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Largaespada, Fernández, Rolando Antonio

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Largaespada Fernández, Rolando Antonio

Comisión

Alejandro Vicondoa
Sumeyra Akin
Felipe González

Santiago, Agosto de 2021

Spillovers of US Uncertainty Shocks to Nicaragua

Rolando Largaespada Fernández *

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Abstract

Given that Nicaragua is an economy closely linked to that of the United States, uncertainty shocks in the United States could be relevant and transmitted to the Nicaraguan economy. Thus, this work aims to identify the effects of uncertainty shocks in the US on prices and Nicaraguan economic activity through a VAR model, finding slight decreases in prices and a significant and persistent contraction for economic activity. Then, when conducting a counterfactual analysis on potential transmission mechanisms, the decrease in prices is transmitted through remittances and the evolution of international prices. Meanwhile, credit to the private sector represents an important channel through which the effects are transmitted to economic activity. Thus, policies aimed at mitigating credit frictions can reduce the magnitude of the negative effect on economic activity.

Keywords: Uncertainty shocks, VAR model, Credit, Economic Activity.

*Email: ralargaespada@uc.cl. Student of the Master in Economics at the Institute of Economics of the Pontificia Universidad Católica de Chile. I thank the members of the thesis committee, Alejandro Vicondoa, Sumeyra Akin and Felipe Gonzalez for their valuable help and comments throughout the process of preparing this thesis. I also thank my family and the Central Bank of Nicaragua for their support. The files, databases and codes used in this document can be accessed through the link: https://drive.google.com/drive/folders/163atRf-H_6H5zylvC9y8S9UdnTVK3jw8?usp=sharing

1 Introduction

Nicaragua is a small economy, with trade openness, free capital mobility and that operates under a crawling peg exchange rate scheme. Although it is true that it is below its Central American peers in terms of economic development, during the 2010-2017 period it stood out as the country with the highest GDP growth within the region (5.1 percent, on average).

However, in recent years, events from a local perspective such as the deterioration of solvency indicators in social security that have put its long-term viability at risk, tax reform, the outbreak of the socio-political crisis in mid-April 2018 and its consequent armed confrontations, and from a global perspective the COVID-19 pandemic as of March 2020, these last two events have caused a deep economic crisis in Nicaragua, where GDP between 2018-2020 suffered a cumulative reduction of 8.8 percent, a sharp contraction of almost 29 percent in international reserves from May to December 2018, these being the policy instrument that supports the exchange rate regime, and a significant contraction of credit despite the policies implemented by the bank central and the supervisory institution of financial institutions, aimed at providing liquidity to reactivate credit.

Due to their characteristics, the socio-political crisis in 2018 and the coronavirus pandemic in 2020 represent potential sources of economic uncertainty because at the time these events materialized, a lot of uncertainty was generated about their future evolution, which are closely related with economic activity. Thus, it is interesting to study the macroeconomic effects caused by unanticipated variations in global uncertainty.

Global shocks of uncertainty can be transmitted through increased uncertainty in Nicaragua, given that Nicaragua lacks an indicator that gives a signal of the volatility generated around global and idiosyncratic events[1], this document builds an economic policy uncertainty indicator (EPUC) for Nicaragua, following the methodology set out in Baker, Bloom, and Davis (2016) and Becerra and Sagner (2020), an indicator is obtained that reflects greater uncertainty in the periods in which events generating uncertainty occurred, which can be a starting point in the discussion of the generation of economic volatility indicators for

[1]There are no indicators of the stock market and asset prices.

Nicaragua and Central America.

However, it is difficult to show that this indicator reflects pure effects of uncertainty. But being Nicaragua an open economy that is very synchronized with the economic cycle of the United States, Mendieta (2018) estimates a correlation of 0.80, it is also the largest trading partner and the main source of remittances; given this, uncertainty shocks in the US could be relevant and transmitted to the Nicaraguan economy. Thus, the macroeconomic effects caused by uncertainty shocks in a country like the US will be studied.

An additional reason that makes it interesting to study it is that the works carried out within the Central American region such as: Iraheta (2008), Olivas, Rueda, and Treminio (2018), Checo, Pradel, and Ramırez (2018), and Mendieta (2018) are limited to studying the effects of shocks on the international price of oil, or on the product and/or US interest rates, and they do not consider the uncertainty factor within their models that can explain an important part of the variation in prices and activity economical.

Therefore, this research studies the effect of uncertainty shocks in the US on prices and economic activity in Nicaragua through a VAR model, analyzing the potential channels through which this uncertainty is transmitted. The VAR model contains a set of endogenous variables and a variable exogenous to the system that measures uncertainty shocks. These shocks are obtained by updating the Piffer and Podstawski (2018) estimates that identify structural uncertainty shocks net of the effect of negative news using the Proxy SVAR approach.

The set of endogenous variables that are considered in our model is made up of the uncertainty of the US measured through the Chicago Board Options Exchange Market Volatility Index (VIX), the macroeconomic variables that we are interested in studying the effects, be these economic activity and prices , and variables that allow us to explain the mechanisms of transmission of uncertainty in the US, such as domestic interest rates, the EPUC of Nicaragua, credit to the private sector that according to Carrière-Swallow and Céspedes (2013) may be relevant within the context of an economy with a financial market underdeveloped, and remittances that constitute a relevant trade-off due to the fact that

by increasing uncertainty in the US, these can be reduced due to the deterioration of the economic situation of remittance issuers, but on the other hand if they are also deteriorate economic conditions in Nicaragua they may have an incentive to financially support their family in Nicaragua.

Our results reflect that when experiencing an unanticipated increase in uncertainty in the US of one standard deviation, economic activity is reduced by 0.7 percent at the same time and up to three months after the shock, and then tends towards a slow recovery, in line with Carrière-Swallow and Céspedes (2013) that within the context of emerging economies estimate that after a shock of uncertainty there will be more severe falls in economic activity compared to developed economies with slow recoveries.

The shock induces a decline of 0.1 percent on the price level that is maintained for up to six months. Likewise, the inflow of remittances decreases, the uncertainty of Nicaragua increases, there are no significant effects on domestic interest rates, and a strong and persistent contraction of credit to the private sector is generated.

When performing a counterfactual analysis that controls the response of the proposed transmission channels, it was found that in the face of uncertainty shocks in the US, the remittance channel has effects on prices and not on the real economy, with the evolution of international prices being another channel through which there is a decrease in prices. Meanwhile, no significant differences are obtained for economic activity and prices in the absence of a response from the Nicaraguan uncertainty.

For its part, credit to the private sector represents a strong channel through which the effects of the shock of uncertainty in the US on economic activity are transmitted, this in accordance with Carrière-Swallow and Céspedes (2013), who find that for emerging economies with less developed financial markets the credit is a relevant channel through which uncertainty shocks are transmitted to investment and economic activity; so policies aimed at mitigating credit frictions can reduce the magnitude of the negative effect on economic activity and promote a faster recovery of the same.

The rest of the document is structured as follows: section 2 presents the literature review related to the generation of uncertainty indicators and empirical studies on the effect of external shocks within Nicaragua. Section 3 presents the methodology and the EPUC measure for Nicaragua. For its part, section 4 presents the estimation of exogenous uncertainty shocks in the US. Then, section 5 presents the empirical model, the data used, the estimation of the macroeconomic effects and the evaluation of the transmission channels. Finally, section 6 concludes.

2 Literature Review

This section shows the literature related to the generation of uncertainty measures since it has been proposed to construct one for Nicaragua, then a reference is briefly presented that identifies uncertainty shocks in the US, and finally studies carried out within the Nicaraguan context on the effect of external shocks.

2.1 Measures of Uncertainty

A commonly used measure to measure changes in uncertainty corresponds to the VIX, which captures the expected volatility at 30 days of the S&P500 index, however, it does not contain information that allows capturing the idiosyncratic uncertainty of a country, since by construction it is oriented to capture global volatility. Therefore, an alternative proposed by Gilchrist, Sim, and Zakrajšek (2014) is the use of microdata to observe the excesses of profitability of companies and infer a measure of uncertainty from them.

Another alternative is the economic policy uncertainty index developed by Baker, Bloom, and Davis (2016) for the US, which is based on the digital archives of leading newspapers, making a monthly count of articles that contain keywords related to uncertainty, economics, and policymaking.

In line with the above, Becerra and Sagner (2020) present an alternative way to capture information, building an uncertainty index of economic policy for Chile using the official Twitter accounts of news, newspapers and radios; in addition, they add a category related to the economic context. Then, the indicator is built based on the methodology described by Baker, Bloom, and Davis (2016).

2.2 Identification of Structural Shocks

Piffer and Podstawski (2018) identify uncertainty shocks from variations in the price of gold around specific events that are an exogenous source of uncertainty, that is, unexpected or unpredictable events such as: Black Monday in 1987, the 9/11 attack, the fall of Lehman Brothers, among others; they manage to separate the uncertainty shocks in the US from the effect of negative news on the state of the economy, in such a way that they isolate exogenous variations in uncertainty, and then identify the pure effects of this uncertainty on variables such as output, employment, prices, wages, interest rates and stock market index through an SVAR model with an external instrument.

In general, studies that identify the effects of shocks on a set of macroeconomic variables use an SVAR model approach, for example, Gertler and Karadi (2015) provide evidence on the transmission mechanism of monetary policy through the identification of shocks of monetary policy on economic and financial variables.

2.3 Effects of External Shocks on Nicaragua

In the Nicaraguan context, Gámez (2006) studies the impact and relative contribution of external and internal shocks -both supply and demand- on key variables such as output, trade balance and international reserves; for this he uses the SVAR methodology, identifying structural shocks through a Cholesky decomposition. His results on the output suggest that in the short term the movements of the product are mainly explained by supply shocks, and for terms longer than twelve months the supply shocks together with the external shocks

explain around 90% of the variance of the output.

Mendieta (2018) pursues the objective of quantifying the relevance of internal and external shocks for the dynamics of economic growth and inflation through a VAR model under a Bayesian approach, his conclusions for the case of economic growth is that domestic factors they are the most important to explain its short-term dynamics, however, as the horizon of analysis is extended, external factors explain approximately 50% of economic growth in Nicaragua.

Having research that quantifies the effect of external uncertainty shocks on a country like Nicaragua deserves importance due to the high dependence it has on what happens in international markets and/or an economy like the US, which are susceptible to global shocks of uncertainty that can potentially be transmitted to Nicaragua. Therefore, given that no internal application has been found for Nicaragua, or the Central American region, of the effect that external uncertainty shocks have on the macroeconomy, this document will address this empirical gap, estimating the effects on economic activity and prices, and investigating through which channels global shocks of uncertainty are transmitted to Nicaragua.

3 Uncertainty Index for Nicaragua

Since there is no variable that signals uncertainty in Nicaragua, an economic policy uncertainty index (EPUC) will be constructed for Nicaragua following the Becerra and Sagner (2020) methodology.

3.1 Methodology for Uncertainty Index for Nicaragua

The basic information of the most widely disseminated Nicaraguan media tweets used for the construction of the EPUC for Nicaragua was collected through web scraping tools. The selection of the communication media consisted of those that have news segments and report

on the Nicaraguan situation, these correspond to five television channels, a radio medium and a written newspaper (see table 3); which already had official Twitter accounts in 2012, for this reason the period defined for the index calculation is from January 2012 to March 2021.

Then, to filter the information in the tweets, key terms are used within the categories of uncertainty (U), economy (E), politics (P) and economic context (C). For example, the policy category includes terms associated with fiscal policy such as: 'impuesto', 'ministerio de hacienda' or 'deuda pública', and monetary policy: 'tipo de cambio', 'dólar', 'banco central de Nicaragua', 'devalu'.

For the economic context block, those associated with temporary situations that generate uncertainty such as price increases, deterioration of the social security system (INSS) and signs of corruption are used. Likewise, terms related to relevant events that generate uncertainty such as the social outbreak of April 2018 and the COVID-19 pandemic, however, an exercise will also be carried out without these in order to see how influential these events were for the indicator. Defined terms are shown in table 1.

Table 1: EPUC Term Sets

Category	Terms
E	'econom'
U	'incert' or 'inciert'
P	'reforma tributaria', 'impuesto', 'ministerio de hacienda',
	'presupuest', 'deuda publica', 'banco central de nicaragua',
	'devalu', 'tipo de cambio' or 'dolar'
C	'alza de precio', 'alza del precio', 'inss', 'corrup', 'crisis',
	'tranque', 'sosnicaragua', 'protest', 'golpe de estado'
	'pandemia', 'covid', or 'coronavirus'

Formally, the i-th tweet of the communication medium k published at time t is classified depending on whether or not it contains words related to the set m established by Baker, Bloom, and Davis (2016) and Becerra and Sagner (2020):

$$Y_{ikt}(x) = \begin{cases} 1, & \text{if } x \supset any\ m = \{E, P, U, C\} \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

Then, all $Y_{ikt}(x) = 1$ and their associated interaction are stored, this last variable is approximated through the sum of likes, retweets and replies obtained [2]. Thus, for each k the sum of interactions obtained and the monthly frequency of tweets that classify in the set m are calculated; these series are standardized with mean 0 and unit standard deviation.

Unlike Baker, Bloom, and Davis (2016) and Becerra and Sagner (2020) who use a simple average of the series at the k level to obtain the index, in order to refine the index considering the relevance of the information, each k was assigned a weight which will be a function of the interaction obtained monthly, these weights are the proportion of interactions obtained by each k in month t. Then, the weighted average of the series is computed, which represents the EPUC index for Nicaragua with monthly frequency.

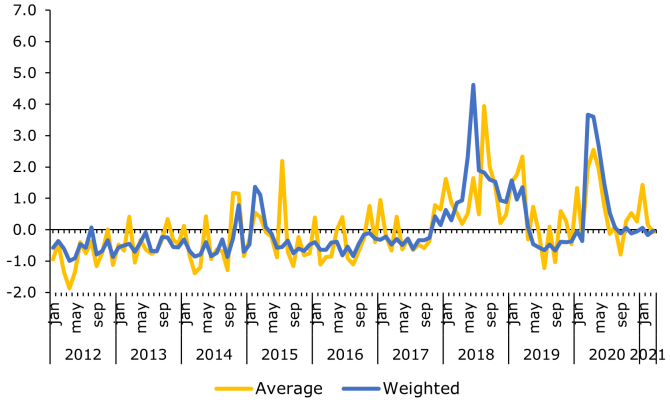
3.2 EPUC for Nicaragua

Panel A) of figure 1 shows the measure of the EPUC for the Nicaraguan economy from 2012, when comparing the indices using a simple average versus a weighted average by interactions, visually both follow the same dynamics with a correlation of 0.72; however, the weighted EPUC may be a more accurate measure of uncertainty since in a certain way it considers the importance of the information disclosed by the media, avoiding irregular variations that may be caused by the publication of information that is not very relevant to the population by part of one or more media.

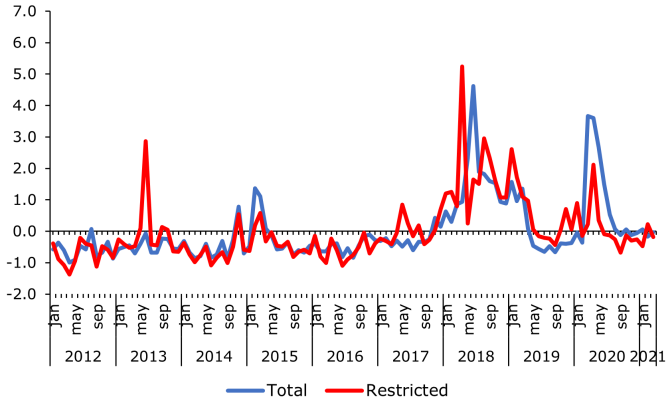
The measures exhibit considerable peaks greater than one standard deviation above the mean, which coincide with important events that generated economic uncertainty, be these: the strong protests as of December 2014 against the terms of the construction of the interoceanic canal in Nicaragua, the outbreak of the socio-political crisis in April 2018 that triggered a wave of violence between civilians and security forces during the rest of the year, the tax reform implemented at the beginning of 2019 that included higher taxes for companies and other items, and the COVID-19 pandemic since the beginning of 2020.

[2]The number of views of the tweet is not used since this information is not available within the tool used

Figure 1: EPUC for Nicaragua



(a) Unrestricted EPUC: Average vs Interaction-Weighted



(b) Unrestricted EPUC vs Restricted EPUC

Notes: Panel a) makes a comparison between the indices obtained using a simple average as in Becerra and Sagner (2020) versus a weighted average by interactions proposed in this document. For its part, panel b) shows the indices using the interaction proxy as weights according to all the terms defined in table 1 versus when the terms associated with the 2018 sociopolitical crisis and COVID-19 are restricted.

As an exercise of robustness, the terms described in table 1 will be restricted, removing those that are related to events such as the outbreak of the sociopolitical crisis and the coronavirus, by dispensing with these it is possible to obtain a "cleaner" measure of the EPUC because the index is prevented from self-selecting greater uncertainty in the periods in which these events took place. See panel B) of figure 1.

Thus, the restricted EPUC describes the same dynamics as the unrestricted EPUC with a correlation of 0.63, capturing greater uncertainty in the events mentioned above; but at the same time it reflects greater uncertainty during June 2013, a period that coincides with the

presentation of the interoceanic canal project and its financing with capital from a Chinese investor, which gave rise to a wide debate from different perspectives, mainly due to the effects economic and environmental consequences.

When compared with the EPU for the US carried out by Baker, Bloom, and Davis (2016), see figure 5, both indices capture idiosyncratic components of uncertainty for the United States and Nicaragua, and do not reflect global uncertainty, so use this index as measure of uncertainty may be reasonable for our study.

While it is true this measure of uncertainty may have disadvantages, it represents a starting point for the generation of measures of volatility or uncertainty in Nicaragua or in the Central American region. The disadvantages to which this index may be exposed come mainly from two senses: (i) it is based on information from Twitter which may be directed at segments of the population that are users of this platform, being difficult to prove that the people within this social network they are representative of the population and that they handle the information with rationality; and (ii) it is built on the media tweet postings that may be motivated by your political line.

For the latter, an index was made for the media considered to be more opposed and another for those most sympathetic to the current government, finding a correlation of 0.40 between the two, whose dynamics in both groups reflect greater uncertainty in the main events that generate uncertainty. (see figure 6).

4 US Uncertainty Shocks

Because we are interested in studying the macroeconomic effects for Nicaragua that cause uncertainty shocks in the United States, a measure is required for uncertainty shocks for the United States. However, measures such as the EPU of Baker, Bloom, and Davis (2016) or excess profitability of companies of Gilchrist, Sim, and Zakrajšek (2014) are exposed to feedback with the state of the economy and react to negative news, so they may not represent

a source of exogenous variation.

For this reason, the uncertainty shocks identified by Piffer and Podstawski (2018) are used from the variations in the price of gold around events that potentially represent a source of exogenous variation in the uncertainty in the US, isolating the effect of the negative news. To do this, they are based on the SVAR identification approach through external instruments proposed by Stock and Watson (2012) and Mertens and Ravn (2013). Being the model of the reduced form:

$$\boldsymbol{y_t} = \boldsymbol{\alpha} + \boldsymbol{\Pi}\left(L\right)\boldsymbol{y_{t-1}} + \boldsymbol{u_t} \tag{2}$$

where y_t is the vector of k endogenous variables, α are the constant terms and $\Pi(L)$ is the lag matrix of the model. Meanwhile, u_t are the shocks of the reduced form, which are linearly related to the structural shocks s_t so that $u_t = Bs_t$; the variance and covariance matrix is normalized to the identity.

Because its purpose was to identify the uncertainty shocks net of the negative news effect, these being orthogonal to the other structural shocks, let s_t^u be the uncertainty shock in time t, s_t^n the news shock and s_t^* the vector of $k-2$ structural shocks, it is possible to write:

$$\boldsymbol{u_t} = \boldsymbol{b^u} s_t^u + \boldsymbol{b^n} s_t^n + \boldsymbol{B^*} s_t^* \tag{3}$$

where b^u and b^n is the impulse vector associated with the uncertainty and news shock, respectively, and B^* is the set of impulse vectors for the other shocks. Since our objective is to obtain the uncertainty shocks, the interest is at b^u.

Being m_t^u an instrument for the shock of uncertainty composed of the variations in the price of gold around events that generate uncertainty and m_t^n an instrument for the shock of news, the proxy SVAR methodology requires that these comply with the conditions of exogeneity and relevance. However, the authors argue that it is not plausible that this instrument of uncertainty is totally exogenous to news shocks.

$$\Phi = \begin{pmatrix} E\left(s_t^u m_t^u\right) & E\left(s_t^u m_t^n\right) \\ E\left(s_t^n m_t^u\right) & E\left(s_t^n m_t^n\right) \end{pmatrix} = \begin{pmatrix} \phi_{11} > 0 & \phi_{12} \\ \phi_{21} & \phi_{22} > 0 \end{pmatrix} \tag{4}$$

For this reason, the authors assume and demonstrate that relevance is fulfilled, but they modify the exogeneity assumption a little, so that the uncertainty instrument is more correlated with uncertainty shocks than with news shocks ($\phi_{11} - \phi_{21} > 0.10$), and analogously, that the news instrument is more correlated with news shocks than with uncertainty shocks ($\phi_{22} - \phi_{12} > 0.10$). Upon compliance with these conditions, s_t^u is identified that represents the uncertainty shocks in the US, net of the effect of negative news.

In Piffer and Podstawski (2018) these uncertainty shocks are until July 2015, therefore, in order to have them until March 2021, the macroeconomic series used in the estimation from the same sources of information used by the authors and the events associated with uncertainty to calculate the variations in the price of gold around these that make up the uncertainty proxy.

Two updates of these events were found, one by Piffer on its website[3] and the other by Bobasu et al. (2021), considering the events in each one, it was found that the latter is more complete because it contains important events in United States politics that are absent in the Piffer update, such as presidential elections, the government shutdown in January 2018 and the trade war with China.

Thus, for the update of the uncertainty shocks until March 2021, the replication codes of Piffer and Podstawski (2018) were used, making slight adjustments to be able to capture the new information. The series of the uncertainty instrument and the uncertainty shocks are presented in Figure 7.

When using this update of the uncertainty shocks to identify their effects on the United States economy, based on the specification used by Piffer and Podstawski (2018), the results remain very similar (see left panel of figure 8), this allows to validate that the series of uncertainty shocks are well identified.

Figure 8 shows the IRF of the effect of the uncertainty shocks identified on the United States, the results suggest that this shock significantly affects financial markets, monetary

[3]See https://sites.google.com/site/michelepiffereconomics/research-1?authuser=0

policy, employment and US industrial production; however, its negative effects on nominal variables, such as wages and consumer prices, are quite limited.

5 Empirical Analysis

This section presents estimates of the effects of uncertainty shocks from the United States on the Nicaraguan economy. First, the empirical model and the data used are specified, then the IRF's of the main macroeconomic variables for Nicaragua are presented in the face of a shock in the uncertainty of the United States and their relative importance through a variances decomposition, and finally the possible mechanisms are analyzed through which these uncertainty shocks are transmitted.

5.1 Empirical Model and Data

For the quantification of the macroeconomic effects in Nicaragua caused by external uncertainty, the United States was chosen, because its economic cycle is very synchronized with that of Nicaragua, Mendieta (2018) estimates a correlation of 0.80; it is also the largest trading partner and the main source of remittances.

In this way, the exogenous variation of uncertainty in the US will be exploited to identify its effects on the main macroeconomic variables in Nicaragua, through a VAR model that includes the uncertainty shocks in the US, presented in the section 4, as a variable exogenous. This is similar to what was done by Mertens and Ravn (2011) and Vicondoa (2019), who as part of their study look at the effects of unanticipated shocks to taxes and US interest rates, respectively. Formally our model is based on the following equation:

$$\boldsymbol{Y_t} = \boldsymbol{\alpha} + \boldsymbol{A}\left(L\right)\boldsymbol{Y_{t-1}} + \boldsymbol{B}\left(L\right)\boldsymbol{s_t^u} + \boldsymbol{\epsilon_t} \tag{5}$$

where Y_t is the vector of endogenous variables, $A(L)$ the polynomial of lags of the set of en-

dogenous variables, s_t^u are the exogenous uncertainty shocks in the US, $B(L)$ the polynomial of lags of these uncertainty shocks in order to allow the persistence of these shocks, and ϵ_t is the vector of residuals.

The set Y_t considers variables that capture the uncertainty of the US measured through the VIX; the main macroeconomic effects that we are interested in studying, these are economic activity and inflation measured by the Monthly Index of Economic Activity (EAI) and the Consumer Price Index (CPI), respectively; and transmission channels relevant to the Nicaraguan economy, such as interest rates, credit to the private sector by financial institutions, and remittances because Nicaragua is a net recipient of remittances, which are an important component of household income (approximately 14.6% of GDP in 2020), Furthermore, we are interested in studying the Nicaraguan uncertainty channel, which is why the EPUC for Nicaragua constructed in section 3 is included.

The system presented in 5 was estimated by Ordinary Least Squares. These estimates do not depend on an ordering of the variables, nor on imposing restrictions on the response of the variables to exogenous uncertainty shocks in the US. Nor is it necessary to identify the other system shocks, since our interest is to study the effect of uncertainty shocks in the US, which are already identified and defined as an exogenous variable to the system.

The sample used consists of 111 observations, starting in January 2012 because the EPUC constructed begins in that period and ending in March 2021. Table 4 contains the data sources of these variables and the transformation with which they were entered in the VAR system, table 5 presents the descriptive statistics and figure 9 shows the series that make up the endogenous set.

The order of the VAR was determined with the good use of the information criteria of Akaike, Schwarz and Hannan-Quinn that measure the relative quality of models, for which two lags of the set of endogenous variables were used and a lag for the shock of uncertainty in the US, figure 10 shows that when using this amount of lags enforces the residuals to be stationary.

5.2 Macroeconomic Effects

This section presents how the Nicaraguan macroeconomy responds to a shock of uncertainty in the US, initially a simple model is estimated where the set of endogenous variables is limited to uncertainty in the US, uncertainty in Nicaragua, inflation and economic activity in Nicaragua. Figure 11 reflects the responses to a shock that increases uncertainty in the US by one standard deviation.

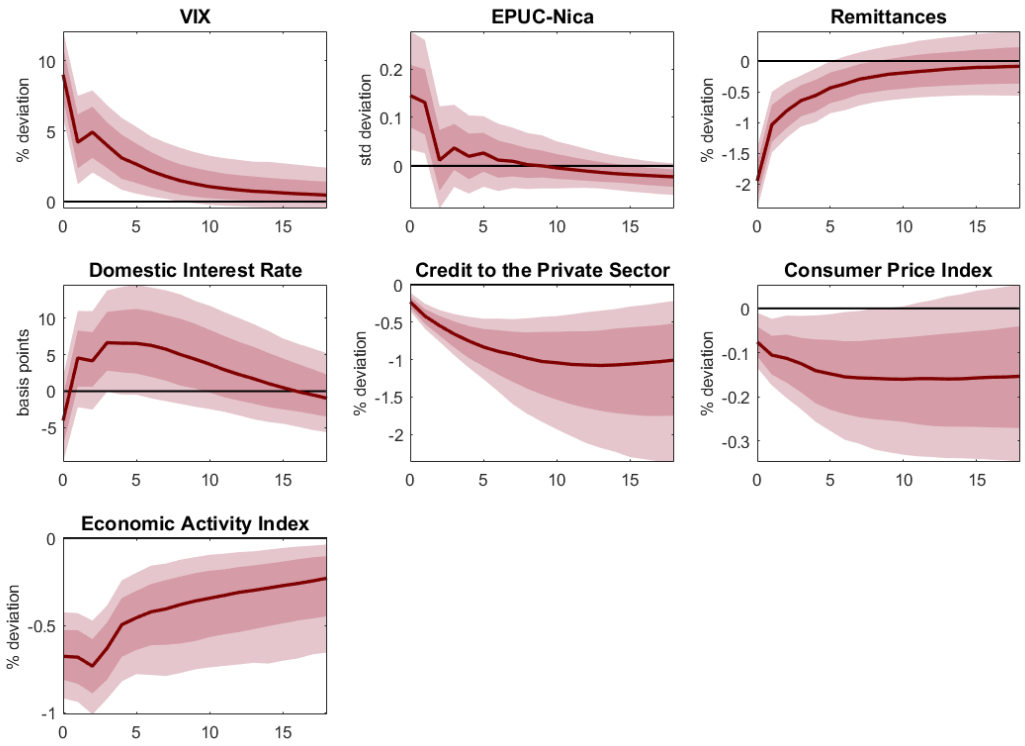
By adding two possible channels of transmission of uncertainty (see figure 12), be these, the channel of interest rates and remittances, the results are maintained. Then, when adding credit to the private sector, the dynamics of the IRF obtained are similar to the previous specifications of the set of endogenous variables (see figure 2). In addition, there are efficiency gains from including this new information because the confidence intervals are now smaller.

As a robustness test, to see if the IRF depends on the United States uncertainty measure used within the estimates, figure 13 uses the EPU of Baker, Bloom, and Davis (2016), finding that the results are not statistically different and therefore they do not depend on the measure used. Additionally, estimates were made for different configurations of the lag polynomial of the uncertainty shock, $B(L)$, figure 14 suggests that the dynamics of the IRF for a number of lags other than one is within the 90% confidence intervals of the base estimates, giving robustness to the results.

Thus, figure 2 shows the IRF to a shock that increases the uncertainty in the US by one standard deviation considering the entire set of endogenous variables defined in the previous subsection. The effect of said shock, naturally, causes a contemporaneous increase of the VIX of 9 percent, with relatively persistent effects, also a slight contemporaneous increase of the uncertainty of Nicaragua is observed in approximately little more than 0.1 standard deviations, whose effect vanishes after the second month with 90 percent confidence.

Likewise, the remittances received by Nicaraguans suffer a contemporary decrease of 2 percent, with slightly more slight decreases that continue until five months after the shock occurred. On the side of the credit portfolio, there are strong effects towards a contraction

Figure 2: IRF from a one standard deviation uncertainty shock in the US.



Notes: Solid lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

of the portfolio that persists for several months, the high persistence can be explained by the fact that the shock generates a decrease in the demand and/or supply of credit that naturally, it contracts loan deliveries, resulting in a decrease in the balance of the loan portfolio in subsequent periods.

On the other hand, focusing on the variables of interest, the price level shows a slight decrease of 0.1 percent that is maintained up to six months after the shock occurred; and economic activity is reduced by 0.7 percent in the period in which the shock occurs, this magnitude is maintained for three months, and then moves towards a slow recovery trend.

The foregoing is in line with Carrière-Swallow and Céspedes (2013), which for emerging economies in relation to developed countries, find that they suffer more severe falls in investment and consumption after a shock of uncertainty, with slow recoveries and that after said

shock there are no experiences a subsequent overshoot of economic activity. A suggestive result is that the fact that both economic activity and the price level are decreasing may be associated with the uncertainty shocks in the US mainly impacting demand.

To complement the analysis, table 2 shows the variance decomposition of the prediction error of each variable within the endogenous set from the IRF's. Specifically, it refers to the percentage of the variance of the prediction error, which is attributable to the US uncertainty shock, h months ahead of each of the system variables.

Thus, the variance decomposition accounts for the relative relevance of the US uncertainty shock in explaining the variations of the variables of interest, prices and economic activity, and of the transmission mechanisms contemplated in this document, for different forecasting horizons.

Table 2: Forecast Error Variance Decomposition

h	EPUC-Nica	Remittances	Int. Rate	Credit Priv.	Cons. Price	Ec. Activity
6	0.87	3.64	0.54	3.51	0.61	3.70
12	0.94	3.96	1.38	16.02	1.77	6.09
18	0.95	4.00	1.75	36.86	2.86	8.17
24	0.99	4.00	1.80	61.57	3.71	9.86

Notes: The table shows the forecast error variance decomposition using base specification at horizons 6, 12, 18 and 24 months.

In this sense, the uncertainty shock in the US explains around 3% of the price variation and 8% of the economic activity, this result is similar to that found by Miescu (2019), which for emerging economies estimates that the shocks of uncertainty explains between 3%-5% of the variation in prices and between 8%-12% of the variation in economic activity, for horizons of 1 to 2 years.

In turn, it is important to note that this shock is very important to explain the variations in credit to the private sector, especially when the projection horizon is extended. For Nicaraguan uncertainty, the uncertainty shock in the US is relatively insignificant, explaining 1% of its variance. And for remittances, it is moderately relevant with 4% of its variation explained by this shock.

According to Bello (2010), remittances are a relevant source of income for Nicaraguan households, so the decline in economic activity can be explained by the fact that remittances to Nicaragua are reduced, thus Nicaraguan households that receive remittances they experience a reduction in their budget line, which causes them to have less money available to consume and therefore decreases economic activity, and given this lower demand, prices experience a reduction.

Alternatively, the explanation may be the increase in Nicaraguan uncertainty, according to Kimball and Weil (2009) risk-averse economic agents generate precautionary savings to meet their future needs, for this reason their disposable income to consume and invest is reduced, implying a contraction of the demand that causes economic activity and prices to decrease.

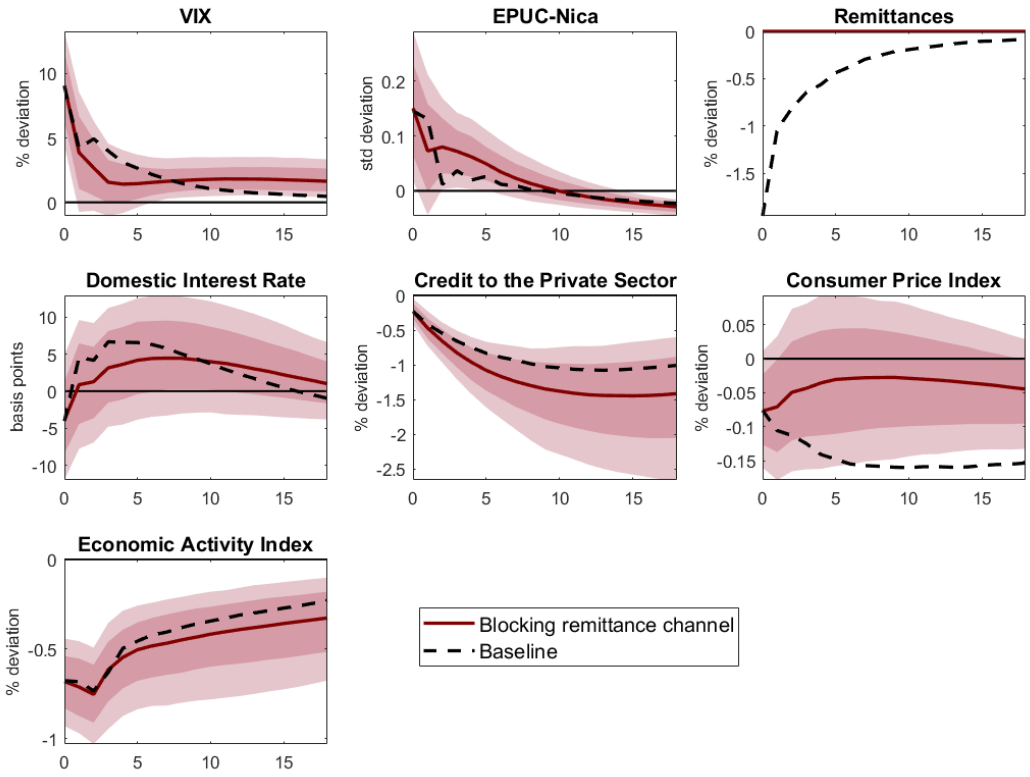
Another channel proposed in the literature is the credit channel, Carrière-Swallow and Céspedes (2013) argue that the dynamics of investment and consumption, which are closely related to economic activity, depend on the depth of financial markets.

5.3 Transmission Channel Analysis

To explore the possible explanations for the decline in economic activity and prices discussed in the previous subsection, this subsection performs a counterfactual analysis to assess the remittance channel, Nicaraguan uncertainty, and credit to the private sector.

Georgiadis, Müller, and Schumann (2021) performs a counterfactual analysis using Bayesian techniques to assess the impact of a global uncertainty shock in the absence of an appreciation of the dollar, in this way the possible channels through which the uncertainty shock is transmitted to the Nicaraguan economy will be evaluated. However, a simpler methodology will be used for the counterfactual estimates, which will consist of imposing that the variable of the channel of interest does not react to the shock of uncertainty and that it also has no effect on the other variables of the system, thus blocking the response of the variable of the channel of interest, with the same logic used by Georgiadis, Müller, and Schumann (2021).

Figure 3: IRF from a one standard deviation uncertainty shock in the US, blocking remittances channel



Notes: Solid and dotted lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

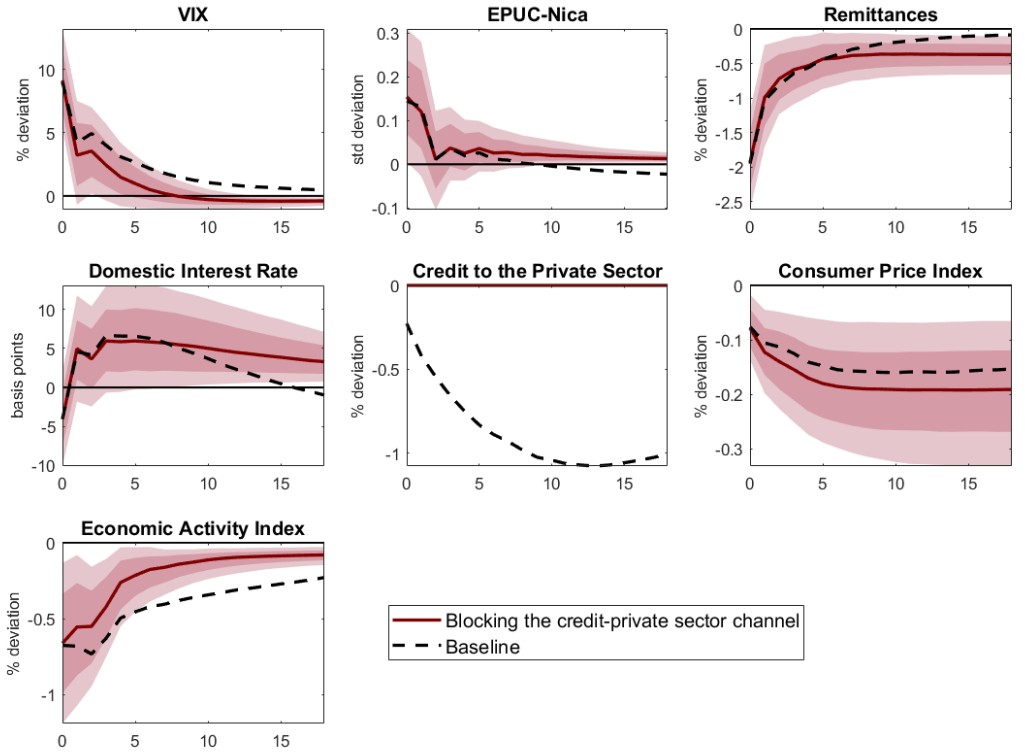
In figure 3 the solid red line are the IRF when blocking the remittance channel and the dotted black line are the IRF presented in figure 2. Thus, by imposing that remittances do not react to the shock of uncertainty in the US, now the effect on prices cannot be distinguished from zero, that is, by not having the negative reaction of remittances, households do not see their income reduced through this way, which theoretically indicates that there is more money in the economy, which does not allow prices to decrease.

However, this theoretical increase in income does not appear to be significant enough to attenuate the negative effects of uncertainty on economic activity, which suggests that in the face of uncertainty shocks, the remittance channel has nominal effects and not on the real economy. A potential channel that could also affect prices are changes in purchasing power, but when adding the bilateral real exchange rate between Nicaragua and the United States

to the set of endogenous variables, it is found that the uncertainty shock in the United States does not cause changes in the dynamics of the real exchange rate, see figure 15.

An alternative explanation of the negative effect on prices is that the change in international or United States prices caused by the uncertainty shock is transmitted to domestic prices; when looking at figure 8 the effect of uncertainty shocks on prices in the United States, it is found that their dynamics is somewhat similar to that found for Nicaragua, with a slight decrease during the first months after the shock occurred, and therefore the dynamics of prices can be partially explained by the evolution of international prices.

Figure 4: IRF from a one standard deviation uncertainty shock in the US, blocking channel of credit to the private sector



Notes: Solid and dotted lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Now, by blocking the uncertainty channel (see figure 16), there are no statistically significant differences on inflation and economic activity, but it is interesting that the absence of a response from Nicaraguan uncertainty attenuates the negative effect on credit to the

private sector that causes the shock of uncertainty in the US; this may be associated with the fact that in times of uncertainty within the national context, financial institutions decide to mitigate the risk through a reduction in the placement of loans to the private sector, however, this is presented as a suggestive explanation due to the fact that the loan portfolio is a result of balance between supply and demand.

On the other hand, figure 4 that considers the counterfactual estimates for credit to the private sector, where the solid red line are the IRF's when blocking the credit channel to the private sector and the dotted black line are the IRFs presented in figure 2. Thus, in the absence of a persistent decline in the loan portfolio, the magnitude of the contraction in economic activity is lower in the periods subsequent to the shock of uncertainty in the US, in turn, the pace of the trend towards recovery is more accelerated, consistent with what was found in Carrière-Swallow and Céspedes (2013), which, by controlling the credit channel, estimate that for emerging economies with less developed financial markets this it can represent up to half of the fall in investment and economic activity generated by the uncertainty shock.

In summary, when considering the results of this counterfactual analysis, it is clear that in terms of economic activity, the most relevant transmission channel is the credit channel to the private sector, meanwhile, the remittance channel and the evolution of international prices act on the evolution of prices in periods of uncertainty shocks in the US.

6 Conclusions

This document has studied the effect of uncertainty shocks in the US on the price level and Nicaraguan economic activity, through a VAR model composed of the variables of interest and potential transmission mechanisms within the endogenous set, adding net uncertainty shocks of the negative news effect estimated according to Piffer and Podstawski (2018) as an exogenous variable.

The results suggest that, when experiencing an unanticipated increase in uncertainty

in the US of one standard deviation, there is a slight decrease in prices of 0.1 percent that is maintained for up to six months after the shock occurred; while economic activity is reduced at the same time and in the three following months by 0.7 percent, and then heading towards a slow recovery trend, said result is in line with Carrière-Swallow and Céspedes (2013) that, within the context of emerging economies, estimate that after an exogenous shock of uncertainty will suffer more severe falls in economic activity compared to developed economies with slow recoveries.

Additionally, uncertainty shocks in the US explain around 3% of the variation in prices and 8% of economic activity, consistent with Miescu (2019) for emerging economies. When conducting a counterfactual analysis, controlling the response of potential transmission channels, no significant differences were found for economic activity and prices in the absence of a response from Nicaraguan uncertainty, meanwhile, the decrease in remittances and the evolution of international prices are the channels through which prices decrease.

For its part, credit to the private sector represents a strong channel through which the effects of the shock of uncertainty in the US are transmitted on economic activity, this in accordance with Carrière-Swallow and Céspedes (2013) who find that for emerging economies with less developed financial markets the credit is a relevant channel through which uncertainty shocks are transmitted to investment and economic activity.

Finally, given that credit frictions generated by uncertainty shocks amplify the decline in economic activity and lead to a slower recovery, it may be important that the monetary and/or fiscal authority employ policies to reduce the cost of financing and provide liquidity to companies and households, this with the aim of boosting aggregate demand once uncertainty has returned to its normal levels.

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7 Appendix

7.1 Tables

Table 3: Media of Greater Dissemination in Nicaragua

Category	Media	Tweets	First Tweet
TV	100% Noticias	132,071	2010M05
	Canal 2	36,511	2010M04
	Canal 4	134,642	2011M05
	Canal 10	31,879	2010M05
	Vos TV	23,118	2010M08
Radio	Radio Ya	142,869	2010M09
Newspaper	La Prensa	189,275	2010M03

Table 4: Information Sources and Transformation of Variables

Variable	Source	Transformation	Label, IRF's*
VIX	FED St. Louis	log-level	% deviation
EPUC - Nica	Own elaboration	Level	Stand. Dev.
Remittances	BCN	log-level	% deviation
Domestic Interest Rate	BCN	% points	basis points
Credit to the Private Sector	CMCA	log-level	% deviation
Consumer Price Index	CMCA	log-level	% deviation
Economic Activity Index	BCN	log-level	% deviation

Notes: The vertical axis for the IRF's of the domestic interest rate is multiplied by 100 due to the magnitude of its results, therefore, they are interpreted as changes in basis points.

Table 5: Descriptive statistics of endogenous variables of the VAR system

Variable	Mean	Stand Dev	Max	Min
VIX	16.55	7.13	63.32	8.02
EPUC - Nica	0.00	1.00	5.24	-1.37
Remittances	113.68	24.83	190.80	82.16
Domestic Interest Rate	3.45	1.10	6.05	1.78
Credit to the Private Sector	3,853.75	860.98	2,273.70	5,364.55
Consumer Price Index	0.39	0.47	1.80	-0.59
Economic Activity Index	0.14	2.12	8.04	-7.82

Notes: The descriptive statistics for the economic activity index and the consumer price index were made based on the monthly variation of said indicators.

7.2 Figures

Figure 5: Nicaraguan EPUC and US EPU of Baker, Bloom, and Davis (2016)

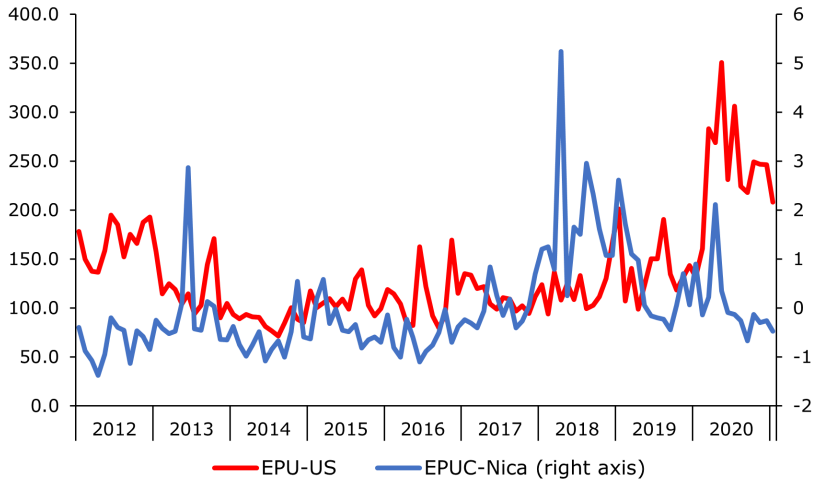
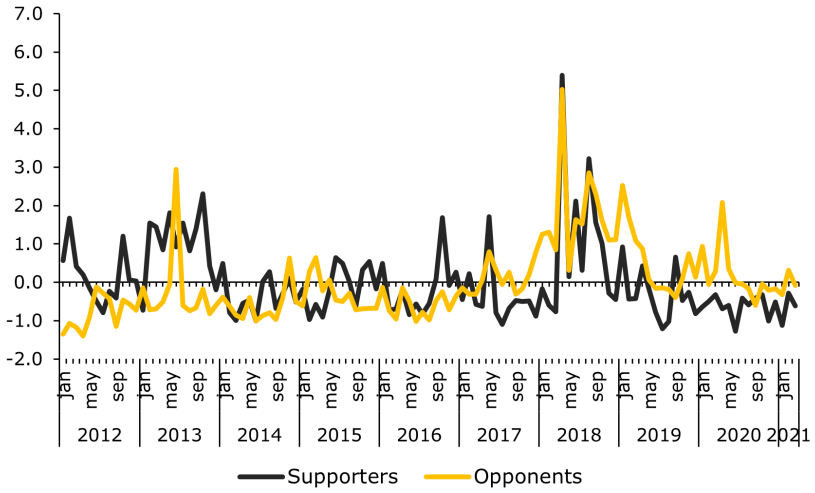


Figure 6: EPUC: Government Supporters vs Government Opponents



Notes: The opposition media group is made up of the three media that have criticized the government the most within the estimation period and the group of pro-government media is made up of the three media that have been sympathetic to the government of the day.

Figure 7: Uncertainty Shocks in the US based on Piffer and Podstawski (2018)

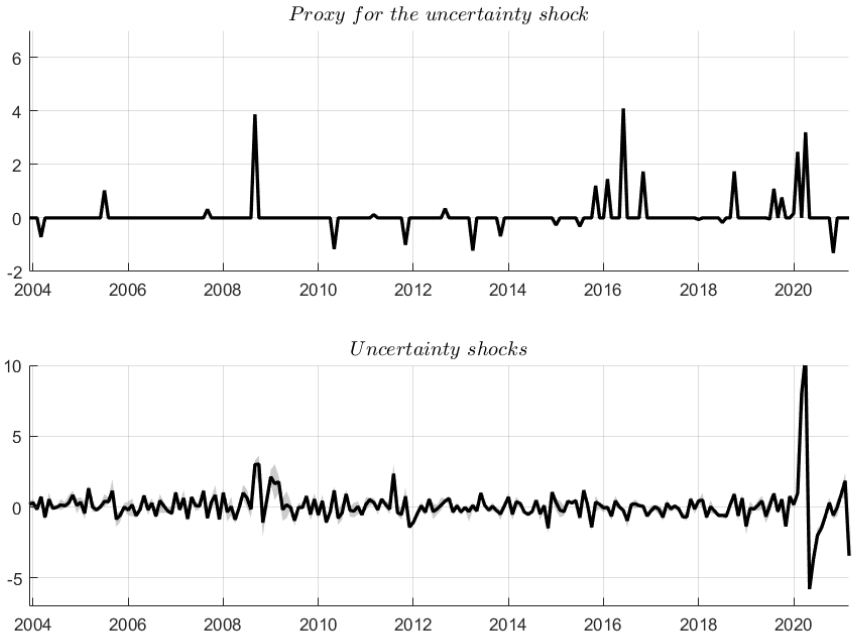
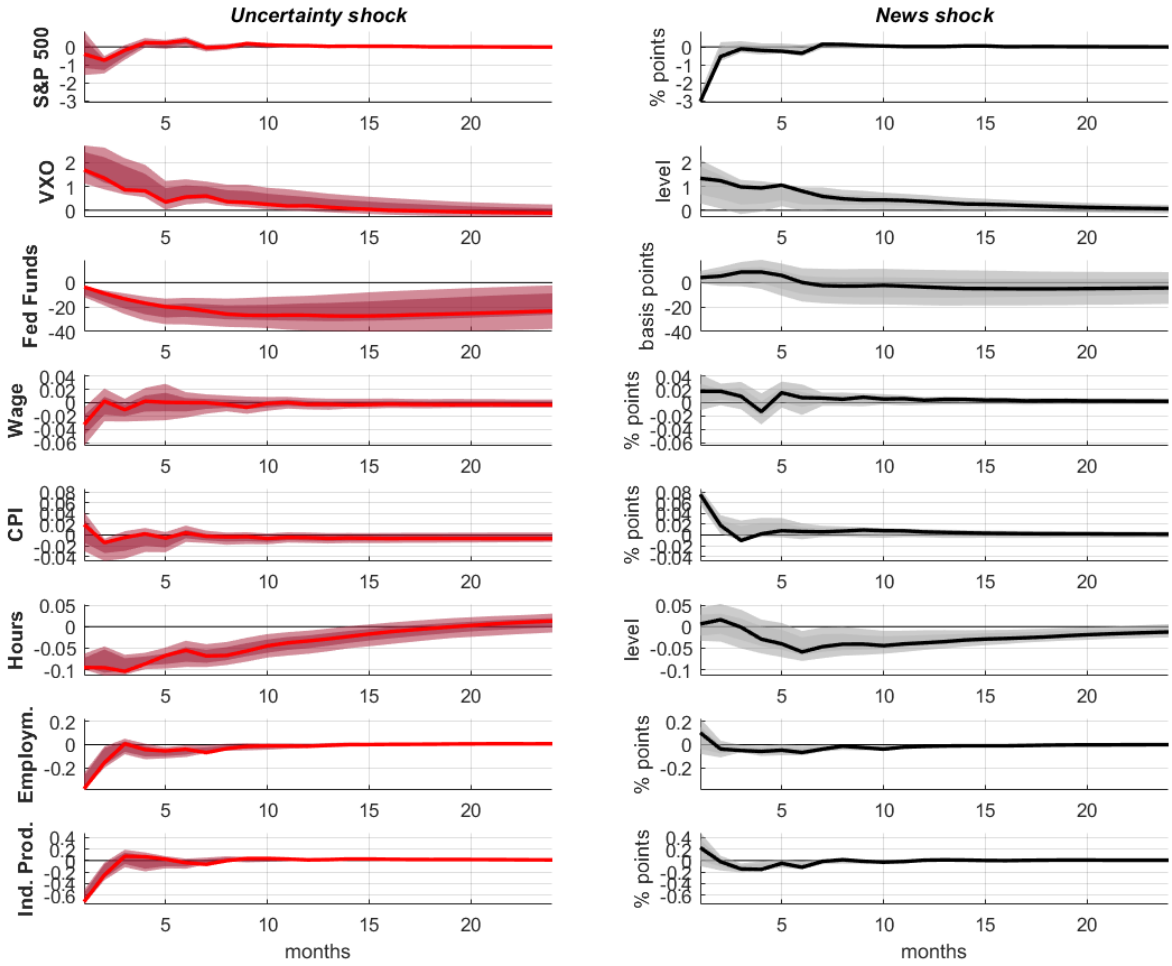


Figure 8: IRF's in the face of an uncertainty shock and a new shock for the United States, results in Piffer and Podstawski (2018).



Notes: Corresponds to the IRF's presented in figure 4 of Piffer and Podstawski (2018), but using the uncertainty shocks updated until March 2021. Solid lines indicate point estimates of IRF. The dark red and light red shaded areas represent the confidence intervals at 68% and 95% confidence, respectively, the inference of which is obtained by computing 1,000 bootstrap replications.

Figure 9: Data used in VAR specifications

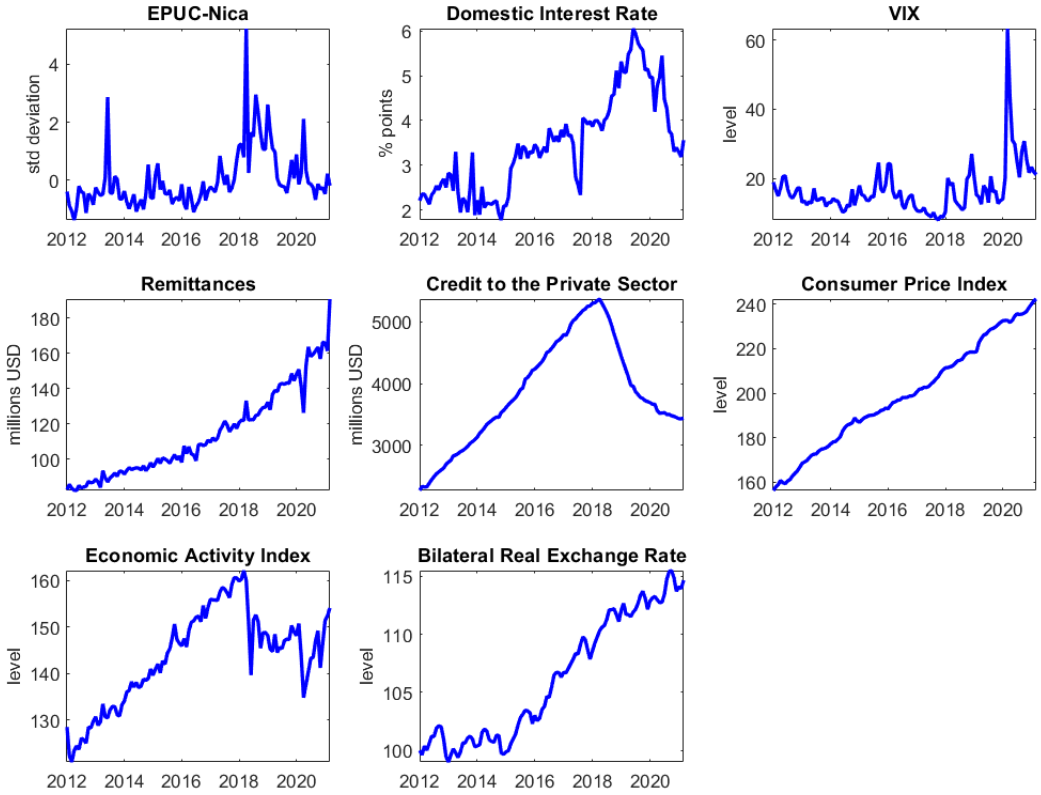


Figure 10: Autocorrelation test for the base model

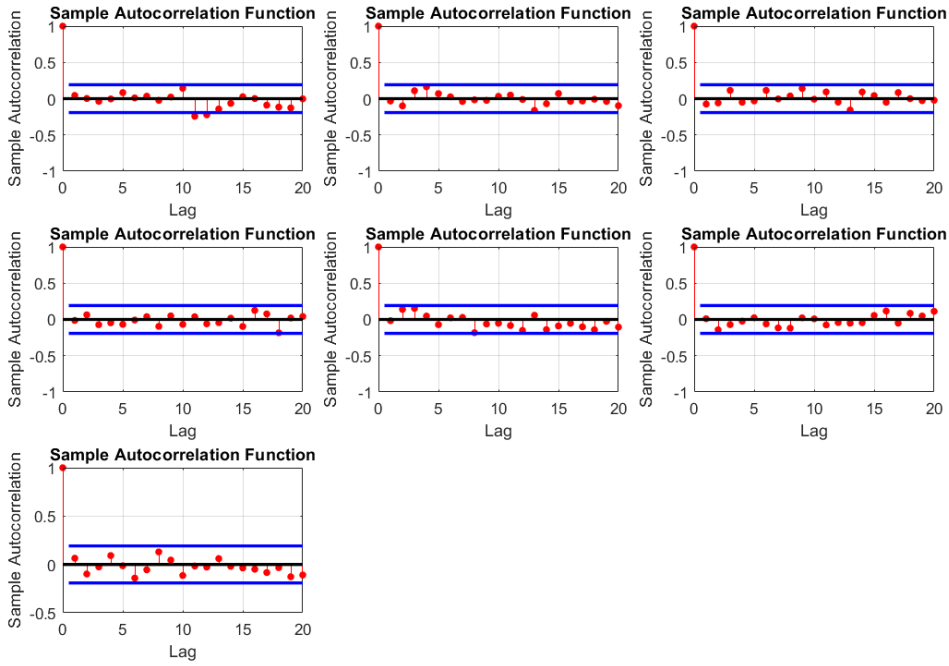
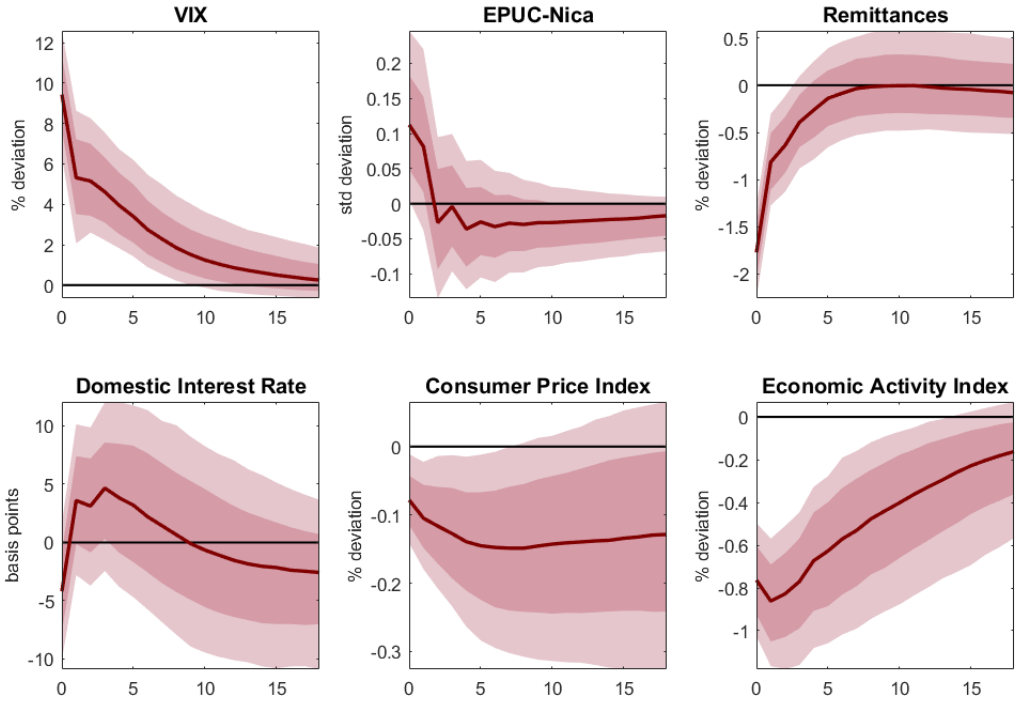


Figure 11: Parsimonious model: IRF from a one standard deviation Uncertainty Shock in the US

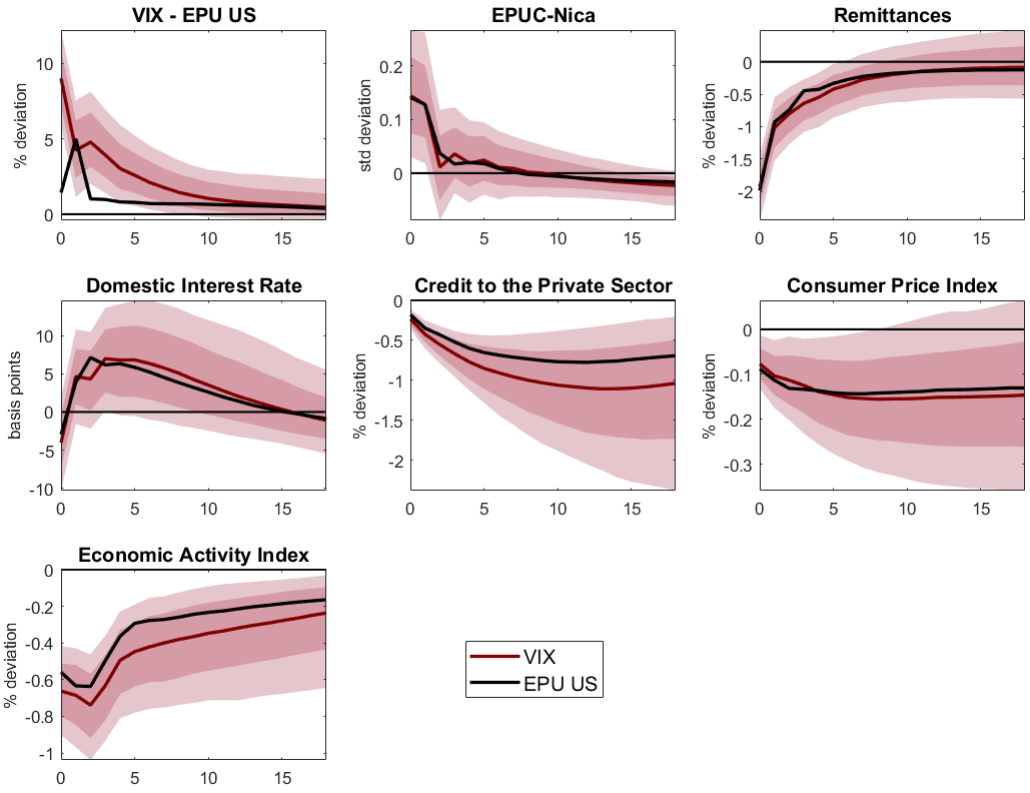
Notes: Solid lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Figure 12: Including remittances and interest rate in the model: IRF an one standard deviation Uncertainty Shock in the US



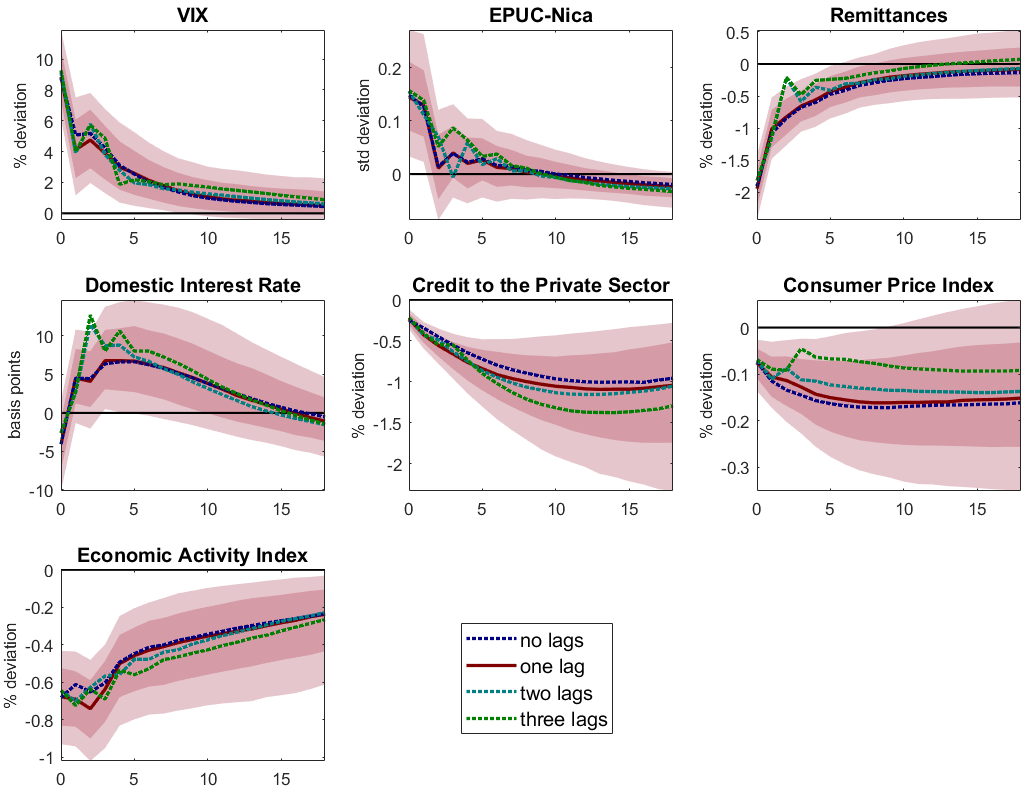
Notes: Solid lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Figure 13: EPU US instead of VIX: IRF an one standard deviation Uncertainty Shock in the US



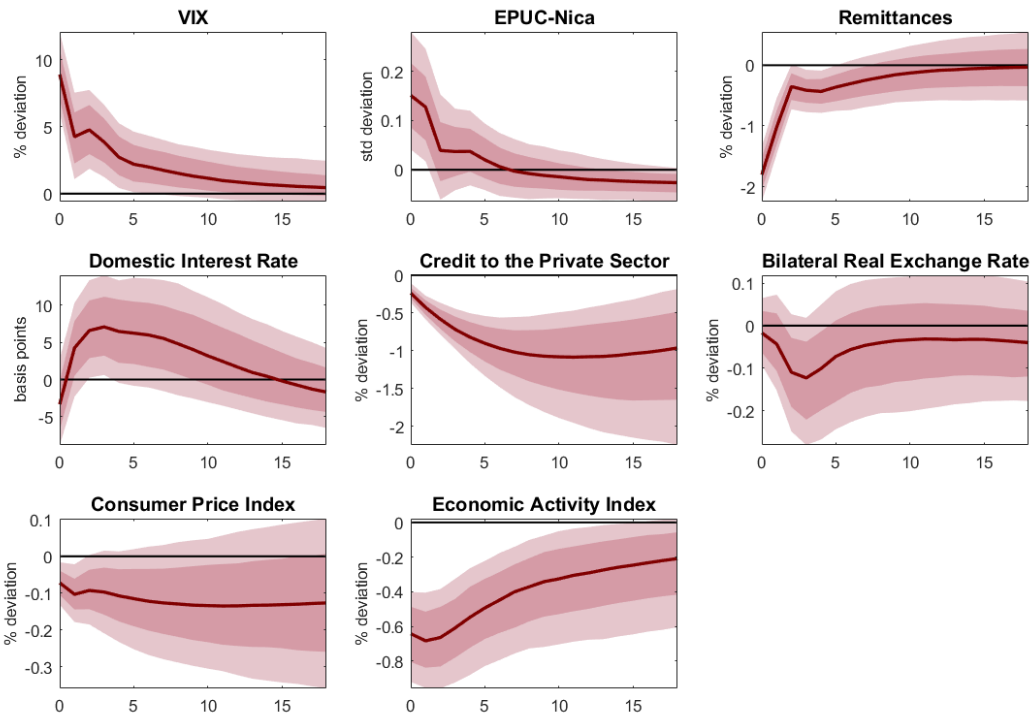
Notes: Solid lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Figure 14: Different numbers of lags for the US Uncertainty Shock: IRF an one standard deviation Uncertainty Shock in the US



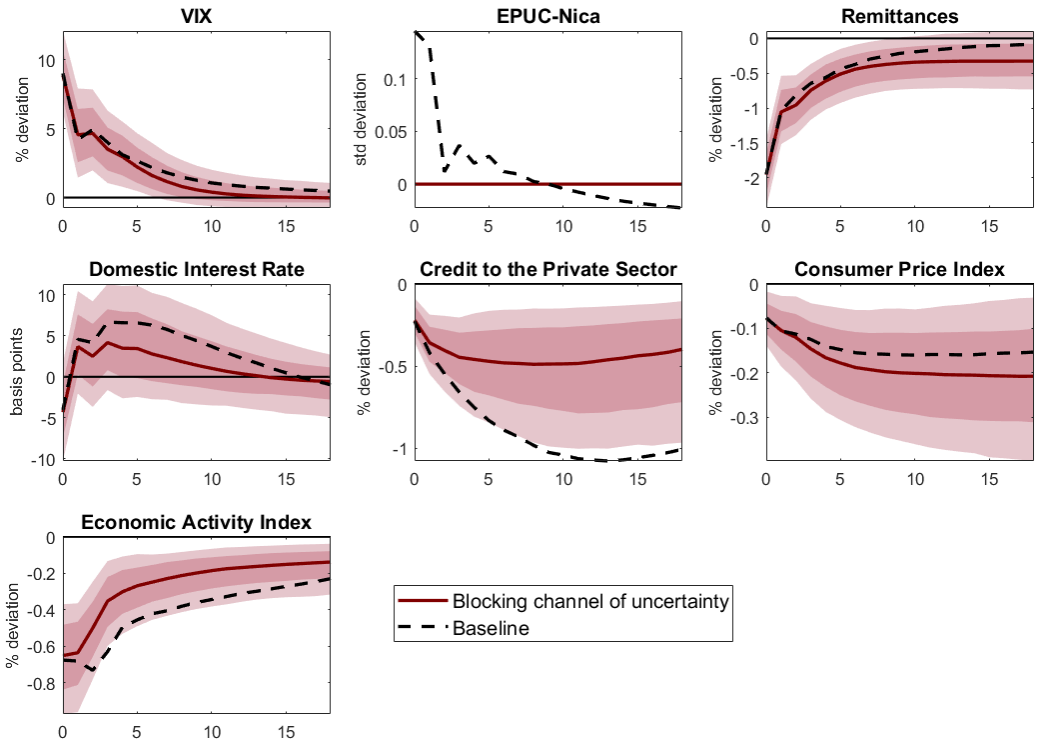
Notes: Solid and dotted lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Figure 15: Including bilateral real exchange rate in the model: IRF an one standard deviation Uncertainty Shock in the US



Notes: Solid lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.

Figure 16: IRF from a one standard deviation uncertainty shock in the US, blocking channel of Nicaraguan uncertainty



Notes: Solid and dotted lines indicate point estimates of IRF from the VAR system (5). The dark red and light red shaded areas represent the confidence intervals at 68% and 90% confidence, respectively, the inference of which is obtained by computing 1,000 Bootstrap replications.