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Effectiveness of Monetary Transmission Mechanism Under Confidence And Uncertainty: Evidence From Brazil

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ABSTRACT

The influence of the monetary transmission mechanism on the economy is largely seen by economists as a ‘‘black box’’. The study evaluates the effectiveness of the monetary transmission mechanism in the case of uncertainty for a highly volatile nation like Brazil. The study aims to understand the characteristics of uncertainty in the economy and measure its influence on the monetary transmission channel of Brazil through the Structural Vector Autoregressive Model. To capture the level of uncertainty prevailing in the economy we use the economic policy uncertainty index and evaluate its influence on the call money rate, real gross domestic product and consumer price index of the Brazilian economy. The results of the study indicate that uncertainty shock resembles an aggregate supply shock and the monetary transmission mechanism is impeded when uncertainty is taken into account. Further, the study finds that the Brazilian economy aligns with the wait and watch perspective of uncertainty suggesting the critical role timely information can play in the economy. For future research, the study can be extended to assess whether Brazil's uncertainty has a spillover effect on the monetary transmission mechanism of its major trading partners.

Keywords: Monetary Transmission Mechanism, uncertainty, Structural Vector Autoregressive Model, wait and watch perspective

JEL Classification: E51, E52, E58

Introduction

Any economy around the world, be it developed or developing, is concerned about its aggregate output and price level for ensuring stability in the economy. The stabilization of output and price level can be undertaken by central banks through monetary transmission mechanism channels. Further, monetary policy has been growing in importance over fiscal policy for ensuring stability as issues like persistent budget deficit and delays in spending decisions do not occur.

The monetary transmission mechanism plays a crucial role in the economy by the transmission channels influencing aggregate output and price levels. Taylor (1995) defines monetary

transmission mechanism as a method of how monetary policy decisions by the central bank result in a change in the real gross domestic product (GDP) and inflation. It becomes essential to understand monetary transmission mechanisms as it throws light on the effectiveness of monetary policy in influencing the economy.

Until the global financial crisis of 2008, there has been limited focus on uncertainty and confidence of economic agents but post the global financial crisis of 2008; the role uncertainty plays in the monetary transmission mechanism has started to grow. Economic uncertainty may refer to lack of clarity on what the future economic situation may hold leading to unpredictability (Kilsen, 2013). There might be an unexpected price shock or an economic downturn or loss of job or even an unexpected external shock. For instance, the COVID-19 pandemic has made the economic and social environment much more uncertain. Consumers are uncertain whether to increase their precautionary savings and spend in the future; businesses are uncertain whether to delay hiring and investment projects until more information is obtained. Finally, the government is uncertain about how consumers and business confidence will react to policy responses.

Several prominent economists from Shiller (2009) to Bernanke (2010) believe that consumer and business confidence and uncertainty channels are useful in assessing the monetary transmission mechanism of the economy, both emerging and developed. The existing literature largely evaluates conventional channels of monetary transmission mechanism, there has been limited evidence of evaluating unconventional channels.

According to a PricewaterhouseCoopers (PWC) report of 2017, Brazil, a large emerging economy that is currently the seventh-largest economy in the world and will be one of the emerging countries that will dominate the world's top ten economies by 2050 by becoming the fifth largest economy (Hawksworth & Clarry, 2017). Brazil has witnessed a turbulent and volatile state of economy accompanied by sluggish growth over the past twenty years compared to any other past crisis that it has undergone. According to a Boston Consulting Group (BCG) report of 2019, one of the recent crises, from 2014 to 2018, was particularly difficult, and recovery since then has been sluggish (Azevedo et al., 2021). From 2014 to 2018, Brazil witnessed the worst economic performance among G-20 countries. Since the beginning of 2017, there is still a considerable divergence between consumer expectations and current consumer conditions (Azevedo et al., 2021).

Given such an uncertain and volatile environment, many companies have tended to take the wait-and-watch approach in their business functions. The market participants have attributed uncertainty to the reason for the economy's sluggish growth which suggests the market participants see the future being highly uncertain leads them to delay their decisions of purchases and investments accompanied by a delay in capital spending and expansion in employment/hiring ultimately contributing to a slower pace of economic growth (Kliesen, 2013).

Thus, it becomes critical to understand how effective are policy executions, primarily monetary policies, influenced by the level of uncertainty prevailing in the economy. This will, in turn, provide inputs on how investments and GDP are trajecting as monetary policy shock is witnessed during uncertain and volatile times for the Brazilian economy.

The aim of the paper is to answer the question- *Is it useful to consider confidence and uncertainty perception as a channel of monetary transmission mechanism?*

The paper aims to achieve the following objectives:

- To examine whether uncertainty shock resemblance an Aggregate Demand (AD) or Aggregate Supply (AS) shock for the Brazilian economy
- To determine to what extent the ineffectiveness of monetary policy transmission when uncertainty is considered and, in turn, its influence on the overall economy (GDP growth, inflation and investment)
- To explore the usefulness in considering uncertainty perception as a channel of the monetary transmission mechanism and what perspective of confidence channel does the Brazilian economy follow.

The rest of the paper is organized as follows: Section 2 provides a review of the literature reflecting on the theoretical frameworks and empirical considerations of the uncertainty channel of monetary policy. Section 3 covers the empirical methodology adopted and discusses the data collected for the analysis and Section 4 presents the empirical analysis and discussion with relevant theoretical considerations. The paper is concluded in Section 5 by drawing policy implications relevant to the conduct of monetary policy in emerging economies.

Literature Review

Taylor (1995) defines monetary transmission mechanism as ‘‘a process through which monetary policy decisions are transmitted into a change in real GDP and inflation’’. There are different frameworks of monetary transmission mechanisms: where the emphasis is placed on financial market price or credit or money or asset price. Taylor discusses the financial market price framework that considers exchange rates a vital monetary transmission mechanism variable and uses rational expectations to distinguish between real and market interest rates. Two types of policy implications emerge: deciding on a fixed or floating exchange rate and the optimal policy rule that central banks can adopt in a flexible exchange rate system.

Mishkin (1995) discusses several monetary transmission channels and their impact on the spending of consumers and investors and hence ultimately impact aggregate output.

Bachman & Sims (2012) evaluate the significance of confidence as a transmission mechanism of fiscal policy shocks. They show that confidence is not a transmission channel of fiscal shocks during normal times however it plays a vital role in times of economic distress. Herein, confidence does not function as transmission as such but as a signal of information about productivity as a consequence of increased government spending.

Baker et al. (2016) develop an index to measure economic policy uncertainty for the USA and later other economies based on the audit criteria on newspaper readings with words on contexts related to Economic Policy Uncertainty (EPU) and uncertainty like political elections, terrorist attacks, wars, failure of financial institutes and fiscal policy decisions. They further use firm-level (micro-level) and macro-level data to ascertain uncertainty. Through a 12-country panel VAR, they find that when uncertainty persists stock volatility is high, reduced investment projects (delays in investments) and employment in sectors where economic policies are targeted like healthcare, defences etc.

Oh (2020) studied the effect of uncertainty shock on inflation through a vector autoregressive model for the US economy. Two types of New Keynesian models are evaluated, the Rotemberg model and the Calvo model on price rigidities. Through a third-order deviation on different sources of uncertainty, he finds that the two models generate different outcomes. In the

Rotemberg model, the high uncertainty scenario leads to a decrease in output and inflation while in the Calvo model it leads to an increase in inflation and a decline in output. The varying results in the model are attributed to the price stickiness assumption of each model and the precautionary pricing effect. Thus, it becomes crucial for policymakers to know what type of model prevails in the economy so as to employ the required monetary policy to stabilize the economy. Finally, he finds that the Rotemberg model is more in line with the empirical literature though the predictions of both the models are robust under different sources of uncertainty.

The existing literature essentially finds three perspectives of the confidence channel: animal spirits, information perspective, and an emerging view called the wait and watch perspective. The animal spirit perspective talks about spontaneous fluctuations in the belief that they will have a causal effect on economic activity (Barsky & Sims, 2012).

The information perspective puts forth that consumer confidence has information about the current state and the future economic state. Barsky & Smith (2012) find that innovation and consumer confidence measures provide information about the future economic state and find that confidence innovation is a ‘‘noisy measure’’ of changes in expected productivity growth over a long-time frame and includes information about the economic condition of the future.

The wait-and-watch perspective discusses that there is an option value for waiting to invest. Uncertainty can increase the cost of decisions on investment and consumption by delaying and waiting for more information to make a more informed decision (Bernanke, 1983).

Pratap & Dhal (2021) show how to use consumer and business confidence or uncertainty perception as a channel of monetary transmission in India. Through local projections methods, they found that in the context of uncertainty shock in India leads to a fall in output and a rise in prices (AS shock). Here an unanticipated uncertainty shock will not create an optimal response of monetary policy for nations like India. Further, using non-linear models they conclude that the monetary transmission mechanism is relatively weaker during high uncertainty. Hence, the extent of uncertainty shock on the demand and supply dynamics will lead to different outcomes requiring different policy implications or measures.

Aastveit et al. (2017) explore empirically using data to see if the effectiveness of monetary policy is influenced by the level of uncertainty prevailing in the economy through structural autoregressive models. Further, the paper delves into US uncertainty's influence on non-US economies policy effectiveness. The paper finds that monetary policy is less effective when uncertainties are high. In the US, investment and GDP responding to a monetary policy shock are halved when economic uncertainty is in its upper decile. US uncertainty has an influence on the weakening of the monetary policy of Canada. The paper provides inputs on considering economic uncertainty as an endogenous than exogenous variable in future research.

Balcilar et al. (2017) conduct an empirical assessment of the effectiveness of monetary policy for five Asian economies China, Hong Kong, India, Japan and South Korea, through a quantile vector autoregressive model-based spillover estimation approach. The paper suggests limited evidence in support of the economic theory that monetary policy efficiency falls during high economic uncertainty prevailing in the nation. Further, they find that some of the chosen Asian economies have large and asymmetric spillovers from economic policy uncertainty and interest rate to economic activity. Their empirical findings favour the credit channel hypothesis over the nonlinearity theory. Further, Balcilar et al. (2021) shows that global market integration and changes in one nation’s EPU will impact another nation’s monetary policy effectiveness, implying a spillover of foreign economy EPU on the domestic economy.

In the previous literature, we assessed various global economy's monetary transmission mechanisms in the context of uncertainty and now we specifically focus on the Brazilian economy.

Minella (2002) uses vector autoregressive estimation of monetary policy impact on output and inflation rate by comparing three different time periods when Brazil witnessed different inflation levels. The paper finds that monetary policy shock does have an impact on output.

Minella & Souza-Sobrinho (2012) used a semi-structural model to capture Brazil's monetary policy transmission mechanism. They conclude that after a monetary policy shock, the household interest rate plays a significant role in explaining changes in economic output. For explaining changes in inflation, the household interest rate and exchange rate are the main transmission channels, while the inflation expectation channel also plays a significant role in this aspect. The paper anticipates that other monetary channels will play a significant role in influencing the inflation-output of Brazil in the future once the financial and credit market completely develop.

Montes & Nogueira (2021) assess the business confidence of Brazil as a transmission channel to investment. They find that an increase in uncertainty of both political and economic policy decreases business confidence which in turn affects investment in Brazil. Political uncertainties because of institutional difficulties have led to economic policy uncertainty which translates to lowering business confidence and thereby investment.

Marschner & Ceretta (2021) assess the influence of not only economic uncertainty but also monetary policies on investment sentiment in Brazil. They found that through the ARDL model that investment sentiment is affected by the transmission mechanism of monetary policy to different extents and time frames and also by economic uncertainty persisting in the economy. They empirically verify that interest rate, inflation, exchange rate and economic uncertainty have an impact on investor sentiment both in the long and short run. According to the empirical verifications done by the authors' exchange rate, inflation and interest rate have a short and long-run influence on investment sentiment. However, economic uncertainty as it increases negatively affects investment sentiments only in the long run because of information asymmetry and psychological conduct among financial executives in decision making. Hence, monitoring investment sentiment in relation to uncertainty and transmission mechanisms can signal information on financial decisions undertaken in the Brazilian economy, thereby policymakers can restore sentiment by assessing this relationship. The study though verified empirically the theoretical relations are limited by using consumer confidence as a proxy for investor sentiment.

The existing literature evaluates monetary transmission mechanisms within the framework of confidence channels for advanced nations and emerging nations with relatively stable uncertainty levels over the past decade; there has been no exclusive evaluation of an economy like Brazil that has had turbulent fluctuations in the market over the past decade. Further, the existing literature on Brazil's monetary transmission is evaluated on well-defined conventional channels without any evaluation of the confidence mechanism as a monetary transmission channel. This particular study will focus on evaluating an economy like Brazil’s monetary transmission in an unconventional channel of uncertainty.

The Model and Data

We employ structural vector autoregressive models to understand how uncertainty shocks influence the monetary transmission mechanism. The vector autoregressive model is widely

used in empirical research to forecast and evaluate policy measures through impulse response and variance decomposition functions. It is a natural generalization of autoregressive models popularized by Sims (1980) and in a sense a system of regression models i.e it has more than one dependent variable.

In the structural VAR model, certain restrictions are imposed based on economic theory to understand the causal impact of shocks on specific variables. The baseline model consists of three endogenous variables that indicate economic activity, price level and monetary policy undertaken by the central bank of the economy. The model is presented as follows:

$$X_t = G_0 + G_1 X_{t-1} \quad + G_p X_{t-p} + U_t$$

Where X is the vector of endogenous variables consisting of economic growth (y), inflation (π) and interest rate (r) and U_t represents error term and p represents the VAR lag length. It becomes critical to obtain the ideal lag length since if the lag length is too small then the model is subject to misspecification and if the lag is too large then degrees of freedom are wasted. Through the lag selection criteria, we obtain the ideal lag length to be 3. The lag selection criteria suggested a lag lengths 1 and 2, after running a stability check for these two lags it was found that the model was unstable through the AR Roots table, hence lag 3 was selected which was found to be stable.

The baseline model can be extended to include the uncertainty index as an additional endogenous variable as the literature shows that uncertainty plays a crucial role in economic decision-making among market participants. For instance, during times of high uncertainty, consumers and investors may delay their economic decision-making irrespective until they have more information about the economic situation. We further undertake a granger causality test and correlation matrix to understand the causality and directionality between uncertainty and confidence (Refer Appendix Table1 & Table 2).

The economic policy uncertainty index has a negative relationship with both consumer and business confidence suggesting that there is an inverse relationship existing between uncertainty and confidence. Further, consumer and business confidence exhibit a moderately strong positive relationship i.e a direct relationship exists between the two variables.

We see that consumer confidence and business confidence are significant in lag 2 and are bidirectional in nature i.e both the variables granger cause each other. There is no granger causality relationship existing between business confidence and economic policy uncertainty, however, there exists a significant unidirectional causality of economic policy uncertainty to consumer confidence at lag 1. This suggests that the economic policy uncertainty index which is news based has an influence on the survey-based index of consumer confidence, implying that consumer sentiments change when they read and see news-based coverage of the economy and markets. Further, it highlights that when there is an economic shock in the nation, the news reports it and consumers watch such coverage and alter their confidence in the economy and the market accordingly which will have an influence on the business confidence of the investors too.

The economic policy uncertainty index is augmented to our baseline model- the following now are our endogenous variables $X_t = \{epu, y, \pi, r\}$.

We are now required to generate impulse responses of the baseline and augmented model. Before running the model it has to be identified, here the use of Cholesky decomposition method is used. Based on economic theories and literature we impose the following restrictions on the SVAR model:

Table 1: Characterization of Variables Under Study

Shock to Endogenous Variable	**Characterized**	**Influence of other endogenous variables on the shock**
Output Shock (Y)	Technology Shock	Contemporaneously not influenced by remaining endogenous variables
Inflation Shock (Π)	Short-run Phillps curve (trade-off between inflation and unemployment)	Contemporaneously not influenced by remaining endogenous variables
Interest Rate Shock (r)	Output, inflation and economic policy uncertainty influence	Contemporaneously influenced by remaining endogenous variables
Economic Policy Uncertainty Shock	Exogenous Shocks	Contemporaneously not influenced by remaining endogenous variables

Source: Authors

To identify the SVAR, get the reduced form of the VAR which is

$$X_t = G_0 + G_1 X_{t-1} + G_2 X_{t-2} + e_t$$

Here X has three variables which are real GDP growth, call money rate and inflation rate.

From here we need to obtain the structural VAR model of

$$AX_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + U_t$$

This will isolate the exogenous shocks to measure the impact of the shocks included in the model. We need to restrict matrix A through identification based on economic theories to recover the structural shocks and structural parameters using the reduced form estimation.

To fulfil the objectives of the study, quantitative analysis is conducted by collecting the data on the Call Money Rate (CMR), Economic Policy Uncertainty Index (EPUI) of Brazil, Real GDP growth and Consumer Price Index (CPI) of Brazil. CMR, EPU, Real GDP and CPI are taken as proxy variables for interest rates, confidence level, growth of the economy and inflation levels in the economy respectively.

Quarterly secondary data is collected for approximately twenty years starting from January 01, 2000, to December 19, 2019. The data of CMR, Real GDP growth and CPI are collected from St. Fred and the OECD Statistical data bank respectively and EPU of Brazil is obtained from policyuncertanity.com which publishes data on uncertainty indices of various nations. The period of 2000 to 2019 is chosen because it considers both normal times for Brazil and highly fluctuating times.

A Structural Vector Autoregressive (SVAR) model is run to generate impulse responses of monetary policy due to changes in the other endogenous variables.

Results and Discussion

We analyze the baseline model and augmented model and run the required impulse response to understand the influence uncertainty has on the economy and monetary transmission mechanism.

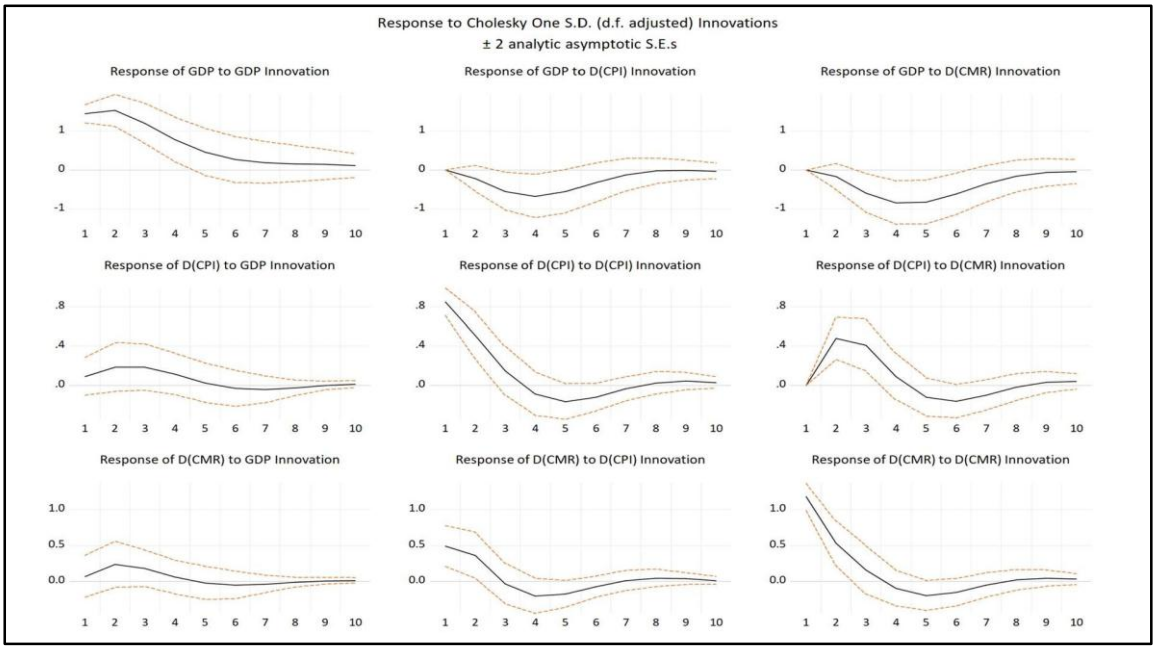
In time series data we need to check for seasonality, structural break and stationarity of the variables under study. The variables are seasonally adjusted and do not display any structural breaks graphically. We run the Augmented Dickey-Fuller test to check for stationarity as when running a vector autoregressive model all the variables are required to be stationary, hence we correct for non-stationary variables through the first difference (Refer Appendix Table 4). Only when all the variables are stationary it is possible to make generalizations of the variable's behaviour in other time periods.

All the variables are made stationarity and granger causality of the variables understudy is conducted before obtaining the impulse response function of the baseline and augmented model (Refer Appendix Table 5). The Structural Vector Autoregressive (SVAR) model was run and the optimal lag length was determined through the lag length criteria. The stability of VAR was checked using the lag structure (AR Roots Graph) and it was found that the ideal lag length is 3 lag. To interpret the coefficients of the SVAR model the impulse response function is used to understand the macroeconomic dynamics of the short and long-run relationship between the variables.

We obtain the impulse response of the baseline model where in particular we examine the interest rate shocks on real GDP and inflation to understand what happens in the case of monetary policy shock in the economy.

To understand the impulse response to assess the impact of monetary policy shock on aggregate output and inflation, we need to ensure the VAR model is stable. If the VAR is not stable then the impact of a particular shock will not die down in t+k period and it will explode (failing to converge to equilibrium). Through the AR roots graph and table, we find the VAR model to be stable, hence the impulse response of the variables will die down and will converge to equilibrium. The Cholesky-dof adjusted method is used to produce an impulse response of over 10 time periods when a positive shock is given to the variables.

Figure 1: Impulse response of baseline model



Source: Authors Calculations done on Eviews

Figure 1 illustrates the standard monetary transmission system in Brazil. Fall in real GDP (Y↓) and fall in inflation (aggregate price or π↑) when there is a monetary policy shock as shown in the third column. The third column of the panel (refer to figure 1) shows the response of variables when there is a shock given to the interest rate (CMR-Call money rate). It shows that when there is a monetary policy shock in Brazil, the aggregate output immediately falls from the first quarter and continues to fall only recovering after the sixth quarter steadily upwards but remaining negative. This is in line with economic theory that when there is monetary policy tightening (increase in interest rate) the borrowing costs increase which discourages investment thereby resulting in lower capital formation and decreased aggregate output (Mankiw, 2016).

Similarly, when there is monetary tightening in the economy the inflation rises up until the third quarter but immediately falls and remains negative till the eighth quarter. This suggests when there is a monetary policy shock in the economy inflation falls. When the central bank increases the interest rate, market participants want to save more and consume less, this will reduce the inflation persisting in the economy.

We obtain the impulse response of the baseline model augmented to economic uncertainty where in particular we examine the interest rate shocks and uncertainty shocks on endogenous variables. By doing so, we can ascertain if there is an impairment in the transmission mechanism when uncertainty is taken into account in the economy. The results are presented in figure 2.

The first column in the panel (see figure 2) shows how endogenous variables respond to an uncertainty shock and the fourth column shows how the endogenous variables respond to a monetary policy shock. In the first column, we see that an uncertainty shock immediately leads to GDP growth falling up until the ninth quarter and after which GDP growth exhibits a positive trend. The uncertainty shock leads inflation to rise steadily upwards since the eighth quarter. Thus, in sum when there is an uncertainty shock in the economy the aggregate output falls and

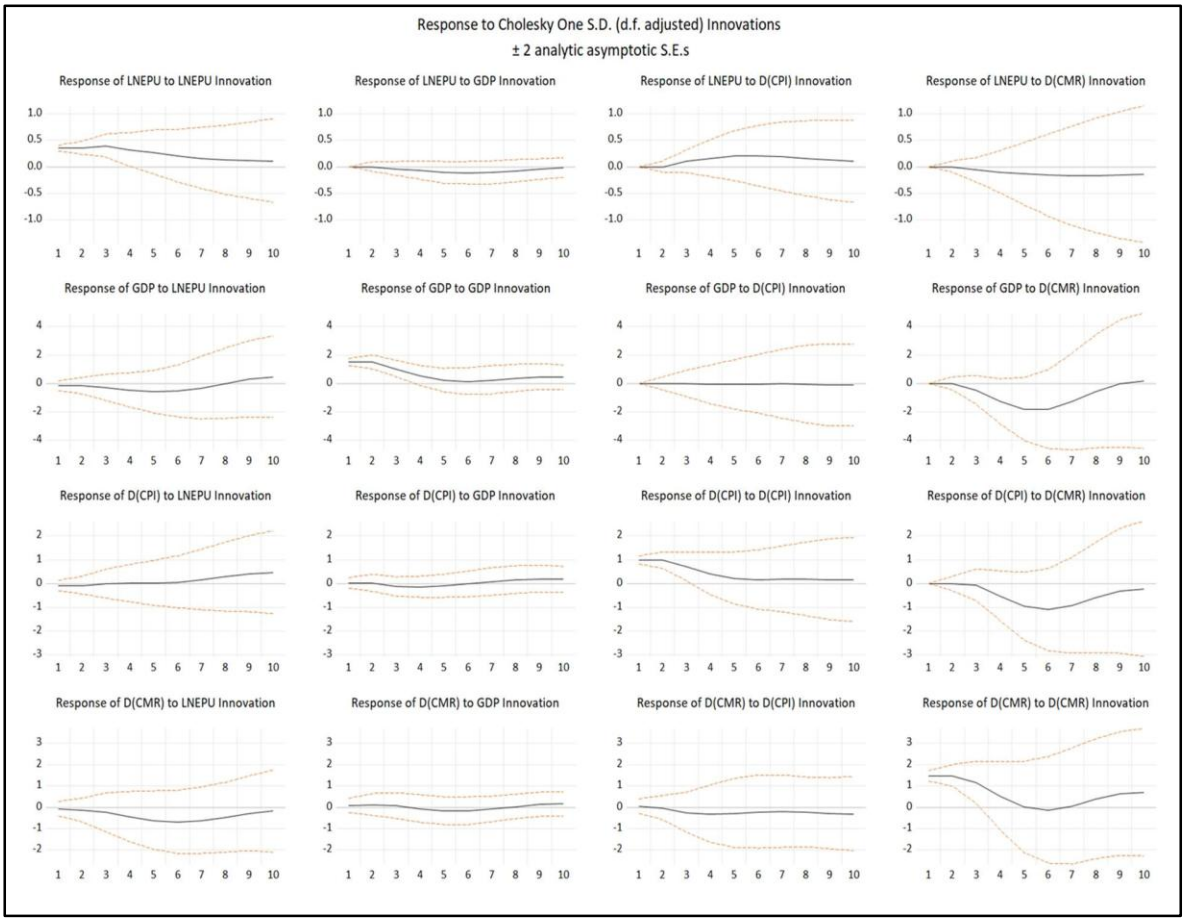
the aggregate price level rises which exhibit an aggregate supply shock in the economy.

Thus, when there is a monetary policy shock (increase in interest rate) both the aggregate output and aggregate price level exhibit negative tendencies, though inflation shows a lag in the negative trend. The findings suggest that monetary policy shocks have an influence on output similar to the findings of Minella (2002) but monetary policy shocks do have a significant influence on inflation though in a lagged manner.

As uncertainty shock can either be characterized as an AD ($Y\downarrow$ and $\pi\downarrow$) shock or as an AS shock ($Y\downarrow$ and $\pi\uparrow$), for the case of Brazil uncertainty shock resembles an AS shock. In the literature, it was seen that in Brazil an increased uncertainty shock reduces business confidence (Monetes & Nogueira, 2021) and negatively influence investment because of information asymmetry (Marschner & Cretta, 2021). Because of lower investments in the economy, there will be impediments to capital accumulation which will result in lower output (Mankiw, 2016). Furthermore, Gouvea (2007) shows that in Brazil price rigidity increases when there is a confidence shock persisting in the nation and this resulted in a disturbance in the inflation rate because of the sluggish price adjusting mechanism leading to higher inflationary pressures. The inflation rising as output falls is in line with the Calvo model on price rigidity as seen in Oh (2020) where AD has fallen in an uncertainty shock but firms self-insure themselves by keeping the price markups higher as a precautionary measure this results in an increase in inflation as output falls.

Looking at the fourth column (see figure 2) we can see that a monetary policy shock in the augmented model resulted in GDP growth and inflation remaining muted till the first two and three quarters respectively and after that, both GDP growth and inflation declined.

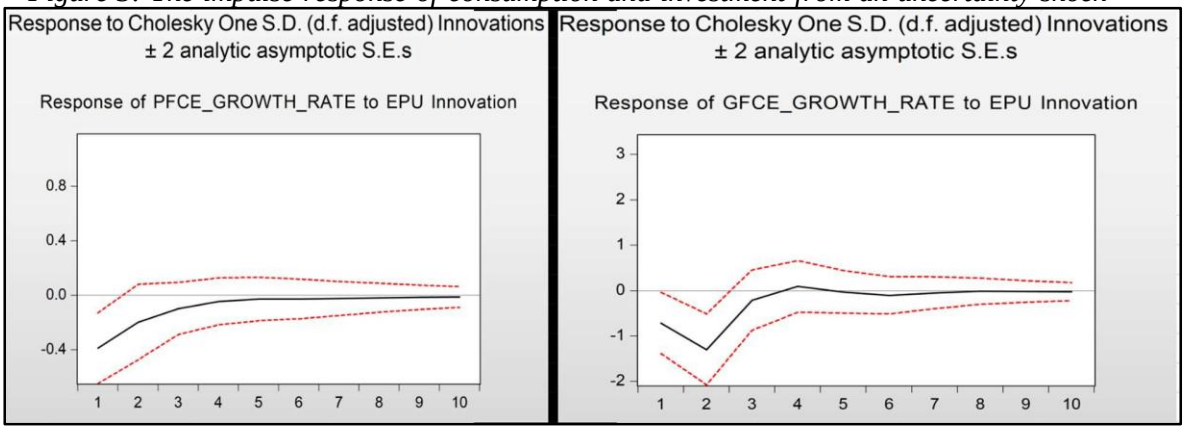
Figure 2: Impulse response of model augmented to uncertainty



Source: Authors Calculations done on Eviews

To understand the influence uncertainty has on the decision-making of market participants in the economy, we evaluate EPU's influence on private final consumption and gross fixed capital formation (see figure 3).

Figure 3: The impulse response of consumption and investment from an uncertainty shock



Source: Authors Calculations done on Eviews

The first diagram of the panel (see figure 3) illustrates how private consumption expenditure responds to a shock by uncertainty. We see when there is an uncertainty shock immediately leads the consumption to fall and steadily recover yet remain negative since quarter 2. By quarter 10 the private consumption fully recovers from the shock and converges to equilibrium.

Similarly, the second diagram of the panel (see figure3) shows the gross fixed capital formation falls immediately with an uncertainty shock and the fall peaks in the second quarter however there is a quicker recovery from the fall relative to private consumption. A steady rise seen in the fourth quarter can be attributed to investors having more information about the economic situation after two quarters since the shock to carry out sound investment decisions. Thus, both consumption and investment negatively react to the uncertainty shock, such significant results imply that i) precautionary savings increases leading to declining in consumption ii) hiring decision of capital and human resources are delayed leading to reduced investment and iii) it takes two quarters since the uncertainty shock for consumption and investment to initiate recovery towards equilibrium.

By comparing the baseline model with the augmented model certain things like the aggregate impact from monetary policy shock are different in both models. The aggregate impact of GDP growth and inflation in the augmented model where uncertainty is taken into account is less than the baseline model during a monetary policy shock. The response of GDP growth remains muted for two quarters after which it falls and inflation also remains insignificant compared to the baseline model. The inflation does not exhibit any trend for the first three quarters since the monetary policy shock and after that, it takes a fall with a quantum less than seen in the baseline model. In the baseline model, both GDP growth and inflation falls respond immediately to a monetary policy shock.

The impediment of the monetary transmission mechanism during an uncertainty shock in Brazil is similar to the findings of the U.S and India as shown by Aastveit et al (2017) and Pratap & Dhal (2021) respectively but the findings are contrary to Balcilar et al (2017) which suggests that there are limited asymmetric spillovers of economic uncertainty in Brazil. The asymmetric influence of monetary policy shock during normal times and uncertain times can be attributed to the responses of market participants (consumers, investors and financial intermediaries).

The results show there might be a cautious approach taken by market participants. Consumers and firms wait and watch and obtain more information before making an economic decision. During times of high uncertainty, consumers may increase their precautionary savings and reduce consumption and firms may decrease and delay investments and hiring decisions. In the financial sector Baun, Caglayan & Xu (2018) find that during uncertainty shocks there is a reduction in the availability of credit as the financial intermediaries become risk averse and the banks non-performing loans rise as uncertainty prevails in the economy. This would distort the channelling of resources from savers to borrowers in the economy and limit the efficient allocation of resources.

Thus, as market participants are waiting for more information about the economic situation so as to make an informed decision this results in them not being as responsive to monetary policy shocks during uncertain times as in normal times. The limited responsiveness of market participants towards monetary policy shocks ultimately weakens the monetary transmission mechanism during such distressing times.

Conclusion

The study aimed to understand the effectiveness of monetary transmission mechanisms under uncertainty. In the baseline, it was evident that inflation and aggregate output decline as monetary policy shock is encountered in Brazil however in the augmented model when uncertainty was taken into account the quantum of impact on aggregate output and inflation from monetary policy shock reduces. This suggests that monetary policy weakens as uncertainty persists in the economy as market participants fail to respond to changes in interest rates when their confidence remains low. Hence, it becomes highly relevant to include uncertainty measures while assessing policy shock or forecasting. To tackle the weakening transmission mechanism, the central bank can adopt unconventional monetary policy tools which can provide temporary support to the economy during times of crisis. Gambacorta, Hofmann, & Peersman (2014) also show that unconventional monetary policy measures adopted by central banks in the wake of the GFC did provide temporary relief to market participants, thereby suggesting that when the scope of conventional tools is limited the use of unconventional tools of the Central Bank can be employed during uncertainty shocks.

Furthermore, for Brazil, an uncertainty shock was the dominant supply side shock of output falling and inflation rising which will lead to deterring the optimal monetary policy response as firms and financial intermediaries remain insensitive to policy changes in highly volatile and uncertain situations.

Lastly, the findings suggest that market participants align with the wait-and-watch perspective of uncertainty where information will play a crucial role for consumers and businesses to make informed decisions, accordingly policymakers need to ensure that there is transparency in the Central Bank's operations. For instance, changes in interest rates or inflation targets or strategies adopted by the Central Bank can be made available to market participants at the relevant time intervals so they can form expectations and make decisions appropriately.

The scope of the study can be expanded in the future to include the impact of unconventional monetary tools employed to influence the transmission mechanism amidst uncertainty and whether Brazil's uncertainty has a spillover effect on the monetary transmission mechanism of its major trading partners and vice versa.

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Appendix

Table 1: Correlation Matrix of confidence and uncertainty

Variable	Log (Economic Policy Uncertainty Index)	Log (Business Confidence Index)	Log (Consumer Confidence Index)
Log (Economic Policy Uncertainty Index)	1	-0.514	-0.313
Log (Business Confidence Index)	-0.514	1	0.680
Log (Consumer Confidence Index)	-0.313	0.680	1

Source: Authors Calculations done on Eviews

Table 2: Granger Causality between confidence and uncertainty

Null Hypothesis **Sample Data: Jan 2000- Dec 2019**	**F-Stat** **(*Lag 1)***	**F- Stat** **(*Lag 2)***
Log Consumer Confidence Index does not Granger Cause Log Business Confidence Index	0.021	3.161**
Log Business Confidence Index does not Granger Cause Log Consumer Confidence Index	2.557	3.805**
Log EPU Index does not Granger Cause Log Business Confidence Index	1.38	0.298
Log Business Confidence Index does not Granger Cause Log EPU Index	0.765	0.531

Log EPU Index does not Granger Cause Log Consumer Confidence Index	2.764***	0.733
Log Consumer Confidence Index does not Granger Cause Log EPU Index	0.777	0.621

****,**,* indicates 10%, 5% and 1% level of significance*

Source: Authors Calculations done on Eviews

Table 3: Variables Under Study

Sl No.	**Variable**	**Data**	**Source**
1	Uncertainty Index	Economic Policy Uncertainty Index	policyuncertanity.com: Baker et al. (2016)
2	Economic Activity	Real GDP (percentage change on the same period the previous year)	OECD Statistics Data Bank
3	Inflation	Consumer Price Index (Percentage change on the same period of the previous year)	OECD Statistics Data Bank
4	Interest Rate	Call Money Rate	St. FRED

Table 4: Augmented Dickey-Fuller Test

Variable	Level	First Difference	Second Difference	Inference
Log(EPU)	-4.289*	-	-	I(0)
Y	-4.039**		-	I(0)
Π	-2.625***	-3.961*	-	I(1)
r	-2.067	-5.343*	-	I(1)

, **, * indicates stationary at 1%, 5% and 10% level of significance*

Source: Authors Calculations done on Eviews

Table 5: Granger Causality of Variables Under study

Null Hypothesis **Sample Data: Q1 2000- Q4 2019**	**F-Stat** **(*Lag 1)***	**F- Stat** **(*Lag 2)***
Consumer Price Index does not granger cause Call Money Rate	0.295	2.003
Call Money Rate does not granger cause Consumer Price Index	27.358*	12.943*
GDP does not Granger Cause Call Money Rate	2.526	1.938
Call Money Rate does not Granger Cause GDP	9.179*	6.582*
GDP does not Granger Cause Consumer Price Index	4.006**	1.118
Consumer Price Index does not Granger Cause GDP	16.574*	5.434*

Log EconomicUncertainty Policy Index does not Granger Cause Call Money Rate	0.556	0.724
Call Money Rate does not Granger Cause Log Economic Policy Uncertainty Index	0.214	0.1997
Log Economic Policy Uncertainty Index does not Granger Cause GDP	2.156	2.279
GDP does not Granger Cause Log Economic Policy Uncertainty Index	8.673*	2.207
Log Economic Policy Uncertainty Index does not Granger Cause Consumer Price Index	0.132	0.1995
Consumer Price Index does not Granger Cause Log Economic Policy Uncertainty Index	0.0069	3.512**

, **, * indicates stationary at 1%, 5% and 10% level of significance*

Source: Authors Calculations done on Eviews