Banks' Risk-Bearing Behavior under Uncertainty: A Dynamic Panel Analysis

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Abstract Some banking decisions (such as the decision on loan loss provisions) are forward-looking and based on expectations, forcing banks to invest in sectors with professionals whose function is to provide forecasts for different variables of the economy to help in their decision making. However, professional forecasters may face uncertainties in the economy that affect their forecasting processes for economic variables, resulting in disagreements in expectations, which may end up affecting banking decisions due to the perception of greater risk in the economic environment. In this sense, this paper investigates the relationship that involves disagreements in expectations about different variables related to economic outcomes and economic policy instruments and credit risk (represented by bank provisions) through a dynamic panel composed of 125 Brazilian banks. Hence, the paper analyzes banks' risk-bearing behavior and their decision-making under uncertainty. For that, the disagreements in expectations were divided into two groups, one related to economic outcomes, and the other to economic policy instruments. The estimates reveal that disagreements in expectations related to Brazil's economic outcomes cause a greater impact on banking provisions than those related to Brazil's economic policy instruments.

Keywords: credit risk, provisions, disagreement in expectations, uncertainty

Resumo Algumas decisões bancárias (como a decisão sobre provisões bancárias) são prospectivas e baseadas em expectativas, obrigando os bancos a investir em setores com profissionais cuja função é fornecer previsões para diferentes variáveis da economia para auxiliar na tomada de decisões. No entanto, os analistas profissionais podem enfrentar incertezas na economia que afetam seus processos de previsão para variáveis econômicas, resultando em divergências nas expectativas, as quais podem acabar afetando as decisões bancárias devido à percepção de maior risco no ambiente econômico. Assim, este estudo investiga a relação que envolve desacordos nas expectativas sobre diferentes variáveis relacionadas aos resultados econômicos e instrumentos de política econômica e risco de crédito (representado por provisões bancárias) por meio de um painel dinâmico composto por 125 bancos brasileiros. Assim, o artigo analisa o comportamento de risco dos bancos e sua tomada de decisão sob incerteza. Para tanto, os desacordos nas expectativas foram divididos em dois grupos, um relacionado aos resultados econômicos e outro aos instrumentos de política econômica. As estimativas revelam que desacordos nas expectativas relacionadas aos resultados econômicos do Brasil causam um impacto maior nas provisões bancárias do que aquelas relacionadas aos instrumentos de política econômica do Brasil.

Palavras-chave: risco de crédito, provisões, desacordo de expectativas, incerteza

Classificação JEL: D80, D84, E44, G21

Área 4 - Macroeconomia, Economia Monetária e Finanças

1. Introduction

Several banking decisions, such as the decision on loan loss provisions, are forward-looking and therefore based on expectations. Once expectations about the economy play a key role in the banking decision-making process, and since the economic environment is surrounded by uncertainties, it is important to understand how uncertainties related to the economic environment affect expectations and the decision-making process of banks in riskier environments.

The role of expectations in banking decisions is so important that banks have sectors with experts in the formation of expectations and forecasts for several economic variables. These expectations are also important to economic policy decisions. The Central Bank of Brazil (CBB) carries out the 'Focus Survey', compiling forecasts of about 140 banks, asset managers and other institutions (such as, real sector companies, brokers, and consultancies). The Survey monitors market expectations for various inflation indices, the GDP growth, the exchange rate, the monetary policy (Selic) rate, fiscal indicators, and external sector variables.

After the 2008 Global Financial Crisis (GFC), the decision-making process of banks in riskier environments became particularly relevant, since banks represent a fundamental part of the economy and can initiate and exacerbate systemic crises. Banks play a critical role and tend to amplify the effects of economic shocks during periods of financial crisis. The banking industry is inherently procyclical, in the sense of reinforcing the business cycle: banks tend to decrease lending during recessions, exacerbating the economic downturn, and to increase it during expansions, thereby contributing to a potential overheating of the economy (Drumond, 2009).

The GFC put the accepted assumptions of financial stability to the test and created an environment of uncertainty with potential impacts on economic policies and banks decisions. This study contributes to the literature on banking macroprudential policies once it is the first to analyze the effects that uncertainties in the expectation formation process about macroeconomic and economic policy variables (represented by disagreements in expectations) exert on an important forward-looking decision that banks must make, that is, the decision on loan loss provisions, which, in turn, reflect on the supply of credit and financial stability.

Therefore, the goal of the paper is to analyze how the decision on loan loss provisions of the Brazilian banking sector (a forward-looking decision able to affect financial stability)[1] is affected by uncertainties arising from different aspects, such as, economic activity, inflation, monetary policies and fiscal policies. In this sense, the paper analyzes banks' risk-bearing behavior and decision-making under uncertainty.

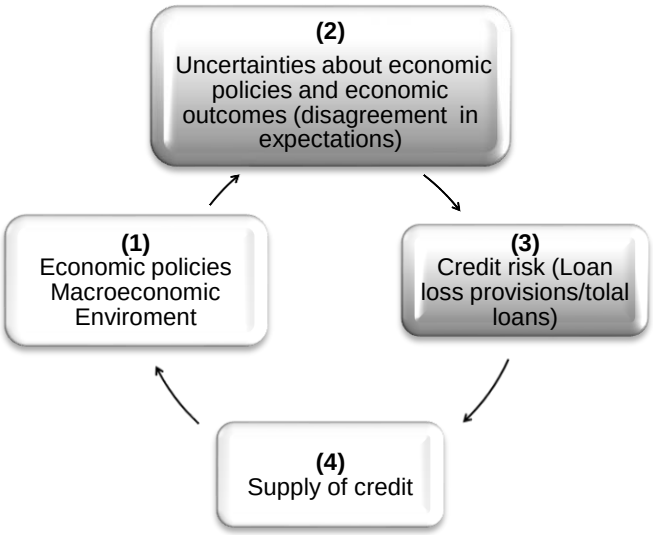
Figure 1 describes how uncertainties affect the supply of credit through the risk-taking channel (captured by the credit risk management policy adopted by banks through loan loss provisions) and emphasizes (in gray) the analysis that is performed by this study.

Looking at the scheme described by figure 1, the first thing that one must keep in mind is that economic policies and the economic environment affect expectations (relationship described between rectangles 1 and 2). This relationship suggests that when there is difficulty in understanding the conduct of economic policies and the objectives of policymakers, and when the macroeconomic results are not compatible with those announced, uncertainties arise in relation to both the conduct of economic policies and the economic results in the economy. These uncertainties are reflected in the expectations

[1] Brazil represents a viable case study since it is one of the few countries to provide free series of expectations related to a wide range of economic variables.

formation process through disagreements in expectations, i.e., agents may not have the same expectations and, therefore, may form different expectations (Mankiw et al., 2003). Recently, a strand of research seeks to investigate the effects that macroeconomic variables have on the disagreement in expectations, i.e., the relationship described between rectangles 1 and 2 for the effects of "Economic Policies and Macroeconomic Environment" on "Uncertainties about economic policies and economic outcomes (Disagreement in expectations)". For instance, regarding the Brazilian economy, Montes and Luna (2018) find evidence that the adoption of discretionary fiscal policies increases the disagreement in expectations about fiscal variables, creating uncertainties about the future behavior of the public debt and the budget balance. Another group of studies showed evidence that central bank transparency and monetary policy signaling, as well as both fiscal and monetary credibility, are important in reducing disagreements in expectations about some important economic variables (such as inflation and output growth) and some economic policy instruments (such as the interest rate and the exchange rate) (e.g., Montes et al., 2016; Oliveira and Curi, 2016; Montes and Acar, 2018, Montes and Ferreira, 2018; de Oliveira and Montes, 2020; Seelajaroen et al., 2020).

Figure 1 Risk taking channel and analysis scheme



On the other hand, since the global financial crisis, there has been a concern among financial market experts, academics and policymakers about how banks react to risky situations and uncertainties (e.g., Ritz and Walther, 2015; Wu et al., 2021; Montes et al., 2021; Nguyen, 2021). As a consequence, a strand of studies emerged with the objective of understanding the context of macroprudential banking policies, and how forward-looking banking decisions, such as the decision on banks' expected loss provisions, are affected by the economic cycle and economic policies (e.g., Montes and Peixoto, 2014; Montes and Scarpari, 2015; Cummings and Durrani, 2016; Antunes et al., 2016; Soedarmono et al., 2017; Montes et al., 2021), and how macroprudential banking policies affect the supply of credit (Bouvatier and Lepetit, 2008; Montes and Monteiro, 2014).

Based on the idea that the disagreement in expectations about a variable reflects the uncertainties of economic agents about the future behavior of the variable, studies use the disagreement in expectations as a proxy for uncertainty (e.g., Bomberger, 1996;

Boero et al., 2008; Söderlind, 2011; Baker et al., 2016; Montes and Curi, 2017; Montes and Luna, 2018; Montes and Ferreira, 2018; Montes and Souza, 2020)[2].

In this sense, to capture uncertainties in the expectations formation process related to economic outcomes and to economic policies, we use disagreements in expectations about economic outcomes and economic policy instruments. In addition, as another contribution of the paper, we check robustness by using the "Economic Policy Uncertainty" index proposed by Baker et al. (2016) instead of the disagreements in expectations related to economic policy instruments; and, instead of the disagreements in expectations related to economic outcomes, we use a measure of economic uncertainty unrelated to economic policy, calculated from the regression where the dependent variable is the Brazilian Economic Uncertainty index, provided by IBRE FGV, and the explanatory variable is the EPU proposed by Baker et al. (2016). The residual series of this regression thus is the series of economic uncertainty unrelated to economic policy. In this sense, another contribution of this paper is to unite two literatures never explored together: one related to the macroprudential policies adopted by the banking sector and the other related to the effects of uncertainties measured by disagreements in expectations and news-based indicators.

Based on dynamic panel data analysis through estimates using the System Generalized Method of Moments (S-GMM) for 125 banks of the Brazilian banking sector, the results reveal to the extent that disagreements in expectations increase, credit risk also increases. Moreover, the estimates indicate that disagreements in expectations related to economic outcomes cause a greater impact on banking provisions than those related to economic policy instruments. The robustness analysis corroborates the findings, indicating that uncertainties affect credit risk, and revealing that the economic uncertainty unrelated to economic policy has a greater effect on bank provisions than economic policy uncertainty.

2. Data and Methodology

The analysis uses a panel data composed of 125 banks[3] from 2006Q01 to 2014Q03[4] (quarterly). Since the main goal of the study is to analyze the effects that uncertainties related to the future behavior of macroeconomic and economic policy variables exert on credit risk, represented by the decision to provision funds against possible expected losses, we use the disagreements in expectations about different macroeconomic and economic policy variables as a way to capture these uncertainties. Basically, all the data

[2] The literature addressing the disagreement in expectations seeks to understand the sources of disagreement, its consequences, how to measure disagreement, and how to link the disagreement in expectations with uncertainties (e.g., Bomberger, 1996; Mankiw et al., 2003; Boero et al., 2008; Patton and Timmermann, 2010; Söderlind, 2011; Dovern et al., 2012; Pfajfar and Santoro, 2013; Andrade et al., 2016; Oliveira and Curi, 2016; Montes et al., 2016; Rico et al., 2016; Acedański, 2017; Montes and Curi, 2017; Montes and Ferreira, 2018; Montes and Luna, 2018; Montes and Souza, 2020). Mankiw et al. (2003) argue that, in the expectations formation process, agents may disagree about the future behavior of different economic variables, and the disagreement in expectations may be substantial and vary over time according to the evolution of uncertainties surrounding the behavior of certain economic variables.

[3] Table A1 Presents the list of banks used in the study.

[4] The justification for the analyzed period is as follows: as an outcome of the GFC, a set of regulatory policy measures, such as capital surcharges and others, were created. Therefore, with these new measures, some bank statistics are changed in Brazil. For that, we used the available information until the full implementation of capital regulation reform in Brazil (Basel III). In addition, we also wanted to avoid the period of political turmoil caused by Luiz Inácio Lula da silva being favored to win the presidential election from 2002 until 2005 and from and the fiscal and political instabilities that surfaced at Dilma's government after 2014.

for the expectations series used to build the disagreements in expectations variables and the remaining control variables were gathered from the Central Bank of Brazil (CBB) database, except the sovereign risk perception variables which were gathered from Bloomberg database.

In order to capture the forward-looking risk-taking behavior of the banks, we use as dependent variable the bank provisions (*PROVISIONS*). Bank provisions represent the amount provisioned by banks in relation to the expected losses in loan operations. Moreover, it represents a proxy for the perception of ex-ante risk (Montes and Peixoto, 2014). The *PROVISIONS* variable is obtained by the ratio between the loan loss provisions provided by banks and gross loans, thus representing the banks' expected loss in relation to loans.[5] Therefore, a decrease in *PROVISIONS* represents a reduction in the credit risk coverage level (de Mendonça and de Moraes, 2018; Montes et al., 2021).

With respect to disagreements in expectations about different macroeconomic variables, we calculate these disagreements for the fixed horizons of 12, 24, 36 and 48 months, and after computing the four maturities of the disagreement in expectations, we extract the first principal component of these series with four maturities.[6] The disagreements are organized in two groups. The first group regards uncertainties related to economic policy instruments and thus formed by: disagreement in exchange rate expectations (*DISAG_EXCH*), disagreement in primary surplus expectations (*DISAG_BUDGET*), and disagreement in monetary policy interest rate expectations (*DISAG_SELIC*). The second group regards uncertainties related to economic results: Disagreement in public debt expectations (*DISAG_DEBT*), disagreement in inflation expectations (*DISAG_IPCA*), disagreement in GDP growth expectations (*DISAG_GDP*) and disagreement in industrial production growth expectations (*DISAG_IPI*).

Following the literature and adopting the same procedures, the disagreements in expectations are the difference between the maximum expected value and the minimum expected value obtained from the survey with financial markets experts for a certain variable in a specific date in the future.[7] Thus, based on Montes et al. (2016), Oliveira and Curi (2016), Montes and Curi (2017), Montes and Luna (2018), Montes and Souza (2020) and de Oliveira and Montes (2020), we introduce the following notation: t is the instant of time in which the projection is made,[8] i identifies the agent who releases the forecast ($i \in$ I, where I is the set of agents surveyed[9]), X is the variable to be forecasted. In this sense, $\mathrm{E_{i,t}X^{a+j}}$ indicates the projection that the i-th agent releases at time t with respect to the value that the variable will take in the end of year $a + j$.[10] Therefore, $E_t^{min}X^{a+j} = \min\left(E_{i,t}X^{a+j}, i \in \mathrm{I}\right)$ represents the minimum value of the expectations

[5] The PROVISIONS series are obtained from the CBB (IEFA/CBB – Information for Economic-Financial Analysis/Central Bank of Brazil).

[6] This procedure is adopted by several studies (e.g., Oliveira and Curi, 2016; Montes et al., 2016; Montes and Luna, 2018) since the first principal component is a good proxy for the common trend.

[7] We follow Oliveira and Curi (2016), Montes et al. (2016), Montes and Luna (2018), Montes and Souza (2020) and de Oliveira and Montes (2020) and use this measure of disagreement throughout the paper, since other measures require the information related with the entire distribution of expectations, which is not provided by the CBB. We are aware of other measures of disagreement, such as the inter-quartile range and Kulback-Liebler divergence measure. However, these measures require the knowledge of the entire distribution of individual forecasts. Alternative measures that are often used, such as the standard deviation and the coefficient of variation need to be interpolated in order to be transformed in fixed horizon, which is not appropriate for the analysis performed in this study (see, for instance, Oliveira and Curi, (2016)).

[8] This instant is characterized by a specific date, namely, a day d, a month m and a year a.

[9] The number of agents in I is I.

[10] $j = 0$: current year; $j = 1$: next year immediately after the current year; $j = 2$: two years immediately after the current year; $j = 3$: three years immediately after the current year.

distribution, whilst, $E_t^{max}X^{a+j} = \max(E_{i,t}X^{a+j}, i \in \mathrm{I})$ denotes its maximum value. Hence, the measure of disagreement that we use throughout this study, $Disag\_X_t^{a+j}$, which is calculated by the range of distribution, is given by the following equation:

$$Disag\_X_t^{a+j} = E_t^{max}(X)^{a+j} - E_t^{min}(X)^{a+j} \quad (1)$$

Forecasts such as $E_{i,t}X^{a+j}$ are known as fixed event ones, since the forecast horizon, $a + j$, varies with the progression of time. In fact, the prospective period of forecasts made at *t* for the value that the variable *X* will take in the end of the year $a + j$ decreases as *t* progress within "*a*", the year in which expectations are made. This pattern of decreasing forecasting horizons as *t* advances throughout the year brings about a seasonal behavior in disagreement measures based on fixed event forecasts because expectations dispersion tends to decrease as the forecasting horizon shrinks[11].

In order to avoid this seasonal behavior inherent to disagreement measures based on fixed event forecasts that several studies recur to fixed horizon forecasts, in which the forecasting horizon does not vary with the passage of time (e.g., Mankiw et al., 2003; Patton and Timmermann, 2010; Dovern et al., 2012; Montes et al., 2016 and Oliveira and Curi, 2016). As proposed in Dovern et al. (2012), the conversion of fixed event forecasts into fixed horizon forecasts is accomplished by applying the formula below:

$$E_tX^{12(j+1)} = \frac{12-(m-1)}{12}E_tX^{a+j} + \frac{m-1}{12}E_tX^{a+j+1},\ j = 0, 1, 2, 3, \ldots \quad (2)$$

where m indicates the month in which the projection is made and $E_tX^{12(j+1)}$ represents the average of agents' expectations with respect to the value that the variable *X* will take at the end of the next $12(j + 1)$ months. We used the same equation to interpolate the minimum and maximum projections to calculate the disagreement in expectations about a certain variable. The result is a term structure of disagreements in expectations consisting of the "vertices" $Disag\_Ex_t^{12}$, $Disag\_Ex_t^{24}$, $Disag\_Ex_t^{36}$ and $Disag\_Ex_t^{48}$.

Since the CBB publishes forecasts for the current and the next three years, the above equation is applied taking $j = 0, 1, 2$. Hence, we can interpolate forecasts for the fixed horizons of 12, 24, 36 and 48 months. This procedure is performed daily, which allows us to build the term structure of disagreements in expectations about a certain a variable for each business day. Then, the time series composed of daily observations are converted into a quarterly frequency by means of an arithmetical quarterly average.

After calculating the four maturities of disagreement in expectations with respect to the macroeconomic variables, we extract the first principal component of these series with four maturities (12, 24, 36 and 48 months), i.e., $Disag\_X_t^{PC}$. The first principal component is a good proxy for their common trend, allowing us to make inference regarding the effects of uncertainties (disagreement in expectations) related to both economic policy instruments and economic outcomes on credit risk (provisions). Moreover, the application of this technique has a long tradition in the study of conventional yield curves (Litterman and Scheinkmann, 1991). In addition, this technique also filters sudden shifts on a given measure of disagreement, which do not

[11] Indeed, the disagreement measure observed in March 2010 for the value that the budget balance will take at the end of 2010 tends to be greater than the disagreement measure observed in September 2010 for the value that the same variable will take at the closing of 2010. The divergence measure tends to increase again in March 2011, since the current year becomes 2011 and forecast time horizon becomes 9 months.

echo upon other measures. This kind of shift can be considered as outliers and therefore, should be neglected.

Aiming to verify whether the disagreements in expectations related to economic policy instruments and economic outcomes affect the risk perception of the banking system measured by the bank provisions, we estimate the following econometric model:

$$PROVISIONS_{\mathrm{i},t} = \beta_0 + \beta_1 PROVISIONS_{\mathrm{i},t-1} + \beta_2 Z_t + \beta_3 DISAGREEMENTS_t + \varepsilon_{\mathrm{i},t} \quad (3)$$

where, i = 1, ..., 125 are the cross sections (banks) and t = 1, ..., 32 is the period (quarterly). With respect to variables of interest, $PROVISIONS_{i,t}$ represents the credit risk, while $DISAGREEMENTS_t$ is the vector that represents the uncertainties related to both economic policy instruments and economic outcomes (i.e., *DISAG_EXCH*, *DISAG_BUDGET*, *DISAG_SELIC*, *DISAG_DEBT*, *DISAG_IPCA*, *DISAG_IPI* and *DISAG_GDP*). Based on Gambacorta and Mistrulli (2004), Dahl (2012), Tabak et al. (2013), de Mendonça and de Moraes (2018) and Montes et al. (2021), besides the dynamic effect represented by $PROVISIONS_{i,t-1}$, Z_t is the vector of control variables formed by the following variables: Sovereign risk perception variables on the short and long scales (*CCR.S* and *CCR*.L)[12], output gap (*GAP*)[13], monetary policy interest rate (*INTEREST RATE*)[14], liquidity indicator (*LIQUIDITY*)[15], credit growth rate (*CREDIT*)[16], an index that corresponds to the central bank communication regarding credit development (*COMMUNICATION*)[17], and the nonperforming loan/total loans ratio

[12] We introduce sovereign risk perception variables because Montes et al. (2021) find evidence of a relationship between sovereign risk perception and provisions. Based on existing studies (e.g., Sy, 2004; Gande and Parsley 2005; Kim and Wu 2008; Cai et al., 2018; de Oliveira and Montes, 2020; Montes et al., 2021), the CCR variables are built upon the long-term foreign-currency Brazilian bonds ratings along with the outlook and watch signals provided by the three main CRAs (Standard & Poor's, Moody's, and Fitch). These signals indicate that a sovereign bond is on review or watch list for upgrade/downgrade prior to the actual upgrade or downgrade actions. Hence, using these credit signals and the transformed linear rating scale, we obtain an aggregate score called the Comprehensive Credit Rating (CCR), which is calculated by summing the rating score and the signals issued in the form of outlook and credit watch for foreign currency debts. For more details, see Montes et al. (2021). Table A2 in the appendix shows the ratings of the three main CRAs and the linear numerical scale, and table A3 shows the credit signals and the numerical value assigned for each of these signals, which are then added to both numerical rating scales.

[13] This control variable is fundamental since the literature points to the existence of a relationship between the business cycle and risk taking by banks (e.g., Pool et al., 2015; de Mendonça and de Moraes, 2018 and Montes et al., 2021). For the construction of GAP, we used the real GDP series and based on this series we applied the Hamilton (2018) methodology to obtain the output gap. The real GDP is calculated using the 12-month accumulated GDP obtained from the Central Bank of Brazil (CBB) – series 4382) and the general price index obtained from the IPEADATA website.

[14] Studies point out that the monetary policy interest rate has an impact on financial stability (e.g., Altunbas et al., 2014; de Mendonça and de Moraes, 2018; de Moraes and de Mendonça, 2019; Montes et al., 2021). Therefore, we cannot neglect the effect of monetary policy on variables related to credit risk.

[15] According to Imbierowicz and Rauch (2014), there is a positive relationship between liquidity and credit risk. Thus, such as de Mendonça and de Moraes (2018) and Montes et al. (2021), we use a liquidity indicator (LIQ) as a control variable.

[16] According to Foos et al. (2010), loan growth is an important indicator of risk taking by banks. Thus, we add the credit growth rate (CRED) to the set of control variables.

[17] As pointed out by de Mendonça and de Moraes (2018), the statements issued by the Central Bank of Brazil (CBB) represent important sources of information that banks take into account in the decision-making process related to credit risk (PROVISIONS). The COM variable developed by de Mendonça and de Moraes (2018) expresses the expectations of the CBB in relation to the future behavior of credit. Thus, based on the content published in the Central Bank of Brazil Inflation Report, the COM variable can assume three values: "+1" in the case of an expected increase in the credit market; "-1" for the expected reduction in the credit market, and "0" for the case where there is no expectation of fluctuation in the credit market.

(*NPL*)[18]. The model also uses four exogenous variables as instruments that are not in the model.[19] Two are associated with the banking literature (a proxy related to the performance of a financial institution (*ROA*)[20] and the capital buffer (BUFFER)[21]) and the other two are related to market measures of sovereign risk (credit default swaps of five years – CDS_5 and credit default swaps of ten years – CDS_10).[22] In turn, $\varepsilon_{i,t}$ is the stochastic error term. Table A5 in the appendix presents the descriptive statistics of all variables and their respective sources.

In relation to the method, the estimates were performed through the System-Generalized Method of Moments (S-GMM) (Arellano and Bover, 1995 and Blundell and Bond, 1998). The reason for adopting the S-GMM is that the use of a lagged dependent variable in the models can generate a problem of correlation with the error term, which causes bias and inconsistency in the OLS estimators (Baltagi, 2005). Moreover, the possibility of endogeneity cannot be overlooked due to the fact that the control variables used in our model can be determined at the same time as the risk measures. To deal with these problems, the solution proposed by Arellano and Bond (1991) is the estimate using the Generalized Method of Moments (GMM) in the first difference (D-GMM). However, Blundell and Bond (1998) show that the use of this method implies weak instruments and presents bias for large and small samples and low precision. To deal with these problems, Arellano and Bover (1995) and Blundell and Bond (1998) proposed the S-GMM. In general, the S-GMM combines regression equations in differences and levels in a system and uses differences and lagged levels of variables in the model as instruments (Bond et al., 2001).

The problem of endogeneity is common in econometrics and can be described as the presence of a correlation between regressors and error terms. This situation violates the assumption of traditional models, which admit only exogenous variables, and results, therefore, in inconsistent parameters. According to Wooldridge (2002), the endogeneity problem occurs (in general) due to the omission of relevant variables, simultaneity and measurement errors. In the model analyzed, there exists the possibility of the occurrence of the three hypotheses. The reason is that it is impossible to know and measure all the variables that affect credit risk. Furthermore, the measure related to credit growth can be influenced by credit risk, which in turn, validates the hypothesis of simultaneity.

Due to the reasons mentioned above, the estimates are based on the S-GMM. The method uses instrumental variables. It is important to mention that when there are many instruments in the estimations, a bias in the results may be created (Roodman, 2009). Therefore, to avoid using an excessive number of instruments in the regressions, the "number of instruments/number of cross-sections" ratio must be less than 1 in the regressions (de Mendonça and Barcelos, 2015). In addition, to verify the validity of the instruments in the models, the overidentification restrictions test (J-statistic) is

[18] See de Mendonça and de Moraes (2018).
[19] For a detailed selection of instrumental variables, see Table A4.
[20] We use the Return on assets because it is a measure that captures the recognized risk-return relationship (credit risk versus return on assets) – see Berger and Bouwman (2013), de Mendonça and de Moraes (2018) and Montes et al (2021).
[21] This variable represents the solvency risk, which corresponds to the level of capital that is greater than the minimum regulatory requirement maintained by banks. In other words, the BUFFER variable is measured by the difference between the capital of financial institutions and the minimum capital required by regulators (see Stolz and Wedow (2011), de Mendonça and de Moraes (2018) and Montes et al. (2021).
[22] CDS is a contract that provides insurance for the risk of default from a sovereign entity. The CDS spread represents the extra premium that investors require to invest in a riskier asset and therefore indicates the credit risk of a sovereign entity.

performed, as suggested by Arellano (2003). Serial correlation tests of first order, AR (1), and second order, AR (2) are also performed.

3. Results

This section presents the results of the estimates for the relationships between disagreements in expectations and credit risk (represented by *PROVISIONS*). Table 1 shows the estimates for the first group of disagreements in expectations, where *DISAG_EXCH*, *DISAG_BUDGET*, and *DISAG_SELIC* are the main explanatory variables of interest. Table 2 shows the estimates for the second group of disagreements in expectations, where *DISAG_DEBT*, *DISAG_IPCA*, *DISAG_GDP* and *DISAG_IPI* are the main explanatory variables of interest. All S-GMM estimates accept the null hypothesis of the Sargan test (J statistic) and, therefore, the overidentification restrictions are valid. Moreover, both serial autocorrelation tests AR(1) and AR(2) do not suggest the presence of serial autocorrelation.

Regarding the effects of the disagreements in expectations, the results show that all coefficients present positive signals and statistical significance. Overall, the results suggest that as uncertainties in the expectation formation process increase (i.e., the disagreements in expectations increase), banks increase loan loss provisions since the credit risk increases. From Table 1, we can infer that the most impactful uncertainty related to Brazil's economic policy instruments is the disagreement in interest rate expectations (*DISAG_SELIC*).

The results in Table 2 reveal that all coefficients related to disagreements are significant at the 1% level, but the most impactful uncertainty related to Brazil's economic outcomes is the disagreement about the expectations of public debt (*DISAG_DEBT*). Comparing both variables with the strongest effects of each table (i.e., *DISAG_SELIC* and *DISAG_DEBT*), we observe that the effect of *DISAG_DEBT* on *PROVISIONS* is stronger than the effect of *DISAG_SELIC*. Once banks have government bonds in custody, then, when fiscal uncertainty increases, banks' expectations of losses might also increase, leading banks to increase credit provisions since credit risk grows. This result is interesting and may be associated with the fact that, once monetary policy in Brazil follows the inflation targeting regime (which is characterized by greater transparency), the forward guidance of agents' expectations about this policy is more effective than the fiscal policy, which makes banks more averse to uncertainties related to the public debt than to uncertainties about the interest rate.

Even the second strongest disagreement from Table 2 (*DISAG_IPI*) is more impactful on banks' credit risk than *DISAG_SELIC*. This result reinforces the theory about the procyclical behavior of banks (Drumond, 2009; Montes and Monteiro, 2014; Antunes et al 2016), in the sense that when banks verify an increase in uncertainties related to industrial production growth (*DISAG_IPI*), which can mean dubious economic growth, their expectations of losses would increase turning banks more sensitive to these uncertainties than to the uncertainties related to the basic interest rate (*DISAG_SELIC*).

Thus, the findings suggest uncertainties related to Brazil's economic outcomes are more impactful on banks' credit risk (captured by *PROVISIONS*) than uncertainties related to economic policy instruments.

Regarding the findings related to the control variables, the estimates confirm the expected relations. Concerning the effect of the sovereign risk perception captured by the *CCR* variables (*CCR.S* and *CCR.L*) on credit risk, the coefficients in Tables 1 and 2 are negative and significant for all estimates. This result corroborates the findings presented by Montes et al. (2021). The negative and significant coefficients for central bank

communication on credit development (*COMMUNICATION*) are in line with de Mendonça and de Moraes (2018) and Montes et al. (2021)

Considering the effect of the output gap (*GAP*) on credit risk (*PROVISIONS*), all coefficients are negative and significant, revealing the perception of credit risk reduces in periods of intense economic activity. The results also reinforce the findings presented by de Mendonça and de Moraes (2018) and Montes et al (2021) for the Brazilian case.

The findings for the effect of the monetary policy interest rate on credit risk reveal positive and significant coefficients, except the coefficient of model 8 in Table 2. The results suggest the presence of the risk-taking channel (Montes et al., 2016; de Mendonça and de Moraes, 2018, Montes et al. 2021).

Positive and significant coefficients for the *LIQUIDITY* variable are in line with previous findings (Imbierowicz and Rauch, 2014; Ghenimi et al., 2017; de Mendonça and de Moraes, 2018; Montes et al., 2021). This result indicates that an increase in liquidity causes an increase in bank risk appetite and therefore credit risk increases. In turn, analyzing the effect of the credit growth rate (*CREDIT*) on credit provisions, all coefficients are negative and significant, reinforcing the findings of de Mendonça and de Moraes (2018) and Montes et. al (2021).

The coefficients for the non-performing loans variable (*NPL*) are positive and significant in all models. *NPL* represents the effective loss and *PROVISIONS* represents the expected loss. Therefore, banks increase provisions when the default rate increases. These results are in agreement with those presented by Montes and Peixoto (2014) and Antunes et al. (2016).

Table 1 Effects of disagreements in expectations related to Brazil's economic policy instruments on credit risk (*PROVISIONS*)

	PROVISIONS					
Regressors	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)	Model(6)
DISAG_EXCH	**0.023*** **	**0.013** **				
	(0.005)	(0.005)				
DISAG_BUDGET			**0.009*** **	**0.007*** **		
			(0.002)	(0.002)		
DISAG_SELIC					**0.077*** **	**0.076*** **
					(0.003)	(0.003)
CCRS	**-0.101*** **		**-0.011** **		**-0.208*** **	
	(0.014)		(0.005)		(0.009)	
CCRL		**-0.050*** **		**-0.003***		**-0.081*** **
		(0.005)		(0.001)		(0.003)
COMMUNICATION	**-0.163*** **	**-0.177*** **	**-0.116*** **	**-0.120*** **	**-0.201*** **	**-0.202*** **
	(0.006)	(0.007)	(0.004)	(0.004)	(0.006)	(0.006)
GAP	**-0.00002*** **	**-0.00003*** **	**-0.00003*** **	**-0.00004*** **	**-0.00005*** **	**-0.00005*** **
	(0.000001)	(0.000001)	(0.0000006)	(0.0000006)	(0.0000007)	(0.0000007)
INTEREST RATE	**0.764*** **	**0.568*** **	**0.982*** **	**1.015*** **	**0.422*** **	**0.330*** **
	(0.042)	(0.042)	(0.028)	(0.027)	(0.032)	(0.030)
LIQUIDITY	**0.089*** **	**0.085*** **	**0.021*** **	**0.021*** **	**0.027*** **	**0.027*** **
	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
CREDIT	**-1.112*** **	**-1.135*** **	**-0.035*** **	**-0.029*** **	**-0.436*** **	**-0.428*** **
	(0.017)	(0.018)	(0.001)	(0.001)	(0.009)	(0.008)
NPL	**0.218*** **	**0.219*** **	**0.184*** **	**0.184*** **	**0.202*** **	**0.203*** **
	(0.001)	(0.001)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
PROVISIONS(-1)	**0.606*** **	**0.607*** **	**0.801*** **	**0.801*** **	**0.687*** **	**0.686*** **
	(0.001)	(0.001)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Panel Observations	2923	2923	2607	2607	2984	2984
AR(1)	-0.485	-0.485	-0.474	-0.466	-0.468	-0.468
P-valor	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.005	0.005	0.003	0.003	0.019	0.020
P-valor	0.780	0.790	0.879	0.894	0.323	0.319
J-statistic	101.080	100.751	109.826	109.662	104.985	105.156
p-Value(J-statistic)	0.290	0.298	0.176	0.179	0.272	0.268
N. inst. / N. cross-sections	0.888	0.888	0.914	0.914	0.883	0.883

Note: Marginal significance levels: *** Denotes p<0.01; ** Denotes p<0.05; * Denotes p<0.1. The dependent variable is PROVISIONS; main independent variables of interest: DISAG_EXCH, DISAG_BUDGET and DISAG_SELIC. White's heteroskedasticity consistent covariance matrix was applied in the regressions. Robust standard errors are in parentheses. S-GMM – uses two-step of Arellano and Bover (1995) without time period effects. Tests for AR(1) and AR(2) check for the presence of first-order and second order serial correlation in the first-difference residuals.

Table 2 Effects of disagreements in expectations related to Brazil's economic outcomes on credit risk (PROVISIONS)

	PROVISIONS							
Regressors	Model(1)	Model(2)	Model(3)	Model(4)	Model(5)	Model(6)	Model(7)	Model(8)
DISAG_DEBT	**0.237*** **	**0.230*** **						
	(0.006)	(0.006)						
DISAG_IPCA			**0.040*** **	**0.044*** **				
			(0.003)	(0.003)				
DISAG_IPI					**0.100*** **	**0.093*** **		
					(0.003)	(0.003)		
DISAG_GDP							**0.013*** **	**0.040*** **
							(0.004)	(0.002)
CCRS	**-0.019*** **		**-0.034*** **		**-0.149*** **		**-0.064*** **	
	(0.007)		(0.009)		(0.006)		(0.009)	
CCRL		**-0.014*** **		**-0.014*** **		**-0.063*** **		**-0.020*** **
		(0.002)		(0.003)		(0.002)		(0.001)
COMMUNICATION	**-0.043*** **	**-0.041*** **	**-0.272*** **	**-0.275*** **	**-0.129*** **	**-0.135*** **	**-0.288*** **	**-0.310*** **
	(0.004)	(0.004)	(0.007)	(0.007)	(0.005)	(0.005)	(0.007)	(0.004)
GAP	**-0.00006*** **	**-0.00006*** **	**-0.000007*** **	**-0.000007*** **	**-0.00004*** **	**-0.00004*** **	**-0.00001*** **	**-0.000002*** **
	(0.000001)	(0.000001)	(0.000001)	(0.000001)	(0.0000009)	(0.0000009)	(0.000001)	(0.0000005)
INTEREST RATE	**1.629*** **	**1.526*** **	**0.400*** **	**0.391*** **	**0.372*** **	**0.273*** **	**0.066***	**-0.021**
	(0.037)	(0.036)	(0.031)	(0.031)	(0.019)	(0.018)	(0.036)	(0.016)
LIQUIDITY	**0.026*** **	**0.026*** **	**0.028*** **	**0.028*** **	**0.026*** **	**0.026*** **	**0.028*** **	**0.021*** **
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
CREDIT	**-0.940*** **	**-0.930*** **	**-0.247*** **	**-0.245*** **	**-0.802*** **	**-0.790*** **	**-0.162*** **	**-0.203*** **
	(0.009)	(0.008)	(0.010)	(0.009)	(0.007)	(0.007)	(0.007)	(0.009)
NPL	**0.195*** **	**0.195*** **	**0.194*** **	**0.195*** **	**0.195*** **	**0.195*** **	**0.183*** **	**0.203*** **
	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
PROVISIONS(-1)	**0.672*** **	**0.672*** **	**0.714*** **	**0.714*** **	**0.672*** **	**0.671*** **	**0.710*** **	**0.648*** **
	(0.0003)	(0.0004)	(0.0005)	(0.0005)	(0.0004)	(0.0003)	(0.0003)	(0.0001)
Panel Observations	2984	2984	2695	2695	2984	2984	2678	2871
AR(1)	-0.486	-0.485	-0.471	-0.471	-0.481	-0.481	-0.466	-0.455
P-valor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.009	0.010	0.005	0.005	0.010	0.011	0.004	0.013
P-valor	0.626	0.624	0.809	0.809	0.591	0.584	0.815	0.478
J-statistic	107.409	107.377	100.683	100.727	105.237	105.165	102.503	108.263
p-Value(J-statistic)	0.146	0.146	0.300	0.299	0.182	0.183	0.281	0.292
N. inst. / N. cross-section	0.850	0.850	0.865	0.865	0.850	0.850	0.904	0.956

Note: Marginal significance levels: *** Denotes p<0.01; ** Denotes p<0.05; * Denotes p<0.1. The dependent variable is PROVISIONS; main independent variables of interest: DISAG_DEBT, DISAG_IPCA, DISAG_IPI and DISAG_GDP. White's heteroskedasticity consistent covariance matrix was applied in the regressions. Robust standard errors are in parentheses. S-GMM – uses two-step of Arellano and Bover (1995) without time period effects. Tests for AR(1) and AR(2) check for the presence of first-order and second order serial correlation in the first-difference residuals.

4. Robustness analysis

In order to check robustness and represent the uncertainty related to economic policies in Brazil, we use the "Economic Policy Uncertainty" index (*EPU*) proposed by Baker et al. (2016) instead of the disagreements in expectations related to economic policy instruments. The indicator is taken from the Web page 'Economic Policy Uncertainty' (EPU) for Brazil.[23] The *EPU* indicator calculated for Brazil is based only on the word count of the newspapers. As mentioned on the webpage: "*We construct the Economic Policy Uncertainty Index for Brazil in the same manner as our newspaper-based EPU Index for the United States, following the methods in "Measuring Economic Policy Uncertainty" by Baker, Bloom and Davis*".[24] Thus, as the value of the index increases, it means more economic policy uncertainty. Since the indicator is provided monthly, a quarterly average was performed on the monthly data of this measure.

We also check the models with lagged control variables to observe whether the results hold.[25] Thus, the following dynamic econometric model is estimated:

[23] https://www.policyuncertainty.com/brazil_monthly.html.

[24] https://www.policyuncertainty.com/brazil_monthly.html

[25] As before, we also estimated the models with contemporaneous control variables, and the results remained the same. We decided, in this section, to report the estimations with lagged controls to show robustness.

$$PROVISIONS_{\mathrm{i},t} = \gamma_0 + \gamma_1 PROVISIONS_{\mathrm{i},t-1} + \gamma_2 Z_{t-1} + \gamma_3 EPU_{t-1} + \epsilon_{\mathrm{i},t} \quad (4)$$

where, i = 1, ..., 125 are the cross-sections (banks) and t = 1, ..., 32 is the period (quarterly). Z_{t-1} is the vector of the lagged control variables, EPU_{t-1} represents the lagged effect of the economic policy uncertainty and $\epsilon_{i,t}$ is the stochastic error term.

In order to capture uncertainties related to economic outcomes, we added to the model a proxy variable for uncertainties related to economic outcomes, which does not consider uncertainties related to economic policy. This variable, which we call '*UNCERTAINTY*', is the residual series of the OLS regression in which the dependent variable is the Brazilian Economic Uncertainty Index[26] (called '*FGV*'), provided by IBRE FGV (Ferreira et al., 2019), and, the explanatory variable is the *EPU* proposed by Baker et al. (2016). Hence, to obtain the variable of economic uncertainty unrelated to economic policy (*UNCERTAINTY*) through the error term (μ), we run an OLS regression to the following model:

$$FGV_t = \delta_0 + \delta_1 EPU_t + \mu_t \quad (5)$$

After extracting the residual series which captures economic uncertainty unrelated to economic policy (*UNCERTAINTY*), we estimated the following econometric model:

$$PROVISIONS_{\mathrm{i},t} = \rho_0 + \rho_1 PROVISIONS_{\mathrm{i},t-1} + \rho_2 Z_{t-1} + \rho_3 UNCERTAINTY_{t-1} + \theta_{\mathrm{i},t} \quad (6)$$

where, i = 1, ..., 125 are the cross-sections (banks) and t = 1, ..., 32 is the period (quarterly). Z_{t-1} is the vector of the lagged control variables and $UNCERTAINTY_{t-1}$ accounts for the dynamic effect of the economic uncertainty and $\theta_{i,t}$ is the stochastic error term.

The results presented in tables 3 and 4 show positive and significant relationships between credit risk (*PROVISIONS*) and economic policy uncertainty (*EPU*) and economic uncertainty unrelated to economic policy (*UNCERTAINTY*). The economic uncertainty unrelated to economic policy variable (*UNCERTAINTY*) showed to be more impactful on *PROVISIONS* than the economic policy uncertainty variable (*EPU*), corroborating our previous findings. Regarding the results of the control variables, they are in agreement with the outcomes previously presented.

[26] This variable seeks to measure uncertainty related to the economy through media word count. The Brazilian Economic Uncertainty Indicator produced by the Getulio Vargas Foundation (FGV) is comprised of two component indicators: (1) Media Uncertainty Indicator, which is based on the frequency of articles mentioning economic uncertainty in high-circulation newspapers; and (2) Forecast Disagreement Uncertainty Indicator, which is based on the dispersion of market experts' forecasts.

Table 3 Effect of economic policy uncertainty (*EPU*) on credit risk (*PROVISIONS*)

	PROVISIONS	
Regressors	Model(1)	Model(2)
EPU(-1)	**0.002****	**0.002****
	(0.001)	(0.001)
CCRS(-1)	**-0.056***	
	(0.031)	
CCRL(-1)		**-0.019***
		0.010
COMMUNICATION(-1)	**-0.227*****	**-0.226*****
	(0.039)	(0.039)
GAP(-1)	**-0.00002*****	**-0.00002*****
	(0.000007)	(0.000007)
INTEREST RATE(-1)	**0.006**	**0.008**
	(0.227)	(0.227)
LIQUIDITY(-1)	**0.019*****	**0.019*****
	(0.004)	(0.004)
CREDIT(-1)	**-0.025**	**-0.025**
	(0.039)	(0.039)
NPL(-1)	**0.120*****	**0.120*****
	(0.012)	(0.012)
PROVISIONS(-1)	**0.601*****	**0.601*****
	(0.011)	(0.011)
Panel Observations	2660	2660
AR(1)	-0.43	-0.43
P-valor	0.000	0.000
AR(2)	0.014	0.014
P-valor	0.452	0.451
J-statistic	49.977	49.901
p-Value(J-statistic)	0.159	0.160
N. inst. / N. cross-sections	0.435	0.435

Note: Marginal significance levels: *** Denotes p<0.01; ** Denotes p<0.05; * Denotes p<0.1. The dependent variable is PROVISIONS; main independent variable of interest: EPU. White's heteroskedasticity consistent covariance matrix was applied in the regressions. Robust standard errors are in parentheses. S-GMM – uses two-step of Arellano and Bover (1995) without time period effects. Tests for AR(1) and AR(2) check for the presence of first-order and second order serial correlation in the first-difference residuals.

Table 4. Effect of uncertainties related to Brazil's economic outcomes (*UNCERTAINTY*) on credit risk (*PROVISIONS*)

	PROVISIONS	
Regressors	Model(1)	Model(2)
UNCERTAINTY(-1)	**0.050*****	**0.052*****
	(0.007)	(0.007)
CCRS(-1)	**-0.748*****	
	(0.117)	
CCRL(-1)		**-0.258*****
		(0.040)
COMMUNICATION(-1)	**0.028**	**0.049**
	(0.072)	(0.074)
GAP(-1)	**-0.00002****	**-0.00002****
	(0.000009)	(0.000009)
INTEREST RATE(-1)	**1.632*****	**1.613*****
	(0.320)	(0.324)
LIQUIDITY(-1)	**0.022*****	**0.022*****
	(0.006)	(0.006)
CREDIT(-1)	**-0.341*****	**-0.339*****
	(0.118)	(0.118)
NPL(-1)	**0.099*****	**0.096*****
	(0.020)	(0.020)
PROVISIONS(-1)	**0.429*****	**0.425*****
	(0.011)	(0.011)
Panel Observations	2705	2705
AR(1)	-0.403	-0.402
P-valor	0.000	0.000
AR(2)	0.009	0.009
P-valor	0.634	0.635
J-statistic	35.298	35.275
p-Value(J-statistic)	0.315	0.316
N. inst. / N. cross-sections	0.356	0.356

Note: Marginal significance levels: *** Denotes p<0.01; ** Denotes p<0.05; * Denotes p<0.1. The dependent variable is PROVISIONS; main independent variable of interest: UNCERTAINTY. White's heteroskedasticity consistent covariance matrix was applied in the regressions. Robust standard errors are in parentheses. S-GMM – uses two-step of Arellano and Bover (1995) without time period effects. Tests for AR(1) and AR(2) check for the presence of first-order and second order serial correlation in the first-difference residuals.

5. Conclusion

Changes in bank provisions reflect the perceptions of the banks regarding the risks involved in the lending process. In turn, the decision to withhold funds in the form of provisions to deal with potential loan losses is subject to the consequences of the lending process itself, as well as to the expectations regarding the macroeconomic environment and the conduct of economic policies. When the future behavior of a variable becomes more uncertain, the expectations formed for that variable tend to diverge, reflecting the greater unpredictability in relation to the future behavior of that variable and, therefore, a situation of greater risk. Therefore, this study analyzed the following assumption: once banks are risk-averse institutions, when disagreements in expectations about both economic policy instruments and economic outcomes increase, reflecting uncertainties about these variables, banks react according to their nature of being risk-averse institutions and increase loan loss provisions.

In this sense, the paper analyzed the relationship involving disagreements in expectations about different variables related to both economic outcomes and economic policy instruments and credit risk (represented by bank provisions). For this, the disagreements in expectations were divided into two groups, one related to economic outcomes, and the other to economic policy instruments. Particularly, the paper sought to identify which of these groups has the greatest effect on provisions, and more precisely, which of the disagreements in expectations has the greatest effect. In line with the objective of the paper and to give robustness to the results, we also estimated the models using uncertainty indicators instead of disagreements in expectations. To capture economic policy uncertainty, we made use of the EPU index for Brazil developed by Baker et al. (2016); and to represent the economic uncertainty unrelated to economic policy, we calculated a series running a regression where the dependent variable is the Brazilian Economic Uncertainty index, provided by IBRE FGV, and the explanatory variable is the EPU proposed by Baker et al. (2016). The residual series of this regression captures the economic uncertainty unrelated to economic policy.

Our findings bring the following implications: in addition to the banking sector being markedly procyclical, its risk aversion is evidenced as information asymmetries increase when expectations become more divergent. Estimates reveal that the disagreements in expectations related to Brazil's economic outcomes have a greater impact on banking provisions than those related to Brazil's economic policy instruments. Robustness analysis corroborates the findings, indicating that uncertainties affect credit risk and revealing that economic uncertainty unrelated to economic policy has a greater effect on bank provisions than economic policy uncertainty.

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Appendix

Table A1 List of Banks

ABC-BRASIL	BCO FORD S.A.	CAIXA GERAL
ALFA	BCO GERADOR S.A.	CITIBANK
BANCO AZTECA DO BRASIL S.A.	BCO GMAC S.A.	CREDIT AGRICOLE
BANCO BRACCE S.A.	BCO GUANABARA S.A.	CREDIT SUISSE
BANCO CNH INDUSTRIAL CAPITAL S.A	BCO INDUSCRED DE INVESTIM. S/A	DEUTSCHE
BANCO FIDIS	BCO KDB BRASIL S.A.	FATOR
BANCO IBM S.A.	BCO KEB DO BRASIL SA	GOLDMAN SACHS
BANCO MONEO S.A.	BCO LA NACION ARGENTINA	HONDA
BANCO PORTO REAL DE INVEST.S.A	BCO LA PROVINCIA B AIRES BCE	HSBC
BANCO RANDON S.A.	BCO LUSO BRASILEIRO S.A.	ICBC DO BRASIL BM S.A.
BANCO SEMEAR	BCO MAXINVEST S.A.	INDUSTRIAL DO BRASIL
BANCO TOPÁZIO S.A.	BCO MODAL S.A.	INDUSVAL
BANCO VIPAL	BCO POTTENCIAL S.A.	ING
BANCOOB	BCO RABOBANK INTL BRASIL S.A.	INTERMEDIUM
BANESTES	BCO REP ORIENTAL URUGUAY BCE	ITAU
BANIF	BCO RIBEIRAO PRETO S.A.	J.MALUCELLI
BANRISUL	BCO STANDARD INV S.A.	JOHN DEERE
BARCLAYS	BCO SUMITOMO MITSUI BRASIL S.A.	JP MORGAN CHASE
BANCO DO BRASIL	BCO TOKYO-MITSUBISHI BM S.A.	MÁXIMA
BBM	BCO TOYOTA DO BRASIL S.A.	MERCANTIL DO BRASIL
BCO A.J. RENNER S.A.	BCO TRIANGULO S.A.	MERCEDES-BENZ
BCO ABN AMRO S.A.	BCO TRICURY S.A.	MIZUHO
BCO ARBI S.A.	BCO VOLKSWAGEN S.A	MORGAN STANLEY
BCO BRJ S.A.	BCO VOLVO BRASIL S.A.	NATIXIS BRASIL S.A. BM
BCO CAPITAL S.A.	BCO WOORI BANK DO BRASIL S.A.	NOVO BCO CONTINENTAL S.A. - B
BCO CARGILL S.A.	BCO YAMAHA MOTOR S.A.	ORIGINAL
BCO CATERPILLAR S.A.	BD REGIONAL DO EXTREMO SUL	OURINVEST
BCO CEDULA S.A.	BES	PANAMERICANO
BCO COMMERCIAL INV. TRUST S.A.	BIC	PINE
BCO COOPERATIVO SICREDI S.A.	BMG	PSA FINANCE
BCO CSF S.A.	BNDES	RENDIMENTO
BCO DA AMAZONIA S.A.	BNP PARIBAS	RODOBENS
BCO DA CHINA BRASIL S.A.	BOFA MERRILL LYNCH	SAFRA
BCO DAYCOVAL S.A	BONSUCESSO	SANTANDER
BCO DE LAGE LANDEN BRASIL S.A.	BPN BRASIL BM S.A.	SCANIA BCO S.A.
BCO DES. DE MG S.A.	BR PARTNERS	SCOTIABANK BRASIL
BCO DES. DO ES S.A.	BRADESCO	SOCIETE GENERALE
BCO DO EST. DE SE S.A.	BRASIL PLURAL	SOCOPA
BCO DO EST. DO PA S.A.	BRB	SOFISA
BCO DO NORDESTE DO BRASIL S.A.	BROOKFIELD	VOTORANTIM
BCO FIBRA S.A.	BTG PACTUAL	VR
BCO FICSA S.A.	CAIXA ECONOMICA FEDERAL	

Table A2 CRAs sovereign credit ratings system, rating classification, and numerical scale

Numerical scale				Credit rating agencies		
Short	Long	Rating classification		S&P	Moody´	Fitch
22	58	Investment grade	Extremely strong capacity to meet financial commitments	AAA	Aaa	AAA
21	55			AA+	Aa1	AA+
20	52		Very strong capacity to meet financial commitments	AA	Aa2	AA
19	49			AA-	Aa3	AA-
18	46		Very strong capacity to meet financial commitments,	A+	A1	A+
17	43		but somewhat susceptible to adverse economic	A	A2	A
16	40		conditions and changes in circumstances	A-	A3	A-
15	37		Adequate capacity to meet financial commitments,	BBB+	Baa1	BBB+
14	34		but more subject to adverse economic conditions	BBB	Baa2	BBB
13	31			BBB-	Baa3	BBB-
12	28	Speculative grade	Less vulnerable in the near-term but faces major	BB+	Ba1	BB+
11	25		ongoing uncertainties to adverse business, financial	BB	Ba2	BB
10	22		and economic conditions	BB-	Ba3	BB-
9	19		More vulnerable to adverse business, financial and	B+	B1	B+
8	16		economic conditions but currently has the capacity to	B	B2	B
7	13		meet financial conditions	B-	B3	B-
6	10		Currently vulnerable and dependent on favorable	CCC+	Caa1	CCC+
5	7		business, financial and economic conditions to meet	CCC	Caa2	CCC
4	4		financial commitments	CCC-	Caa3	CCC-
3	1		Highly vulnerable; default has not yet ocurred, but is	CC	Ca	CC
2			expected to be a virtual certainty	C	C	C
1			Payment default on a financial commitment or breach	SD		RD
			of an imputed promise			D

Table A3 Credit signals and their numerical transformation

	Rating transformation		
Credit signals	Short	Long	Credit signal description
Positive credit watch	+0.25	+2	High likelihood of an upgrade in the short-term (up to 6 months)
Positive outlook	+0.25	+1	High likelihood of an upgrade in the medium or long-term (from 6 months to 2 years)
Stable credit watch	0	0	Neither an upgrade nor a downgrade is expected in the short-term (up to 6 months)
Stable outlook	0	0	Neither an upgrade nor a downgrade is expected in the medium or long-term (from 6 months to 2 years)
Negative outlook	-0.25	-1	High likelihood of a downgrade in the medium or long-term (from 6 months to 2 years)
Negative credit watch	-0.25	-2	High likelihood of a downgrade in the short-term (up to 6 months)

Table A4 List of instruments

Table 1. S-GMM estimates for the effects of uncertanties related to Brazil´s economic instruments of policy on credit risk (PROV)	
Model(1)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -4), GAP(-1 to -3), D(INTEREST RATE(-1)), D(CCRS(-1)), D(DISAG_EXCH(-2)), ROA(-1 to -3)
Model(2)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -4), GAP(-1 to -3), D(INTEREST RATE(-1)), D(CCRL(-1)), D(DISAG_EXCH(-2)), ROA(-1 to -3)
Model(3)	@DYN(PROVISIONS,-2,-4), COMMUNICATION(-1 to -4), GAP(-1 to -4), D(SELIC(-2)), D(LIQUIDITY(-1), CREDIT(-2 to -6), CCRS(-1 to -4), D(NPL(-2)), CDS_10(-1 to -2)
Model(4)	@DYN(PROVISIONS,-2,-4), COMMUNICATION(-1 to -4), GAP(-1 to -4), D(SELIC(-2)), D(LIQUIDITY(-1), CREDIT(-2 to -6), CCRS(-1 to -4), D(NPL(-2)), CDS_10(-1 to -2)
Model(5)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5Y(-1 to -3), D(SELIC(-3)), D(CCRS(-1), DISAG_SELIC(-1 to -4)
Model(6)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5Y(-1 to -3), D(SELIC(-3)), D(CCRS(-1), DISAG_SELIC(-1 to -4)
Table 2. S-GMM estimates for the effects of uncertanties related to Brazil´s economic results on credit risk (PROV)	
Model(1)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5Y(-1 to -3), D(SELIC(-3)), D(CCRS(-1)
Model(2)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5Y(-1 to -3), D(SELIC(-3)), D(CCRL(-1)
Model(3)	@DYN(PROVISIONS,-2,-4), D(CDS_10(-5)), COMMUNICATION (-1 to -3), GAP(-1 to -4), SELIC (-1 to -3), LIQUIDITY(-1), CCRS(-1), CREDIT(-1TO-3), DISAG_IPCA(-1 to -3)
Model(4)	@DYN(PROVISIONS,-2,-4), D(CDS_10(-5)), COMMUNICATION (-1 to -3), GAP(-1 to -4), SELIC (-1 to -3), LIQUIDITY(-1), CCRL(-1), CREDIT(-1TO-3), DISAG_IPCA(-1 to -3)
Model(5)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5(-1 to -3), D(SELIC(-3)), D(CCRS(-1))
Model(6)	@DYN(PROVISIONS,-2,-4), CDS_10(-1 to -2), GAP(-1 to -4), LIQUIDITY(-1), CDS_5(-1 to -3), D(SELIC(-3)), D(CCRS(-1))
Model(7)	@DYN(PROVISIONS,-2,-4), D(CDS_10(-5)), COMMUNICATION(-1 to -3), GAP(-1 to -4), INTEREST RATE(-1 to -2), LIQUIDITY(-1 to -4), CREDIT(-1 to -3), DISAG_IPCA(-1 to -3)
Model(8)	@DYN(PROVISIONS,-2,-4), D(CDS_10(-1)), COMMUNICATION(-1 to -3), GAP(-1 to -4), INTEREST RATE(-1 to -2), LIQUIDITY(-1 to -4), CREDIT(-1 to -3), DISAG_IPCA(-1 to -3)
Table 3. S-GMM estimates for the effects of uncertanties related to Brazil´s economic policy uncertainty on credit risk (PROV)	
Model(1)	@DYN(PROVISIONS,-2,-2), COMMUNICATION(-2), INTEREST RATE(-2 to -4), LIQUIDITY(-2 to -4), CREDIT(-2 to -4), CCRL(-2 to -4), NPL(-2 to -4), EPU(-2 to -6), D(BUFFER(-4))
Model(2)	@DYN(PROVISIONS,-2,-2), COMMUNICATION(-2), INTEREST RATE(-2 to -4), LIQUIDITY(-2 to -4), CREDIT(-2 to -4), CCRL(-2 to -4), NPL(-2 to -4), EPU(-2 to -6), D(BUFFER(-4))
Table 4. S-GMM estimates for the effects of uncertanties related to Brazil´s uncertainty index on credit risk (PROV)	
Model(1)	@DYN(PROVISIONS,-2,-2), GAP(-2), CDS_10(-2 to -6), CDS_5(-1 to -1), LIQUIDITY(-1 to -4), CREDIT(-2 to -3)
Model(2)	@DYN(PROVISIONS,-2,-2), GAP(-2), CDS_10(-2 to -6), CDS_5(-1 to -1), LIQUIDITY(-1 to -4), CREDIT(-2 to -3)

Table A5 Variables description, data sources, and descriptive statistics

Variable	Description	Data Source	Mean	Std. Dev.	Minimum	Maximum	Observations
PROVISIONS	Loan loss provisions/gross loan ratio	IEFA/CBB - devised by authors	5.47	8.424	0	100	3751
DISAG_EXCH	Disagreement in expectations about the Exchange rate	TSMS/CBB - devised by authors	-1.12E-15	1.919	-2.563	4.391	4375
DISAG_BUDGET	Disagreement in expectations about the Budget balance	TSMS/CBB - devised by authors	-3.30E-15	1.935	-1.414	10.386	4375
DISAG_SELIC	Disagreement in expectations about the Interest rate	TSMS/CBB - devised by authors	-4.36E-15	1.353	-2.474	3.067	4375
DISAG_DEBT	Disagreement in expectations about the Public Debt	TSMS/CBB - devised by authors	-3.55E-16	1.556	-3.62	3.73	4375
DISAG_IPCA	Disagreement in expectations about the Inflation	TSMS/CBB - devised by authors	-2.03E-16	1.644	-2.502	3.176	4375
DISAG_IPI	Disagreement in expectations about the Industry Growth	TSMS/CBB - devised by authors	-4.05E-16	1.744	-2.316	3.377	4375
DISAG_GDP	Disagreement in expectations about the Gross domestic product	TSMS/CBB - devised by authors	5.58E-15	1.345	-2.541	2.603	4375
GAP	Difference between GDP and potential output (Hamilton Filter)	TSMS/CBB and document "4382" | IGPM (IPEA DATA)	5335.691	3764.841	-4177.8	13382.85	4375
INTEREST RATE	Monetary policy interest rate	TSMS/CBB and document "4189" accumulated in the month in annual therms	0.865	0.175	0.547	1.333	4375
LIQUIDITY	Liquid assets/total assets ratio	IEFA/CBB - devised by authors	30.048	21.476	0.01	100	3901
CREDIT	Credit growth rate	IEFA/CBB – devised by authors	0.208	5.083	-1	255.905	3602
COMMUNICATION	Macroprudential communication time variant – result of the classification of the CBB's expectation in relation to the credit market	Inflation report/CBB - devised by authors	0.514	0.603	-1	1	4375
CDS_5	Five-year Credit Default Swaps	Bloomberg Database	148.243	52.123	75.833	325.257	4375
CDS_10	Ten-year Credit Default Swaps	Bloomberg Database	189.626	52.92	108.92	352.686	4375
NPL	Nonperforming loan /total loans ratio	IEFA/CBB and document "7019 Balance Sheet" – devised by authors	5.893	8.14	0	100	3764
BUFFER	Difference between the capital of financial institutions and the minimum capital required by regulators (Basel index)	CBB- 50 Iargest banks - devised by authors	3.125	5.164	-2.381	86.259	3884
ROA	Net income/total assets ratio	IEFA/CBB - devised by authors	0.759	2.806	-49.66	24.95	3843

Notes: IEFA/CBB – Information for Economic-Financial Analysis/Central Bank of Brazil. TSMS – Time Series Management System.