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# Uncertainty and Exchange Rate Volatility: the Case of Mexico\*

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**Abstract:** This paper investigates the effect of uncertainty on the volatility of the Mexican peso U.S. dollar exchange rate for the period 1999 - 2018. The empirical analysis consists on estimating a model by OLS and System GMM that includes measures of economic, political, and financial uncertainty, both domestic and international, as explicative variables. The main results show that greater uncertainty leads to higher exchange rate volatility; measures of international uncertainty are found to dominate domestic uncertainty measures, although the domestic uncertainty has also an important effect on the exchange rate volatility; and there is evidence of an amplifying effect of domestic economic uncertainty on exchange rate volatility, especially during periods of recession. These results are shown to be robust to different exchange rate volatility measures, different specifications, and different economic policy uncertainty indices.

**Keywords:** Exchange Rate Volatility, Uncertainty, Expectations

**JEL Classification:** F31, D80, D84

**Resumen:** Este documento investiga el efecto de la incertidumbre sobre la volatilidad del tipo de cambio peso mexicano dólar estadounidense durante el periodo 1999 - 2018. El análisis empírico consiste en estimar un modelo por MCO y MGM en Sistema que incluye como variables explicativas medidas de incertidumbre económica, política y financiera, tanto doméstica como internacional. Los resultados principales muestran que una mayor incertidumbre induce una mayor volatilidad del tipo de cambio; la incertidumbre internacional domina sobre la doméstica, si bien la incertidumbre interna también tiene un efecto importante; y hay evidencia de un efecto amplificador de la incertidumbre sobre la situación económica interna en la volatilidad del tipo de cambio, especialmente en periodo de recesión. Los hallazgos son robustos a diferentes medidas de volatilidad del tipo de cambio, diferentes especificaciones y diferentes índices de incertidumbre económica política.

**Palabras Clave:** Volatilidad del Tipo de Cambio, Incertidumbre, Expectativas

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# 1 Introduction

For Mexico, the exchange rate and its volatility are key economic variables that have the potential to be influenced by a myriad of factors. Mexico is a small open economy that has experienced a rapid rate of international integration since the implementation of the North American Free Trade Agreement (NAFTA) in 1994. The trade agreement included commitments to free capital mobility as well as trade liberalization. Akin to other emerging market economies, Mexico has suffered currency crises, one of which began in December 1994. Since that crisis, Mexico has maintained a floating exchange rate regime and as of the most recent Bank for International Settlements Triannual Central Bank survey, the Mexican peso is the most traded emerging market currency after the Chinese renminbi.

In general, the exchange rate is the key financial variable that connects the domestic economy with the rest of the world. A floating exchange rate regime and high levels of capital flows will result in higher volatility of the exchange rate reflecting the role of the exchange rate as an adjustment mechanism and buffer to external shocks. The exchange rate affects a country's net international investment position depending on the scale of the country's international balance sheet and on the currency composition of its foreign assets and liabilities. In the case of emerging markets, the tendency to rely on foreign-currency debt can generate adverse effects during bouts of currency volatility, particularly depreciations (Lane and Shambaugh (2009) and Asis and Chari (2018)).

Exchange rate volatility is an important issue also because of its documented effect on economic decision making. As noted in Balcilar et al. (2016b), economic agents base their investment and consumption decisions on the value of the domestic currency and on its volatility. Greater exchange rate volatility can have a negative impact via a number of channels. For firms, financing investments—whether through retained profits or external funding—becomes more difficult with higher levels of financial volatility in particular because of increased unpredictability of foreign earned revenues.<sup>1</sup> Firms may delay investment, impeding productivity and GDP growth, if exchange rate shifts lead to uncertain business profits and net worth (Krol (2014)). Also, exchange rate volatility has been linked to firm defaults in emerging economies (Asis and Chari (2018)). For households and portfolio investors, higher volatility can dampen risk appetite. Furthermore, to the extent that the exchange rate influences domestic prices, volatility can lead to inflation uncertainty, possibly inducing tighter monetary policies and lower levels of consumption (Grier et al. (2004) and Grier and Grier (2006)).<sup>2</sup> Thus, exchange rate volatility is an important matter and can represent a challenge to the performance of

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<sup>1</sup>See Domínguez and Tesar (2001) and Lane and Shambaugh (2009) on the magnitude and sectoral elements of exchange rate exposure.

<sup>2</sup>For a further literature review on implications of exchange rate volatility see Krol (2014).

any economy.

Predicting the volatility of the exchange rate remains puzzling. Debate continues about the process of expectation formation and the role of fundamental macro variables. Models using macro fundamentals have had limited success in predicting exchange rates, particularly at time horizons shorter than 5 to 10 years. An often quoted study is Meese and Rogoff (1983), which showed that exchange rate models based on macro variables such as money supply, interest rates and output, did not outperform a random walk in explaining nominal exchange rate movements. In the survey Frankel and Rose (1995), the authors reiterate that basic monetary macro models have not been shown to perform satisfactorily. In addition, Rogoff (1999) makes the case that it is challenging to firmly demonstrate a systematic relationship between exchange rates and macroeconomic fundamentals.

In Engel et al. (2008), the authors argue that exchange rate models should take a financial market perspective, emphasizing the role of uncertainty.<sup>3</sup> In Engel (2006), the exchange rate is modeled under rational expectations as the expected present discounted value of current and future fundamentals. Thus current news announcements that affect expectations about future macro fundamentals are determinants of exchange rates. As discussed further in for example Engle (1982) and Grier and Grier (2006), this literature argues surprises about macroeconomic data or policy are the key drivers of exchange rate adjustments. Using expectation surveys and data announcements, researchers have identified volatility caused by the surprise component of these announcements. For a discussion of the empirical literature, see Neely (2011). Generally, the evidence suggests surprises are associated with higher exchange rate volatility.

Building on this literature, in this paper we analyze potential drivers of the Mexican peso (MXN) US dollar (USD) exchange rate volatility focusing on a range of uncertainty measures, not just macroeconomic surprises.<sup>4</sup> To construct our uncertainty measures, we exploit the data from Banco de México's Survey of Professional Forecasters (SPF).<sup>5</sup> Our survey-based measures have the advantage of being direct, model-free measures that also have enough granularity to distinguish between macroeconomic versus political uncertainty.<sup>6</sup> In addition to our survey-based measures, we also consider the impact

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<sup>3</sup>See Jurado et al. (2015) for an analysis of economic uncertainty, and its measurement, in macro models more generally.

<sup>4</sup>In the empirical literature on uncertainty, three main approaches have been used to proxy uncertainty: 1) volatility of asset prices 2) ARCH or GARCH estimates of the conditional variance of prices and/or other type of aggregates, 3) statistics characterizing the distribution of survey data, specifically surveys on entrepreneurs' expectations about the future demand for their firms' products or output prices changes and/or individual forecasters' expectations about the economic climate for investment decisions. We build our measures based on this last approach, although we also use other uncertainty measures.

<sup>5</sup>Since the SPF began in January 1999, our sample period covers January 1999 - December 2018.

<sup>6</sup>Section 2 of the paper explains the construction of these uncertainty variables in more detail.

of other measures of uncertainty that have commonly been used by researchers as uncertainty proxies such as the VIX, and including media-based indices such as the Economic Policy Uncertainty (EPU) index from Baker et al. (2016).

Our hypothesis is that uncertainty has an observable impact on exchange rate volatility, and that our survey-based measures will contain information not captured in other uncertainty measures.<sup>7</sup> Nested within this will be tests of the relative importance of different types of uncertainty, in particular international versus domestic, political, economic and financial. Mexico provides an illustrative case of an economy affected by uncertainty along these multiple dimensions. Mexico's banking sector includes subsidiaries of several large global banks that were affected by the global financial crisis. The US renegotiation of NAFTA under the Trump administration has been cited as a key driver of exchange rate volatility. Others have pointed to domestic political uncertainty surrounding Mexican presidential elections as an explanation to such exchange rate volatility. We will also test for evidence of interaction effects between uncertainty and the domestic business cycle and the political cycle.

We test our uncertainty hypotheses using regression analysis. The analysis is performed in two stages. In the first stage, we estimate a univariate GARCH (1, 1) model to derive the MXN/USD exchange rate volatility measure.<sup>8</sup> In the second stage, we regress the estimated exchange rate volatility on different uncertainty measures, including the surprise component of macroeconomic data announcements for gross domestic product (GDP) and inflation, and the controls. Finally, in order to investigate if the effect of uncertainty on exchange rate volatility is amplified during election and/or recession periods we introduce some interaction terms: a measure of domestic political uncertainty (DPU) interacted with an election dummy, DPU interacted with a recession dummy, and a measure of domestic economic uncertainty (DEU) interacted as well with a recession dummy.<sup>9</sup> The sample period covers January 1999 (when the SPF survey began) to December 2018.

Our emphasis on uncertainty draws on a literature that has proliferated since the 2008 global financial crisis. Policymakers and researchers have focused on uncertainty as a key determinant of macroeconomic aggregates such as output, employment, investment and productivity growth, as well as financial variables such as stock market volatility (Liu and Zhang (2015) and Antonakakis et al. (2013)) and asset prices gen-

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<sup>7</sup>Future work can exploit the time variation of individual respondents to the same questions, as well as characteristics of the cross-sectional distribution of the responses other than those used in this paper.

<sup>8</sup>Similar to Benavides and Capistrán (2012), this model was chosen from the ARCH family since Hansen and Lunde (2005) found no evidence in their analysis of exchange rates that the GARCH (1,1) model was outperformed by more sophisticated models when they compared 330 ARCH-type models.

<sup>9</sup>See Garfinkel et al. (1999) and Krol (2014) for election and recession analysis, respectively.

erally (Brogaard and Detzel (2015)).<sup>10</sup>

There is also research specifically analyzing the impact of uncertainty on exchange rates, most papers using one or two measures of uncertainty. Several papers use news-based economic policy uncertainty measures and find evidence of uncertainty effects.<sup>11</sup> Kurasawa (2016) finds that during several periods the EPU index from Baker et al. (2016) for the US and for Japan have been correlated with the level of US dollar Japanese yen exchange rate. Balcilar et al. (2016a) uses a nonparametric causality-in-quantiles test on 16 currency pairs and find that the differential between the US and domestic EPU measures has explanatory power for the variance of the Mexican peso US dollar exchange rate returns, but not the level. For other references on exchange rates, see Kido (2016), Liu and Pauwels (2012) and Beckmann and Czudaj (2017). We include these indices in our model in addition to our survey-based uncertainty measures.

Two papers are most similar to our approach of using multiple uncertainty measures. In Krol (2014), the author uses data from 1990-2010 for a sample of ten developed and emerging economies, and focuses on the role of general economic versus economic policy uncertainty using the indices from Baker et al. (2016) and Brogaard and Detzel (2015). The author finds evidence that both domestic and international (US) economic policy uncertainty directly increase exchange rate volatility, and that for developed economies this effect is stronger during recessionary periods. General economic uncertainty increases exchange rate volatility, but the effect is smaller. Maveé et al. (2016) analyze the drivers of volatility of the South African rand after the global financial crisis, 2009-2015. They find that rand volatility is mainly driven by global factors, such as commodity price volatility and the VIX. Domestic political uncertainty is positively associated with exchange rate volatility, but domestic macroeconomic surprises are not statistically important.<sup>12</sup>

Our paper’s main results show that the survey-based DPU measure, as well as the VIX and the EPU from Baker et al. (2016), are the main drivers of the MXN/USD exchange rate volatility. Furthermore, and in contrast to the DPU result, there is no evidence that DEU on its own is a driver of the MXN/USD exchange rate volatility,

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<sup>10</sup>For example, Bloom (2009) simulate the impact of macro uncertainty shocks on employment, output and productivity growth. Baker and Bloom (2013) assess the effect of disaster shocks on growth. Jones and Olson (2013) analyze the relationships between uncertainty and output and inflation. Balcilar et al. (2014) study the role of uncertainty as a determinant of US inflation. Karnizova and Li (2014) and Balcilar et al. (2016b) use uncertainty measures to predict economic recessions in the United States. López-Noria and Zamudio-Fernández (2018) and Cembreros et al. (2019) explore the effect of uncertainty on foreign direct investment in Mexico.

<sup>11</sup>To construct the news-based measures, text searches are applied to newspapers to quantify the frequency of words such as uncertainty in the news. An example is the group of uncertainty measures constructed by Baker et al. (2016).

<sup>12</sup>Relative to the domestic macroeconomic conditions, it may be that surprises were external ones during this sample period. However, in our longer time period we also find that in the Mexico case domestic macro surprises add little explanatory power.

it only has an impact during recession periods. In line with Maveé et al. (2016), we also find that neither the domestic macro surprises nor the EMBI+ index have a distinct impact on the MXN/USD exchange rate volatility.<sup>13</sup> Comparing the effect of international versus domestic uncertainty, simulations and standardized coefficient estimates show that both have had a similar effect on the MXN/USD exchange rate volatility, although the EPU index's effect seems to dominate.

The results are robust to different MXN/USD exchange rate volatility measures (i.e. we also estimate our main specification using a realized exchange rate volatility obtained from Bloomberg), different specifications, different econometric techniques (we estimate our main specification by Ordinary Least Squares (OLS) and the Generalized Method of Moments (GMM)), and different global EPU indexes (one that includes data on Mexico's EPU index and one that excludes it).

The contributions of this paper to the empirical literature are three-fold. First, we analyze the impact of different dimensions of uncertainty. We consider measures of political and economic uncertainty, as well as of financial instability and trade policy uncertainty, rather than just focusing on economic or economic policy uncertainty as in Balcilar et al. (2016a), Krol (2014), Sin (2015) and Kurasawa (2016). In addition, we include both domestic and international uncertainty.

Second, we use Banco de México's SPF to build our domestic and international uncertainty measures.<sup>14</sup> In particular, we use the surveyed analysts' perceptions about factors that they consider will most limit economic growth in the following six months.<sup>15</sup> To our knowledge, this is the first paper that exploits these data from the SPF.<sup>16</sup> Empirical analyses such as Balcilar et al. (2014), Balcilar et al. (2016a), Krol (2014) and Sin (2015), proxy uncertainty with the news-based EPU index from Baker et al. (2016) or Brogaard and Detzel (2015).

Third, this paper adds another case study of an emerging economy currency, however over a long time period, and one that is highly liquid and heavily traded. See Table 1. In the most recent BIS triennial survey, the Mexican peso was the emerging economy currency with the second highest average daily turnover, after the Chinese renminbi, and has consistently been in the top 15 global currencies since 2001.<sup>17</sup>

The paper proceeds as follows. Section 2 describes the empirical model and the data. Section 3 presents the results, while Section 4, robustness tests. The analysis on the relative contribution of each independent variable to the MXN/USD exchange rate

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<sup>13</sup>See for JP Morgan Emerging Markets Bond Index (EMBI).

<sup>14</sup>In Jurado et al. (2015), the authors argue that survey based measures are preferred.

<sup>15</sup>Section 2 explains the construction of these uncertainty variables in more detail.

<sup>16</sup>López-Noria and Zamudio-Fernández (2018) also derive their uncertainty measures based on Banco de México's SPF, but they concentrate on the analysts' perceptions regarding the economic climate for investment decisions.

<sup>17</sup>See Bank for International Settlements (2016).



Table 1: Mexican peso vs. major currencies  
(ranked by average daily turnover)

	OTC Foreign Exchange Daily Turnover		Domestic Currency Gov. Bonds	
	(USD bn)	% nominal GDP	(USD bn)	% nominal GDP
USD	4,438	23.82	17,252	88.97
EUR	1,591	13.32	9,431	74.80
JPY	1,096	22.14	9,427	193.49
GBP	649	24.39	2,669	101.69
AUD	348	27.51	647	46.90
MXN	97	9.00	362	31.5

Daily turnover includes cash and derivatives markets. USD, GBP, EUR general government total debt securities reported, issuance is primarily in domestic currency.

For the rest of the countries, general government domestic debt securities are reported.

Source: Triennial Central Bank Survey, IMF, BIS.

volatility is presented in Section 5 and the conclusions in Section 6.

## 2 Empirical Model and Data

In order to analyze the uncertainty-exchange rate link, we estimate an econometric model where the MXN/USD exchange rate volatility is the dependent variable and, its lag, uncertainty measures and other control variables are the independent variables. The estimated specification can be written as follows:

$$\hat{\sigma}_t^2 = \beta_0 + \beta_1 \hat{\sigma}_{t-1}^2 + \beta_2 DPU_t + \beta_3 DEU_t + \beta_4 IPU_t + \beta_5 IFI_t + \beta_6 X_t + \beta_7 Z_t + \epsilon_t \quad (1)$$

Where:

### *Exchange rate volatility*

$\hat{\sigma}_t^2$  is the monthly MXN/USD exchange rate volatility. This volatility was estimated using a univariate Generalized Autoregressive Conditional Heteroskedasticity GARCH (1,1) model and daily data from Banco de México on the FIX MXN/ USD exchange rate.<sup>18</sup> This model takes the form (Engle (1982) and Bollerslev (1986)).<sup>19</sup>

<sup>18</sup>The FIX MXN/USD exchange rate is determined by Banco de México based on the average of the wholesale exchange rate market returns. It is published by the Diario Oficial de la Federación (DOF in Spanish) one day after Banco de México has determined it. The FIX MXN/USD exchange rate is used to pay bills denominated in dollars in Mexico one day after the DOF has published it.

<sup>19</sup>We conducted ARCH-LM tests to verify if the series being analyzed presents ARCH effects. The results show that the series rejected the null in favor of ARCH effects. As in Benavides and Capistrán (2012), the tests were carried out using up to seven lags.

$$Y_t = c + \varphi Y_{t-1} + \varepsilon_t + \theta \varepsilon_{t-1} \quad (2)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (3)$$

Similar to Benavides and Capistrán (2012), this model was chosen from the ARCH family since Hansen and Lunde (2005) found no evidence in their analysis of exchange rates that the GARCH (1,1) model was outperformed by more sophisticated models when they compared 330 ARCH-type models. Once we obtained the estimated daily MXN/USD exchange rate volatility, we calculate the monthly average of this variable.

$\hat{\sigma}_{t-1}^2$  is the lagged dependent variable and it is also included in the main specification in order to control for the persistence of the series. Its inclusion indicates we are estimating a dynamic model.

### ***Survey based uncertainty measures***

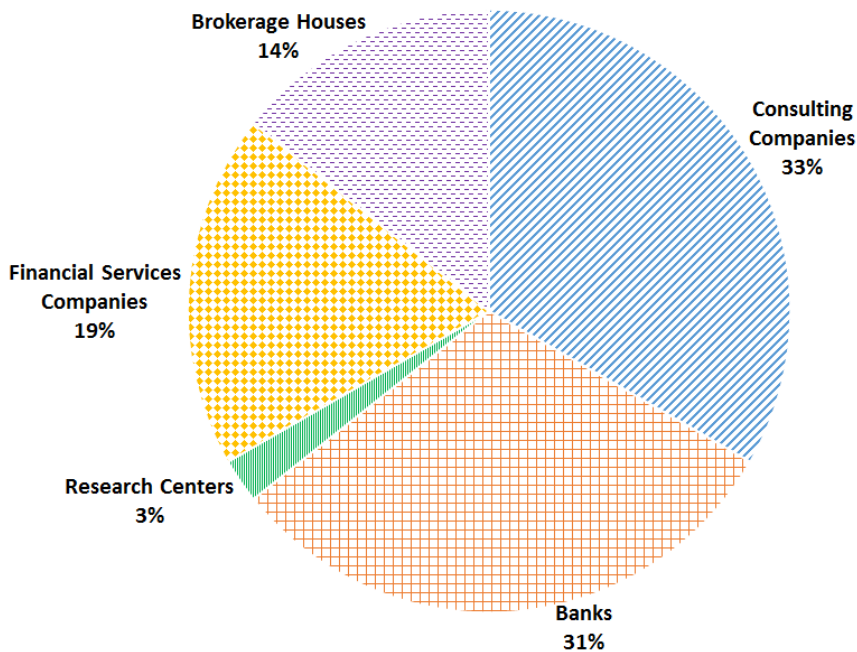
$DPU_t$ ,  $DEU_t$ ,  $IPU_t$  and  $IFI_t$  stand for domestic political uncertainty, domestic economic uncertainty, international political uncertainty, and international financial instability, respectively. These variables are constructed using Banco de México's SPF, which is a survey of macroeconomic forecasts for the rates of inflation, real GDP growth, exchange rates, interest rates, labour indicators, public finances indicators, trade balance, current account, foreign direct investment, factors affecting growth, among others. Since January 1999, Banco de México's SPF has been conducted monthly and comprises the responses of an average of 35 economic analysts from the private sector, both national and foreign. About one third of the surveyed analysts work at banks and one third at consultancies. Figure 1 shows the distribution of the analysts participating in the SPF per sector.

In order to build our uncertainty measures we focus on the following question from the SPF:

*Which are the three factors that you consider will most limit growth in economic activity in the following six months?*

The respondents of the survey choose three options out of a list of 32 factors related to inflation and monetary policy in Mexico; external conditions (foreign trade policy, international political instability, monetary policy in the US, fiscal policy in the US, oil price, international financial instability, the level of foreign interest rates, among others); domestic economic conditions (firms' level of debt, families' level of debt, platform of oil production, uncertainty about the domestic economic situation, among others); public finances; governance (domestic political uncertainty, corruption, impunity, lack of rule of law, security issues); and other. We then calculate the percentage distribution of the

Figure 1: Surveyed professional forecasters by sector



Source: Banco de México's Survey of Professional Forecasters.

responses and we derive our uncertainty measures as the percentage each uncertainty response obtained (i.e. domestic political uncertainty, domestic economic uncertainty, international political uncertainty, and international financial instability). Figure 2 plots our four survey based uncertainty measures, which vary considerably over time. We can also see that  $DPU_t$  picks up election uncertainty but does not spike with every election cycle. This is graphical evidence that the survey measure of  $DPU_t$  captures more information than just election activity. In particular, the result of the 2012 election was much less uncertain than in other cycles. Since the SPF began in January 1999, the empirical analysis conducted in this paper covers the period January 1999 to December 2018.

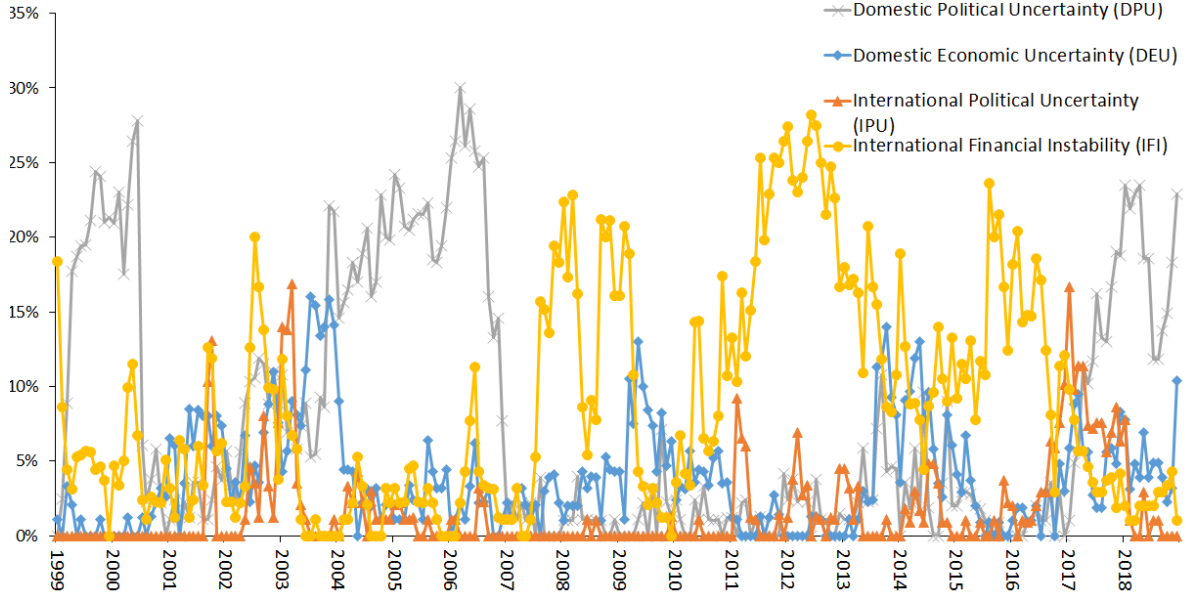
### ***Other uncertainty measures***

$X_t$  stands for other uncertainty measures that may also affect the MXN/USD exchange rate volatility. The following paragraphs describe these measures.

The global  $EPU_t$  index is a GDP-weighted average of 19 national economic policy uncertainty indices (Australia, Brazil, Canada, Chile, China, France, Germany, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States).<sup>20</sup> Each of these national indices reflects

<sup>20</sup>Mexico is included in this global EPU index, but according to Steven J.Davis this is not a problem since Mexico's weight in it is small, around 2%. Nonetheless, as a robustness check, we also estimate regressions using an earlier version of the global EPU index, which excludes Mexico and covers the

Figure 2: Banco de México survey uncertainty measures, monthly data



Source: Uncertainty measures derived by the authors with data from Banco de México’s Survey Professional Forecasters.

the relative frequency of own-country newspaper articles that contain terms related to the economy and policies that have been implemented or proposed.

We also incorporate a trade policy uncertainty index in specification (1) in order to analyze if uncertainty regarding NAFTA and Mexico’s trade liberalization policies has had an impact on the MXN/USD exchange rate volatility. This index was built by Banco de México using the standardized results from Google Trends regarding internet searches for the terms: NAFTA, *TLCAN* (NAFTA in Spanish), *Renegociación* (Renegotiation in Spanish), *Renegociación TLC* (NAFTA’s renegotiation in Spanish), *Aranceles* (tariff in Spanish), Trump NAFTA, *TLCAN Trump Mexico*, *libre comercio* (free trade in Spanish), and *que es NAFTA* (what is NAFTA in Spanish). For more details see Cebrenos et al. (2019). Figure 3 shows the development of this trade policy uncertainty index from 2004 to 2018.<sup>21</sup>

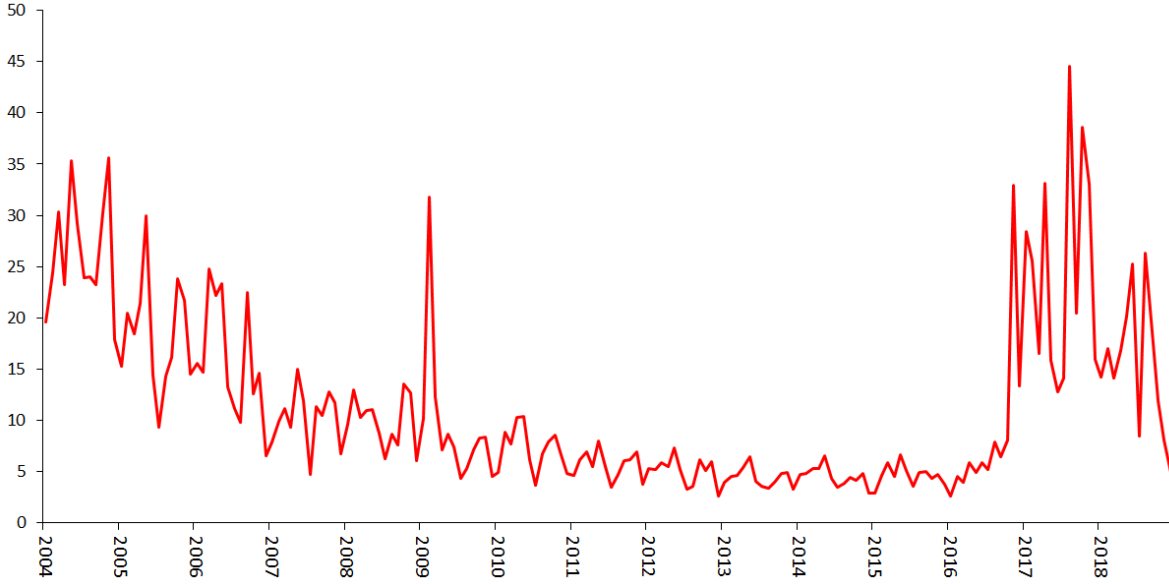
We also include the Chicago Board Options Exchange Volatility Index (VIX). The  $VIX_t$  is constructed using the implied volatilities of the S&P 500 index options and it is considered a measure of global financial market volatility, and has been used as a proxy for global uncertainty.<sup>22</sup> The  $VIX_t$  differs from our surveyed-based measure of  $IFI_t$  in that it measures the sentiment of a large and diverse set of investors based around the

period January 2001-December 2016. See Section 4 for more details.

<sup>21</sup>Data derived from Google Trends is available from January 2004 onwards, so this trade policy uncertainty index starts in that date.

<sup>22</sup>See for Chicago Board Options Exchange Volatility Index (VIX).

Figure 3: Trade uncertainty index based on Google Trends



Note: The trade uncertainty index was built using the standardized results from Google Trends regarding internet searches for different terms related with trade.  
 Source: Banco de México and Google Trends.

world, while  $IFI_t$  reflects the market sentiment of an average of 35 economic analysts focused on Mexico.

We also include uncertainty measures for GDP and inflation in equation (1) that capture the surprise component of macroeconomic data announcements. We use Banco de México’s SPF to build these surprises as the deviation between the observed data of the economic indicator (i.e. GDP or inflation) and the mean of the surveyed forecasters’ expectations on that same economic indicator.

Computing the GDP surprise poses challenges because of the quarterly frequency of the observed data (the SPF is conducted monthly), and the fact that the data are first released 2 months after the end of the quarter. Consequently, from the monthly SPF data we have three expected values for each quarter, 1 for each of the 3 monthly surveys before the GDP value is published. For example, the surveys for November, December and January ask for the forecasters’ expected value for Q4 GDP. Then Q4 GDP is published in February, and surveys from February onward do not ask for expected values for Q4. Therefore, to compute the monthly GDP surprise for each of those 3 months, we subtract each of the Q4 expected values derived from Banco de México’s SPF from the Q4 GDP value published in February. Table 2 shows how was the GDP surprise constructed. The unit of measurement is basis points. Figure 4 shows the evolution of the GDP and inflation surprises across time. The biggest GDP surprise (negative) coincides with the global financial crisis.

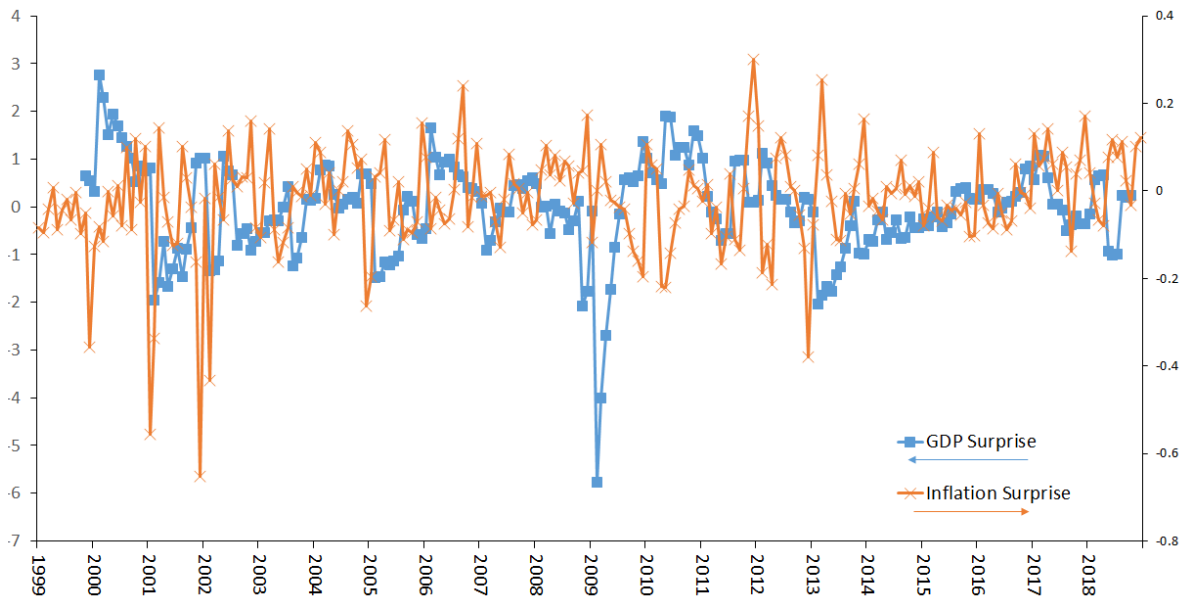
Table 2: GDP surprises calculation

	survey forecast	published data	GDP surprise
Jan	$E[Q4]$		$Q4 - E[Q4]$
Feb	$E[Q1]$	Q4	$Q1 - E[Q1]$
Mar	$E[Q1]$		$Q1 - E[Q1]$
Apr	$E[Q1]$		$Q1 - E[Q1]$
May	$E[Q2]$	Q1	$Q2 - E[Q2]$
Jun	$E[Q2]$		$Q2 - E[Q2]$
Jul	$E[Q2]$		$Q2 - E[Q2]$
Aug	$E[Q3]$	Q2	$Q3 - E[Q3]$
Sep	$E[Q3]$		$Q3 - E[Q3]$
Oct	$E[Q3]$		$Q3 - E[Q3]$
Nov	$E[Q4]$	Q3	$Q4 - E[Q4]$
Dec	$E[Q4]$		$Q4 - E[Q4]$

Note: This table shows how the GDP surprises are computed since the SPF is conducted every month and the GDP is published every quarter.

Source: From authors' own calculations.

Figure 4: Mexico macro surprises for the GDP and the Inflation, basis points



Note: The macro surprises are built as the deviation between the observed data of the economic indicator (i.e. GDP or inflation) and the mean of the surveyed forecasters expectations on that same economic indicator.

Source: From authors' own calculations.

### *Additional independent variables*

$Z_t$  includes other factors such as the US dollar price of a barrel of Mexican crude oil export mix, and a country risk proxy.<sup>23</sup> We control for the US dollar price of a barrel of Mexican crude oil export mix because Mexico is one of the top 15 oil exporters in the world and the price volatility of this commodity has been shown to affect MXN/USD exchange rate volatility.

Table 3 presents summary statistics for the dependent variable and the explanatory variables included in equation (1).

Table 3: Summary statistics of the variables used in the regressions

		Obs.	Mean.	Median	Std Dev.	Min	Max
Dependent Variable	$\log(\hat{\sigma}_{Garch}^2)$	240	-10.73	-10.85	0.71	-11.98	-7.69
	$\log(\sigma_{RealizedVol})$	240	2.21	2.18	0.41	1.36	3.72
Banco de México Survey Variables	Domestic Pol. Unc. (%)	240	7.95	3.60	8.59	0.0	30.0
	Domestic Econ. Unc. (%)	240	3.87	3.10	3.59	0.0	16.0
	International Pol. Unc. (%)	240	1.70	0.0	3.12	0.0	16.90
	International Fin. Instability (%)	240	8.83	6.10	7.51	0.0	28.20
	GDP Surprise (observed-expected)	228	-0.02	0.08	0.98	-5.77	2.77
	Inflation Surprise (observed-expected)	240	-0.02	-0.01	0.12	-0.65	0.30
Other Independent Variables	Global Econ. Policy Unc. (Index)	240	114.98	105.11	48.21	50.31	304.33
	Trade Policy Unc. (Google) <sup>a</sup> (Index)	180	11.40	7.95	8.59	2.65	44.50
	VIX (Index)	240	19.96	18.14	7.87	9.51	59.89
	$d\log(\text{Oil price})$	239	0.01	0.02	0.10	-0.43	0.27

Note: (a) Calculated by Banco de México using data from Google Trends (2004-2018).

Source: Banco de México, INEGI, Google Trends, and policyuncertainty.com.

Before estimating equation (1), we perform stationarity tests on the variables used in the regressions: the Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and the tests from Ng and Perron (2001). Table 4 shows the test results. All the test results for the oil price (i.e. US dollar price of a barrel of Mexican crude oil export mix) show non-stationarity. Hence, we use the first difference of the oil price series in our regressions. The log of our alternative exchange rate volatility measure (realized volatility), the inflation surprise series and the Global Economic Policy Uncertainty index fail the Ng and Perron (2001) tests, (the 10% critical value is -5.7). However, these pass two of the stationarity tests and we do not transform these variables. Nevertheless when viewing the regression estimations, these stationarity issues can be kept in mind.<sup>24</sup>

We also analyzed the correlations between the dependent variable and the explanatory variables considered in equation (1) and we obtained that the  $DPU_t$ ,  $IFI_t$ ,

<sup>23</sup>Other controls, such as domestic and foreign interest rates, inflation and industrial production were considered but they were not statistically significant or worsened the overall model fit.

<sup>24</sup>The test in Ng and Perron (2001) was developed to address problems with time series that display large negative moving average roots, and/or an AR root close to one. For our variables, the autoregressive roots were above 0.95 for only two (Oil price (0.97) and Trade Policy Uncertainty Index (0.97)). Some of the MA coefficients were negative, however they were all much less negative than -0.8 (the value emphasized in Ng and Perron (2001)). Thus these series are not likely to be affected by the problems corrected by the tests in Ng and Perron (2001) and as such we put more weight on the ADF and PP tests.

the  $VIX_t$ , and the  $EPU_t$  are some of the variables that correlate the most with the MXN/USD exchange rate volatility.<sup>25</sup>

Table 4: Stationarity tests for variables used in the regressions

	Aug. Dickey- Fuller	Phillips- Perron	Ng and Perron	Stationary ADF/PP/NP	Transf.
$\log(\hat{\sigma}_{Garch}^2)$	0.0000	0.0000	-7.4136	Y/Y/Y	
$\log(\sigma_{RealizedVol})$	0.0000	0.0000	-4.1745 <sup>+</sup>	Y/Y/N	
Domestic Political Unc. (DPU) (%)	0.0743	0.0808	-6.0563	Y/Y/Y	
Domestic Economic Unc. (DEU) (%)	0.0008	0.0000	-12.1466	Y/Y/Y	
International Political Unc. (IPU) (%)	0.0000	0.0000	-10.4958	Y/Y/Y	
International Financial Inst. (IFI) (%)	0.0022	0.0042	-6.4491	Y/Y/Y	
GDP surprise (observed-expected)	0.0000	0.0000	-25.2139	Y/Y/Y	
Inflation Surprise (observed-expected)	0.0000	0.0000	-1.3537 <sup>+</sup>	Y/Y/N	
Global Econ. Policy Unc. (EPU Index)	0.0132	0.0475	-5.4413 <sup>+</sup>	Y/Y/N	
Trade Policy Uncertainty (Google) <sup>a</sup> (Index)	0.0230	0.0000	-6.4832	Y/Y/Y	
VIX (Index)	0.0004	0.0003	-7.1925	Y/Y/Y	
Oil price (\$, dollar)	0.1294 <sup>+</sup>	0.2277 <sup>+</sup>	-3.4116 <sup>+</sup>	N/N/N	Log first diff.

Note: The Trade Uncertainty Index is calculated using data from Google Trends.

Inflation and GDP surprises are calculated as the deviation between the observed figure and the surveyed forecasters' expectations.

<sup>+</sup> Cannot reject the null hypothesis of a unit root. Reject unit root using Ng and Perron MSB statistic.

For more detail see Table 15 in the Appendix.

Source: The authors performed the stationarity tests.

## 2.1 Interaction Terms

Following Krol (2014), we also investigate whether the impact of uncertainty on the MXN/USD exchange rate volatility is amplified during election or recessionary periods. In order to analyze whether elections amplify the effect of uncertainty, we introduce an interaction term between  $DPU_t$  and an election dummy. The election dummy is equal to 1 for the three months before and one month after an election has taken place in Mexico and, zero otherwise.<sup>26</sup> During our sample period, Mexico had four elections (see Table 5).

Furthermore, in order to study the influence of recessions, we interact a recession dummy with our measures of  $DPU_t$  and  $DEU_t$ .

<sup>25</sup>For details see Table 16 in the Appendix.

<sup>26</sup>We also performed sensitivity checks using election periods of 6 months and 9 months, and the results were robust.



Table 5: Twentieth and twenty first century election cycles for Mexico

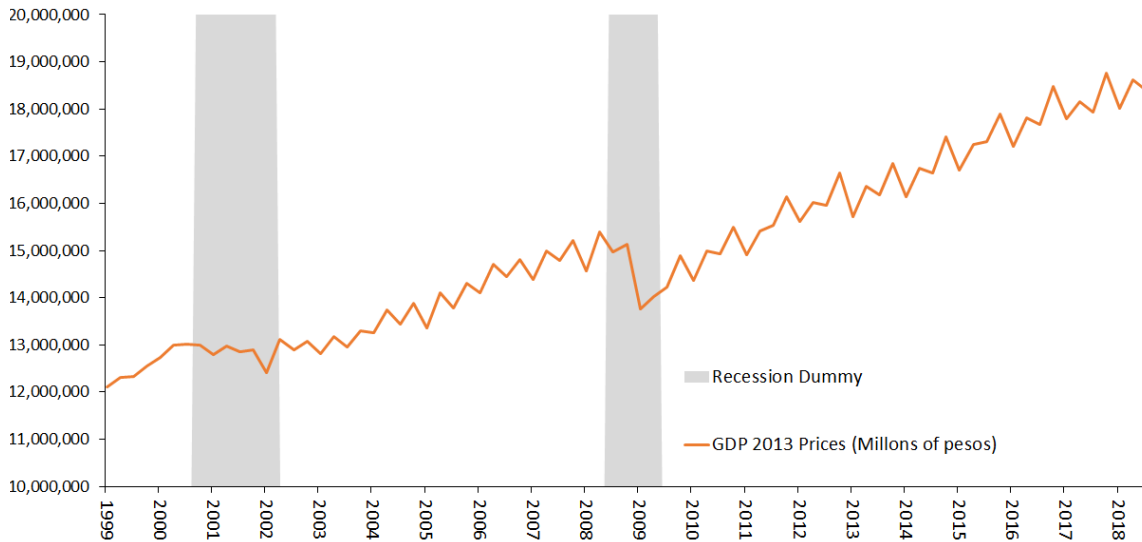
Name of winner	Year
Ernesto Zedillo Ponce de León	1994
Vicente Fox Quesada	2000
Felipe de Jesús Calderón Hinojosa	2006
Enrique Peña Nieto	2012
Andrés Manuel López Obrador	2018

Note: Every election is held on July 1st (or 2nd), except for the election of Ernesto Zedillo who was elected on August 21, 1994. The election period comprises 4 months, April-July. Our sample includes four election periods.

Source: The authors built this table.

The recession dummy is equal to 1 if there is a recession period, the shaded areas in Figure 5, and equal to 0 if there is an expansionary period.<sup>27</sup>

Figure 5: Mexico's GDP



Source: The GDP data was obtained from INEGI, while the data used by the authors to build the recession dummy was obtained from Banco de México.

<sup>27</sup>In order to determine the peaks and troughs of the business cycle (i.e. booms and recessions), the Bry and Boschan (1971) algorithm is applied to the "Global Indicator of Economic Activity" series (IGAE in Spanish), which is monthly and published by INEGI. A recession is defined as a decline in the IGAE for two consecutive quarters (6 months).

### 3 Results

Tables 6 and 7 report the OLS results of estimating equation (1), considering the global EPU index that includes Mexico. Table 6 includes, apart from the uncertainty measures and the additional independent variables ( $VIX_t$  and the US dollar price of a barrel of Mexican crude oil export mix) mentioned in Section 2, the GDP and inflation surprises, while Table 7 additionally includes the interaction term between  $DPU_t$  and the election dummy and the interaction terms between  $DPU_t$  and  $DEU_t$  and the recession dummy. We mainly find that of the two domestic surveyed-based uncertainty measures ( $DPU_t$  and  $DEU_t$ ) considered, only  $DPU_t$  has a positive and a consistently statistically significant effect (except for some columns) on the MXN/USD exchange rate volatility. The results also show that the  $VIX_t$  and the  $EPU_t$  indices, two of the international and non-surveyed based uncertainty measures considered in the specification, have a positive and a consistently statistically significant effect on the MXN/USD exchange rate volatility as well, which suggests that greater global financial and economic policy uncertainty tends to lead to higher exchange rate volatility in the Mexican economy.

Regarding the trade policy uncertainty index, we find that it does not have a statistically significant effect on the MXN/USD exchange rate volatility in any of the estimated specifications. It may be the case that the effect of trade policy uncertainty on the MXN/USD exchange rate volatility has been captured by the international uncertainty measures such as the  $VIX_t$  and the  $EPU_t$  indices.

In line with Maveé et al. (2016), which study the case of the South African rand, we also find that none of the macro surprises included in the estimated specification are statistically significant.<sup>28</sup> This suggests that other measures of uncertainty may be more important for emerging economies, although further research is required to assess to what degree the Mexico and South Africa cases can be generalized.

The oil price variable is negative and statistically significant in some of the estimated specifications. A possible explanation for this result is the following: Mexico is an oil producer and exporter, so if the international oil price increases, Mexico's government oil revenue increases as well. This effect reduces uncertainty regarding the government's revenues and so it is translated into lower MXN/USD exchange rate volatility.

Similar to Krol (2014), the results show that during recession periods, an increase in  $DEU_t$  leads to higher MXN/USD exchange rate volatility, which is evidence of an amplifying effect during recessions. In contrast,  $DPU_t$  does not seem to have a statistically significant effect on the MXN/USD exchange rate volatility during election or recession periods. The election period result is robust to using longer election periods,

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<sup>28</sup>This was also true for specifications that included the absolute values of the macro surprises.

for example 6 and 9 month periods.

Finally, our main findings regarding  $DPU_t$ , the  $VIX_t$  and the  $EPU_t$  remain and are robust to inclusion of JP Morgan's Emerging Markets Bond Index (EMBI+ (Mexico)), a measure of bond spreads for Mexico, higher levels are associated with higher country risk.

In order to control for possible cases of endogeneity (some regressors might be a function of exchange rate volatility, rather than a determinant of it), we estimate equation (1) by GMM, an instrumental variables econometric technique. The results are presented in Tables 8 and 9. Similar to Tables 6 and 7, we mainly find that  $DPU_t$  has a positive and a statistically significant effect (except for column 4 in Table 8) on the MXN/USD exchange rate volatility. We also find that an increase in the  $VIX_t$  and the  $EPU_t$  indices leads to higher MXN/USD exchange rate volatility. However, in contrast to Tables 6 and 7 which present some unexplained negative and statistically significant effects of the  $IPU_t$ , the recession dummy and the interaction between  $DPU_t$  and the recession dummy on the MXN/USD exchange rate volatility, Tables 8 and 9 show that these effects are no longer statistically significant.

It should be mentioned that in order to control for general forms of heteroskedasticity and serial correlation in the error term of equation (1), HAC robust standard errors are presented both in the OLS and the GMM estimated specifications. In the case of the GMM results we additionally include Hansen's J test for the exogeneity of the set of instruments considered in the estimated specifications. The results on this test show that the null hypothesis  $E\{z_i u_i(\beta)\} = 0$  is not rejected, which suggest that the models are correctly specified.

Table 6: Estimation Results by *OLS*; includes marco surprises

	Dependent Variable: $\log(\hat{\sigma}_{Garch}^2)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.7619*** (0.0335)	0.6447*** (0.0441)	0.6332*** (0.0600)	0.7329*** (0.0541)	0.6381*** (0.0464)	0.6508*** (0.0434)	0.6430*** (0.0463)
Domestic Political Uncertainty (DPU)	0.0044 (0.0027)	0.0068* (0.0030)	0.0074 (0.0054)	0.0078 (0.0051)	0.0083** (0.0030)	0.0074* (0.0029)	0.0088** (0.0029)
Domestic Economic Uncertainty (DEU)	0.0145+ (0.0077)	0.0084 (0.0068)	0.0072 (0.0089)	0.0087 (0.0091)	0.0105 (0.0069)	0.0090 (0.0068)	0.0106 (0.0069)
International Political Uncertainty (IPU)	-0.0005 (0.0072)	-0.0145+ (0.0085)	-0.0031 (0.0117)	0.0181 (0.0113)	-0.0203* (0.0084)	-0.0135 (0.0085)	-0.0194* (0.0084)
International Financial Instability (IFI)	0.0192*** (0.0049)	0.0079+ (0.0043)	0.0049 (0.0050)	0.0116** (0.0044)	0.0062 (0.0044)	0.0085* (0.0043)	0.0067 (0.0044)
Global Econ. Policy Unc. ( <i>With Mexico</i> ) <sup>a</sup>		0.0035*** (0.0010)	0.0034** (0.0011)		0.0043*** (0.0011)	0.0035*** (0.0010)	0.0042*** (0.0011)
Trade Policy Uncertainty (Google) <sup>b</sup>			-0.0008 (0.0056)	-0.0005 (0.0061)			
VIX		0.0125* (0.0057)	0.0193* (0.0082)	0.0188* (0.0089)	0.0138* (0.0057)	0.0120* (0.0058)	0.0133* (0.0059)
$d\log(\text{Oil price})$		-0.5093+ (0.2773)	-0.5191 (0.3390)	-0.7541+ (0.4019)	-0.4548 (0.2955)	-0.5434+ (0.2785)	-0.4848 (0.2955)
GDP Surprise					0.0150 (0.0245)		0.0099 (0.0246)
Inflation Surprise						-0.2714 (0.2263)	-0.2057 (0.2280)
Constant	-2.8182*** (0.3865)	-4.5936*** (0.6176)	-4.7944*** (0.8279)	-3.4218*** (0.7098)	-4.7680*** (0.6488)	-4.5375*** (0.6121)	-4.7185*** (0.6501)
Adj R-Squared	0.6948	0.7466	0.7837	0.7589	0.7582	0.7474	0.7582
Akaike	234.5062	192.9292	151.0433	169.6381	180.1478	193.1474	181.1536
F-stat	151.3957	108.6547	80.5365	65.8174	96.1942	103.9468	89.8551
No. of Obs.	239	239	180	180	228	239	228

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

$\log(\hat{\sigma}_{Garch}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate.

(a) This index is a GDP weighted average of 19 national economic policy uncertainty indices, including Mexico, and covers the period January 1999 - December 2018.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

Table 7: Estimation Results by OLS; includes recession dummies, election dummies, and EMBI+ index

	$\log(\hat{\sigma}_{Garch}^2)$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.6378*** (0.0431)	0.6244*** (0.0595)	0.6292*** (0.0465)	0.6337*** (0.0439)	0.6100*** (0.0612)	0.6404*** (0.0434)
Domestic Political Uncertainty (DPU)	0.0032 (0.0034)	0.0031 (0.0059)	0.0060+ (0.0031)	0.0058+ (0.0031)	0.0072 (0.0053)	0.0066* (0.0032)
Domestic Economic Uncertainty (DEU)	0.0088 (0.0066)	0.0068 (0.0089)	0.0082 (0.0068)	0.0024 (0.0066)	-0.0012 (0.0080)	0.0089 (0.0069)
International Political Uncertainty (IPU)	-0.0118 (0.0085)	-0.0004 (0.0120)	-0.0153+ (0.0084)	-0.0152+ (0.0087)	-0.0043 (0.0113)	-0.0147+ (0.0085)
International Financial Instability (IFI)	0.0055 (0.0044)	0.0025 (0.0051)	0.0066 (0.0046)	0.0059 (0.0045)	0.0041 (0.0051)	0.0083+ (0.0044)
Global Econ. Policy Unc. ( <i>With Mexico</i> ) <sup>a</sup>	0.0034*** (0.0010)	0.0033** (0.0011)	0.0036*** (0.0010)	0.0036*** (0.0010)	0.0037** (0.0011)	0.0035*** (0.0010)
Trade Policy Uncertainty (Google) <sup>b</sup>		-0.0003 (0.0056)			-0.0013 (0.0057)	
VIX	0.0132* (0.0058)	0.0199* (0.0082)	0.0114* (0.0057)	0.0139* (0.0061)	0.0153* (0.0074)	0.0117+ (0.0068)
$d\log(\text{Oil price})$	-0.5029+ (0.2760)	-0.5597 (0.3400)	-0.4846+ (0.2707)	-0.6053* (0.2742)	-0.6637* (0.3284)	-0.5130+ (0.2769)
Election Dummy	0.2741+ (0.1449)	0.1748+ (0.0969)				
DPU*Election Dummy	0.0006 (0.0060)	0.0059 (0.0049)				
Recession Dummy			0.1408 (0.1393)	-0.3575** (0.1186)	-0.2050 (0.2783)	
DPU*Recession Dummy			-0.0873+ (0.0449)		-0.1633 (0.2655)	
DEU*Recession Dummy				0.0609* (0.0239)	0.0900** (0.0301)	
EMBI+(Mexico)						0.0001 (0.0003)
Constant	-4.6441*** (0.6024)	-4.8594*** (0.8179)	-4.7300*** (0.6365)	-4.6962*** (0.6198)	-4.9750*** (0.8234)	-4.6507*** (0.6018)
Adj R-Squared	0.7533	0.7879	0.7497	0.7523	0.7916	0.7456
Akaike	188.4829	149.3245	191.8696	189.4544	147.1127	194.7996
F-stat	93.4136	88.2386	89.2794	105.9004	73.8263	96.6363
No. of Obs.	239	180	239	239	180	239

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

$\log(\hat{\sigma}_{Garch}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate.

(a) This index is a GDP weighted average of 19 national economic policy uncertainty indices, including Mexico, and covers the period January 1999 - December 2018.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

Table 8: Estimation Results by GMM; includes macro surprises

	Dependent Variable: $\log(\hat{\sigma}_{Garch}^2)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.6634*** (0.0700)	0.6757*** (0.0695)	0.4373** (0.1482)	0.7591*** (0.0973)	0.7062*** (0.0531)	0.6232*** (0.0646)	0.6183*** (0.0645)
Domestic Political Uncertainty (DPU)	0.0364** (0.0121)	0.0077* (0.0037)	0.0149+ (0.0086)	0.0104 (0.0080)	0.0073* (0.0036)	0.0092* (0.0041)	0.0101* (0.0045)
Domestic Economic Uncertainty (DEU)	0.0633** (0.0238)	0.0065 (0.0131)	0.0092 (0.0129)	-0.0054 (0.0247)	-0.0038 (0.0104)	0.0051 (0.0145)	0.0110 (0.0143)
International Political Uncertainty (IPU)	0.0263 (0.0265)	0.0040 (0.0167)	-0.0437 (0.0368)	0.0402* (0.0171)	-0.0083 (0.0112)	-0.0108 (0.0169)	-0.0109 (0.0149)
International Financial Instability (IFI)	0.0826*** (0.0242)	0.0082 (0.0072)	-0.0110 (0.0124)	0.0034 (0.0089)	0.0074 (0.0074)	0.0024 (0.0084)	0.0036 (0.0086)
Global Econ. Policy Unc. ( <i>With Mexico</i> ) <sup>a</sup>		0.0021 (0.0017)	0.0105* (0.0050)		0.0025 (0.0018)	0.0044*** (0.0013)	0.0044*** (0.0013)
Trade Policy Uncertainty (Google) <sup>b</sup>			-0.0086 (0.0054)	-0.0067 (0.0073)			
VIX		0.0186* (0.0088)	0.0231** (0.0071)	0.0249** (0.0080)	0.0123* (0.0053)	0.0198* (0.0084)	0.0197** (0.0074)
$d\log(\text{Oil price})$		-0.5766 (0.3988)	-0.3734 (0.4486)	-0.7285+ (0.4267)	-0.5263 (0.3350)	-0.6047 (0.5009)	-0.6120 (0.4155)
GDP Surprise					0.0070 (0.0270)		-0.0022 (0.0362)
Inflation Surprise						-0.3145 (0.3028)	-0.3427 (0.3077)
Constant	-4.9304*** (1.0366)	-4.2213*** (0.9489)	-7.5533*** (2.0573)	-3.1045* (1.2779)	-3.7635*** (0.7100)	-5.0036*** (0.8647)	-5.0979*** (0.8436)
Hansen's J-Test: (p-value)	(0.3105)	(0.5462)	(0.9458)	(0.7069)	(0.7167)	(0.9226)	(0.9614)
No. of Obs.	180	180	178	180	228	178	178

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .  $\log(\hat{\sigma}_{Garch}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate.

(a) This index is a GDP weighted average of 19 national economic policy uncertainty indices, including Mexico, and covers the period January 1999 - December 2018.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

Table 9: Estimation Results by *GMM*; includes recession dummies, election dummies, and EMBI+ index

	Dependent Variable: $\log(\hat{\sigma}_{Garch,t}^2)$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.6687*** (0.0763)	0.6544*** (0.0764)	0.6235*** (0.0617)	0.5755*** (0.0557)	0.5877*** (0.0718)	0.5890*** (0.0825)
Domestic Political Uncertainty (DPU)	0.0202* (0.0095)	0.0253+ (0.0146)	0.0076* (0.0036)	0.0084* (0.0038)	0.0120+ (0.0066)	0.0072+ (0.0040)
Domestic Economic Uncertainty (DEU)	0.0024 (0.0122)	-0.0073 (0.0132)	0.0106 (0.0153)	0.0093 (0.0151)	-0.0012 (0.0131)	-0.0014 (0.0131)
International Political Uncertainty (IPU)	-0.0054 (0.0233)	0.0073 (0.0462)	-0.0057 (0.0117)	-0.0108 (0.0128)	-0.0077 (0.0124)	-0.0105 (0.0159)
International Financial Instability (IFI)	0.0125 (0.0144)	-0.0017 (0.0160)	0.0071 (0.0091)	0.0062 (0.0088)	0.0009 (0.0061)	0.0035 (0.0100)
Global Econ. Policy Unc. ( <i>With Mexico</i> ) <sup>a</sup>	0.0048* (0.0019)	0.0057* (0.0023)	0.0035** (0.0012)	0.0047** (0.0015)	0.0049*** (0.0012)	0.0033+ (0.0018)
Trade Policy Uncertainty (Google) <sup>b</sup>		-0.0085 (0.0108)			-0.0057 (0.0065)	
VIX	0.0165+ (0.0085)	0.0226** (0.0088)	0.0140+ (0.0078)	0.0154+ (0.0083)	0.0172** (0.0065)	0.0159 (0.0112)
$d\log(\text{Oil price})$	-0.6798 (0.4820)	-0.6616 (0.4031)	-0.4958 (0.4471)	-0.5401 (0.4957)	-0.7230* (0.3175)	-0.5319 (0.5737)
Election Dummy	-1.2830 (1.3233)	-0.8573 (1.2213)				
DPU*Election Dummy	0.0216 (0.0587)	-0.0049 (0.0682)				
Recession Dummy			0.2753 (0.2779)	-0.2724 (0.2105)	-0.2136 (0.2653)	
DPU*Recession Dummy			-0.1939 (0.3109)		-0.1762 (0.2380)	
DEU*Recession Dummy				0.0860* (0.0336)	0.0925** (0.0337)	
EMBI+(Mexico)						0.0013 (0.0016)
Constant	-4.6047*** (0.9981)	-4.7483*** (0.8615)	-4.8593*** (0.8143)	-5.5291*** (0.7769)	-5.3225*** (0.8999)	-5.4099*** (1.0666)
Hansen's J-Test: (p-value)	(0.8356)	(0.6925)	(0.7148)	(0.7484)	(0.7428)	(0.9219)
No. of Obs.	156	180	180	180	178	178

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .  $\log(\hat{\sigma}_{Garch,t}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate.

(a) This index is a GDP weighted average of 19 national economic policy uncertainty indices, including Mexico, and covers the period January 1999 - December 2018.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

## 4 Robustness Tests

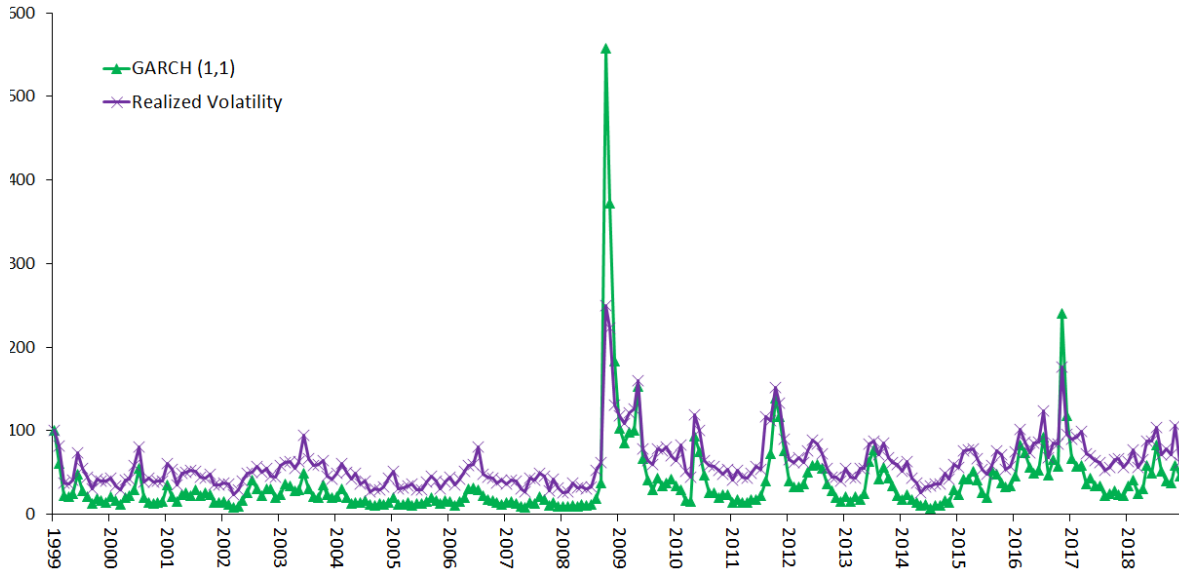
We perform some additional exercises in order to test for the robustness of the results.

### 4.1 Alternative Exchange Rate Volatility Measure

First, we re-estimate equation (1) by OLS using a measure of realized MXN/USD exchange rate volatility as a dependent variable, rather than the MXN/USD exchange rate volatility we obtained from the estimated GARCH (1,1) model. The realized exchange rate volatility is based on daily observed data from Bloomberg on the spot MXN/USD exchange rate. It is calculated by annualizing the standard deviation ( $\sigma$ ) of periodic logarithmic returns over the sample period.<sup>29</sup> Figure 6 plots our two exchange rate volatility measures for the sample period. Both measures of exchange rate volatility are converted into monthly time series.

The results of this first exercise are presented in Table 10.

Figure 6: Monthly averages on daily data, Jan. 1999=100



Source: The GARCH(1,1) model was estimated by the authors using daily data from Banco de México on the FIX Mexican peso (MXN) US dollar (USD) exchange rate. The realized volatility was obtained from Bloomberg.

### 4.2 Alternative Global EPU Index (it excludes Mexico)

Second, we re-estimate equation (1) by OLS and GMM using as a dependent variable the MXN/USD exchange rate volatility derived from the GARCH (1,1) model and,

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<sup>29</sup>For more details see Bloomberg.



as one of the explanatory variables, the  $EPU_t$  index that excludes Mexico. As we mentioned in Section 2, the  $EPU_t$  index that excludes Mexico is an earlier version of the index and it only covers the period January 2001 - December 2016. The results are presented in Tables 11 and 12.

Our main findings from both exercises show that regardless of the  $EPU_t$  index we include as an explanatory variable (with or without including Mexico) and the econometric technique we employed to estimate equation (1),  $DPU_t$ , as well as the  $VIX_t$  and the  $EPU_t$  indexes continue to have a positive and a statistically significant effect on the MXN/USD exchange rate volatility. We also confirm that the effect of  $DEU_t$  on the MXN/USD exchange rate volatility is amplified in recession periods.

### 4.3 Simulations

Sections 3 and 4 show that higher international and domestic uncertainty may lead to higher MXN/USD exchange rate volatility. In order to investigate the size of this effect, we perform simulations using specification (2) in Table 8. We choose this specification for three reasons. First, it includes the survey-based uncertainty measures we derived from Banco de México's SPF, as well as international indicators such as the  $VIX_t$ , the  $EPU_t$  and the price of a barrel of Mexican crude oil export mix. This is important since this set of regressors includes the variables that we found had a statistically significant effect on the MXN/USD exchange rate volatility. Second, this particular specification was estimated by GMM, which is robust to the possibility of endogeneity. Finally, this regression includes as an independent variable the most recent  $EPU_t$  index published by Bloom, Baker and Davis, so it covers the complete sample period (January 1999 – December 2018).

We conduct the simulations fixing the uncertainty measures for each and every month during the period 2007 – 2018 equal to the lowest level they reached during the sample period. Since all uncertainty measures were at their sample minimum level in 2007, just before the eruption of the global financial crisis, the simulations start in that year. We build counterfactual scenarios for the MXN/USD exchange rate volatility from 2007 to 2018 under the assumption of minimum uncertainty, and compare them with the base scenario where MXN/USD exchange rate volatility is that derived from the estimated GARCH (1,1) model. Figure 7 plots several counterfactual scenarios for MXN/USD exchange rate volatility, as well as the base scenario.

The results show that if uncertainty (proxied, for example, by the domestic political uncertainty ( $DPU_t$  in equation (1))) for each and every month during the period 2007-2018 had been equal to 1% (the sample period minimum), then MXN/USD exchange rate volatility would have been that depicted with the triangle pattern, a lower exchange

Table 10: Estimation Results by *OLS*; includes macro Surprises, recession dummies, election dummies and EMBI+ index

	Dependent Variable: $\log(\sigma_{RealizedVol})$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(\sigma_{RealizedVol-1})$	0.6138*** (0.0525)	0.5756*** (0.0689)	0.6244*** (0.0535)	0.6050*** (0.0513)	0.5612*** (0.0677)	0.5489*** (0.0656)	0.6177*** (0.0517)
Domestic Political Uncertainty (DPU)	0.0025 (0.0023)	0.0028 (0.0039)	0.0041* (0.0021)	-0.0004 (0.0025)	-0.0007 (0.0041)	0.0026 (0.0038)	0.0027 (0.0024)
Domestic Economic Uncertainty (DEU)	0.0035 (0.0048)	0.0031 (0.0065)	0.0049 (0.0049)	0.0037 (0.0047)	0.0028 (0.0065)	-0.0026 (0.0062)	0.0030 (0.0048)
International Political Uncertainty (IPU)	-0.0051 (0.0058)	0.0031 (0.0074)	-0.0084+ (0.0050)	-0.0032 (0.0058)	0.0052 (0.0073)	0.0022 (0.0071)	-0.0049 (0.0058)
International Financial Instability (IFI)	0.0032 (0.0028)	0.0014 (0.0033)	0.0023 (0.0027)	0.0016 (0.0028)	-0.0003 (0.0033)	0.0007 (0.0034)	0.0029 (0.0029)
Global Econ. Policy Unc. ( <i>With Mexico</i> ) <sup>a</sup>	0.0021** (0.0007)	0.0021* (0.0008)	0.0026*** (0.0006)	0.0020** (0.0007)	0.0020** (0.0008)	0.0023** (0.0008)	0.0021** (0.0007)
Trade Policy Uncertainty (Google) <sup>b</sup>		-0.0001 (0.0036)		0.0003 (0.0034)	0.0003 (0.0034)	-0.0007 (0.0036)	
VIX	0.0065* (0.0030)	0.0120** (0.0043)	0.0073* (0.0030)	0.0069* (0.0030)	0.0124** (0.0042)	0.0090+ (0.0046)	0.0073+ (0.0037)
$d\log(\text{Oil price})$	-0.2221 (0.1717)	-0.1778 (0.1853)	-0.1661 (0.1742)	-0.2255 (0.1718)	-0.2145 (0.1842)	-0.2734 (0.1719)	-0.2171 (0.1687)
GDP Surprise			0.0050 (0.0153)				
Inflation Surprise			-0.1761 (0.1413)				
Election Dummy				0.1229 (0.0759)	0.0777 (0.0579)		
DPU*Election Dummy				0.0045 (0.0038)	0.0079* (0.0036)		
Recession						-0.0968 (0.1570)	
DPU*Recession Dummy						-0.1752 (0.1327)	
DEU*Recession Dummy						0.0598** (0.0182)	
EMBI+(Mexico)							-0.0001 (0.0002)
Constant	0.4286*** (0.0992)	0.4364*** (0.1018)	0.3314*** (0.0944)	0.4683*** (0.0993)	0.4908*** (0.1041)	0.5544*** (0.1055)	0.4273*** (0.0995)
Adj R-Squared	0.6797	0.7191	0.7072	0.6901	0.7292	0.7320	0.6786
Akaike	-9.3595	-6.6467	-25.4800	-15.3722	-11.3287	-12.3028	-7.6294
F-stat	68.7550	52.8652	56.2210	61.9349	57.6689	47.7637	60.8406
No. of Obs.	239	180	228	239	180	180	239

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ . Bloomberg realized volatility is calculated by annualizing the standard deviation of periodic log returns over the historic time horizon.

(a) This index is a GDP weighted average of 19 national economic policy uncertainty indices, including Mexico, and covers the period January 1999 - December 2018.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

Table 11: Estimation Results by *OLS*; includes macro surprises, recession dummies, election dummies, EMBI+ index and global economic policy uncertainty index without Mexico

	Dependent Variable: $\log(\hat{\sigma}_{Garch}^2)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.6357*** (0.0527)	0.6130*** (0.0630)	0.6432*** (0.0511)	0.6276*** (0.0530)	0.6042*** (0.0634)	0.5920*** (0.0637)	0.6242*** (0.0521)
Domestic Political Uncertainty (DPU)	0.0096** (0.0037)	0.0121* (0.0055)	0.0096** (0.0035)	0.0068+ (0.0038)	0.0079 (0.0059)	0.0119* (0.0053)	0.0096* (0.0037)
Domestic Economic Uncertainty (DEU)	0.0060 (0.0071)	0.0107 (0.0104)	0.0070 (0.0071)	0.0060 (0.0071)	0.0103 (0.0103)	0.0014 (0.0091)	0.0050 (0.0072)
International Political Uncertainty (IPU)	-0.0246* (0.0109)	-0.0085 (0.0164)	-0.0235* (0.0108)	-0.0243* (0.0110)	-0.0096 (0.0164)	-0.0112 (0.0162)	-0.0259* (0.0110)
International Financial Instability (IFI)	0.0016 (0.0057)	-0.0021 (0.0058)	0.0027 (0.0057)	-0.0006 (0.0061)	-0.0050 (0.0065)	-0.0030 (0.0060)	0.0028 (0.0058)
Global Econ. Policy Unc. ( <i>Without Mexico</i> ) <sup>a</sup>	0.0051*** (0.0015)	0.0056*** (0.0014)	0.0048** (0.0015)	0.0052*** (0.0015)	0.0058*** (0.0014)	0.0059*** (0.0014)	0.0048** (0.0016)
Trade Policy Uncertainty (Google) <sup>b</sup>		-0.0016 (0.0070)			-0.0005 (0.0069)	-0.0020 (0.0072)	
VIX	0.0151* (0.0065)	0.0206* (0.0081)	0.0155* (0.0068)	0.0155* (0.0066)	0.0207* (0.0082)	0.0178* (0.0075)	0.0126 (0.0077)
$d\log(\text{Oil price})$	-0.4194 (0.3155)	-0.5988+ (0.3480)	-0.4270 (0.3121)	-0.4241 (0.3174)	-0.6038+ (0.3481)	-0.7578* (0.3362)	-0.4012 (0.3207)
GDP Surprise			0.0260 (0.0280)				
Inflation Surprise			-0.1718 (0.2541)				
Election Dummy				0.1284 (0.0955)	0.1598 (0.0993)		
DPU*Election Dummy				0.0072+ (0.0041)	0.0062 (0.0044)		
Recession Dummy						-0.2874 (0.2649)	
DPU*Recession Dummy						-0.1302 (0.2503)	
DEU*Recession Dummy						0.0930** (0.0281)	
EMBI+(Mexico)							0.0005 (0.0005)
Constant	-4.8474*** (0.7401)	-5.2299*** (0.8748)	-4.7621*** (0.7206)	-4.9270*** (0.7428)	-5.3082*** (0.8798)	-5.3955*** (0.8643)	-5.0086*** (0.7311)
Adj R-Squared	0.7685	0.8040	0.7682	0.7698	0.8056	0.8122	0.7685
Akaike	159.9023	129.8918	162.0877	160.7754	130.4681	125.9877	160.9166
F-stat	93.9752	72.3052	82.3859	99.2958	84.2677	67.1116	82.8052
No. of Obs.	192	156	192	192	156	156	192

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .  $\log(\hat{\sigma}_{Garch}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate.

(a) This index does not include Mexico and covers the period from January 2001 - December 2016.

(b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

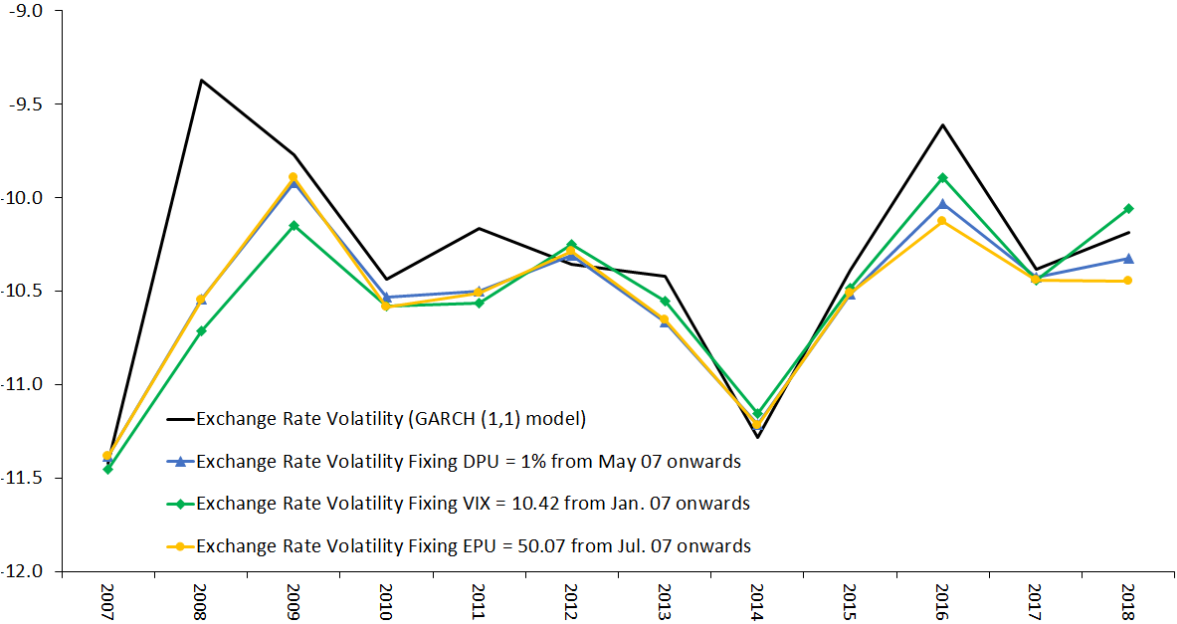
Table 12: Estimation Results by *GMM*; includes macro surprises, recession dummies, election dummies, EMBI+ index and global economic policy uncertainty index without Mexico

	Dependent Variable: $\log(\hat{\sigma}_{Garch}^2)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\log(\hat{\sigma}_{Garch,t-1}^2)$	0.5726*** (0.0748)	0.5408*** (0.0848)	0.5908*** (0.0679)	0.5266*** (0.0887)	0.5886*** (0.1075)	0.4748*** (0.0845)	0.6030*** (0.0750)
Domestic Political Uncertainty (DPU)	0.0128** (0.0049)	0.0169* (0.0069)	0.0123** (0.0044)	0.0124+ (0.0072)	0.0260+ (0.0142)	0.0209** (0.0076)	0.0078+ (0.0040)
Domestic Economic Uncertainty (DEU)	0.0057 (0.0164)	0.0119 (0.0144)	0.0062 (0.0140)	0.0110 (0.0136)	-0.0050 (0.0138)	0.0050 (0.0154)	-0.0048 (0.0133)
International Political Uncertainty (IPU)	-0.0269 (0.0265)	-0.0280 (0.0365)	-0.0228 (0.0252)	-0.0376 (0.0248)	-0.0299 (0.0485)	-0.0422 (0.0320)	-0.0090 (0.0201)
International Financial Instability (IFI)	-0.0093 (0.0108)	-0.0119 (0.0112)	-0.0071 (0.0102)	-0.0112 (0.0135)	-0.0143 (0.0161)	-0.0170 (0.0121)	-0.0009 (0.0110)
Global Econ. Policy Unc. ( <i>Without Mexico</i> ) <sup>a</sup>	0.0082** (0.0027)	0.0093** (0.0034)	0.0073*** (0.0020)	0.0103*** (0.0029)	0.0085* (0.0038)	0.0116*** (0.0032)	0.0040+ (0.0022)
Trade Policy Uncertainty (Google) <sup>b</sup>		-0.0044 (0.0074)			-0.0111 (0.0096)	-0.0076 (0.0080)	
VIX	0.0201** (0.0068)	0.0217** (0.0071)	0.0199* (0.0080)	0.0188* (0.0074)	0.0242** (0.0083)	0.0166* (0.0069)	0.0162+ (0.0086)
$d\log(\text{Oil price})$	-0.5001 (0.3778)	-0.4717 (0.4134)	-0.5483 (0.3856)	-0.5008 (0.3534)	-0.4913 (0.3852)	-0.5388+ (0.3253)	-0.5608 (0.4942)
GDP Surprise			-0.0083 (0.0354)				
Inflation Surprise			-0.2903 (0.3438)				
Election Dummy				-0.5987 (0.9609)	-0.1386 (0.9181)		
DPU*Election Dummy				0.0365 (0.0382)	-0.0222 (0.0593)		
Recession Dummy						-0.1305 (0.2693)	
DPU*Recession Dummy						-0.2665 (0.2299)	
DEU*Recession Dummy						0.0967** (0.0310)	
EMBI+(Mexico)							0.0012 (0.0010)
Constant	-5.8465*** (1.0609)	-6.3140*** (1.2092)	-5.5862*** (0.9372)	-6.5313*** (1.2412)	-5.6436*** (1.4893)	-7.1073*** (1.1481)	-5.2720*** (1.0027)
Hansen's J-Test: (p-value)	(0.8870)	(0.9740)	(0.9303)	(0.7436)	(0.8436)	(0.8436)	(0.9339)
No. of Obs.	156	156	156	156	156	156	156

Note: HAC robust standard errors in parentheses. +  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .  $\log(\hat{\sigma}_{Garch}^2)$  is the estimated variance extracted from Garch (1,1) model of log differences of the exchange rate. (a) This index does not include Mexico and covers the period from January 2001 - December 2016 (b) Calculated by Banco de México using data from Google Trends, which starts in January 2004.

rate volatility compared to the base scenario. This same interpretation can be given to the rest of the counterfactual scenarios.

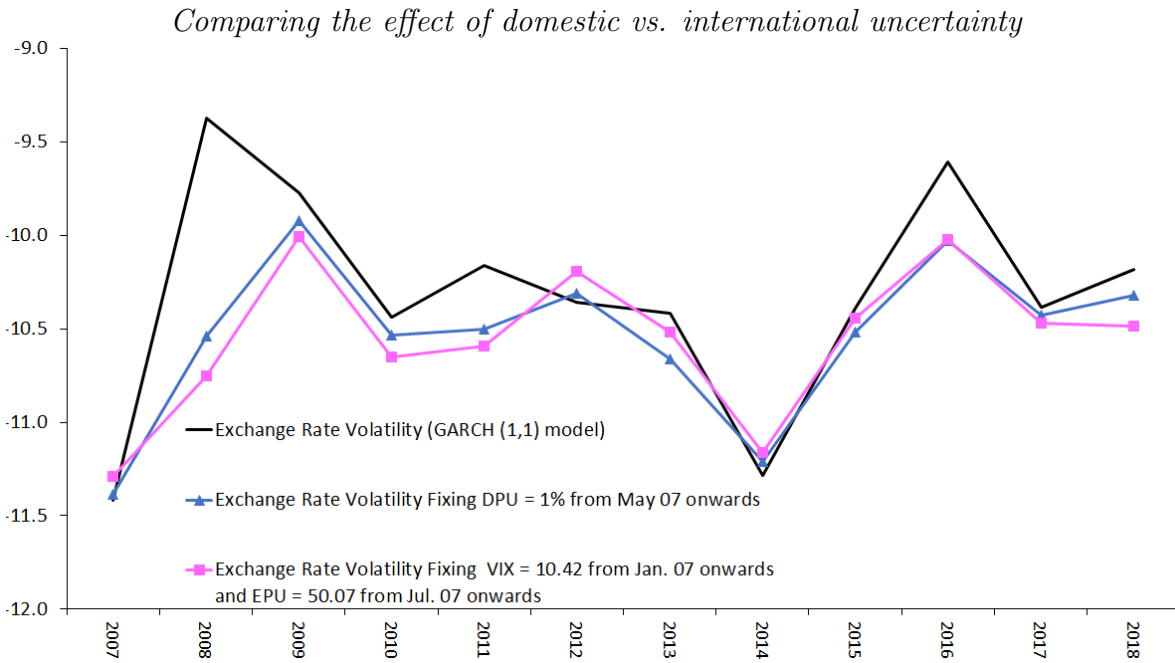
Figure 7: Simulation exercises, exchange rate volatility derived from the GARCH(1,1) model (log)



Note: This simulation was performed using specification (2) in Table 8.  
 Source: From authors' own calculations.

Furthermore, in order to assess whether international uncertainty, measured by the  $VIX_t$  and the  $EPU_t$  indices, is having a bigger or a smaller effect on the MXN/USD exchange rate volatility than the domestic uncertainty, measured by  $DPU_t$ , we build two additional counterfactual scenarios. The first one (depicted with a square pattern) is built under the assumption that the  $VIX_t$  and the  $EPU_t$  indices are equal to 10.42% and 50.07%, respectively, from 2007 onwards; while the second one (depicted with the triangle pattern), under the assumption that  $DPU_t$  is equal to 1%, from 2007 onwards. Figure 8 presents both counterfactual scenarios and the base scenario.

Figure 8: Simulation exercises, exchange rate volatility derived from the GARCH(1,1) model (log)



Note: This simulation was performed using specification (2) in Table 8.  
 Source: From authors' own calculations.

We additionally calculate the yearly average standard deviation of both the counterfactual and the base scenarios of the MXN/USD exchange rate volatility, depicted in Figures 7 and 8, as a proportion of the yearly average standard deviation of the base scenario. Table 13 shows the results. These proportions show that both international and domestic uncertainty have had a similar effect on the MXN/USD exchange rate volatility during the sample period, although the  $EPU_t$ 's effect seems to be the predominant.

Table 13: A comparison between the effect of the international and the domestic uncertainty measures on the MXN/USD exchange rate volatility

Base Scenario	DPU	VIX	EPU	VIX&EPU
1.0000	0.8902	0.9591	0.8851	0.9612

Source: From authors' own calculations.

## 5 Relative Contribution of Explanatory Variables to the MXN/USD Exchange Rate Volatility

Based on specification (2) from Table 12,<sup>30</sup> we also analyze the relative contribution of each independent variable to the MXN/USD exchange rate volatility. Hence, we calculate beta coefficients from that particular specification according to the formula:

$$\beta_{coefficient} = \frac{\hat{\beta}_x * \sigma_x}{\sigma_{GARCH(1,1)}} \quad (4)$$

where  $\hat{\beta}_x$  stands for the estimated coefficient of the independent variable,  $\sigma_x$  stands for the regressor's standard deviation, and  $\sigma_{GARCH(1,1)}$ , for the standard deviation of the MXN/USD exchange rate volatility derived from the estimated GARCH (1,1) model.

The calculated beta coefficients from that specification are presented in Table 14. The results show that  $EPU_t$  is the variable that contributes the most to the MXN/USD exchange rate volatility, followed by the  $VIX_t$  and the  $DPU_t$ , in that order, respectively. Therefore, we conclude that the main drivers of the MXN/USD exchange rate volatility during the sample period are both the international and domestic uncertainty.

Table 14: Beta coefficients

Variable	Beta coefficient
Domestic Political Uncertainty (DPU)	0.1764* (0.07165)
Domestic Economic Uncertainty (DEU)	0.0463 (0.0562)
International Political Uncertainty (IPU)	-0.0662 (0.0862)
International Financial Instability (IFI)	-0.1191 (-0.1187)
Global Econ. Policy Unc. ( <b><i>Without Mexico</i></b> )	0.5313** (0.1948)
Trade Uncertainty (Google)	-0.0414 (0.0696)
VIX	0.2280** (0.0750)
$d\log(\text{Oil price})$	-0.0611 (0.0536)

Note: Standard errors in parenthesis.

+  $p < .1$ , \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

Source: From authors' own calculations.

<sup>30</sup>We choose this specification since the dependent variable was derived from a GARCH (1,1) model, and it was estimated by GMM in order to control for possible endogeneity problems.

## 6 Conclusion

We investigate the impact of uncertainty on the MXN/USD exchange rate volatility over the period 1999-2018. The analysis is conducted in two stages: in the first one, we estimate a univariate GARCH (1,1) model to derive a MXN/USD exchange rate volatility measure; while in the second one, we regress the estimated exchange rate volatility on different uncertainty measures, both domestic and international, and on the US dollar price of a barrel of Mexican crude oil mix. We also consider GDP and inflation surprises in the estimated specification to account for the surprise component of macroeconomic data announcements. Finally, in order to investigate if the effect of uncertainty on the MXN/USD exchange rate volatility is amplified during election and/or recession periods, we include interaction terms between some of the uncertainty measures and an election dummy and, those same uncertainty measures and a recession dummy.

The main results show that the domestic political uncertainty measure, as well as the VIX and the EPU indices, have a positive and a statistically significant effect on the MXN/USD exchange rate volatility. We additionally find that the effect of the domestic economic uncertainty measure on the MXN/USD exchange rate volatility is amplified during recession periods. These results are robust to different MXN/USD exchange rate volatility measures (we alternatively use a realized MXN/USD exchange rate volatility measure that we obtained from Bloomberg); different specifications; different econometric techniques (we use both OLS and GMM); and different global EPU indexes (one that includes data on Mexico's EPU index and one that excludes it).

We also conduct some simulations in order to analyze the size of the uncertainty effect on the MXN/USD exchange rate volatility. The findings suggest that if the international and/or domestic uncertainty had adopted, from 2007 onwards, their lowest level during the sample period, the MXN/USD exchange rate volatility would have been reduced. In addition, when we compare the effect of the international uncertainty to that of the domestic uncertainty, the simulations and some calculations show that both have had a similar effect on the MXN/USD exchange rate volatility, although the EPU index's effect seems to be the predominant.

Overall, the results suggest that the MXN/USD exchange rate volatility is affected by both domestic and international uncertainty and that a stable macroeconomic environment should be procured in order to contain exchange rate volatility.



# A Supplemental Material

Table 15: Stationarity tests lag selection

	Aug. Dickey-Fuller	Phillips-Perron	Ng and Perron
$\log(\hat{\sigma}_{Garch}^2)$	1	1	3
$\log(\sigma_{RealizedVol})$	1	1	11
Domestic Political Unc. (DPU) (%)	1	1	2
Domestic Economic Unc. (DEU) (%)	1, D1	1	6
International Political Unc. (IPU) (%)	1	1	14
International Financial Inst. (IFI) (%)	1	1	3
GDP surprise (observed-expected)	1	1	5
Inflation Surprise (observed-expected)	1	1	14
Global Econ. Policy Unc. (Index)	1	1	3
Trade Policy Uncertainty (Google) <sup>a</sup> (Index)	1, D2	1	13
VIX (Index)	1	1	9
Oil price (\$)	1, D1	1	1

Note: Results for models specified with an intercept and no trend.

Lag selection criteria for ADF: Schwarz Information Criterion, PP: Barlett kernel, NP: Modified Akaike Information Criterion.

+ Cannot reject the null hypothesis of a Unit Root.

Source: The authors performed the stationarity tests.

Table 16: Correlations for variables used in the regressions

		$\log(\hat{\sigma}_{Garch}^2)$	$\log(\sigma_{RealizedVol})$
Banco de México Survey Variables	Domestic Pol. Unc. (%)	-0.24	-0.26
	Domestic Econ. Unc. (%)	0.11	0.13
	International Pol. Unc. (%)	0.10	0.12
	International Fin. Instability (%)	0.38	0.35
	GDP Surprise (observed-expected)	-0.07	-0.06
	Inflation Surprise (observed-expected)	0.08	0.06
Other Independent Variables	Global Econ. Policy Unc. (Index)	0.59	0.60
	Trade Policy Unc. (Google) <sup>a</sup> (Index)	-0.12	-0.12
	VIX (Index)	0.39	0.34
	$d\log(\text{Oil price})$	-0.19	-0.18

Note: (a) Calculated by Banco de México using data from Google Trends (2004-2018).

Source: Calculated by the authors using data from Banco de México, INEGI, Google Trends, and policyuncertainty.com.

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