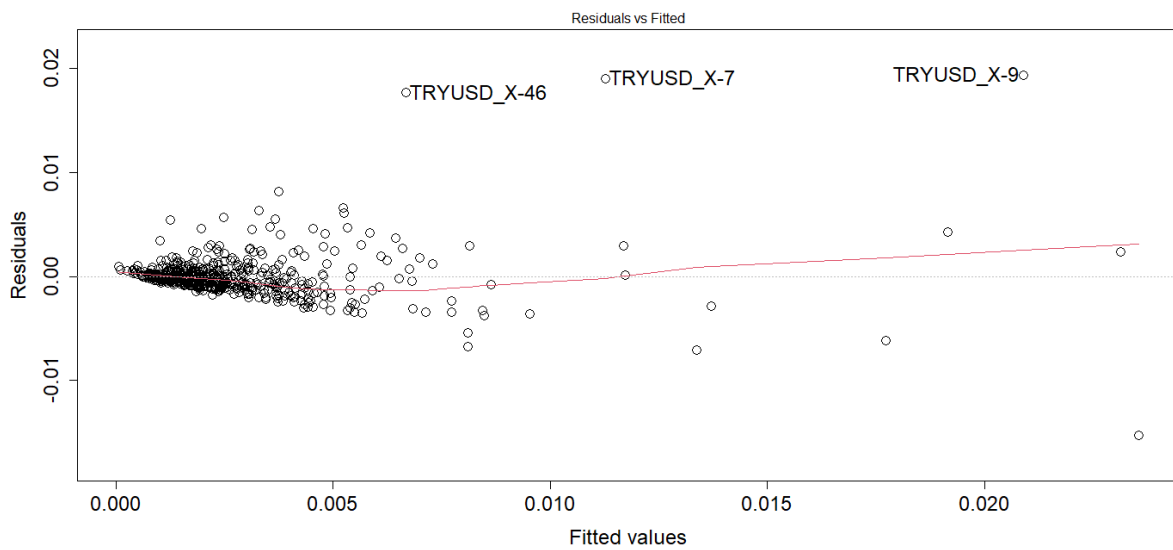


Figure S27: Residuals versus fitted values for the OLS model over the whole period with Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

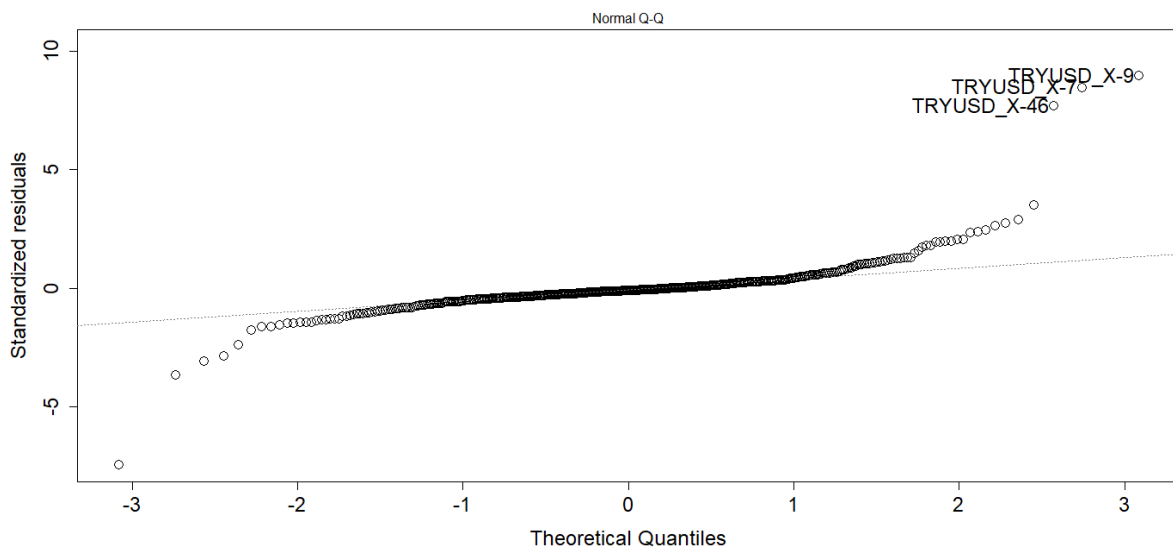


Figure S28: Standardized residuals versus theoretical quantiles for the OLS model over the whole period with Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

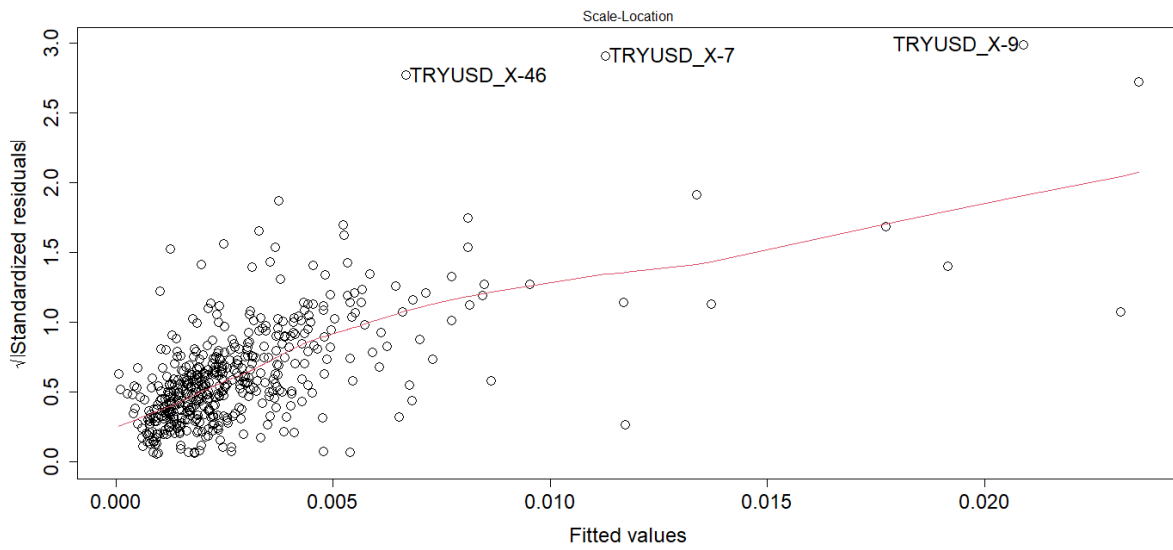


Figure S29: Standardized residuals versus fitted values for the OLS model over the whole period with Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

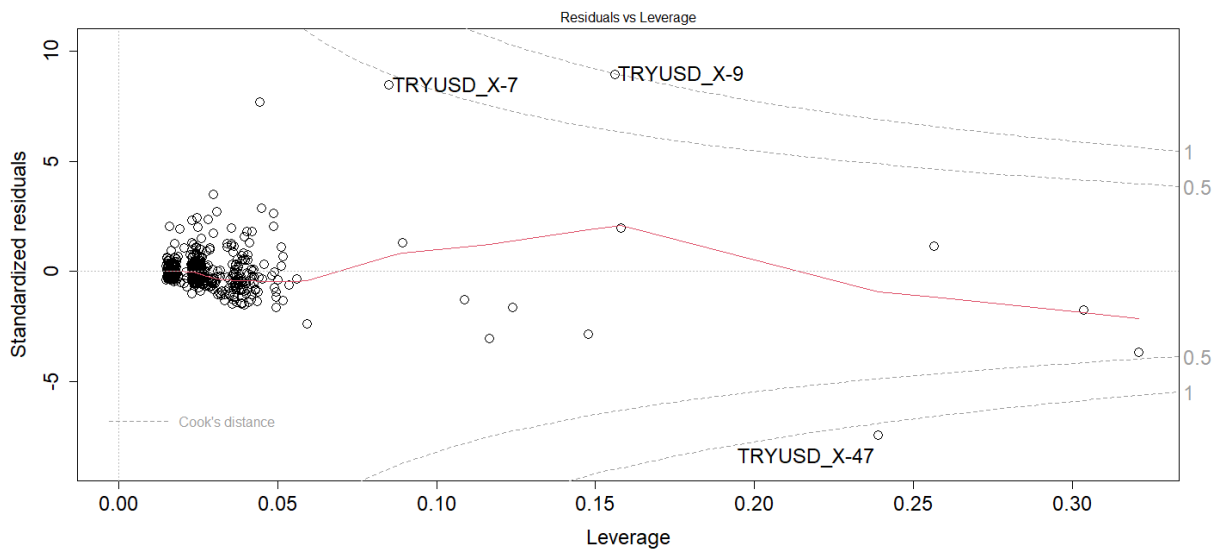


Figure S30: Standardized residuals versus leverage for the OLS model over the whole period with Turkey

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

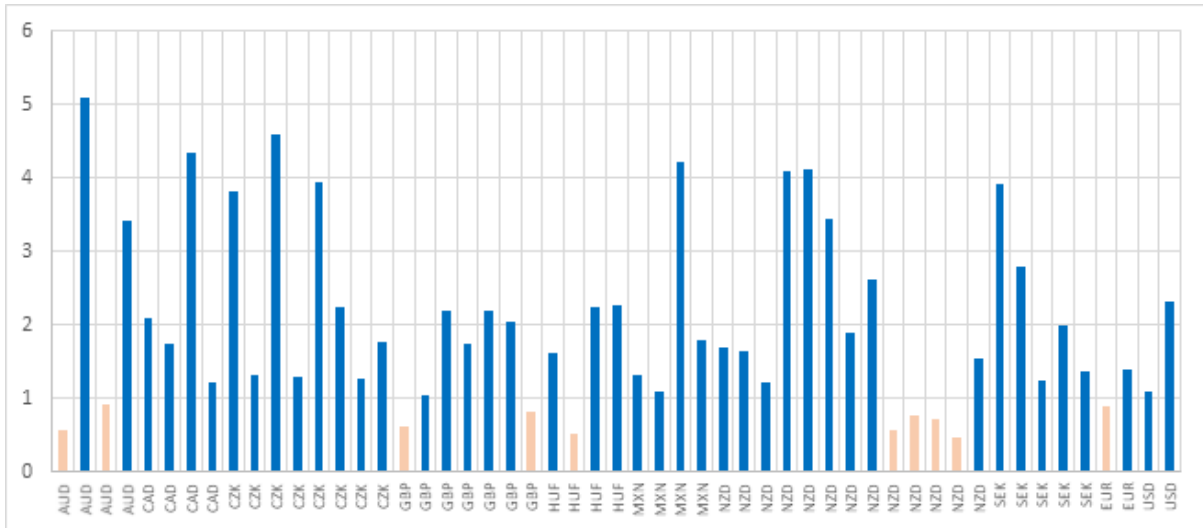


Figure S31: Ratios of amplitude of variations for surprises versus non surprises closest neighbours, excluding Turkey (blue bar: ≥ 1 , light orange bar: < 1).

Note: For each monetary surprise, a ratio is calculated. It divides its amplitude of variation by the average of the ones for the two non-surprises closest neighbors. This average is computed before and after the date of the monetary surprise for the same country (or alternatively the two before if none after). A ratio above one signal that the impact of a monetary surprise on exchange rate is higher than the one of monetary decisions that are as expected.

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023

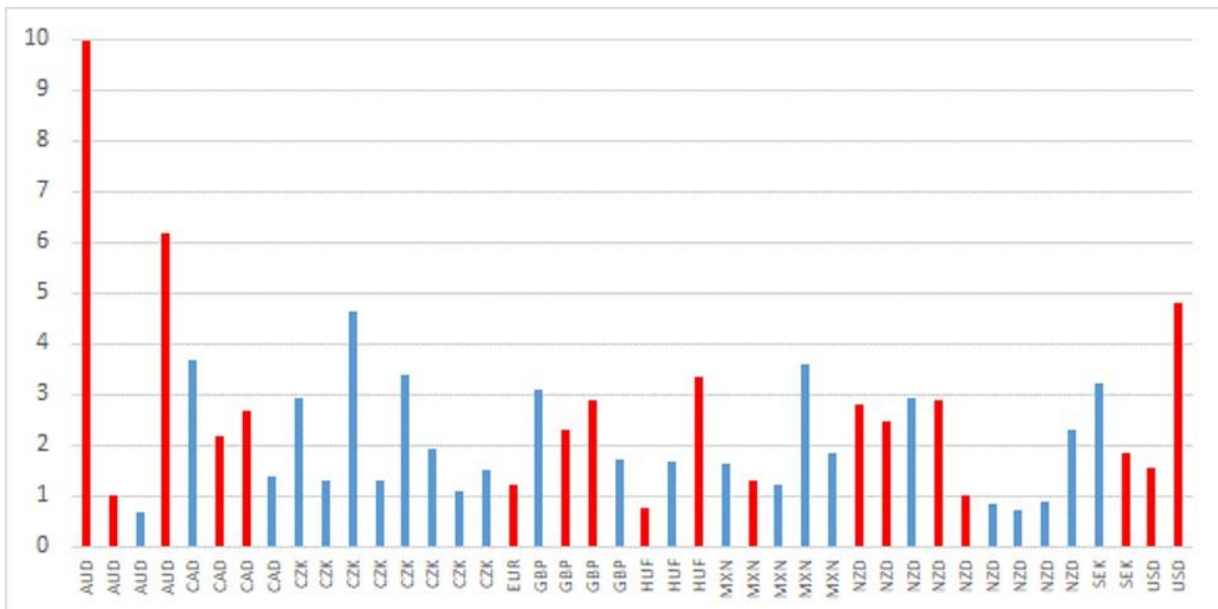


Figure S32: Ratios of amplitudes of surprises vs. median of pure non surprises. In red: surprise on both interest rates and other aspects of monetary decisions.

Source: Free Forex Data (HistData.com), Central bank websites, focus-economics.com, Factiva, Period: January 2018 - November 2023