

Steer Boldly through the Mud: Uncertainty and Monetary Policy Power and Transmission*

Daniel Osorio

Banco de la República de Colombia

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Abstract

What is the effect of uncertainty on the power and transmission of monetary policy decisions to the economy? To answer this question, this paper takes Colombia as a case study and follows a two-step strategy: firstly, the paper compiles a wide set of monetary policy shocks in Colombia, both from external sources and from internal VAR-based estimations following Bernanke and Blinder (1992) and Christiano et al. (1999) including measures of policy uncertainty within the system; secondly, the paper uses local projections (Jordà (2005)) to estimate impulse-response functions from those shocks to real activity (power of monetary policy) and bank interest rates (transmission of monetary policy), and to estimate the effect of policy uncertainty on those functions. Consistently with an ample theoretical literature, the results show that, under heightened uncertainty, there is a considerable loss of power for monetary policy. The evidence is less conclusive for the effect of uncertainty on the transmission of monetary policy. The policy implication of these findings is straightforward: under heightened policy uncertainty, monetary authorities should react more strongly to shocks affecting the economy.

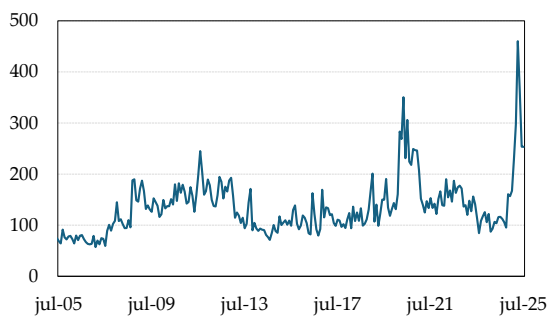
Keywords: Power of Monetary Policy, Monetary Policy Shocks, Local Projections, Economic Policy Uncertainty.

JEL Codes: E52, E58.

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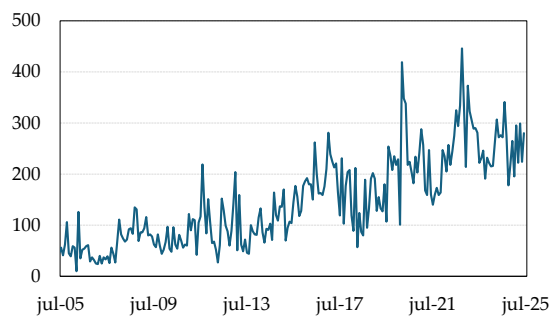
In recent times, there has been a growing interest in the effects of uncertainty on the economy. This might be related to a series of local and global events that have led to a heightened perception of policy uncertainty. For instance, Figure 1 shows the last two decades of the US Economic Policy Uncertainty Index (EPU) calculated by policyuncertainty.com following the methodology of Baker et al. (2016): the EPU spikes around events of heightened uncertainty, such as the global financial crisis, the pandemic, and the recent abrupt changes to US trade policy. At a local level, Figure 2 shows, for the same time horizon, the Colombia Economic Policy Uncertainty Index (CEPU) calculated by Fedesarrollo (2024) using a similar methodology: the perception of uncertainty in Colombia also reflects specific events such as the slowdown of 2016-2017, the pandemic, or the volatility of financial markets at the end of 2022, following the start of the current administration, under which uncertainty has remained persistently high.

Figure 1: Economic Policy Uncertainty - United States



Source: policyuncertainty.com.

Figure 2: Economic Policy Uncertainty - Colombia



Source: Fedesarrollo.

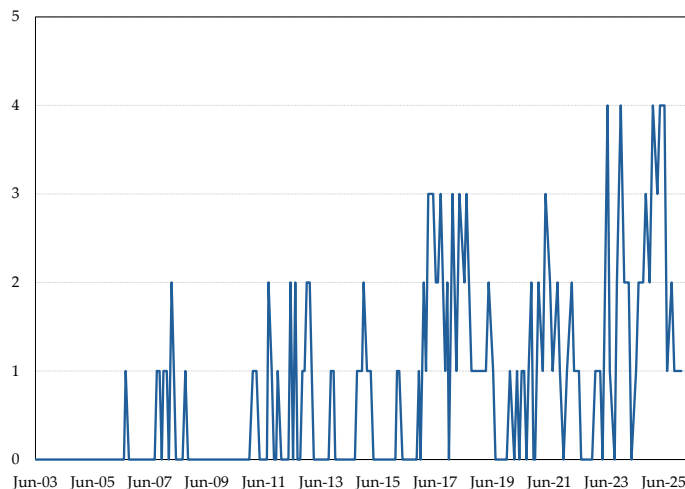
The statements and communications of policymakers also reflect this interest in uncertainty. For the case of Colombia, Figure 3 shows a simple count of instances of the word “uncertainty” in the minutes published by the Board of Directors of the Central Bank shortly after their monthly meetings. Mentions of “uncertainty” have become increasingly recurrent over time; in the recent past, they were even more common than during the pandemic.

The interest of policymakers in the effects of uncertainty can be justified for multiple reasons. Firstly, heightened uncertainty could lead policymakers to react in a different fashion to observed economic conditions (Brainard (1967)). Secondly, uncertainty can serve as a signal of the future state of aggregate demand, particularly considering the link between uncertainty and key aggregates, such as investment (Vásquez-Escobar et al. (2024); Fernandes and Rigato (2025)). Finally, policymakers might be interested in the effects of uncertainty on the transmission, or the power, of their decisions onto the wider economy.

This paper focuses on the latter argument by studying the effects of policy uncertainty on the effectiveness of monetary policy. More specifically, the paper studies whether a higher degree

of policy uncertainty has any effect on the power and transmission of monetary policy; that is, on its capacity to influence the course of aggregate real activity and bank rates, respectively.

Figure 3: Instances of “Uncertainty” in Minutes of the Board of Directors - Colombia



Source: Banco de la República, own calculations.

To analyze this question, this paper takes Colombia as a case study and follows a two-step methodology. In the first step, the paper compiles a diverse set of monetary policy shocks, both from external sources and from internal VAR-based estimations following Bernanke and Blinder (1992) and Christiano et al. (1999), including measures of policy uncertainty within the system. Shocks sourced externally include those estimated using the methodology by Romer and Romer (2004) and those calculated as the difference between the observed and expected monetary policy rate, using high-frequency information from financial markets. In the second step, the paper deploys the local projections method (Jordà (2005)) to estimate the dynamic response of real activity and bank rates to monetary policy shocks (that is, to estimate the power and transmission of monetary policy, respectively). Further estimations include interaction terms between monetary shocks and policy uncertainty, which capture the effect of the latter on the power and transmission of monetary policy. In the case that uncertainty has an effect on the power of monetary policy (that is, on its capacity to influence real activity), analyzing its effect on the transmission of monetary policy (its capacity to influence bank rates) acquires special policy relevance, as it helps to establish whether the effect of uncertainty on power operates on the link between monetary policy and the financial system or on the link between the financial system and the wider economy. An additional set of estimations includes triple interaction terms between shocks, policy uncertainty, and shock sign dummies to analyze whether any loss of power or transmission is asymmetrical (that is, whether it occurs differentially for expansionary or contractionary policy shocks).

The main findings of the paper can be summarized as follows: firstly, the estimation of monetary policy shocks using VAR-based techniques indicates that monetary policy does not react in a systematic fashion to economic policy uncertainty. Secondly, the impulse-response functions estimated using local projections illustrate the relatively high power and transmission of monetary policy in Colombia. There is a negative, statistically significant impact of shocks on real activity with a 12-month to 24-month lag; and a positive, immediate, statistically significant impact of shocks on consumer and business bank rates. Thirdly, when including interaction terms between monetary shocks and policy uncertainty, the evidence shows a considerable loss of power for monetary policy when uncertainty increases; that is, there is a reduction in the effect of monetary shocks on real activity. The evidence is less conclusive in the case of the transmission of monetary policy: the effect of uncertainty on the link between monetary shocks and bank rates depends closely on the specific shock that is used. Finally, when including triple interaction terms between shocks, uncertainty, and shock sign dummies, there is no evidence that this loss of power is asymmetric; that is, it is not possible to reject the hypothesis that the loss is of a similar magnitude for expansionary or contractionary shocks.

By first studying the empirical link between uncertainty and both the power and transmission of monetary policy, this paper contributes to two strands of the literature. The first strand focuses on the macroeconomic effects of uncertainty: from a theoretical point of view, Bloom (2009) develops a model to analyze the contractionary effects of shocks to the second moment of the distribution of the structural perturbations of the model; from an empirical point of view, Ramey and Ramey (1995), Bloom et al. (2018) and Baker et al. (2016) use forecasting models, structural model estimations, and natural experiments, respectively, to calculate the negative effects of uncertainty on consumption and investment. The second strand focuses on the challenges of policymaking under uncertainty and can be subdivided into two groups. One group focuses on the solution to the problem of optimal monetary policy under additive or parameter uncertainty (see Brainard (1967), Walsh (2003) and Ferrero et al. (2019)). In the case of parameter uncertainty, optimal monetary policy reacts more *cautiously* to perturbations. The second group focuses on durable consumption and investment choices through the lens of “real options” (Bernanke (1983); Bloom (2014); Hurst et al. (2000); Bertola et al. (2005)). In this case, the response of consumption and investment to monetary policy is weakened (or delayed) under uncertainty. According to this, firms and consumers might be less sensitive to policy stimuli under heightened uncertainty, which, in turn, might require “stronger” or “bolder” policy action. These ideas offer some lenses through which the findings of this paper can be translated into policy recommendations.

The remainder of this paper unfolds as follows: Section 1 presents the two step methodology of the paper, including a description of the data to be used; section 2 presents the main findings of each of the two steps; finally, section 3 presents some concluding thoughts.

1 Methodology

This paper closely follows the two-step methodology of Brandao-Marques et al. (2020) and Meneses-González (2022). The first step consists of isolating exogenous variations (shocks)

of the relevant policy instrument, which in this case corresponds to the policy rate of the Banco de la República (the Central Bank of Colombia)¹. According to Ramey (2016), among others, this step is necessary to estimate the empirical effect of monetary policy on any macroeconomic variable without contaminating the result with the systematic reaction of monetary policy to those same variables. To do this, this paper compiles a set of estimated monetary policy shocks from two sources: firstly, external, off-the-shelf shocks estimated using the method by Romer and Romer (2004) or computed as the difference between the observed and expected monetary policy rate, where the latter is captured by surveys or high-frequency information from financial markets; secondly, internal estimations using a standard VAR methodology coupled with a simple Cholesky identification strategy.

The second step uses these shocks, interpreted as purely exogenous variations in monetary policy, to estimate the dynamic response of Colombian real activity and bank rates to them through the deployment of the local projections method of Jordà (2005). The resulting impulse-response functions (IRFs) capture what might be called the “base power” and the “base transmission” of monetary policy; that is, its capacity to influence and steer the course of real activity and bank rates, respectively. Afterwards, the paper proceeds to estimate the effect of policy uncertainty on the power of monetary policy by including interaction terms between observed policy uncertainty and monetary shocks as part of the estimation of the IRFs of real activity. Whenever estimates of these interaction coefficients turn out to be statistically different from zero, the evidence will be consistent with uncertainty having some effect on the power of monetary policy.

In the case that uncertainty has an effect on the power of monetary policy, the paper proceeds to include the same interaction terms between observed policy uncertainty and monetary shocks as part of the estimation of the IRFs on bank rates. This procedure has a special policy relevance: if uncertainty affects power, it helps to establish whether that effect operates on the link between monetary policy and the financial system (which would be the case whenever estimates of the interaction coefficients here turn out to be statistically different from zero, which would be interpreted as uncertainty having an effect on transmission as well as power) or on the link between the financial system and the wider economy (which would be the case whenever estimates of the interaction coefficients here turn out to be statistically not different from zero, which would be interpreted as uncertainty having an effect on power but not on transmission).

Finally, the paper estimates whether the impact of uncertainty on power depends on the stance of monetary policy, that is, on whether monetary shocks are positive or negative. To elucidate this, the paper includes triple interaction terms between policy uncertainty, monetary shocks, and shock sign dummies. Whenever estimates of these triple interaction coefficients turn out to be statistically different from zero, the evidence will be consistent

¹The literature does not offer a satisfactory theory about the conceptual meaning of these shocks. Their interpretation as simple innovations from a policy rule does not allow for a clear understanding of the economic origins of the shocks. Traditionally, these shocks have been interpreted as the result of changes in the preferences of the monetary authority, for instance, as a result of changes in the composition of the decision bodies (Owyang and Ramey (2004)) or measurement error in the information set used by the monetary authorities (Christiano et al. (1999)).

with an asymmetric effect of uncertainty on the power of monetary policy.

Before detailing the econometric specifications to be estimated and the coefficients of interest, the following subsection describes relevant data and data sources.

1.1 Data

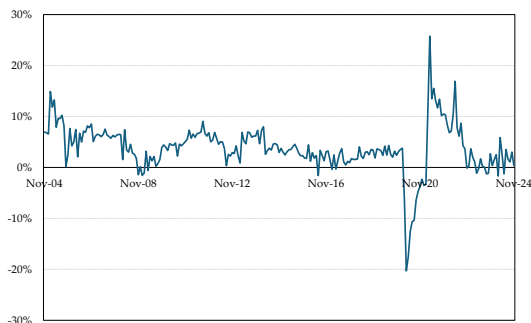
1.1.1 Real Activity

In dealing with the power of monetary policy, real economic activity is the main macroeconomic focus of this paper and is captured through the following observables:

- Economic Monitoring Indicator (ISE, for its acronym in Spanish), published by the National Administrative Department of Statistics (DANE), seasonally adjusted (SA). ISE is “a synthetic index whose purpose is to provide a measure of the evolution of real economic activity in the short term, [...] adjusted to the methodology used in the quarterly national accounts; [and] composed of a heterogeneous set of monthly indicators representative of economic activities”²
- Real stock of consumer, business, and mortgage loans of credit institutions, published by the Financial Superintendency of Colombia (SFC).

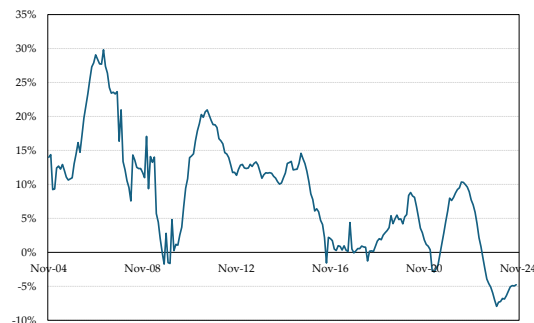
Both variables are captured at a monthly frequency for the period from November 2003 to December 2024 and are included in the regressions in logs, growth rates, and cyclical components obtained using the filter by Hodrick and Prescott (1997). Figures 4 and 5 show the growth rates of these variables across the horizon of study.

Figure 4: SA-ISE Annual Growth Rate



Source: DANE.

Figure 5: Real Loans Annual Growth Rate



Source: SFC.

1.1.2 Uncertainty

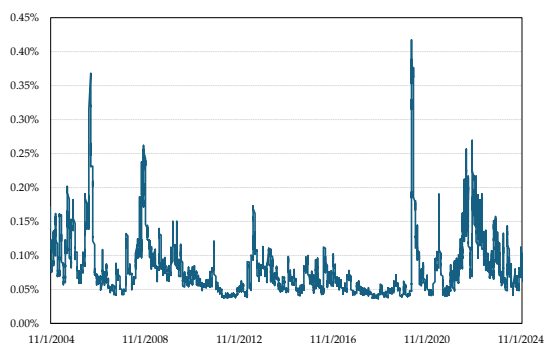
This paper uses three complementary measures of policy uncertainty:

²See www.dane.gov.co.

- Colombia Economic Policy Uncertainty Index (CEPU), calculated and published by Fedesarrollo (Figure 2). This index replicates, for the case of Colombia, the method by Baker et al. (2016), which is based on the normalized proportion of “*words related to political or economic policy uncertainty in the news of the main national newspaper*” in the total number of published pieces (Fedesarrollo (2024), own translation).
- US Economic Policy Uncertainty Index (EPU), calculated and published by policyuncertainty.com following the method by Baker et al. (2016) for the US (Figure 1). EPU is used to mitigate the concern that CEPU might be endogenously related to the distribution of Colombian monetary policy shocks.
- Conditional volatility of Colombian sovereign 10-year debt securities, TES (V10). This volatility is estimated by the Banco de la República, and it is used to capture uncertainty arising mainly from fiscal policy. Figure 6 shows the behavior of V10 during the horizon of study. Similar to the case of CEPU, the figure shows the effect of the pandemic and the volatility of financial markets during the second semester of 2022 on fiscal uncertainty.

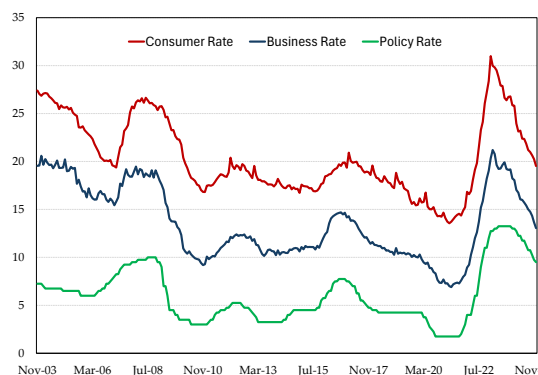
The three measures of uncertainty are captured at a monthly frequency for the horizon of study and are included in regressions in their original form.

Figure 6: V10



Source: Banco de la República.

Figure 7: Bank and Policy Rates



Source: SFC.

1.1.3 Monetary Policy and Bank Rates

For the estimation of monetary policy shocks, the paper also employs monthly data for the monetary policy rate of the Banco de la República, total and core (excluding food and regulated items) annual CPI inflation (sourced from DANE and the Banco de la República, respectively), and total and core annual inflation expectations reported by the Banco de la República from survey data.

Finally, monthly bank rates are taken as the average interest rates on disbursements of consumer and business (so-called “ordinary commercial”) loan operations reported by Colombian

credit institutions to the SFC. Figure 7 shows these bank rates and the monetary policy rate during the horizon of study.

1.2 Econometric Specifications

1.2.1 Monetary Policy Shocks

To identify a historical time series of monetary policy shocks in Colombia, isolating the systematic response of the policy rate to the state of the economy, this paper uses a simple strategy following Bernanke and Blinder (1992) and Christiano et al. (1999). This strategy consists of assuming that monetary policy shocks correspond to the residuals of the OLS estimation of the following specification (broadly interpreted as a reaction function of monetary policy):

$$i_t = \Gamma_0 + \sum_{j=1}^p \rho_j i_{t-j} + \sum_{j=0}^p \alpha_j (\pi_{t-j} - \pi_{t-j}^*) + \sum_{j=0}^p \Upsilon_j (\pi_{t-j}^e - \pi_{t-j}^*) + \sum_{j=0}^p \gamma_j G_{t-j} + \sum_{j=0}^p \lambda_j e_{t-j} + \sum_{j=0}^p \delta_j U_{t-j} + \nu_t \quad (1)$$

where i represents the policy rate, π a measure of inflation, π^e the expected, 12-month ahead inflation expectations, π^* the inflation target, G a measure of excess demand, e the nominal depreciation rate, and U a measure of policy uncertainty. Interpreting the residuals of the OLS estimation of specification (1) as pure monetary policy shocks is equivalent to assuming that inflation, inflation expectations, excess demand, and uncertainty do not respond contemporaneously to monetary policy (Ramey (2016)). In other words, the residuals of the estimation of specification (1) are exactly those that would be obtained from the estimation of a VAR with a triangular ordering (Cholesky) where the policy rate is placed last. This is a plausible assumption taking into account that the economy reacts with a lag to monetary policy (recursivity assumption).

As explained before, the paper also uses off-the-shelf monetary shocks sourced from the literature. Specifically, the paper also uses the following sources:

- Monetary shocks estimated using the method by Romer and Romer (2004): these shocks are obtained as “*the residuals from regressing the policy rate on the set of information of the Board of Directors, [which] includes the current policy rate, observed GDP, and two-quarters ahead forecasts of inflation and GDP from the staff of the Banco de la República, as well as the changes in those forecasts from previous meetings*” (López et al. (2020), own translation).
- Monetary shocks estimated as the difference between the observed policy rate and the expected policy rate by participants in financial markets (Romero et al. (2021)). Expectations are obtained from high-frequency information in financial markets (specifically the 1-month Overnight Index Swap prices, OIS) or from survey data (specifically the Bloomberg survey to financial market analysts).

The point value of all monetary shocks, estimated and sourced elsewhere, is set to zero for those months in which the Board does not decide on the policy rate as part of its yearly schedule (that is: February, May, August, and November, after 2018).

1.2.2 Monetary Policy Power and Transmission

Using the set of shocks, the paper employs the local projections method (Jordà (2005)) to estimate the dynamic effect of shocks on the measures of real activity and bank rates. This method consists of estimating the following specification:

$$Y_{t+h} = \Lambda_h + \beta^h \nu_t + \sum_{j=1}^J \theta_j^h \nu_{t-j} + \sum_{j=1}^J \psi_j^h Y_{t-j} + \varepsilon_{t+h} \quad (2)$$

for $h \in \{0, 1, \dots, H\}$ with H as the time horizon of the IRFs³, ν as the monetary policy shock and Y as a measure of real activity (for power) or bank rates (for transmission).

In this estimation⁴, the coefficients of interest comprise the full set of β^h for $h \in \{0, 1, \dots, H\}$. These coefficients represent an IRF to the horizon H . Monetary policy has “power” to influence real activity (“transmission” to bank rates) whenever $\hat{\beta}^h < 0$ ($\hat{\beta}^h > 0$) for some $h < H$ in the estimation that uses real activity (bank rates) as dependent variable.

1.2.3 Power, Transmission, and Uncertainty

In the context of these estimations, studying whether uncertainty has any effect on the power or on the transmission of monetary policy is equivalent to calculating whether the estimated IRFs change systematically in the face of uncertainty. To accomplish this, specification (2) is enlarged to include an interaction term between the shocks ν_t and a measure of uncertainty, U_t :

$$Y_{t+h} = \Lambda_h + \beta^h \nu_t + \phi^h \nu_t U_t + \sum_{j=1}^J \theta_j^h \nu_{t-j} + \sum_{j=1}^J \psi_j^h Y_{t-j} + \varepsilon_{t+h} \quad (3)$$

In this specification, the coefficients of interest comprise the full set of ϕ^h for $h \in \{0, 1, \dots, H\}$. According to equation (3), the effect of a monetary shock on real activity or bank rates at horizon h is given by the following expression (where, naturally, shocks are assumed to be independent):

$$\frac{dY_{t+h}}{d\nu_t} = \beta^h + \phi^h U_t \quad (4)$$

³In the rest of the paper, $H = 40$.

⁴due to the serial correlation of the error term ε_{t+h} , the estimation must incorporate the correction by Newey and West (1987)

Given that $U_t > 0$ by construction (it is either a volatility or a normalized proportion), under the premise that monetary policy has power (transmission) such that $\beta^h < 0$ ($\beta^h > 0$) for some $h < H$, there is a loss of power (transmission) for monetary policy under heightened uncertainty whenever $\phi^h > 0$ ($\phi^h < 0$) *for the same* h .

1.2.4 Asymmetry

Finally, in case $\beta^h < 0$ and $\phi^h > 0$ for some $h < H$ (that is, there is a loss of power for monetary policy under uncertainty), it is of interest to determine whether the loss of power varies depending on the policy stance, that is, on whether monetary shocks are expansionary ($\nu_t < 0$) or contractionary ($\nu_t > 0$). To accomplish this, a triple interaction term between ν_t , U_t , and a shock sign dummy *dummy*, D_t , is added to specification (3):

$$Y_{t+h} = \Lambda_h + \beta^h \nu_t + \phi^h \nu_t U_t + \kappa^h \nu_t U_t D_t + \sum_{j=1}^J \theta_j^h \nu_{t-j} + \sum_{j=1}^J \psi_j^h Y_{t-j} + \varepsilon_{t+h} \quad (5)$$

where $D_t = 1$ if $\nu_t > 0$ (and $D_t = 0$ otherwise), and Y is a measure of real activity. In this specification, the effect of a contractionary policy shock on real activity is given by the following expression:

$$\frac{dY_{t+h}}{d\nu_t} = \beta^h + (\phi^h + \kappa^h)U_t \quad (6)$$

Therefore, in specification (5), the coefficients of interest comprise the full set of κ^h for $h \in \{0, 1, \dots, H\}$. Under the premise of a loss of power under uncertainty ($\beta^h < 0$ and $\phi^h > 0$), the loss of power is greater for contractionary shocks if $\kappa^h > 0$ *for the same* h .

2 Results

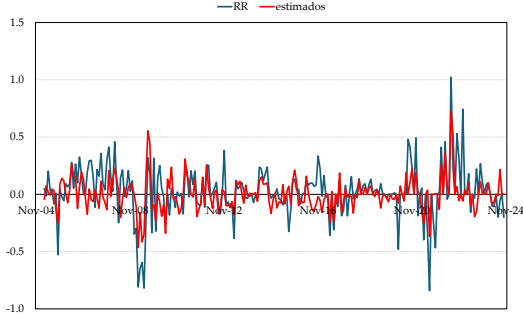
2.1 Monetary Policy Shocks

Tables 1-3 at the end of the paper present the results of the estimation of specification (1) under different configurations. These estimations include uncertainty and the state of the economy with the aim of determining whether monetary policy reacts systematically to uncertainty.

The results presented in the tables indicate that monetary authorities in Colombia respond mainly to contemporaneous inflation, to a lesser degree to lagged inflation and real activity, and do not respond at all to uncertainty.

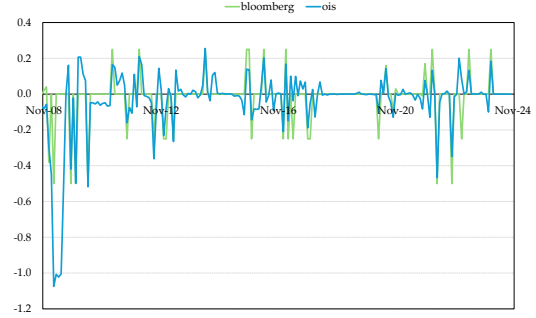
Figure 8 shows the estimated residuals of specification (1), together with monetary shocks sourced from external estimations using the method by Romer and Romer (2004). Both sets of shocks are remarkably similar, and tell a similar history. More specifically, both shocks indicate the persistence of expansionary shocks during the pandemic and contractionary shocks in recent times.

Figure 8: Monetary shocks: Specification (1) and Romer and Romer (2004)



Source: López et al. (2020) updated.

Figure 9: Monetary Shocks: OIS and Bloomberg



Source: Romero et al. (2021) updated.

Figure 9 shows monetary shocks as the difference between the observed and expected policy rate (Romero et al. (2021)), where expectations are captured through high-frequency OIS prices or from Bloomberg surveys. These shocks turn out to be slightly different from those presented above, both in their magnitudes and in their narratives. Specifically, OIS and Bloomberg shocks are more expansionary around the time of the pandemic and the global financial crisis, and do not seem persistently contractionary in recent times. The recurrence of shocks equal to zero is also evident in the case of these sources.

2.2 Monetary Policy Power

Figures 10 and 11 show the estimation of IRFs from projection (2); that is, the set of $\hat{\beta}^h$ for $h \in \{0, 1, \dots, H\}$ with confidence intervals at 95% using directly the policy rate and the monetary shocks from the method by Romer and Romer (2004), and the log of SA-ISE as dependent variable. In both figures, the main finding of this paper is shown: monetary policy in Colombia has considerable power, evident in a fall of SA-ISE of between 2% and 4% after a 1% shock to the policy rate with a lag of 18 months approximately. These results are consistent with those obtained elsewhere in the literature. Figures 12 and 13 show similar IRFs using the log of real loans as dependent variable. In this case, even though point estimates are similar, only perturbations to the observed policy rate reflect statistically significant power.

Finally, using OIS and Bloomberg shocks, the estimations indicate power of monetary policy when using the real annual growth rates of SA-ISE and total loans as dependent variables (not their levels). The power of monetary policy on loans (Figures 16 and 17) is more evident in comparison with SA-ISE, which flickers only occasionally during the horizon of projection (Figures 14 and 15).

Figure 10: IRF (specification (2))
 $i_t \rightarrow \log(ISE_{t+h})$

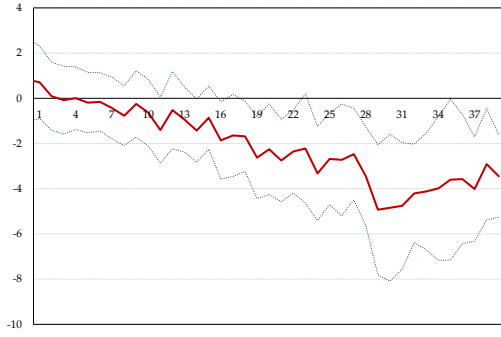


Figure 11: IRF (specification (2))
 $RR2004 \rightarrow \log(ISE_{t+h})$

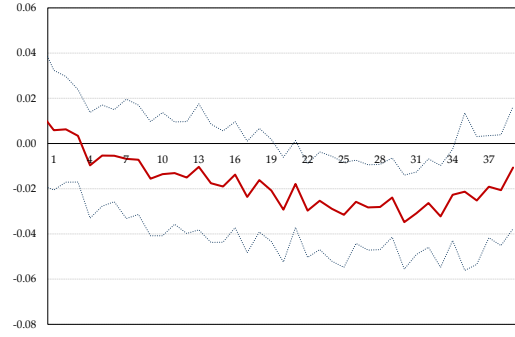


Figure 12: IRF (specification (2))
 $i_t \rightarrow \log(Loans_{t+h})$

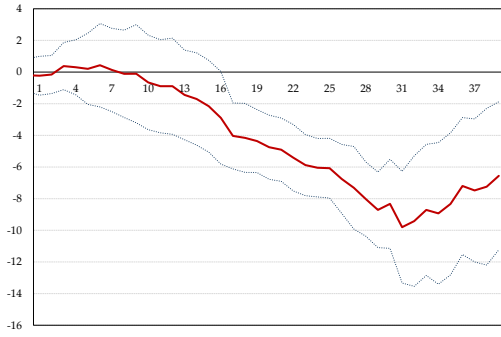


Figure 13: IRF (specification (2))
 $RR2004 \rightarrow \log(Loans_{t+h})$

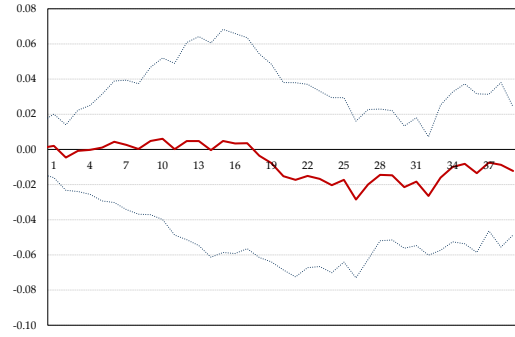


Figure 14: IRF (specification (2))
 $OIS \rightarrow \Delta \log(ISE_{t+h})$

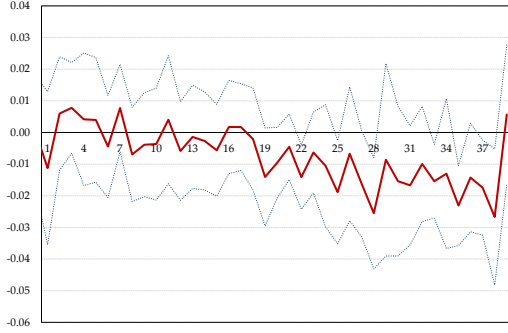


Figure 15: IRF (specification (2))
 $Bloomberg \rightarrow \Delta \log(ISE_{t+h})$

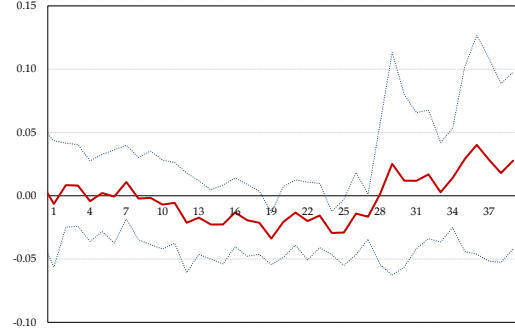


Figure 16: IRF (specification (2))
 $OIS \rightarrow \Delta \log(Loans_{t+h})$

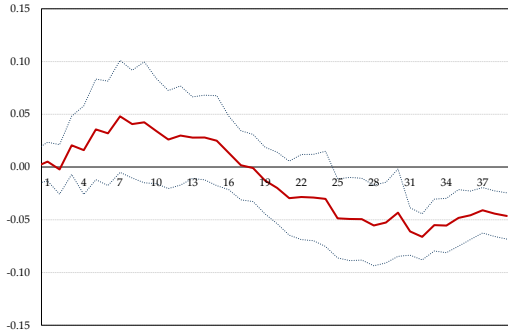
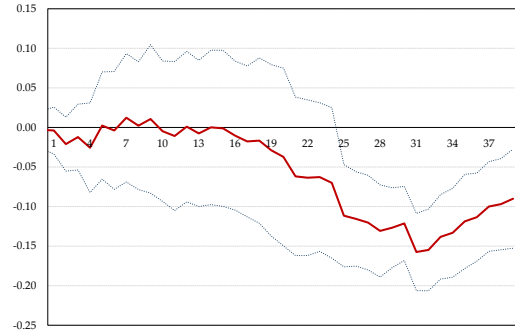


Figure 17: IRF (specification (2))
 $Bloomberg \rightarrow \Delta \log(Loans_{t+h})$



2.3 Monetary Policy Transmission

Figures 18-21 show the estimation of IRFs from projection (2); that is, the set of $\hat{\beta}^h$ for $h \in \{0, 1, \dots, H\}$ with confidence intervals at 95% using directly the policy rate and the monetary shocks from the method by Romer and Romer (2004), and consumer and business loans bank rates as dependent variables. All figures show that monetary policy in Colombia has a considerable degree of transmission, evident in an immediate and persistent increase of bank rates after a shock increase in the policy rate. The magnitude of the immediate increase is about the same size as the shock, it increases gradually and eventually peters out after about 23 months. These results are consistent with those obtained elsewhere in the literature.

Figure 18: IRF (specification (2))
 $i_t \rightarrow$ Consumer Bank Rate

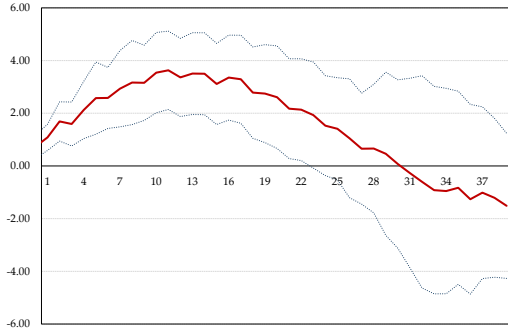


Figure 19: IRF (specification (2))
 $RR2004 \rightarrow$ Consumer Bank Rate

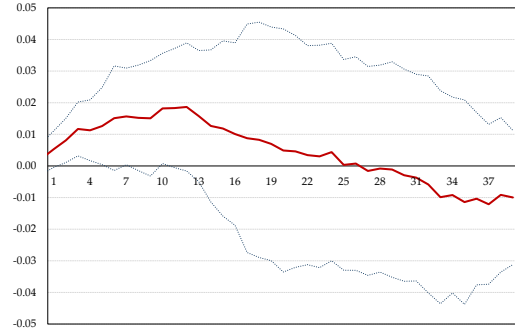


Figure 20: IRF (specification (2))
 $i_t \rightarrow$ Business Bank Rate

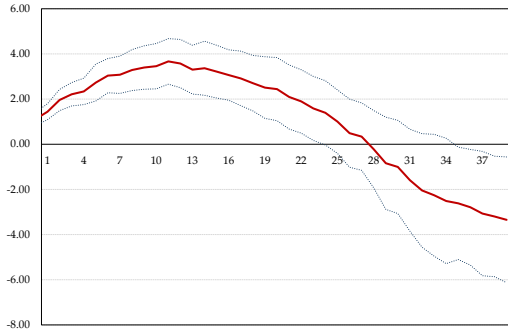
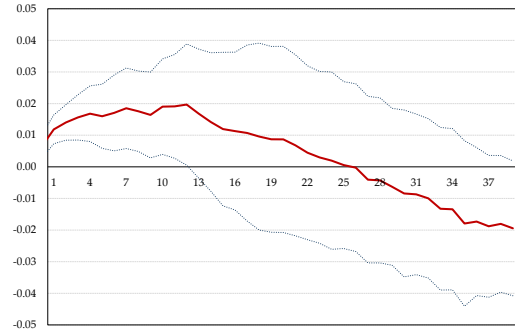


Figure 21: IRF (specification (2))
 $RR2004 \rightarrow$ Business Bank Rate



Using OIS and Bloomberg shocks (Figures 22-25), the point estimates are consistent with the previous results but estimates are not statistically significant. For this reason, the analysis of transmission in the following subsections focuses only on perturbations to the original policy rate and shocks estimated using the method by Romer and Romer (2004).

Figure 22: IRF (specification (2))
Bloomberg → Consumer Bank Rate

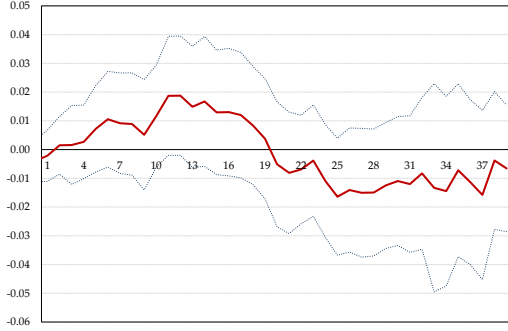


Figure 23: IRF (specification (2))
OIS → Consumer Bank Rate

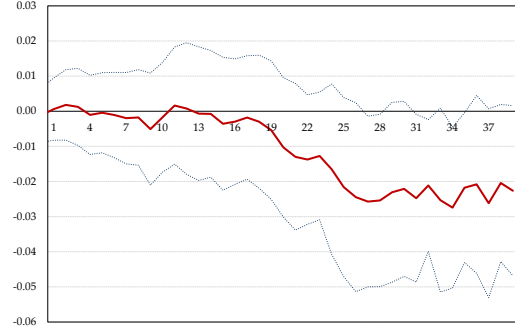


Figure 24: IRF (specification (2))
Bloomberg → Business Bank Rate

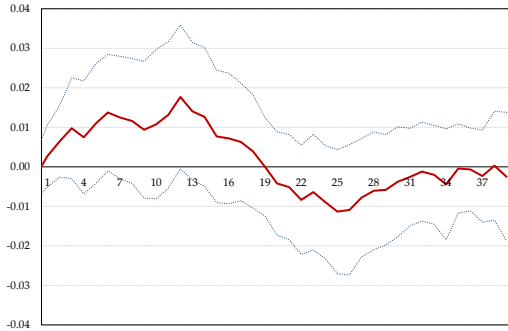
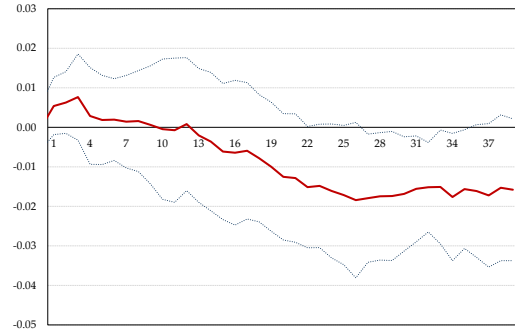


Figure 25: IRF (specification (2))
OIS → Business Bank Rate



2.4 Power and Uncertainty

From these estimations, the paper proceeds to estimate specification (3) for the same set of shocks and real activity measures as dependent variables, with the aim of studying whether uncertainty has any effect on the estimated power of monetary policy. As described before, these estimations use three alternative measures of uncertainty: CEPU, EPU and V10.

For the case of CEPU, Figures 26-29 show, in the same order as Figures 10-13, the point estimates of base coefficients (β^h), in green, and of (ϕ^h) from specification (3). For optimal visualization, only the confidence intervals of the latter are shown.

With the exception of Romer and Romer (2004) shocks and the log of real loans (Figure 29), that did not show any power in Figure 13, the other three configurations show a statistically

significant loss of power of monetary policy ($\hat{\phi}^h > 0$) under uncertainty. In its maximum point, for a base level of uncertainty of 1, the loss of power is between a tenth and a fourth of the originally estimated power.

Figure 26: β^h (green) and ϕ^h
 $i_t \rightarrow \log(ISE_{t+h})$, CEPU

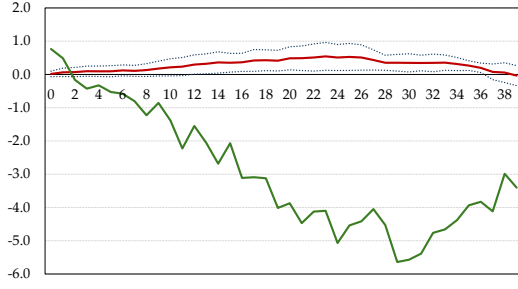


Figure 27: β^h (green) and ϕ^h
R&R (2004) $\rightarrow \log(ISE_{t+h})$, CEPU

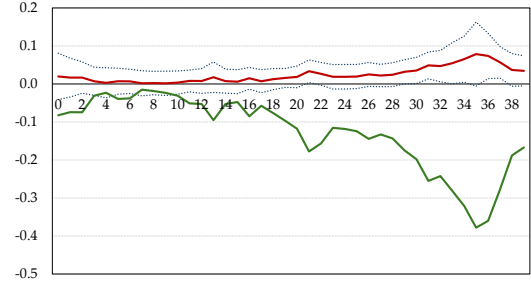


Figure 28: β^h (green) and ϕ^h
 $i_t \rightarrow \log(Loans_{t+h})$, CEPU

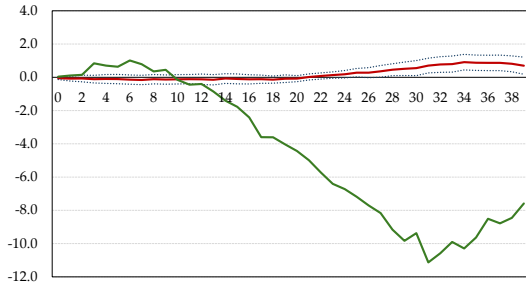
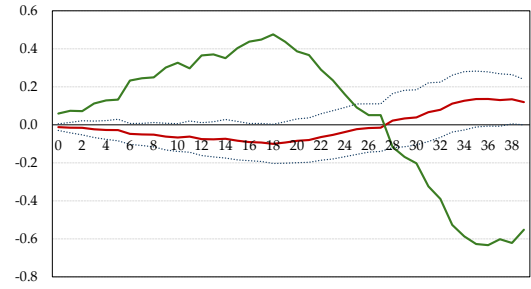


Figure 29: β^h (green) y ϕ^h
R&R (2004) $\rightarrow \log(Loans_{t+h})$, CEPU



The results for Bloomberg and OIS shocks are shown, following the same structure of Figures 14-17, in Figures 30-33. In this case, uncertainty does not have any considerable impact on power using SA-ISE as dependent variable (which in any case was low in the base estimations). It does have a considerable effect on the growth rate of real loans (where high power had been identified previously), and the magnitude of the loss is remarkably similar as the one estimated above.

Figure 30: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(ISE_{t+h})$, CEPU

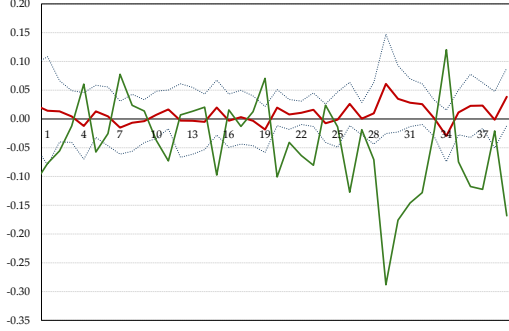


Figure 31: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(ISE_{t+h})$, CEPU

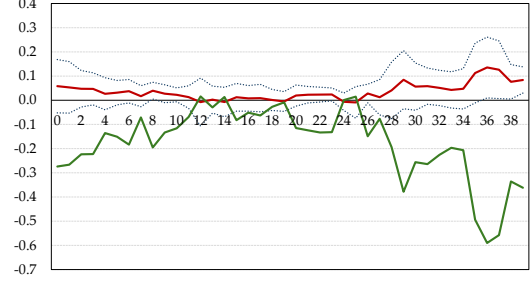


Figure 32: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(Loans_{t+h})$, CEPU

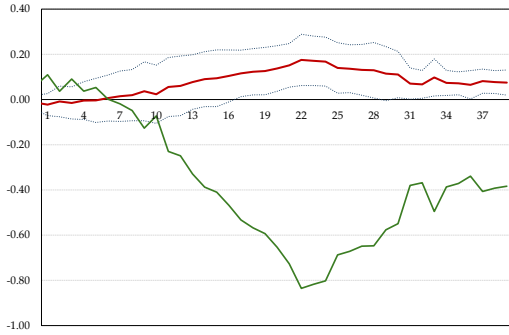
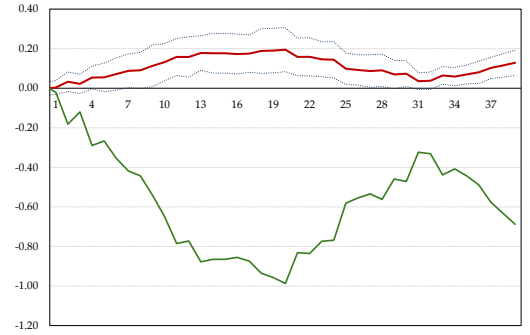


Figure 33: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(Loans_{t+h})$, CEPU



As explained before, the estimations are also carried out using EPU and V10 as alternative measures of uncertainty. The results of these estimations are presented at the end of the paper in Figures 46-65.

For the case of perturbations to the original policy rate and of Romer and Romer (2004) shocks, the results are confirmed. The only notable difference is that, when using V10 (Figure 60), power is slightly strengthened when using perturbations to the original policy rate (that is, $\hat{\phi}^h < 0$). For the case of OIS and Bloomberg shocks, no loss of power is documented.

2.5 Transmission and Uncertainty

According to the previous subsection, the evidence is consistent with a considerable loss of power for monetary policy under heightened uncertainty. From a policymaker's perspective, it is important to understand the mechanism through which this loss of power operates. To progress in this direction, this paper estimates specification (3) for the same set of shocks

and bank rates as dependent variables, with the aim of studying whether uncertainty has any effect on the estimated transmission of monetary policy. If, under heightened uncertainty, there is a loss of transmission as well as a loss of power, the policymaker might conclude that the latter occurs within the link between monetary policy and the financial system (because bank rates react less under uncertainty to policy shocks). If, on the contrary, there is a loss of power but not of transmission, the policymaker might conclude that the loss of power occurs within the link between the financial system and the wider economy (because real activity reacts less under uncertainty to policy shocks despite bank rates reacting as usual). The policy implications of each scenario would necessarily be different.

Figures 34 and 35 show point estimates and confidence intervals of (ϕ^h) from specification (3) when using CEPU as the relevant uncertainty measure, and perturbations to the original policy rate. Both figures show a considerable loss of transmission of monetary policy under heightened uncertainty. However, Figures 36 and 37, which use shocks estimated using the method by Romer and Romer (2004), show no loss of transmission of monetary policy.

Figure 34: ϕ^h
 $i_t \rightarrow$ Consumer Bank Rate, CEPU

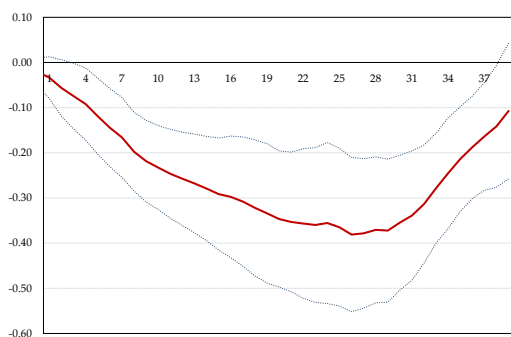
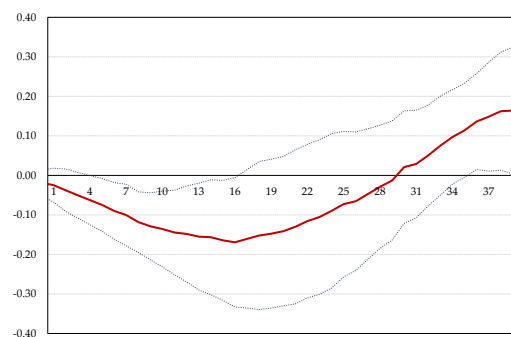


Figure 35: ϕ^h
 $i_t \rightarrow$ Business Bank Rate, CEPU



These findings are largely confirmed when using EPU (Figures 54-57 at the end of the paper) but not with V10 (Figures 66-69 at the end of the paper), which shows a slight increase in transmission when using shocks estimated with the method by Romer and Romer (2004) and no loss of transmission when using perturbations to the original policy rate.

Figure 36: ϕ^h
RR2004 $\rightarrow$ Consumer Bank Rate, CEPU

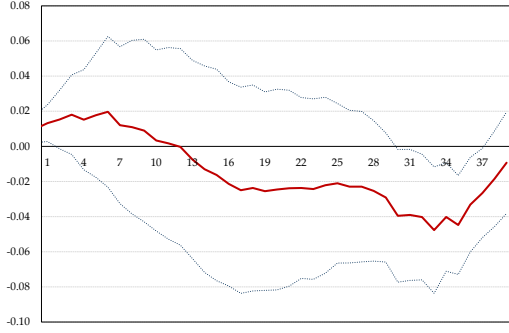
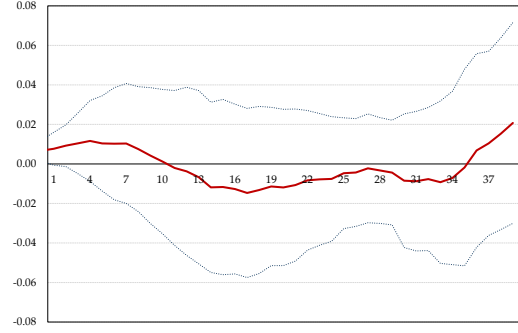


Figure 37: ϕ^h
RR2004 $\rightarrow$ Business Bank Rate, CEPU



2.6 Asymmetry

The last set of results corresponds to the estimation of specification (5). Building on the analysis above, only results using CEPU and EPU are shown, given that it is with these measures that the loss of power of monetary policy has been documented. For the case of CEPU, Figures 38-41 show the estimates of κ^h from specification 5 for perturbations to the original policy rate and for Romer and Romer (2004) shocks.

Figure 38: κ^h
 $i_t \rightarrow \log(ISE_{t+h})$, CEPU

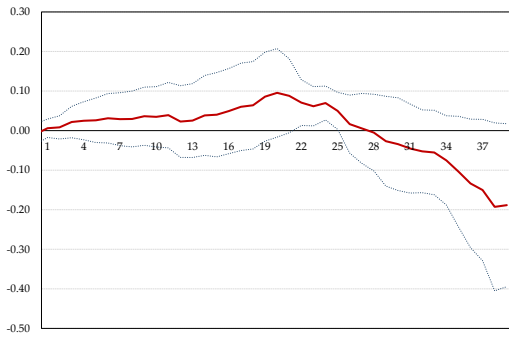
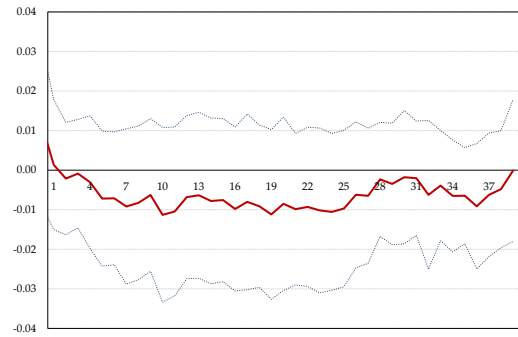


Figure 39: κ^h
R&R (2004) $\rightarrow \log(ISE_{t+h})$, CEPU



Results indicate that there is no systematic pattern of asymmetry for the loss of power of monetary policy under uncertainty. The paper only finds: (i) asymmetry with a 2-year lag for the power of perturbations to the original policy rate on SA-ISE - at that horizon, there is no power in the base estimations to begin with; and (ii) some small degree of asymmetry for the power of Romer and Romer (2004) shocks on real loans at a very long horizon.

Similarly to the previous case, this setup did not exhibit any power to begin with in base estimations(Figure 13).

Figure 40: κ^h
 $i_t \rightarrow \log(Loans_{t+h}), \text{CEPU}$

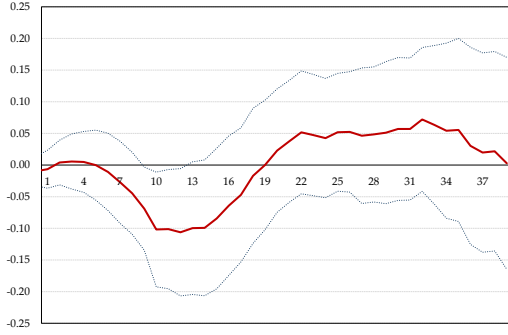
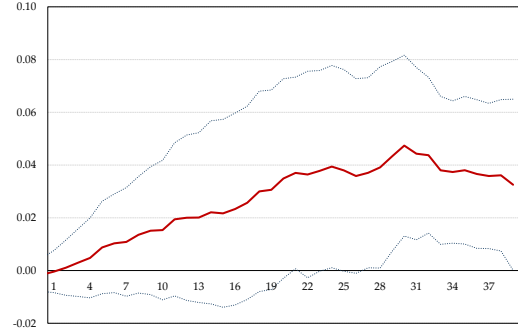


Figure 41: κ^h
 $R\&R(2004) \rightarrow \log(Loans_{t+h}), \text{CEPU}$



Similar results are obtained with OIS and Bloomberg shocks (Figures 42-45), with the exception of Bloomberg shocks on real loans. Again, in this case the starting point was no power at all (Figure 17).

Figure 42: κ^h
 $OIS \rightarrow \Delta \log(ISE_{t+h}), \text{CEPU}$

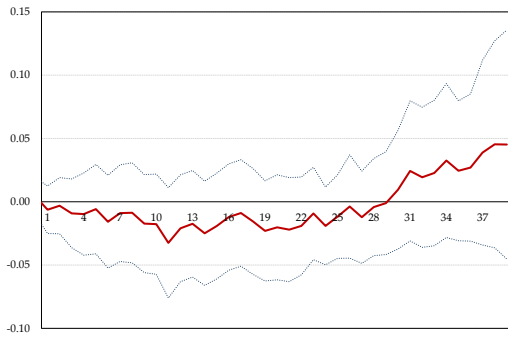
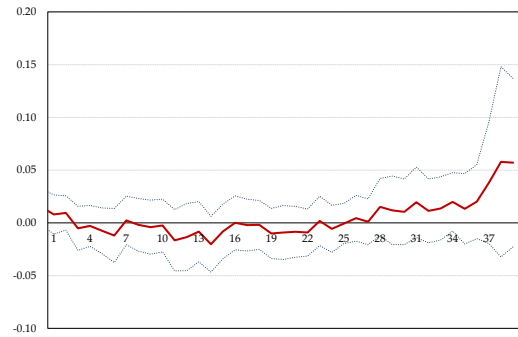


Figure 43: κ^h
 $Bloomberg \rightarrow \Delta \log(ISE_{t+h}), \text{CEPU}$



Finally, Figures 70-77 at the end of the paper present the results using EPU as a measure of uncertainty. The findings are similar to those described in this subsection.

Figure 44: κ^h
 OIS $\rightarrow \Delta \log(Loans_{t+h})$, CEPU

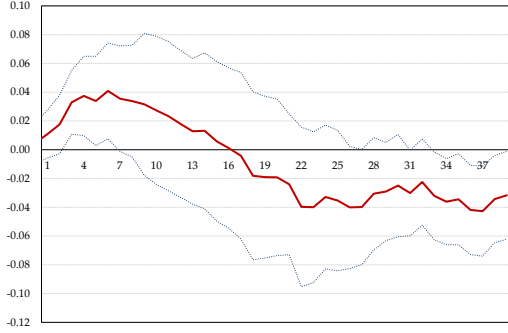
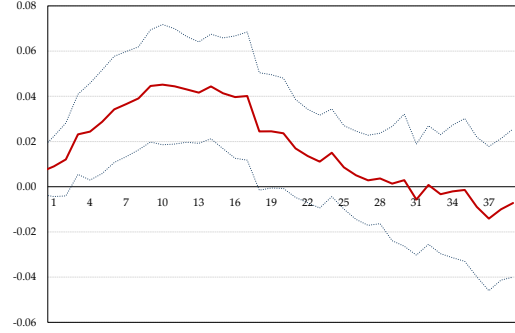


Figure 45: κ^h
 Bloomberg $\rightarrow \Delta \log(Loans_{t+h})$, CEPU



3 Discussion

The main findings of this paper indicate that: (i) monetary policy in Colombia has a remarkable degree of power and transmission, that is, a great capacity to influence the course of aggregate demand and bank rates; (ii) the evidence is consistent with a considerable loss of power for monetary policy when the perception of uncertainty heightens (which would indicate that monetary policy loses control over aggregate demand when uncertainty is higher); and (iii) there is no systematic evidence to conclude that the loss of power is equivalent to a loss of transmission, or that it depends on the stance of monetary policy. These findings are consistent with some of the theoretical literature mentioned above and (in the case of the loss of power) with recent empirical evidence for other countries (for instance, the case of the European Central Bank documented by Falconio and Schumacher (2025)).

These findings might have important implications for monetary policymaking. At least since Brainard (1967), there has been ample recognition that monetary policy should steer more “cautiously” when parameter uncertainty is high (for example, exercising caution with smoother changes in the policy rate than those that would be prescribed without parameter uncertainty). This has been traditionally referred to as the “Brainard principle”. However, the policy recommendation that arises from this paper is, in some ways, the precise opposite: if monetary policy loses power under uncertainty, monetary authorities should react more strongly (“steer boldly”) to economic conditions when the perception of uncertainty heightens. In any case, the nature of uncertainty is relevant. Brainard (1967) considered an environment in which there is uncertainty about the power of monetary policy itself (parameter uncertainty) and compared optimal monetary policy with and without this class of uncertainty. In this paper, uncertainty is taken as a general perception of society or participants in financial markets.

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Estimation Results - Specification (1)

Table 1: A. Monetary Policy Shocks (no interactions)

	Dependent variable: policy rate							
i_{t-1}	0.907	**	1.102	**	1.077	**	1.062	**
	(0.010)		(0.067)		(0.068)		(0.061)	
$\pi_t - \pi_t^*$	0.204	**	0.153	**	0.134	*	0.165	**
	(0.045)		(0.052)		(0.054)		(0.048)	
$\pi_{t-1} - \pi_{t-1}^*$	-0.072		-0.007		0.040		-0.101	
	(0.049)		(0.088)		(0.093)		(0.084)	
$\pi_t^e - \pi_t^*$	-0.063		0.020		0.043		0.039	
	(0.103)		(0.107)		(0.106)		(0.097)	
$\pi_{t-1}^e - \pi_{t-1}^*$	0.047		-0.015		-0.047		-0.027	
	(0.102)		(0.155)		(0.158)		(0.142)	
ISE Gap _t	0.006		0.006		0.008		0.013	
	(0.008)		(0.008)		(0.008)		(0.007)	
ISE Gap _{t-1}	0.013		0.004		0.002		-0.004	
	(0.008)		(0.010)		(0.010)		(0.009)	
Loans Gap _t	0.007		0.007		0.010		0.006	
	(0.011)		(0.011)		(0.011)		(0.010)	
Loans Gap _{t-1}	0.008		0.016		0.019		0.017	
	(0.011)		(0.013)		(0.013)		(0.012)	
e_t	-0.003		-0.000		-0.002		-0.005	
	(0.003)		(0.003)		(0.003)		(0.003)	
e_{t-1}	-0.004		-0.009		-0.004		-0.001	
	(0.003)		(0.005)		(0.005)		(0.005)	
$CEPU_t$	-0.001	*	-0.001		-0.000		-0.000	
	(0.000)		(0.000)		(0.000)		(0.000)	
$CEPU_{t-1}$	-0.000		-0.000		-0.000		-0.000	
	(0.000)		(0.000)		(0.000)		(0.000)	
Number of observations	239		238		237		236	
F statistic	3994.90		2690.99		2055.81		2184.04	
Adjusted R-squared	1.00		1.00		1.00		1.00	

** p<.01, * p<.05

Continues in Table 2.

Table 2: B. Monetary Policy Shocks (no interactions)

Dependent variable: policy rate				
i_{t-2}	-0.175	**	-0.067	-0.160
	(0.061)		(0.101)	(0.090)
$\pi_{t-2} - \pi_{t-2}^*$	-0.042		-0.111	-0.034
	(0.054)		(0.091)	(0.084)
$\pi_{t-2}^e - \pi_{t-2}^*$	-0.018		0.163	0.200
	(0.105)		(0.156)	(0.141)
ISE Gap $_{t-2}$	0.009		0.019	0.023
	(0.008)		(0.010)	(0.009)
Loans Gap $_{t-2}$	-0.013		-0.005	-0.008
	(0.011)		(0.013)	(0.012)
e_{t-2}	0.005		-0.005	-0.004
	(0.003)		(0.005)	(0.005)
$CEPU_{t-2}$	-0.000		0.000	-0.000
	(0.000)		(0.000)	(0.000)
i_{t-3}			-0.074	0.520
			(0.065)	(0.092)
$\pi_{t-3} - \pi_{t-3}^*$			0.032	0.030
			(0.054)	(0.080)
$\pi_{t-3}^e - \pi_{t-3}^*$			-0.175	-0.230
			(0.105)	(0.137)
ISE Gap $_{t-3}$			-0.014	-0.027
			(0.008)	(0.009)
Loans Gap $_{t-3}$			-0.015	-0.001
			(0.011)	(0.012)
e_{t-3}			0.007	0.012
			(0.003)	(0.005)
$CEPU_{t-3}$			-0.000	-0.000
			(0.000)	(0.000)
Number of observations	239	238	237	236
F statistic	3994.90	2690.99	2055.81	2184.04
Adjusted R-squared	1.00	1.00	1.00	1.00

** p<.01, * p<.05

Continues in Table 3.

Table 3: C. Monetary Policy Shocks (no interactions)

Dependent variable: policy rate						
i_{t-4}						-0.469 ** (0.058)
$\pi_{t-4} - \pi_{t-4}^*$						-0.004 (0.047)
$\pi_{t-4}^e - \pi_{t-4}^*$						-0.014 (0.092)
ISE Gap $_{t-4}$						0.011 (0.007)
Loans Gap $_{t-4}$						-0.010 (0.009)
e_{t-4}						-0.004 (0.003)
$CEPU_{t-4}$						0.000 (0.000)
Intercept	0.009 ** (0.002)		0.007 ** (0.002)		0.007 * (0.003)	0.003 (0.002)
Number of observations	239		238		237	236
F statistic	3994.90		2690.99		2055.81	2184.04
Adjusted R-squared	1.00		1.00		1.00	1.00
** p<.01, * p<.05						

Estimation Results - Specification (3) with EPU

Figure 46: β^h (green) and ϕ^h
 $i_t \rightarrow \log(ISE_{t+h})$, EPU

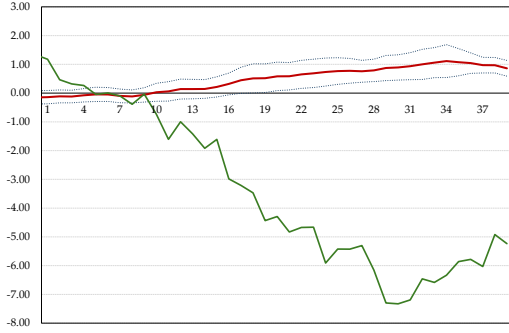


Figure 47: β^h (green) and ϕ^h
R&R (2004) $\rightarrow \log(ISE_{t+h})$, EPU

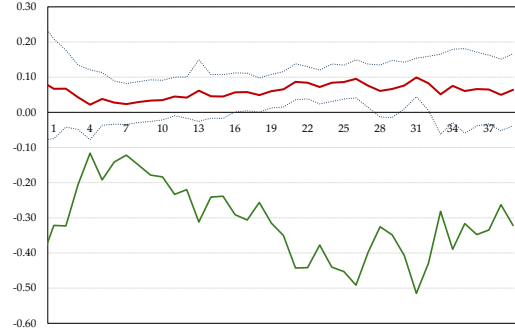


Figure 48: β^h (green) and ϕ^h
 $i_t \rightarrow \log(Loans_{t+h})$, EPU

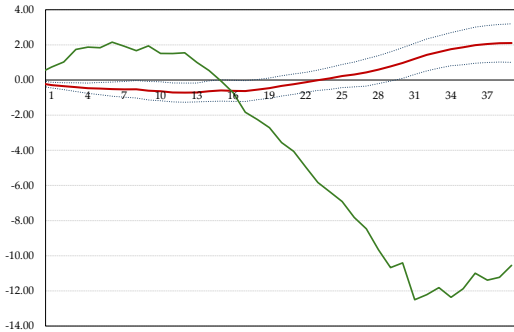
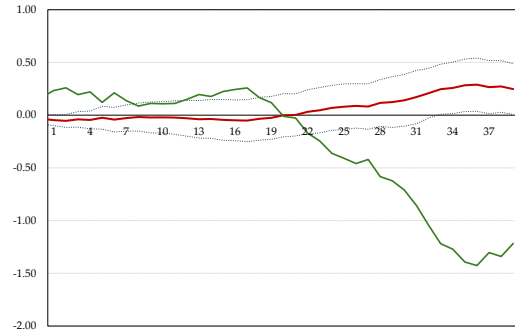


Figure 49: β^h (green) and ϕ^h
R&R (2004) $\rightarrow \log(Loans_{t+h})$, EPU



Estimation Results - Specification (3) with EPU

Figure 50: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(ISE_{t+h})$, EPU

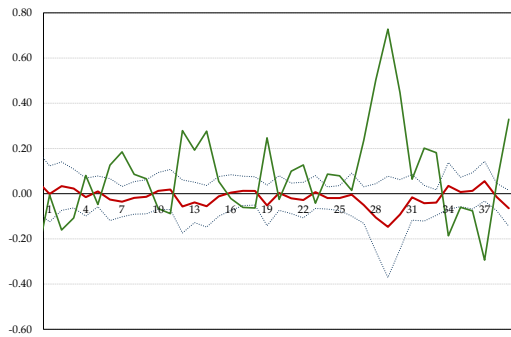


Figure 51: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(ISE_{t+h})$, EPU

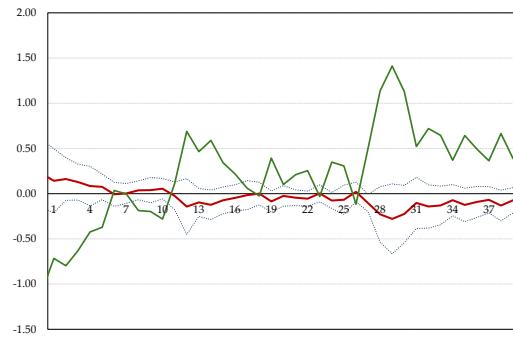


Figure 52: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(Loans_{t+h})$, EPU

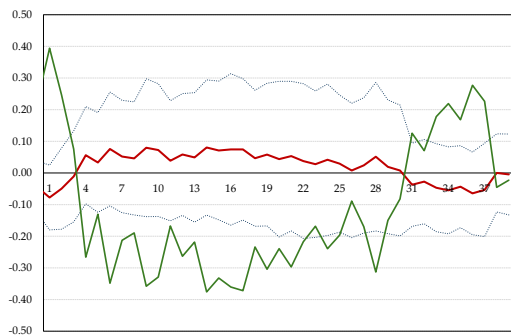
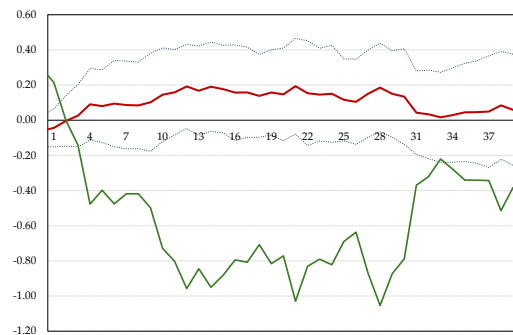


Figure 53: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(Loans_{t+h})$, EPU



Estimation Results - Specification (3) with EPU

Figure 54: ϕ^h
 $i_t \rightarrow$ Consumer Bank Rates, EPU

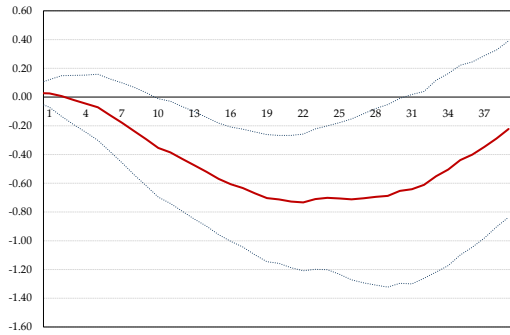


Figure 55: ϕ^h
 $i_t \rightarrow$ Business Bank Rates, EPU

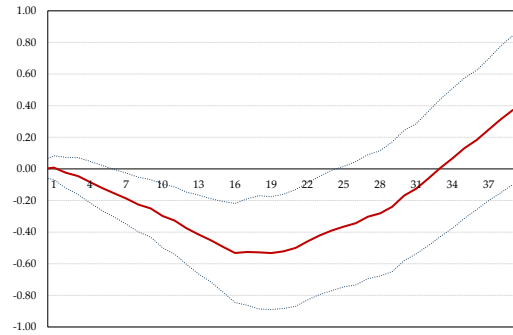


Figure 56: ϕ^h
 RR2004 $\rightarrow$ Consumer Bank Rates, EPU

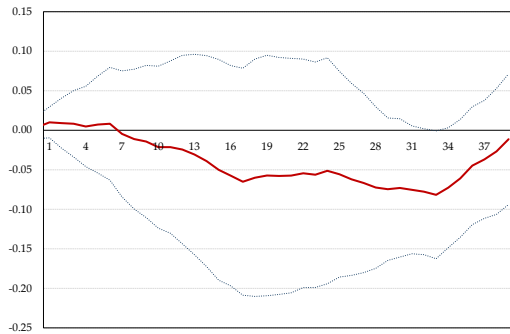
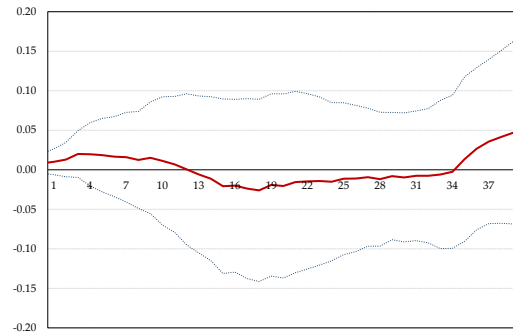


Figure 57: ϕ^h
 RR2004 $\rightarrow$ Business Bank Rates, EPU



Estimation Results - Specification (3) with V10

Figure 58: β^h (green) and ϕ^h
 $i_t \rightarrow \log(ISE_{t+h})$, V10

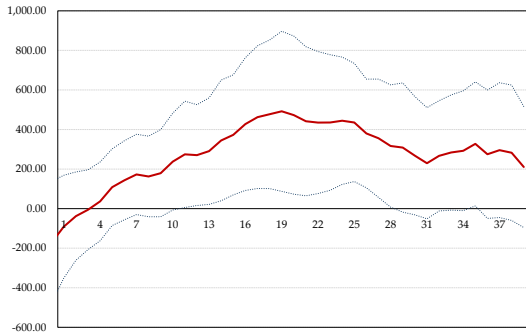


Figure 59: β^h (green) and ϕ^h
R&R (2004) $\rightarrow \log(ISE_{t+h})$, V10

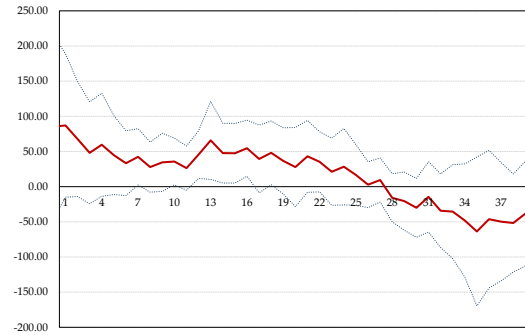


Figure 60: β^h (green) and ϕ^h
 $i_t \rightarrow \log(Loans_{t+h})$, V10

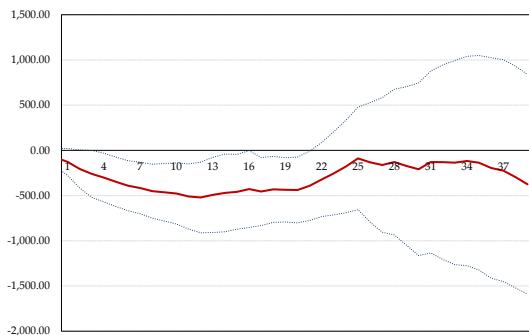
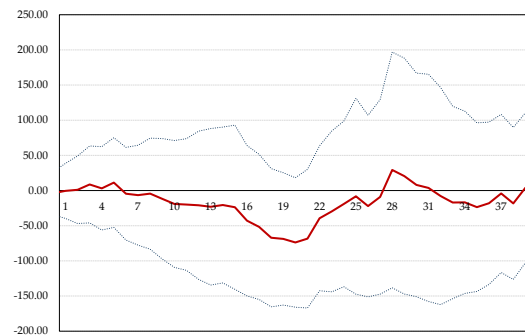


Figure 61: β^h (green) and ϕ^h
R&R (2004) $\rightarrow \log(Loans_{t+h})$, V10



Estimation Results - Specification (3) with V10

Figure 62: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(ISE_{t+h})$, V10

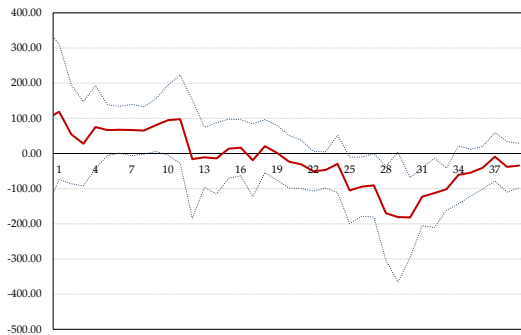


Figure 63: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(ISE_{t+h})$, V10

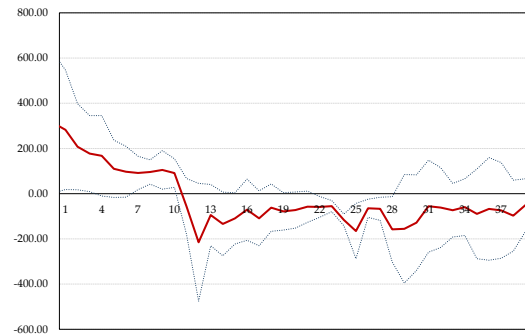


Figure 64: β^h (green) and ϕ^h
OIS $\rightarrow \Delta \log(Loans_{t+h})$, V10

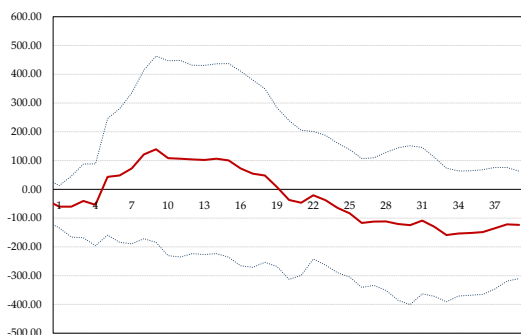
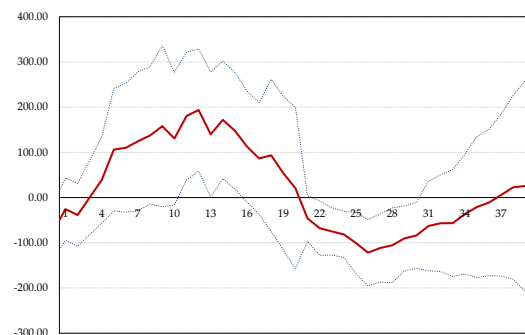


Figure 65: β^h (green) and ϕ^h
Bloomberg $\rightarrow \Delta \log(Loans_{t+h})$, V10



Estimation Results - Specification (3) with V10

Figure 66: ϕ^h
 $i_t \rightarrow$ Consumer Bank Rates, V10

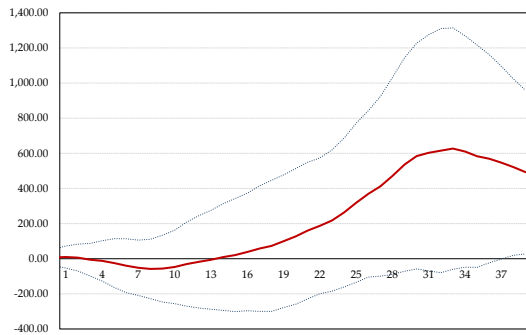


Figure 67: ϕ^h
 $i_t \rightarrow$ Business Bank Rates, V10

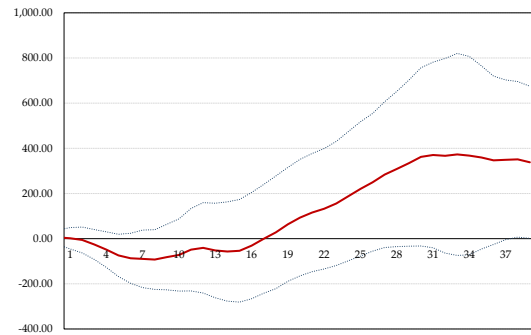


Figure 68: ϕ^h
 RR2004 $\rightarrow$ Consumer Bank Rates, V10

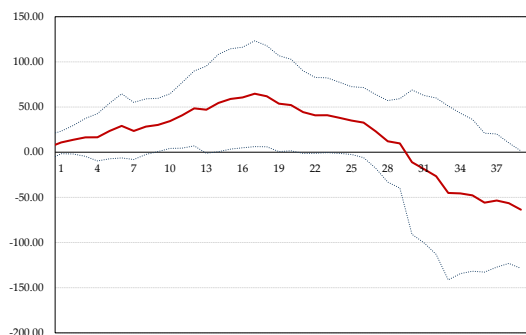
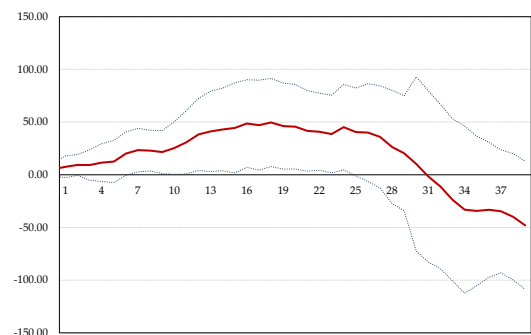


Figure 69: ϕ^h
 RR2004 $\rightarrow$ Business Bank Rates, V10



Estimation Results - Specification (5) with EPU

Figure 70: κ^h
 $i_t \rightarrow \log(ISE_{t+h})$, EPU

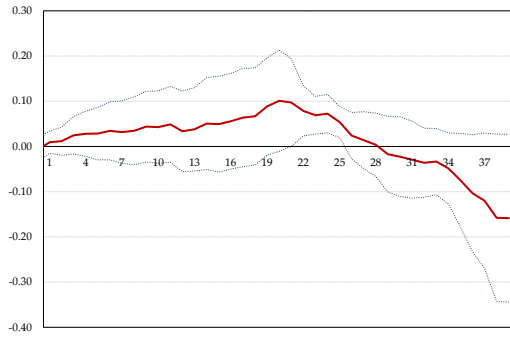


Figure 71: κ^h
 R&R (2004) $\rightarrow \log(ISE_{t+h})$, EPU

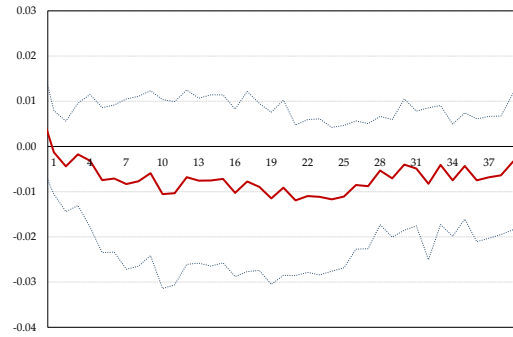


Figure 72: κ^h
 $i_t \rightarrow \log(Loans_{t+h})$, EPU

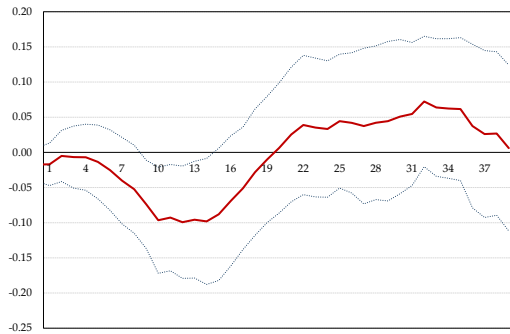
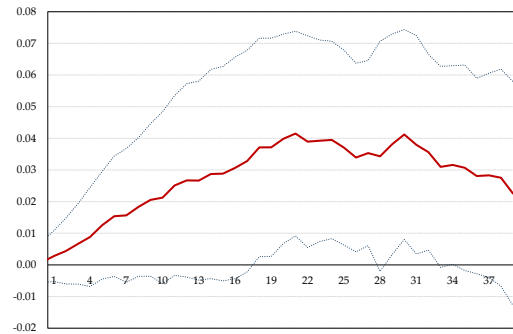


Figure 73: κ^h
 R&R (2004) $\rightarrow \log(Loans_{t+h})$, EPU



Estimation Results - Specification (5) with EPU

Figure 74: κ^h
OIS $\rightarrow \Delta \log(ISE_{t+h})$, EPU

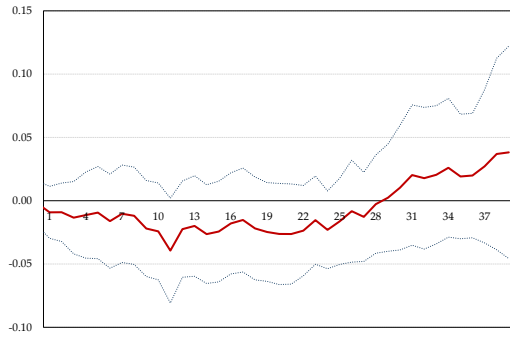


Figure 75: κ^h
Bloomberg $\rightarrow \Delta \log(ISE_{t+h})$, EPU

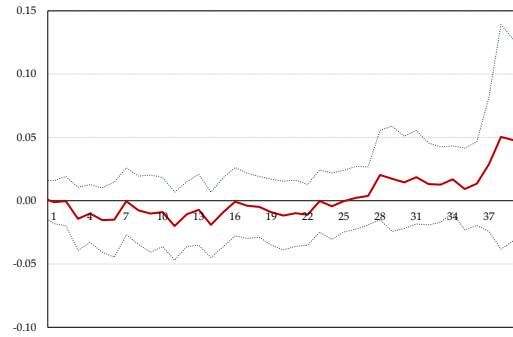


Figure 76: κ^h
OIS $\rightarrow \Delta \log(Loans_{t+h})$, EPU

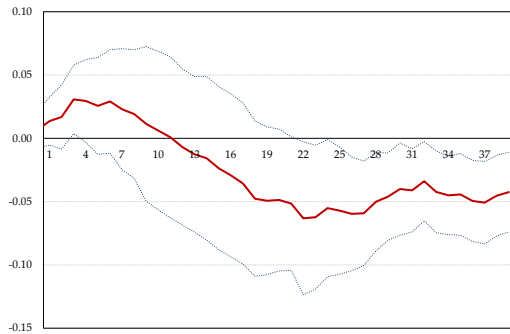


Figure 77: κ^h
Bloomberg $\rightarrow \Delta \log(Loans_{t+h})$, EPU

