11th Biennial IFC Conference on "Post-pandemic landscape for central bank statistics"

BIS Basel, 25-26 August 2022

The impact of central bank interventions on non-performing loans under Covid-19 pandemic – The United Kingdom and Brazilian Study Case[1]

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[1] This presentation was prepared for the conference. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

The Impact of Central Bank Interventions on Non-Performing Loans Under the COVID-19 Pandemic

The United Kingdom and Brazilian Study Case

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Abstract: This paper aims to assess the impact of the Central Bank's monetary policies implemented to minimise the effect caused by the COVID-19 Pandemic on the Credit Lending environment. Those policies are reflected in many economic variables, including the number of non-performing loans rate. Thus, this work can be defined as a quantitative case study using the Ordinary Least Squares (OLS) methodology to evaluate the British and Brazilian banks' NPL behaviour from a macroeconomic perspective and assess government interventions and the economic' response. The work concludes that implementing a conventional macroeconomic policy parallels quantitative easing that positively influences the Brazilian economy. The outcome from the model developed is consistent with what is observed in other countries; estimating the trajectories and levels with a certain confidence level throughout the NPL time series is possible.

Keywords: Banking, Credit Risk, IFRS 9, Non-Performing Loan, COVID-19.

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Introduction

Default probabilities are essentially compelled by how companies are tied to economic, domestic and foreign cycles and how they are linked to their business conditions (Pesaran et al., 2006). Thus, regulators have implemented macroeconomic and credit-specific factors in forecasting default since numerous studies have explored the benefits of dynamic factor analysis in credit risk modelling. Basel Accords for Unexpected Loss Estimation and IFRS 9 and CECL for Expected Loan Loss are good examples of how exogenous factors can be modelled to predict default.

Those two international specifications were the regulator's response to the global Financial Crisis (GFC) of 2007 - 2009. Basel III (Basel Committee on Banking Supervision 2010) corresponds to the regulatory capital banks should hold to absorb the unexpected loss. IFRS 9 (International Accounting Standards Board 2014) and the Current Expected Credit Losses (CECL), the two international accounting standards, drive banks to adopt a forward-looking approach to calculating their expected loss using macroeconomic factors.

The countries can use tools to manage their financial systems and their monetary policies. It can vary from country to country, and as expected, there are individual contrasts specific to the Brazilian and British economies, which the Central Bank led. The most common actions to manage monetary policy objectives are modifying the interest rate, buying and selling government bonds, regulating foreign exchange rates, and changing the number of money banks must maintain as reserves (Domanski, Kohlscheen, and Moreno 2016). However, actions should be more robust during a global recession, as observed during the COVID-19 Pandemic.

The economic dynamics are a significant driver of the evolution of arrears in the pool of loans granted to non-financial companies or individuals, followed by the financial pressure induced by the monetary conditions. However, lending allows companies and householders to provide resources for investment projects or debt repayments. Thus, the lending policy's role in commercial banks' exercise is essential, as it may impact the cost of credits and the loan portfolio quality. However, governmental intervention can drive how financial institutions design their lending policy during deep recessions, promoting economic reaction.

Central Bank Mandates and Early Response to the Covid-19

Central Banks have as their primary objective financial stability or stability in the value of their currency. The Macroeconomic theory argues that the best way to keep inflation under control is to give the responsibility to set monetary policy to an independent central bank (Castillo-Martinez, 2019). However, monetary policy decisions are implemented quite differently in different countries, and the level of development of their economies is a significant factor for implementation.

Financial institutions provide essential services to the real economy, such as deposits and lending, for retail and commercial purposes. However, during a deep recession, it is common to see an increase in unemployment and a reduction in consumption and output, causing a natural deflation. Thus, once the COVID-19 Pandemic started, the Brazilian Central Bank (BCB) and the Bank of England (BoE) and most of their global peers intervened in the economy to avoid the deflation trap and preserve jobs.

The GFC, followed by quantitative easing by major central banks, slow growth in European economies, and a growing recognition of social inequality, has led some observers to argue for changes to central bank mandates. The more orthodox notes that controlling inflation was insufficient to prevent the GFC. That line of debate leads to discussions concerning a central bank's role in financial stability, its potential use of macroprudential tools and whether it should be the prudential Supervisor. However, the reaction to COVID-19 utilising further quantitative easing was essential for the Central banks to deliver the expected financial stability.

Table 1 below shows the critical social-economic differences between Brazil and the United Kingdom, which is considered a developed economy, while Brazil is a developing economy.

Key Metrics Brazil Vs. United Kingdom (2020) Table 1

Metric (2020)	Brazil	United Kingdom
Unemployment rate:	13.7%	3.7%
Base Rate:	4.5%	0.8%
Inflation Rate:	3.2%	1.0%
Cost of Living: (USA = 100%)	49.8%	95.5%
Commercial taxes and contributions:	65.1%	30.6%
GDP per capita	6,970 US$	40,320 US$
GDP (current US$)	$ 1449 bi	$ 2700 bi
Government debt (% of GDP):	92.0%	104.0%
Government debt (% of GDP):	88.0%	103.0%
IMF Financial Development Index (Rank)	20	5

Source: World Bank Data

The Response to the Covid-19 Bank of England and Brazilian Central Bank

The policymakers reduced bank exposure to liquidity, solvency, and financial stabilisation issues. The approach used by the BCB and the BoE to put in place an effective crisis management regime was based on four main aspects:

- **Supervision** - Early intervention involves the Supervisor's ability and willingness to act early in problem banks cases, in which predictive actions can be applied.
- **Resolution** - The power to apply measures that minimise stability risks for the rest of the system at the minimum cost while protecting assets' value.
- **Deposit Insurance** - Provides certainty to small depositors, mitigating the risk of runs and contagion to similar institutions.
- **Emergency Liquidity Assistance** - The provision of emergency liquidity, on a bilateral basis, to solvent banks to preserve financial stability.

The BCB implemented changes through conventional monetary policy; however, the policymakers also called for unprecedented unconventional monetary policy measures (or Quantitative Easing) due to the severity of the crisis. The section below summarises the list of actions taken by the BCB in response to the COVID-19 Economic crisis.

Liquidity Measures

The Brazilian Central Bank dealt with seizing the money markets by providing liquidity to the Brazilian banking system. These measures imply a potential expansion in the system liquidity of BRL 1,217 bn, amounting to about 16.7% of GDP.

BCB Liquidity Support — Table 2

Support Measure	Support Value	
	BRL (bn)	** USD (bn) range
Loans backed by L.F. guaranteed by credit operations	670	122-149
New Term Deposit with Special Guarantees - DPGE	200	36 - 44
Reduction in reserve requirement ratio on time deposits (from 31% to 25%) and Regulation enhancement on Liquidity Coverage Ratio (LCR)	135	25-30
Loans backed by debentures	91	17-20
Additional reduction in reserve requirement ratio on time deposits (from 25% to 17%)	70.00	13-16
Change on reserve requirement on savings deposits	55,8	44905
One-year term repurchase backed by federal securities	50	44874
More flexibility on LCA regulation	2,2	0.4 - 0.5
Total	1.274,00	232 - 283
Total as a % Of GDP*	17,50%	

* As a percentage of the 2019 Brazilian GDP.

**F.X. range: from BRL 4.5/USD to BRL 5.5/USD, given the high uncertainty.

Sources: BCB 2020

The Bank of England focused on reducing the Bank Rates and a New Term Funding Scheme and applied similar measures to the Central Bank of Brazil.

BoE Liquidity Support — Table 3

Support Measure	Description	Support Value
Bank rate	A reduction of the Bank Rate by 50 basis points	0.25%
Term Funding Scheme	provide funding for a term of four years of at least 5% of market participants' real economy lending stock at rates equal to, or around, the Bank Rate	£5 of funding for every £1 of positive net-lending to SMEs
Bond Purchases	Maintenance of the BOE's stock of sterling non-financial investment-grade corporate bond purchases (valued at £10 billion) and government bond purchases (valued at £435 billion)	£ 445 billion
Mortgage holidays	Mortgage providers will grant three-month mortgage holidays	N/A
SME loans	provide loans of up to £5 million to SMEs, with no interest due for the first six months.	£79 billion

Source: Bank of England

Capital Measures

Financial institutions may face losses after the COVID-19 crisis. BCB adjusted the regulation on capital requirements to provide financial institutions with better conditions to sustain credit flow. These measures can increase credit supply by BRL 1,197 billion, amounting to about 16.4% of GDP.

BCB Capital Relief — Table 4

Support Measure	Support Value	
	BRL (bn)	** USD (bn) range
Reduction of ACP factor (from 2.5% to 1.25%)	637	116-142
Overedge of investments (tax effects)	520	95-116
Reduction in the capital requirement for credit operations for SMEs	35	6.4- 7.8
Temporary reduction of capital requirement for smaller financial institutions	16,5	3.0 - 3.7
Reduction of capital requirement on DPGE exposures	12,7	2.3 - 2.8
Working Capital Program to preserve business continuity (CGPE)	127.00	23 -28
Total	1.348,20	245 - 300
% of GDP*	16,70%	

* As a percentage of the 2019 Brazilian GDP.

**F.X. range: from BRL 4.5/USD to BRL 5.5/USD, given the high uncertainty.

Sources: BCB

Other Measures

BCB implemented some regulatory changes to facilitate the application and acceptance of Credit Facilities for householders and corporates.

BCB Other Measures — Table 5

Support Measure	Support Value	
	BRL (bn) *	** USD (bn) range
Swap lines with U.S. Federal Reserve	637	116-142
Creation of a unique credit line for SMEs (PESE)	520	95-116
Real estate-backed loans	35	6.4- 7.8
Purchase of private securities by BCB in the secondary market	16,5	3.0 - 3.7

* As a percentage of the 2019 Brazilian GDP.

**F.X. range: from BRL 4.5/USD to BRL 5.5/USD, given the high uncertainty.

Sources: BCB

The BoE has also applied some supervisory measures to reduce the pressure on banks and allow the institutions to provide customers with financial support via supervisory actions.

BoE Supervision Support — Table 6

Support Measure	Description
investigation of open-ended funds	suspended until further notice
Non-critical obligations	on site-visits and deadlines for firms and FMIs that are not critically postponed
Senior Management Function	They are easing the review of applications for Senior Management Functions to reduce regulatory burdens.

Source: Bank of England

The effectiveness of those monetary policies in the economy has an immediate effect, and it can be crucial to define the recovery from the crisis. Thus, the Central Bank's primary goal is to preserve jobs and maintain financial stability. Those policies are reflected in many economic variables, including the number of non-performing loans.

Non-Performing Loans (NPL)

Most of the published papers prove the high correlation between the macroeconomic environment and the non-performing loan rate, constating that default rates rise once the economy starts a downturn, and the expected loss amount, commonly called provisions, also tends to increase. It is not different in Brazil and the United Kingdom.

Graph 1 shows that NPL levels and provisions follow the same trend. However, since the Pandemic began, NPL loans have been reduced. However, credit loss provision rates have increased, which is not natural behaviour and can be explained by the macroprudential rules adopted by the BCB.

Provision and NPL Ratios - March 2011 to January 2021 (Source: BCB) — Graph 1

The ratio between the NPL and the provision of the Brazilian banking system, shown in Graph 1, makes this gap between the perception of risk and the NPL clearer. The forward-looking component and the uncertainty about the pandemic outcome drive these abnormal behaviours.

In this context, this paper aims to evaluate the NPL behaviour of Brazilian banks from a macroeconomic perspective and clarify the behaviour of NPL in the COVID-19 Pandemic.

In addition to this introduction, this work has four sections. In the literature review, a general context about NPL modelling is sought. The methodology describes the steps followed to achieve the objective of this work. The result and analysis show the developed models. In conclusion, there are the main findings, limitations, and future work.

A similar comparison for the British banking sector could not be performed due to the lack of information from the BoE or other official entities.

Literature Review

Since the global financial crisis (GFC) 2007 -2009, there has been an evolution concerning the guidelines for managing credit portfolios. The two most recent international requirements, IFRS 9, CECL and Basel III, also resulted from the recession. Equally to the GFC, the COVID-19 Pandemic produced reflections on the adequacy of the current methodologies adopted and opened an international discussion on possible improvements to the existing instruments; This is the topic for the following section.

Credit Risk during the COVID-19 Pandemic

All countries that have taken measures to reduce the adverse effects caused by the COVID-19 Pandemic, particularly by monetary policies adopted by their respective central banks, such as the European Central Bank (ECB) and the Federal Reserve (FED), observed some positive outcomes from those actions (Teresienė, Keliuotytė-staniulėnienė, and Kanapickienė 2021). The authors used panel data regression to estimate this paper's main factors influencing long-term loans. As a result, the effects of the COVID-19 Pandemic on financial stability by increasing liquidity and reducing profitability and the banking sector solvency.

(Acharya and Steffen 2020) They conducted a study to investigate the effect of credit risk on the Bank's liquidity during the COVID-19 Pandemic, using a sample of American companies with financial variables available in Capital I.Q. The authors highlight the significant impact of credit risk on financial institutions' liquidity in this period.

(Gubareva 2020) assessed the effects of the COVID-19 Pandemic, specifically on the liquidity of emerging market securities. In this case, the protection of companies in the financial sector is more resistant to liquidity shocks, associating this situation with the lack of legislation in non-financial companies. However, the author highlights the slow recovery of credit spreads to pre-crisis levels due to increased credit risk from COVID-19.

As discussed in previous sections, the outcome of central banks and governments' actions to contain the negative impacts of COVID-19 has been lectured in recent works and evaluated the Pandemic's effect on Small and Medium Enterprises (SMEs). (Corredera-Catalán, di Pietro, and Trujillo-Ponce 2021) They observed the credit quality and the Spanish guaranteed system's effectiveness on

portfolio evaluation. The authors stated that one way of addressing SMEs' vulnerabilities might be through Mutual Guarantee Systems (MSGs), which guarantee access to financing with credit risk mitigation providing less impact on the public budget.

Those collaterals' disposition to SMEs leading is essential to provide the necessary cash to guarantee these companies' continuance amid social distance and lock-down measures during hibernation (Didier et al., 2021). There were measures to make labour relations more flexible in Brazil and provide greater credit access to help SMEs during the COVID-19 Pandemic (Central Bank of Brazil 2020).

In the context of the COVID-19 pandemic emergency, effective crisis resolution in banks is critical to avoiding adverse effects during this period, mainly due to the significant increase in NPL caused by the borrower's repayment capacity (Bodellini and Lintner 2020). The COVID-19 pandemic's effect on the NPL was discussed by (Hardiyanti and Aziz 2021); modelling a simple regression, the authors concluded the impact of COVID-19 on commercial banks' NPL in Indonesia.

Going beyond the simple NPL hypothesis assessment, as in the paper by (Hardiyanti and Aziz 2021), other studies identified factors connected with NPL and econometric methods. That research could quantify the factors' significance in predicting the NPL, a subject addressed in the following subsection.

Non-Performing Loan Modelling

Even before the 2007-2009 crisis and the consequent improvements incorporated into the risk management and credit risk quantification mechanisms due to the recession, NPL modelling was already a way of understanding the economy. (Chang et al. 2008) conducted a study on the relationship between the Brazilian NPL and credit concentration. Using a panel data approach, the authors identified a significant effect of banking concentration on the NPL.

As shown in Figure 1: Provision and NPL Percentage Series - March 2011 to January 2021 (Central Bank of Brazil), the theme became more popular after the global economic crisis, and financial institutions and their regulators recognised the need to understand these relationships. (Louzis, Vouldis, and Metaxas 2012) Lists macroeconomic variables such as GDP, unemployment, interest rate and public debt, and the bank-specific information among NPL. (Messai and Jouini 2013) Brought a similar approach with the use of information from banks in European countries (Italy, Greece and Spain), finding hostile relations between the NPL and GDP and a positive with the unemployment rate and the real interest rate of the economy, among similar results from (Makri, Tsagkanos, and Bellas 2014), (Chaibi and Ftiti 2015). (Bholat et al., 2018) Furthermore, (Bolognesi et al. 2020) started discussions and brought reflection, including the IFRS 9 perspective.

Ordinary Least Squares (OLS) Models on Credit Risk

The Ordinary Least Squares (OLS) estimator is, according to (Hayashi 2011), the most straightforward econometric procedure but with properties that make it applicable to different sample sizes. The use of this approach for modelling NPL and aggregate levels. Table 7 shows papers published in that context during the last ten years.

Studies Using OLS for NPL Modelling Table 7

Reference Material	Period	Reference Title
Pakistan financial sector	1999 - 2009	(Ahmad, Abbas, and Bashir, 2013)
Ukrainian banking system	2008 - 2016	(Vasilyeva, Sysoyeva, and Vysochyna 2016)
Italian Banking System	2005 - 2013	(Cucinelli 2016)
Japan Commercial Banks	1990 - 2013	(Vithessonthi 2016)
U.S. banking industry	1984 - 2016	(Ghosh 2017)
Financial Institutions Sample	2000 - 2013	(Kumar et al., 2018,)
Euro Area Banks	2003 - 2016	(Anastasiou, Louri, and Tsionas 2019)
GCC Countries	1998 - 2016	(Abdelbaki 2019)
BRICs	2000 - 2016	(Syed and Tripathi, 2019)
Six South East Asian Countries	2004 - 2018	(Tran and Nguyen 2020)
Vietnam Banks	2008 - 2017	(Dao et al., 2020)
UAE countries	2008 - 2016	(Jreisat 2020)

This paper aims to evaluate the NPL behaviour of the British and Brazilian banks from a macroeconomic perspective. NPL factors were assessed using The Ordinary Least Squares methodology in this context. The following section sets out the steps followed to meet the proposed objective.

Methodology

This paper can be characterised as a case study with a quantitative approach. In summary, the steps taken to achieve the objective of this research can be defined as follows:

Exploratory data analysis: The time series' trends, characteristics and the selection of an econometric model were analysed.

Econometric Modelling: To assess the factors influencing NPL in the Brazilian banking sector.

Projections and comparisons: to verify the differences between the series projected by the econometric model developed and those observed after the policy measures to minimise the economic impacts of COVID-19.

For this work's graphic representation, Matplotlib (Hunter 2007) and the applications of tests and econometric models, EViews were used[1].

[1] EViews12 Student Version Lite, IHS Global Inc., Irvine, CA, USA

Data and Scope

The data used in this work were obtained from the Time Series Management System (Central Bank of Brazil n.d.), where BCB stores aggregated information regarding credit-related data in Brazil and information on economic activity and monetary policy, among others.

The data used for the United Kingdom information was extracted from the Bank of England MLAR Statistics Report in conjunction with the Financial Conduct Authority (FCA) and considered all the Residential loans to individuals: Regulated and Non-regulated accounts information.

The NPL time series used in this work comprises the total balance of credits in default over 90 days on the total credit balance amount. The NPL series are available monthly from March 2011 to February 2021. The Gross Domestic Product (GDP) data are granted quarterly in most NPL modelling works. Thus, the projections adopted a quarterly-based period for econometric modelling, covering from 2011Q2 to 2019Q4. However, the projections data were based on data from 2020Q1 to 2020Q4.

The data for modelling was selected for econometric techniques given the need for interpretation and consistency of each macroeconomic factor—the results and effects in the series and the predominance of these methods in NPL modelling studies.

Exploratory Analysis and Econometric Modelling

The exploratory analysis was conducted to verify the time series' characteristics to choose the most appropriate modelling methodology. The time series variables were evaluated to assess the collinearity and their stationarity. For the assessment of correlation, the Johansen test was used. For stationarity, the Augmented Dickey-Fuller (ADF), Phillips-Perron (P.P.) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests (KPSS) were applied (Hayashi 2011).

These results enabled identifying the most appropriate variables for modelling using the OLS econometric approach. It was considered only the most functional macroeconomic characteristics, and the consistency of the model's parameters was analysed, following the macroeconomic theory. The results obtained in the tests and the modelling are described in more detail in the following section.

Results and Analysis

The hypotheses regarding the variables used to develop the models in this work were based on the literature's best usage. The input was the seasonal adjusted GDP growth, actual interest rate (Selic) and unemployment rate provided by the BCB (Central Bank of Brazil n.d.). This last variable was necessary to apply seasonality adjustment using the R language (R Core Team 2020).

Model Development

Table 8 presents the champion model used for the Brazilian Central Bank, and it brings the results of the tests using the most significative variables and the p-value on the relationship between each independent and dependent variable.

OLS Champion Model Equation (Brazil) Table 8

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0	0.02	-0.25	0.8
GDP Growth	-3.94	0.77	-5.09	0
D_NPLm $_{(-1)}$	0.65	0.08	7.7	0
D_rselic$_{(-1)}$	0.04	0.02	1.96	0.06
DUMMY	-0.27	0.08	-3.41	0

Where the NPL stands for non-performing loan, Selic stands for Real Federal securities interest rate, and U.R. stands for Unemployment rate season corrected.

This result suggests that, in this period, other factors are not captured in the variables that impacted NPL, which can be interpreted as the result of actions to contain the impacts of the COVID-19 Pandemic on NPL.

Model Measure - OLS Champion Model (Brazil) Table 9

Model Measurement Criteria	Coefficient	Calculation Method	Prob.
R-squared	0.78	Mean dependent var	-0.05
Adjusted R-squared	0.76	S.D. dependent var	0.21
S.E. of regression	0.1	Akaike info criterion	-1.55
Sum squared residual	0.35	Schwarz criterion	-1.33
Log-likelihood	33.65	Hannan-Quinn criteria.	-1.47
F-statistic	28.83	Durbin-Watson stat	1.97
Prob(F-statistic)	4.28	Breusch-Godfrey - LM 4 lags	0.78

The tests applied to the residuals generated by model two indicate the absence of autocorrelation. All the independent variables' importance can be considered significant at the level of significance of 10%. Thus. Model two will be considered for the following projections and evaluations because of the residues' best diagnostic results.

OLS Champion Model Equation (UK) Table 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YoY GDP Growth	0.0005	0.00017	2.8	0.0085
Employment and Unemployment Hazard Ratio	0.638	0.04	14.7	0
Real Disposable Income	-0.00089	0.000265	-3.3	0.0019

Analog to the results presented above on the Brazilian case, the methodology was applied to the United Kingdom data. The best model tested was selected to represent the forward-looking perspective on Non-performing loans in the British economy. Table 10 shows the results of the model and table 11 the Model Measures.

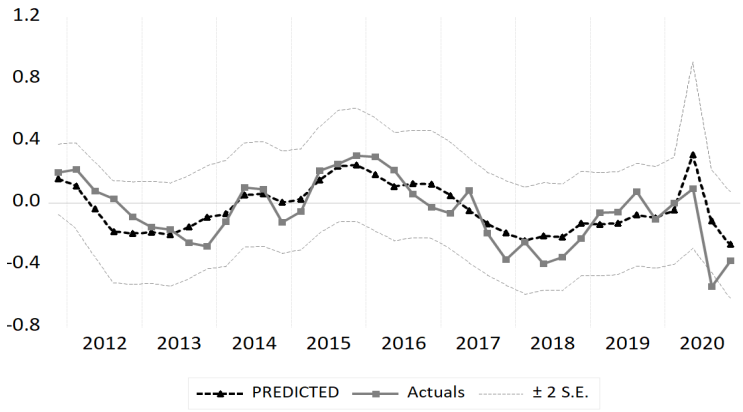
Model Measure - OLS Champion Model (UK) Table 11

Model Measurement Criteria	Coefficient	Calculation Method	Prob.
R-squared	0.88	Mean dependent var	0.25
Adjusted R-squared	0.87	S.D. dependent var	0.19
S.E. of regression	0.07	Akaike info criterion	-2.34
Sum squared residual	0.17	Schwarz criterion	-2.2
Log-likelihood	45.05	Hannan-Quinn criteria.	-2.29
Durbin-Watson stat	1.69		

NPL Forecast and Discussion

After evaluating the factors related to the NPL series before the impacts of the COVID-19 Pandemic in Brazil and the UK, the projections for 2020 aim to assess the NPL trend explained by the independent variables (GDP and interest rate). Graph 2 and 3 shows the dynamic estimates of the NPL variation made in the model compared to the observed values, in addition to the confidence intervals calculated with two standard errors.

Comparison Between Predicted and Actual Values Differences in NPL (Brazil) Graph 2



Comparison Between Predicted and Actual Values Differences in NPL (UK) Graph 3

It is essential to highlight the 2020Q1 period when the measures to contain the coronavirus's spread and the economic actions to prevent its effects on the economy started in March 2020. This quarter has a minor impact compared to the others regarding the results of the macroeconomic variables that sustain the model. Two critical movements should be highlighted: a reduction in the real Selic rate and two significant variations in GDP, with a considerable contraction in 2020Q2. A substantial recovery followed them in 2020Q3. These results are reflected in an increase in the NPL gap in 2020Q2 and a sharp reduction in 2020Q3.

It is possible to notice that during the entire period before the COVID-19 Pandemic, the model's estimates were close to the observed values projected from the factors that affect the NPL. It is noted that in 2020Q1. The comparative calculations can be attributed to the brief period affected by the pandemic scenario. 2020Q2, a period with a Zero Lower Bound (ZLB), follows a decreasing trajectory with the most significant GDP contraction in the historical series. There is a similar trajectory comparing the estimated and the observed value. However, the NPL variation estimate is more exacerbated than the empirical. It is within the interval of two standard errors.

In 2020Q3, the GDP recovery and the Selic trend reduced NPL. Thus, based on the relationship between the variables observed in the available historical series, the estimate is outside the confidence interval constructed from the standard error for the first time in the period. Finally, it is noted that there is a reduction in magnitude outside the observed pattern.

Another relevant movement is that observed in 2020Q4. The model estimates a rare moment of inversion of the observed trajectory by considering the significant effect of the lag of the response variable. The estimated model's expected outcome would be a drop, while a positive variation of the NPL was observed.

This result suggests that, in this period, other factors are not captured in the variables that impacted NPL, which can be interpreted as the result of actions to contain the impacts of the COVID-19 Pandemic on NPL.

Conclusions

This study aimed to assess the factors related to NPL in the British and Brazilian banking systems and the behaviours expected during the COVID-19 Pandemic. Several measures to contain the negative impacts on the economy and credit have been adopted by central banks worldwide.

It is possible to conclude that there is a positive influence on the real interest rate and a negative one between GDP over NPL and the lag of the dependent variable itself. These relationships make it possible to estimate the trajectories and levels with a certain confidence level throughout the NPL time series.

Considering the relationships' estimation between the variables, a movement was out of the pattern observed in the rest of the series. It becomes robust in the period of solid GDP recovery. This result may indicate additional factors to the model influencing the curves, resulting from direct actions to reduce the impact on the credit circumstance.

It induces that the NPL observed in 2020 impacts the measures adopted to control the Pandemic. It is important to note that an increase below the expected by the model in 2020Q2 and a sharp reduction in 2020Q3 beyond the confidence interval of the model estimate in 2020Q4 when part of the measures to contain the Pandemic ceased to be in force. There was a trajectory reversal and compensation for the sharp drop beyond what was predicted in the previous movement.

Because of the current scenario, the authorities and banks must analyse this situation with caution, given the continuity of the Pandemic's effects in Brazil and the smaller scope for applying similar measures and include some new factors such as the current geopolitical risk, the global rise in inflation and current political environment.

There are limitations in this work that are important to mention. The projected results start from a premise of adequate model adjustment for the presented comparisons. However, they may indicate the model's calibration in an out-of-period and outside the modelling space for some independent variables. Relationships in similar directions to other literature works may minimise these relationships. Nevertheless, the magnitude of the estimated effect is different.

Updating the model with new periods to minimise these limitations are alternative for future work. Concluding, using variables related to the Pandemic and more robust models considering Brazilian and British regional data and panel data is a suggested exercise.

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The Impact of Central Bank Interventions on Non-Performing Loans Under COVID-19 Pandemic

The United Kingdom and Brazilian Study Case.

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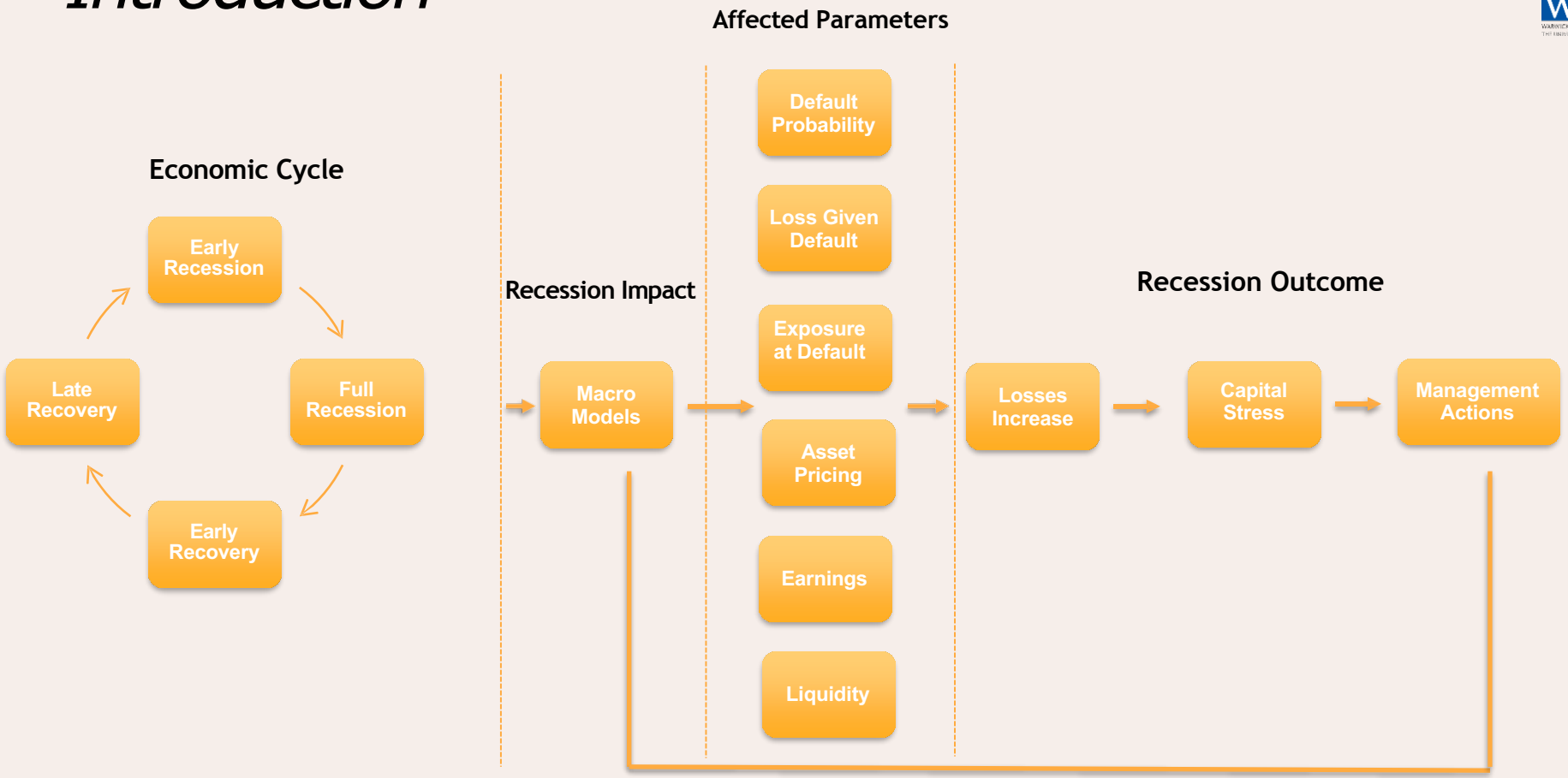
Objectives

Assess the **impact** of the Bank of England (BoE) and the Brazilian Central Bank's (BSB) **monetary policies** implemented to minimise the effect caused by the Covid-19 pandemic on the country's **Non-Performing Loans**.

Non-Performing Loans: is a bank asset that is subject to late repayment or is unlikely to be repaid by the borrower in full.

*"Non-performing loans represent a major challenge for the banking sector, as it **reduces the profitability** of banks and is often presented as **preventing banks from lending** more to businesses and consumers, **slowing down economic growth**."*

Introduction



Actions are taken by the BoE and BCB in response to the Covid-19 Economic crisis.

Brazilian Central Bank

1. **Liquidity Support**
- Offer to Commercial banks and building societies long-term funding.
2. **Capital Relief** – BCB adjusted the regulation on capital requirements to provide financial institutions with better conditions to sustain credit flow.
3. **Regulatory changes** to facilitate the application and acceptance of credit facilities for householders and corporates.

Bank of England

1. **Monetary Policy** – Cut our interest rate to 0.1%
2. **Liquidity Support**:
- Offer to Commercial banks and building societies long-term funding.
- Helped businesses pay their staff and suppliers.
3. **Capital Relief** – Helped banks to expand lending

Methodology

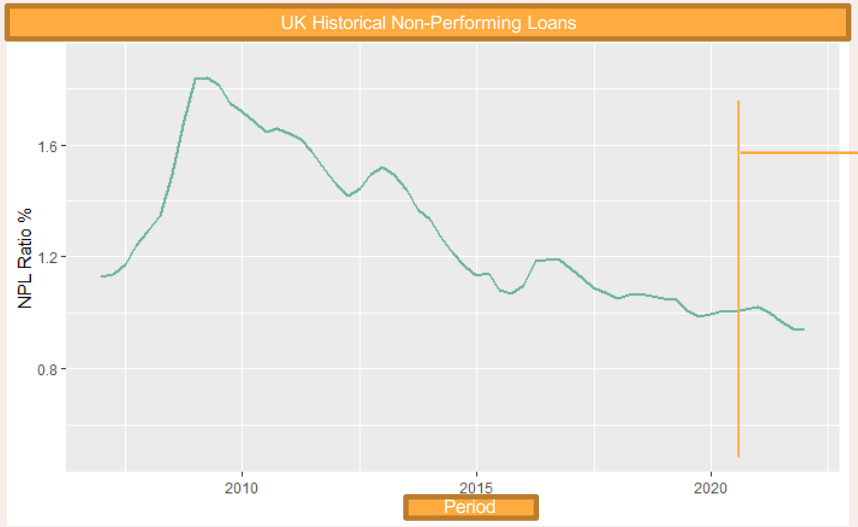
- The steps taken to achieve the objective of this research can be defined as follows:
  - **Exploratory data analysis**: the time series' trends, characteristics and the selection of an econometric model were analysed.
  - **Econometric Modelling**: to assess the factors influencing NPL in the British and Brazilian banking sectors.
  - **Projections and comparisons**: to verify the differences between the series projected by the econometric model developed and those observed after the policy measures to minimise the economic impacts of COVID-19.

Data and Scope

- Econometric modelling: 2007Q2 to 2019Q4
  - UK: Exploring 25 Variables to predict Non-Performing Ratio over time. (Source ONS and BoE)
  - Brazil: Exploring 35 Variables to predict Non-Performing Ratio over time. (SFN Bacen)
- The NPL time series used in this work comprises the total outstanding balance of credits with 90 days in arrears on the total credit balance amount.
- Projection data: 2020Q1 to 2021Q4.

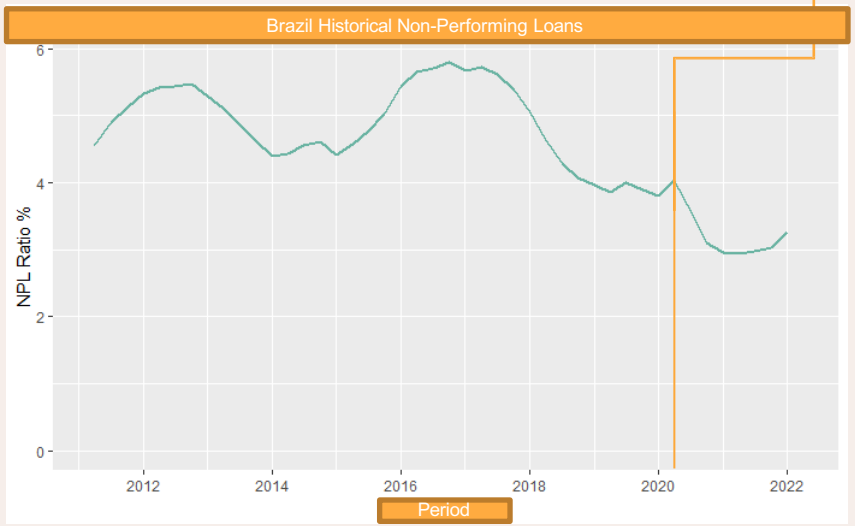
Non-Performing Loans (NPL)

Provision and NPL Percentage Series - Mar 2007 to Jan 2021



Source: Financial Conduct Authority. n.d. "Mortgage Lending and Administration Return" Accessed November 28. 2021.

Covid outbreak – March 2020



Source: Central Bank of Brazil. n.d. "Time Series Management System." Accessed November 28. 2021.

Model Results

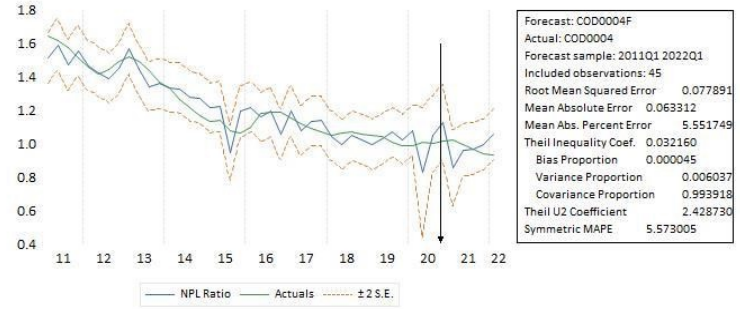
United Kingdom

- YoY GDP – Annualised GDP Growth
- UR Hazard – UK: Hazard Rates: Employment to Unemployment (SA, %)
- Real Disp. Income – Household real disposable income

Variable	Coefficient	Std. Error	t-Statistic	Prob.
YoY GOD	4.94E-06	1.77E-06	2.796809	0.0085
UR: Hazard	0.638709	0.043372	14.72643	0.0000
Real Disp. Income	-8.92E-06	2.65E-06	-3.370723	0.0019

R-squared	0.876323	Mean dependent var	0.245444
Adjusted R-squared	0.868828	S.D. dependent var	0.199620
S.E. of regression	0.072298	Akaike info criterion	-2.336387
Sum squared resid	0.172491	Schwarz criterion	-2.204427
Log likelihood	45.05496	Hannan-Quinn criter.	-2.290329
Durbin-Watson stat	1.685265		

Comparison (C.I.) Between Predicted and Actual Values Differences in



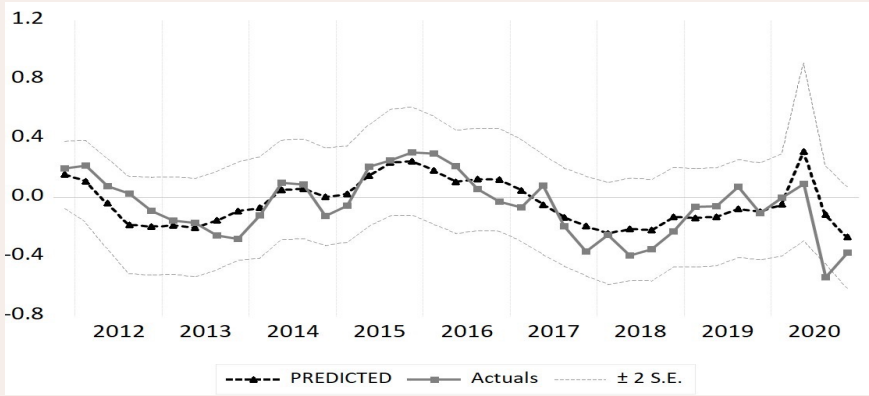
Brazil

- NPL – Non-Performing Loans
- GDP – Seasonally adjusted GDP growth
- SELIC – Real interest rate (Selic)
- UR – Seasonality adjustment Unemployment Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0080	0.0186	-0.4303	0.6702
GDP Growth	-39.783	21.160	-18.801	0.0702
D_NPLm (-1)	0.7071	0.0934	75.676	0.0000
D_RSELIC(-1)	0.0520	0.0256	20.326	0.0513

R-squared	0.7427	Mean dependent var	-0.0341
Adjusted R-squared	0.7161	S.D. dependent var	0.1970
S.E. of regression	0.1050	Akaike info criterion	-15.568
Sum squared resid	0.3196	Schwarz aiterion	-13.754
Log likelihood	296.866	Hannan-Quinn alter.	-14.957
F-statistic	279.057	Durbin-Watson stat	21.142
Prob(F-statistic)	0.0000		

Breusch-Godfreey Correlation LM Test 4 lags: F(4.25) p-value 0.2949



Conclusions

- It can be induced that the NPL observed in 2020 impacts the measures adopted to control the pandemic. Bearing in mind that:
- There was an increase below the expected by the model in 2021Q2;
- There was a sharp reduction in 2020Q3, beyond the confidence interval of the model estimate, and in 2021Q4, when part of the measures to contain the pandemic ceased to be in force.
- There was a trajectory reversal and compensation for the sharp drop beyond what was predicted in the previous movement.