On the Determinants of Loan Default in the Saudi Banking System

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Abstract

The main purpose of this paper is to examine the key determinants influencing the non-performing loans (NPLs) in the Saudi banking system. To do so, we consider a set of macroeconomic, banking, and external factors over the period 2010Q1-2023Q3. The contribution of this work to the literature includes providing fresh evidence following the COVID-19 pandemic, utilizing quarterly observations unlike preceding literature, and adopting time series econometric techniques to identify key elements influencing NPLs. A vector error correction model (VECM) is estimated to capture NPL dynamics over both the long-run and short-run. The empirical evidence reveals that NPLs are determined by a combination of macro, banking, and external factors. Specifically, macroeconomic and external variables appear to have a significant impact on NPLs, and their effects are in parallel with theoretical expectations. Likewise, the impact of return on equity on NPLs is significant as expected by theory; however, the impact of other banking factors is against expectations.

Keywords: NPLs determinants, macroeconomic, bank-specific, external, error correction model, Saudi Arabia

JEL Classification: C13, E51, E31, G2, G2

1. Introduction

Over the last couple of decades, the global economy has witnessed a series of economic downturns, including the 2008 Global Financial Crisis (hereafter GFC) and the recent Covid-19 pandemic. Although each crisis has its own causes, dynamics, and governmental responses, several recurrent patterns are common and regularly emerge. All crises have financial consequences that may materialize at several levels, including the government, corporations, households, and the financial sector itself. As a result, some loans become non-performing in the aftermath of a crisis, and banks must control an increase in non-performing loans (NPLs) in a way that supports their own sustainability and the stability of the financial system as a whole. When NPLs exceed acceptable levels, the banking supervisory authorities should interfere to maintain financial stability.

To explore the macro-specific, bank-specific, and external-specific determinants of NPLs in the Saudi economy and financial system, one must first understand the definition and applicability of the term NPLs in the corporate world context. Beck et al. (2013) define NPLs as the sum of money borrowed upon which the debtors fail to make the scheduled interest or principal payments for a period lasting more than 90 days consecutively. Although NPLs are often categorized into non-specialized and specialized loans, the former are the most common. Furthermore, non-specialized NPLs are classified into the substandard level of loans that defaulted for $\geq$ 90 days up to 180 days, doubtful level of a default period between 180 and 360 days, and lost level of loans that defaulted for over 360 days.

Despite the challenging environment during the COVID-19 crisis, banks have continued to support the economy, with minimal losses in banks' balance sheets, particularly in NPLs, as displayed in Figure 1. For instance, given that the global economy experienced a sharp hit and caused a halt in economic activities in many parts of the world, banks were less affected compared to the 2008 GFC crisis. That said, the extensive monetary and fiscal support measures that took place in many parts of the world in 2020 have contributed to mitigating the increase in defaults of both corporate and household loans. In addition, compared to 2008, when the global financial crisis emerged, banks are better capitalized and have accumulated an adequate level of credit and ample liquidity. However, risks remained since most of the new bank loans to the private sector were subject to fiscal support measures in 2021. This means that once the government support measures and other fiscal support measures are lifted, the real economy and banks can be impacted, and non-performing loan levels can eventually increase.
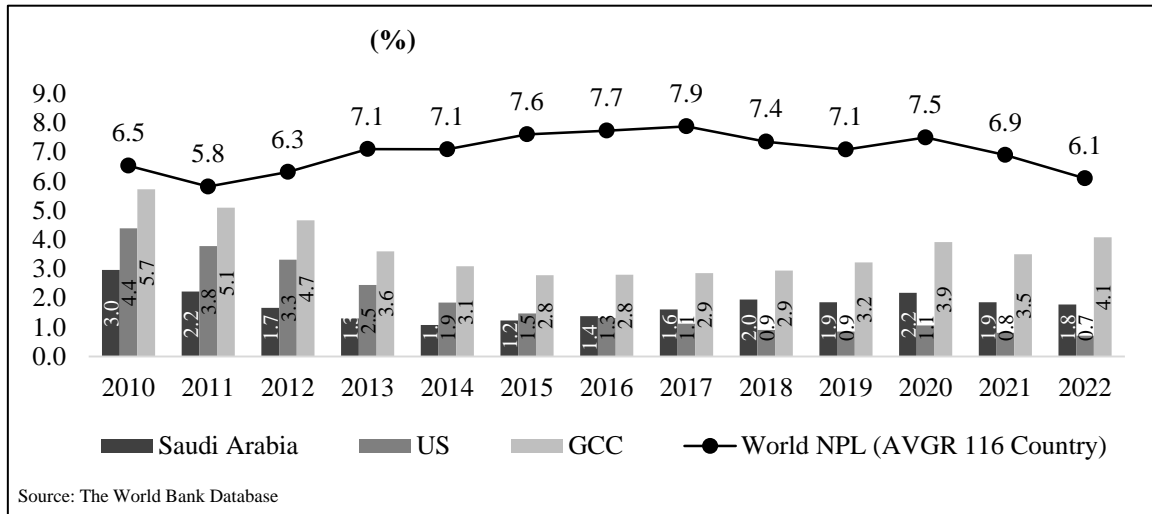
Figure 1. Average World NPL

In the case of Saudi Arabia, local banks were better prepared in terms of capital and liquidity. Figure 2 shows that the capital adequacy ratio was trending upward as of 2009. The capital adequacy ratio reached 20 percent by the end of 2023, reflecting the strong position of Saudi banks. The preparedness of the financial system for such a crisis could be attributed to the strong banking supervision and regulations under the umbrella of the Saudi Central Bank.
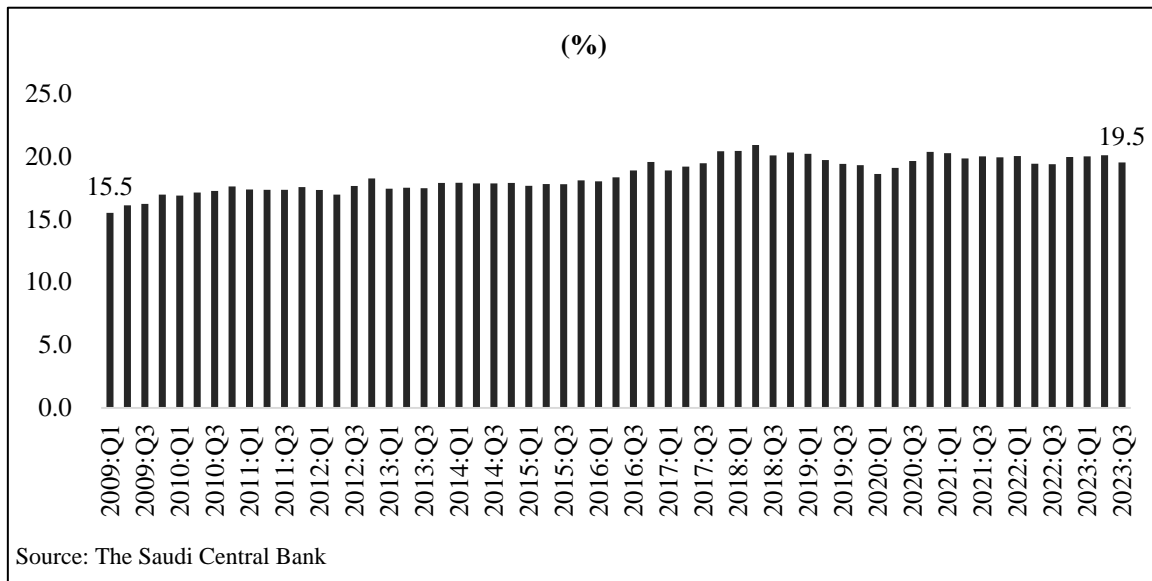

Figure 2. Capital Adequacy Ratio in Saudi Arabia

In addition, since 2020, the level of NPLs has trended downwards while the level of credits has trended upwards, as shown in Figure 3. This is attributed to governmental support, particularly as a guarantor for some private sector credits. In this context, the most important factor was the loan payment deferment and other support measures that were put in place to support businesses and households during the pandemic.
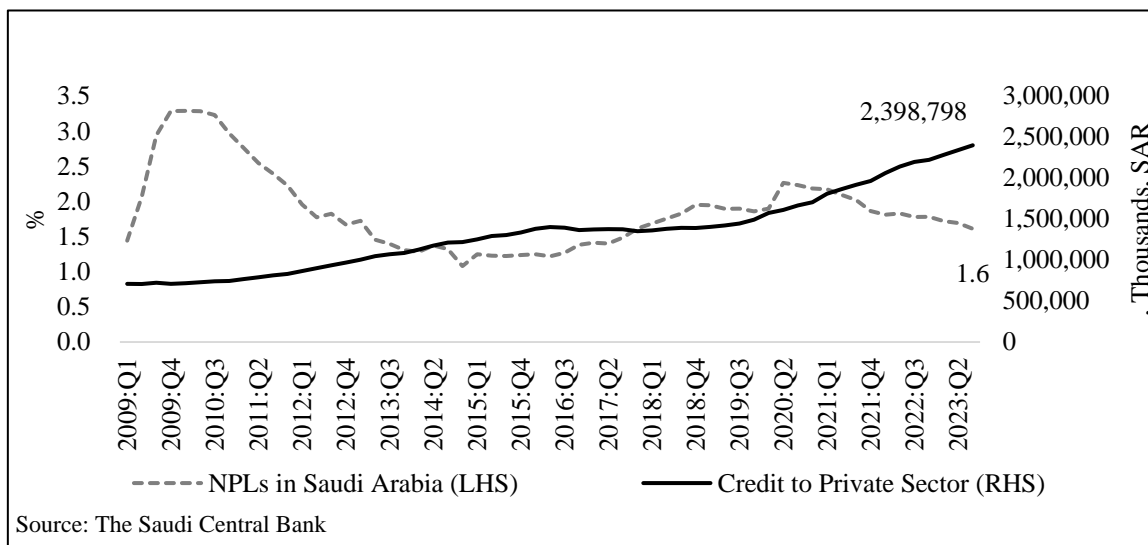
Figure 3. NPL and Credit to the Private Sector in Saudi Arabia

Monitoring NPLs in Saudi Arabia remains crucial for checking the soundness of the banking sector, given the loan concentration in some sectors like real estate, construction, and households. Indeed, most recent statistics reveal that both construction and real estate loans represent roughly 14 percent of total loans during 2023, while personal loans share exceeded 50 percent of total loans, as shown in Figure 4.
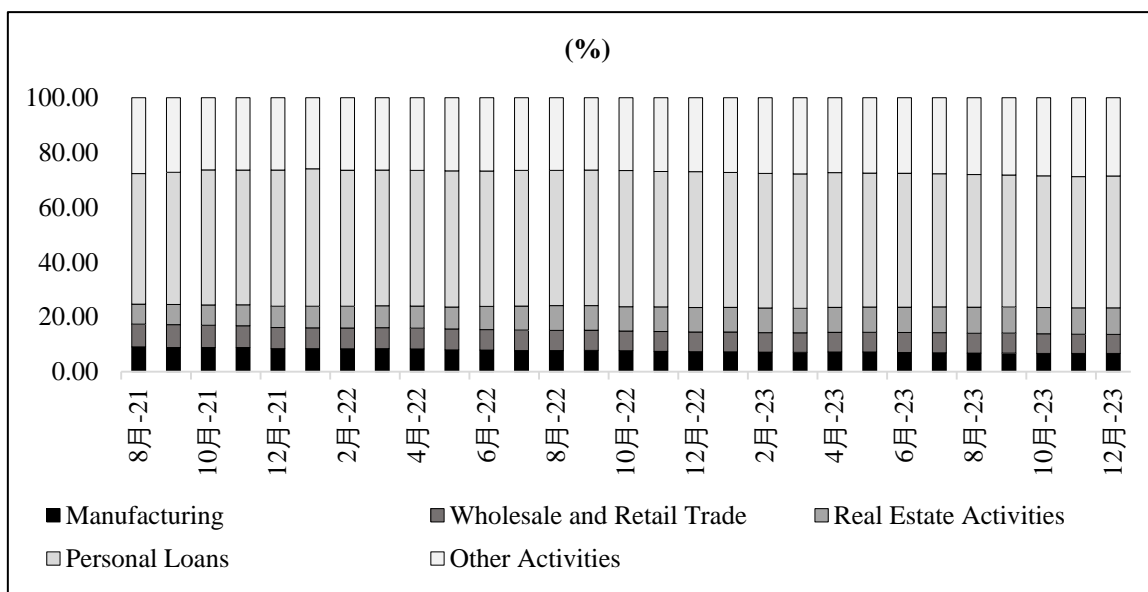

Figure 4. Share of Credit by Economics Activity

In addition, Saudi Arabia is transitioning into a more diverse economy, guided by its Vision 2030, where the financial sector needs to be sound and able to provide credit to the economy; therefore, monitoring NPLs becomes very critical to avoid vulnerabilities.

Against this backdrop, this paper contributes to the literature in three respects. First, to our knowledge, it is the first work that studies the impact of the macroeconomic environment in Saudi Arabia during the recent period following the pandemic crisis. Therefore, our analysis provides fresh evidence of the macroeconomic impact on NPLs in Saudi Arabia. Second, using time series econometrics techniques, namely the cointegration tests of Johansen and Juselius (1990) and the error correction (EC) Model, enabled us to capture the short and long-run relationships between NPLs and their determinants. As far as we know, this is the second paper that relies on time series techniques, while the vast majority of the literature adopts panel data econometric methods. Third, we utilized a quarterly dataset to identify the key determinants of NPLs in Saudi Arabia, and as we know, none of the existing studies relevant to Saudi Arabia analyzed NPL dynamics with quarterly data.

The rest of the paper is outlined as follows: Section 2 summarizes the prevailing literature focusing on NPL determinants, while Section 3 describes the data. The econometric methodology and empirical results are presented in Section 4. The conclusion and policy recommendations are contained in Section 5.

2. Literature Review

A large share of the literature has been devoted to analyzing the factors affecting NPLs, which can be classified into general macroeconomic and banking-specific factors. The prevailing empirical literature provides several causes for the rise of NPLs across advanced and less advanced economies, with analysis dating back three decades. Indeed, the study of NPLs has raised interest among economists, financial analysts, and policymakers following the 2008 GFC and, most recently, the Covid-19 pandemic.

Such interest started in the late 1980s with Keeton and Morris (1987), who explored the data for 2470 US banks between 1979 and 1985 to identify the causes behind NPLs. Their analysis showed that weak local economic conditions, loan concentration in some industries, and different risk-taking behaviors by banks are the key factors explaining loan defaults. By focusing on Texas Banks, Clair (1992) utilized annual data from 1984 through 1990 and showed that rapid credit growth tends to diminish loan quality affecting banks with lower capital adequacy ratios. Keeton (1999) revisited the issue of NPLs by investigating the data of 50 US banks from 1982 to 1996 and concluded that weak credit standards are a key factor behind the rising NPLs.

The development of new econometric techniques helps provide further insight into NPLs determinants. Indeed, several studies have examined the determinants of NPLs based on various panel data procedures. For instance, Salas and Saurina (2002) considered a combination of macro and bank-specific factors to explain NPLs fluctuations. Based on annual data over the period of 1985-1997 for Spanish commercial and saving banks, the researchers estimated a dynamic panel data model using the Generalized Methods of Moments (GMM) of Arellano and Bond (1998). Their estimated model confirmed that factors influencing NPLs consist of economic growth, business, and household debts, credit growth, bank inefficiency, portfolio structure, bank size, net interest margin, solvency ratio, and market power.

Fofack (2005) conducted a causal relationship assessment between non-performing loans and a set of macro and banking variables for 16 Sub-Saharan African countries based on annual data spanning from 1993 to 2002. He implemented a causality procedure and confirmed the existence of a strong causality running from macroeconomic variables to non-performing loans. Results indicated that economic growth, exchange rate, net interest margins, real interest rate, and interbank loans were critical determinants of NPLs in these countries. By employing quarterly data from 1998Q1 to 2008Q3, Festic and Repina (2009) found that unfavorable economic conditions, rapid credit growth, and higher loan concentration tend to accelerate the growth of non-performing loans. Boudriga et al. (2009) studied 46 banks from 12 countries[1], including Saudi Arabia in the MENA region, over the period 2002-2006 to examine whether banks, business, and institutional factors affect NPLs or not. The results showed that not only bank-specific factors (e.g. loan loss provisions, credit growth, bank capitalization level) influence NPLs, but also other factors relevant to business and institutions (foreign ownership, quality of credit bureaus information, and institutional environment) were critical factors influencing NPLs.

By encompassing banks' data from 26 advanced economies from 1998 to 2009, Nkusu (2011) investigated NPLs determinants and found that NPLs are determined by a combination of bank and macro factors. In specific, she concluded that unfavorable macroeconomic conditions like declining GDP growth, rising unemployment rates, increasing interest rates, and falling real estate prices & equity prices are associated with a surge in NPLs' rates. She also found that rising NPLs worsened economic conditions.

Using the GMM estimation approach for dynamic panel models, Ćurak et al., (2013) attempted to investigate the impact of both macroeconomic and bank-specific factors on NPLs in 10 southeastern European countries[2] over the period 2003-2010. The estimated results indicated that weak economic performance, high inflationary pressure, and high lending rates increase NPLs. Likewise, for bank-specific factors, the smaller size of banks, lower bank profitability, and higher solvency rate tend to increase NPLs. Klein (2013) examined whether macroeconomic conditions influence NPLs in selected Central, Eastern, and South-Eastern Europe (CESEE) countries[3] using annual data spanning from 1998 to 2011. The estimated panel data models confirmed the essential role of macroeconomic variables like GDP growth,

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[1] These countries are Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Saudi Arabia, Tunisia, Qatar, United Arab Emirates, and Yemen.

[2] These countries are Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Macedonia, Moldavia, Montenegro, Romania, Serbia, and Slovenia.

[3] The selected countries are Bosnia & Herzegovina, Bulgaria, Hungary, Croatia, Czech Republic, Estonia, Latvia and Lithuania.

inflation rate, and unemployment rate in explaining NPLs trends. Abid et al., (2014) also analyzed 16 Tunisian Banks' NPLs using dynamic panel data from 2003 to 2012. They found evidence confirming that macroeconomic and banking factors like economic growth, inflation, lending rate, and banking performance indicators have explanatory power for NPLs variations.

Dimitrios et al. (2016) analyzed the impact of various macro and banking variables on NPLs movements based on quarterly data covering the period 1990Q1-2015Q2 in 15 European countries. The estimated panel data models with different specifications confirmed that banks' profitability indicators, unemployment, output gap, income tax, and public debt are among the key determinants of NPLs. Another study by Laryea et al. (2016), focusing on Ghana's banking system from 2005 to 2010, concluded that highly capitalized banks tend to take on more credit risk leading to higher NPLs, and on the other hand, the smaller the bank, the more cautious it becomes regarding credit risks leading to lower the NPLs. They have also found evidence that NPLs influence both ROE and ROA negatively. In a well-structured panel data analysis, Gosh (2017) analyzed sectoral NPLs data on the largest 100 US commercial banks spanning from 1992:Q4 to 2016:Q1. The study concluded that the macroeconomic environment affects real estate loans and commercial & industrial loans by the biggest margin compared to other sectors. The author also explored the impact of NPLs on sector-specific product and labor markets and found that total NPLs have the most distinct effect on US housing prices and real GDP growth. Financial development also influences NPLs.

In a cross-country analysis, Ozili (2017) found that two financial development proxies, namely: foreign bank presence and financial intermediation, are positively associated with NPLs. This suggests that NPLs increase with higher financial development. Furthermore, the author explained that weak supervision encourages financial institutions to instigate lower lending standards, which subsequently gives rise to NPLs. The NPLs are also observed to be significantly associated with regulatory capital ratios and bank liquidity, implying that banking sectors with higher regulatory capital and liquidity experience fewer NPLs. In addition, Mohanty et al., (2018) assessed the role of macroeconomic conditions on NPLs and introduced a new insight into corporate-specific variables and levels of NPLs on different types of banks in India from 2000 to 2015. The empirical findings showed that macroeconomic and bank-specific factors affect NPL ratios. They also found that corporate-specific variables such as net sales growth and net profit margin have a statistically negative impact on the NPLs ratio.

Szarowska (2018) attempted to ascertain the determinants of NPLs in selected Central and Eastern European (CEE) countries[4] based on annual panel data over the period 1999–2015. The results indicated that unemployment and lending rates are positively associated with NPLs. Conversely, economic growth, inflation rate, and exchange rate appear to be negatively related to NPLs. According to Ogbebor and Ighodaro (2019), NPLs in eight African economies[5] are determined by economic growth, inflation, money supply, and level of investment as confirmed using annual data spanning from 2000 to 2016. Radivojević et al., (2019) followed the GMM estimation procedure to identify the influential factors affecting the NPLs dynamic with annual data starting from 2000 to 2015 for all Latin American countries except Colombia. Their findings showed that only economic growth and household final consumption expenditures could explain the trend of NPLs, while no evidence is found for the banking factors.

According to Louzis et al., (2019), macroeconomic variables such as real GDP growth rate, unemployment rate, lending rates, and public debt have a strong effect on the levels of NPLs in Greece. They utilized data containing information about the biggest nine banks in Greece from 2003:Q1 to 2009:Q3. The estimated dynamic panel data models revealed that bank-specific variables such as banks' performance and efficiency also affect NPLs. They also concluded that the determinant of NPLs ultimately depends on the type of loans.

While most of the existing literature appears to utilize panel data models with different estimation methods, there is another strand of the empirical literature relying on time series techniques to assess the nexus between non-performing loans and their determinants. For example, Badar and Javid (2013) analyzed the macroeconomic determinants of NPLs for Pakistan using monthly data spanning from 2002:01 to 2011:12. They conducted the Granger causality procedure and found that only changes in inflation and exchange rates led to changes in NPLs. Similarly, Hussain et al., (2013) explored the effects of macroeconomic variables on non-performing loans in the banking system of Pakistan based on a simple ordinary least square (OLS) estimation approach with quarterly data starting from 1990:Q1 to 2013:Q2. They found evidence suggesting that NPLs are negatively associated with economic growth and positively associated with energy crises and exchange rates.

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[4] These countries are Bulgaria, Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, and Slovakia.

[5] These countries are Egypt, Ghana, Kenya, Morocco, Nigeria, Senegal, South Africa, and Tunisia.

Based on quarterly data for 2003:Q1-2014Q4, Kjosevski et al., (2019) applied an autoregressive distributed lag (ARDL) cointegration method to assess the critical determinants of problematic loans for households and businesses in Macedonia. The results showed that non-performing loans are affected by macro and bank-specific factors, including economic growth, inflation, exchange rate, unemployment, credit growth, and bank's solvency ratio. Zheng et al., (2020) focused on analyzing the micro and macro factors determining NPLs dynamics in Bangladesh by utilizing common cointegration procedures and estimating a Vector Error Correction Model (VECM) and Autoregressive Distributed Lag (ARDL) model based on data with annual frequency spanning from 1979 to 2018. The estimated results confirm that both macro and micro factors, including economic growth, exchange rate, credit growth, unemployment, liquidity, profitability, lending rate, and deposit rates, are essential determinants explaining NPLs trends. Focusing on the banking system of Italia with quarterly data over the period 2008Q3-2020Q4, Foglia (2022) also documented the presence of a strong relationship between non-performing loans and critical macroeconomic factors like GDP growth, unemployment, public debt, and credit growth based on the estimated ARDL model.

When it comes to empirical analysis in the context of Saudi Arabia, the literature remains limited and includes Saudi Arabia within a group of countries like the GCC and MENA countries. For instance, Espinoza and Prasad (2010) used the data for more than 80 banks in the GCC countries over the period of 1995-2008 to study the relationship between non-performing loans and a set of macroeconomic and microeconomic factors. The estimated dynamic panel data model indicated that both bank-specific and macro factors play an important role in determining NPLs in the GCC banking system. They also documented evidence showing higher NPLs tend to make economic conditions worse.

Touny and Shehab (2015) considered a set of Arab countries[6] to investigate how macroeconomic conditions affect non-performing loans from 2000 to 2012. The authors estimated a dynamic panel data model and found that macroeconomic factors have a role in capturing the behavior of NPLs with a positive impact of public debts on NPLs. Khandelwal et al. (2016) examine how non-performing loans respond to changes in the global economy, domestic macroeconomic environment, and bank-specific factors. The estimated panel data models based on the GMM approach with data spanning from 1999 to 2014 indicated that NPLs are determined by changes in domestic and global macroeconomic conditions as well as bank-specific factors. Their analysis based on panel VAR models also suggested that an increase in the NPL ratio worsens macroeconomic conditions.

Farooq et al., (2019) investigated the underlying causes of non-performing loans in the GCC region by considering pivotal bank-specific and macro factors over the period of 2009-2015. The conducted empirical analysis based on panel data models estimated by the GMM method showing that economic growth, inflation, return on assets, and bank size are important determinants of NPLs in the region. Abdelbaki (2019) attempted to explore the key factors explaining the dynamic of non-performing loans in the GCC countries[7]. With the aid of various estimation techniques for panel data models based on data on annual frequency covering the period of 1998-2016, he found that domestic and global factors like non-oil economic growth, credit growth, inflation, interest rate, and tightened global conditions are essential determinants for NPLs. By relying on a time series econometric approach, Polat (2018) identified the key determinants of non-performing loans for the case of Saudi Arabia and Turkey based on annual data over the period of 2000-2016 that were used to estimate the logit model for both countries. The estimated beta regressions revealed the importance of macroeconomic conditions in determining the NPLs for both countries though it appeared that they played an essential role in Saudi Arabia compared to Turkey.

3. Data

As implied earlier, the purpose of this study is to investigate the determinants of non-performing loans in Saudi Arabia. A set of quarterly time series covering the period of 2010Q1-2023Q3 is chosen to best capture the NPLs' behavior as it simultaneously interacts with three dynamics, namely, macro-specific, bank-specific, and external-specific variables. As a result, ten variables are utilized to achieve the objective of this study. The data have been obtained from various sources, including the Saudi Central Bank (SAMA), the General Authority for Statistics of Saudi Arabia (GSTAT), and the St. Louis Federal Reserve Bank, as shown in Table 1. All variables except interest rate, banking sectors' returns on assets, banking sectors' returns on equity, and NPLs are expressed in the natural logarithm. Table 2 summarizes the descriptive statistics of these variables.

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[6] These countries include Egypt, Morocco, Tunisia, Jordan, Lebanon, Saudi Arabia, Kuwait, Oman and United Arab Emirates.

[7] The GCC countries consist of Kingdom of Bahrain, Kuwait, Oman, Qatar, Kingdom of Saudi Arabia, and the United Arab Emirates.

Table 1. Data Sources

Variables	Source	Definition
NPL	SAMA	The ratio of non-performing loans to total loans
GDP	GASTAT	Real non-oil private gross domestic product
CPI	GASTAT	Consumer price index
Credit	SAMA	Total bank credit to the private sector
TASI	SAMA	Saudi stock market index
SAIBOR	SAMA	3 months average Saudi Arabia interbank offered rates
ROA	SAMA	Bank's return on assets
ROE	SAMA	Bank's return on equity
WPO	St. Louis Fed	The world price of oil, Brent.
VIX	St. Louis Fed	Global stock market volatility index - Chicago Board Options Exchange

Table 2. Descriptive Statistics

	NPL	RGDP	CPI	Credit	SAIBOR	TASI	Oil	VIX	ROA	ROE
Mean	1.83	12.46	4.76	14.09	1.71	10.10	4.30	2.88	2.03	13.51
Median	1.80	12.50	4.77	14.13	0.98	10.07	4.34	2.83	2.10	13.80
Maximum	3.30	12.68	4.89	14.69	6.09	10.55	4.78	3.54	2.40	17.00
Minimum	1.10	12.12	4.58	13.48	0.60	9.80	3.39	2.33	1.20	6.60
Std. Deviation	0.54	0.15	0.07	0.33	1.34	0.21	0.35	0.29	0.23	2.18
Skewness	1.11	-0.64	-0.45	-0.09	1.90	0.55	-0.46	0.36	-1.81	-1.00
Kurtosis	4.01	2.67	2.81	2.30	6.22	2.23	2.37	2.44	6.61	3.85
Observation	55	55	55	55	55	55	55	55	55	55

Note: NPL, SAIBOR, ROE, and ROA are in level while the remaining variables reflect logarithm form.

While the literature points out several NPL determinants, we consider a set of macro-specific and bank-specific, and external-specific variables given the economic structure of Saudi Arabia. Therefore, it is worth mentioning the rationale behind the selection of these variables. The NPL is used as the dependent variable as accelerating NPLs are considered a proxy of credit risk in the banking sector. Indeed, there is a strong correlation between high NPLs and financial distress or financial crisis (Kapopoulos, et al., 2017). When it comes to macroeconomic factors influencing NPLs, economic growth measured by real non-oil private GDP is one of the potential factors capturing NPL trends. In other words, higher non-oil private GDP growth implies that the economy is performing well and translates into higher incomes improving the debt service capacity of borrowers, which in turn leads to lower NPLs (Mohaddes, et al., 2017). Another important factor is inflation, which could have twofold effects. Under inflationary pressure, debt service would be easier as inflation reduces the real value of the loan; however, it also could reduce the borrowers' income in the real term, especially when wages are sticky. (Klein 2013, Benazić & Radin 2015). It is also reported that higher inflation could result in rising lending rates, which could accelerate NPLs (Fofack 2005 and Klein 2013).

Additionally, equity market – measured by the TASI index – can also play a potential role in determining NPLs. With falling stock prices, the rise of NPLs is anticipated through wealth effects and the decline in collaterals' value (Klein 2013, and Beck et al., 2015). It has also been extensively documented in the literature that interest rate is one of the pivotal attributes in determining the level of NPLs. An increase in interest rates brings forth an additional burden on loan payments. High lending interest reflects the high-risk premium that banks charge for low-credit quality debtors indicating a poor credit portfolio (Tanaskovic and Jandric 2015). In addition, credit growth – which is the most critical bank-specific factor – shapes NPLs as it leads to more accumulation of loans, which in turn means that there are higher chances of bad loans taking place (Utari et al., 2012). In addition, rapid credit expansion is considered to be one of the most important causes of non-performing loans as, typically, banks are willing to take on risky clients, which raises the chances of NPLs (Akinlo, 2014).

Regarding bank-specific factors, both ROA and ROE reveal the managerial efficiency of a bank in converting its assets and equity into income. Good management should lead to lower NPLs. (Radivojević et al., 2019, and Khan et al., 2020).

To account for external conditions, we consider both oil prices and the global stock market volatility index (VIX) as key attributes influencing the level of non-performing loans. The inclusion of oil prices is mainly due to the essential role of Saudi Arabia as one of the largest oil-producing countries in the world, and changes in oil prices would have various macro and financial implications on the Saudi economy (Al Rasasi & Banafa 2015, Callen et al., 2015, Al Rasasi 2017, Al Rasasi et al., 2017, 2019 & 2020, Hasanov et al., 2022). For oil-exporting countries, upturns in oil prices reflect higher borrowers' income and firms' profitability implying lower NPL levels. In contrast, in countries with heavy reliance on imported oil, spikes in oil prices may reduce borrowers' income leading to a higher probability of defaults. (Beaton et al., 2016, Miyajima 2016, Khandelwal et al., 2016, and Al-Khazali & Mirzaei 2017). Because financial systems usually are sensitive to global financial and monetary conditions, we use the global stock market volatility

index as a proxy for global risk aversion and tight financial conditions (Espinoza & Prasad 2013, Klein 2013, Khandelwal et al., 2016, and Abdelbaki 2019).

4. Econometric Analysis[8]

4.1 Initial Assessment

To have some insight into NPLs and their determinants, we started our analysis   by evaluating the correlation between NPLs and the explanatory variables; Table 3 provides the correlation matrix. This matrix apparently reveals that NPL is moderately correlated with real non-oil private GDP and the global stock market volatility index (VIX). Nonetheless, the correlation tends to be somewhat lower between NPLs and other factors. On the other hand, the correlation between macroeconomic variables and NPLs appears to be noticeable.

Table 3. Correlation between NPLs and their Determinants

	NPL	RPGDP	CPI	CREDIT	SAIBOR	TASI	Oil	VIX	ROA	ROE
NPL	1.00									
RPGDP	-0.53	1.00								
CPI	-0.49	0.96	1.00							
CREDIT	-0.40	0.96	0.98	1.00						
SAIBOR	-0.19	0.63	0.62	0.64	1.00					
TASI	-0.26	0.70	0.73	0.76	0.43	1.00				
Oil	0.18	-0.33	-0.29	-0.33	-0.05	0.21	1.00			
VIX	0.53	-0.12	-0.01	0.05	-0.07	0.05	-0.01	1.00		
ROE	-0.11	-0.06	-0.17	-0.19	0.26	0.03	0.48	-0.31	1.00	
ROA	-0.19	-0.42	-0.51	-0.56	-0.14	-0.29	0.46	-0.41	0.82	1.00

The next step in our empirical analysis is in line with common practice in empirical research by assessing the stochastic properties of the variables being under investigation to avoid spurious regressions. To do so, we have applied various unit root tests to check the data, including Augmented Dickey-Fuller (1980), Philips & Perron (1988), Kwiatkowski et al., (1992), Elliott et al., (1996), Ng & Perron (2001). In addition, we rely on unit root tests that account for seasonality like Hylleberg et al. (1990) and Canova & Hansen (1995)[9]. The results from applied tests confirm that the variables are integrated into order one[10].

Afterward, we test for cointegration as encouraged by Engle and Granger (1987), who argue that variables with order one of integration are more likely to be cointegrated. To confirm whether our variables are cointegrated or not, we conduct multivariate cointegration tests – Trace and Maximum Eigenvalue – developed by Johansen and Juselius (1990). The results of both tests, as summarized in Table 4, reveal that these variables are cointegrated. In other words, there exists a long-run relationship between NPLs and their determinants. It is also worth noting that there are multiple cointegration relationships among the variables other than NPLs; however, we will focus on analyzing the cointegration relationship between NPLs and other variables as it lies under the scope of this study.

Table 4. Cointegration Tests

Panel A: Trace Test						
H_0	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$	$r \leq 5$
Test Statistics	323.47*	251.94*	188.61*	137.77*	102.68*	69.81*
H_0	$r \leq 6$	$r \leq 7$	$r \leq 8$	$r \leq 9$		
Test Statistics	47.86*	29.79*	15.49	3.84		
Panel B: Maximum-Eigenvalue Test						
H_0	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$	$r \leq 5$
Test Statistics	71.53*	63.34*	50.84*	46.23	40.08	33.88
H_0	$r \leq 6$	$r \leq 7$	$r \leq 8$	$r \leq 9$		
Test Statistics	27.58	21.13	14.26	3.84		

* indicates the rejection of the null hypothesis at 5% significance level.

4.2 Long-run and Short-run Dynamics

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[8] We use the Eviews 13 software to conduct the econometric analysis.

[9] Schwarz (1985) argues that tests like Dickey and Fuller (1980) and Philips and Perron (1988) are weak in power and tend to reject the null hypothesis when it is true. Hence, we apply more efficient unit root tests. We also apply seasonal unit root tests for data with seasonality as these tests tend to provide results that are more accurate compared to standard tests.

[10] The detailed results are available from the authors upon request.

Both tests of Johansen and Juselius (1990) assure the presence of a long relationship between NPLs and their determinants. To understand the dynamics of NPLs over the long run and short run, we estimate the following vector error correction model (VECM) based on the Maximum Likelihood method.

$$\Delta NPL_t = c + \sum_{i=1}^{k} \beta_{i1} \Delta NPL_{t-i} + \sum_{i=1}^{k} \beta_{i2} \Delta Macro_{t-i} + \sum_{i=1}^{k} \beta_{i3} \Delta Bank_{t-i} + \sum_{i=1}^{k} \beta_{i4} \Delta Ext_{t-i} + \varphi(\alpha_1 Macro_{t-1} -$$

$$\alpha_2 Bank_{t-1} - \alpha_3 Ext_{t-1}) + \epsilon_t \qquad (1)$$

where NPL is the dependent variable, the macro variables include $real\ Private\ GDP, CPI, SAIBOR\ and\ TASI$, and the bank-specific determinants consist of $Credit, ROA, and\ ROE$. The external determinants are $Oil\ and\ VIX$. The error term is donated by ε_t, and $k\ and\ \Delta$ denote the lag length criteria selected based on the Akaike information criteria and the difference, respectively.

The estimated parameters of VECM are summarized in Table 5. Clearly, the estimates indicate that NPL, in the long run, is determined by a combination of macro, bank-specific, and external factors. In particular, it appears that real non-oil private GDP has the most significant impact on NPLs in Saudi Arabia, with a negative relationship implying better economic growth leading to lower NPL ratios. More practically, a 1 percent increase in real non-oil private GDP will roughly lead to a 1.8 percent decline in the growth rate of NPLs. This can be justified by the fact that better economic conditions increase the ability of borrowers to repay the debt due to the general increase in their income. This result is consistent with the findings of the existing empirical literature (Espinoza & Prasad 2010, Boudriga et al., 2010, Touny & Shehab 2015, Khandelwal et al., 2016, Miyajima 2016, Jabbouri &Naili 2019, and Abdelbaki 2019).

Regarding the impact of inflation on NPLs, we find evidence suggesting a positive relationship between the two variables. In particular, a higher inflation rate of one percent causes NPLs to increase by 6.8 percent. Understandably, higher inflation typically reduces disposable income, particularly in the medium and low-income in retail sector, which increases the risk of higher loan default at the aggregate level. This fact is in line with the conclusion of previous studies (Polat 2018, Farooq et al., 2019, Jabbouri &Naili 2019).

With regards to stock market performance, our estimated model indicates the positive impacts on NPLs by roughly 2.3 percent. Notably, higher stock market performance leads to higher NPLs, likely due to the fact that when the general stock index increases, typically on average, its constituents generate higher returns or higher valuation. Consequently, the banking sector listed in the Saudi stock market (which accounts for 15 percent of the total value traded) is likely to generate higher returns. In theory, when banks are performing well, they tend to take more risks on credit (Xu et al., 2015). Therefore, the likelihood of higher NPLs increases, as we can see from the results. Miyajima (2016) documented a similar finding confirming the positive nexus between the stock market and NPLs.

Concerning interest rates, our results confirm the negative impact of rising interest rates on NPLs; particularly, a rising domestic interest rate by one percentage point would push NPLs down by 0.2 percent. This is expected as higher interest rates generate additional burdens on loans and encourage banks to increase their risk premium (or collaterals) on loans they charge for borrowers with low credit scores, leading to a reduction in the demand for loans, which may translate to a lower NPLs. It is also worth mentioning that Espinoza and Prasad (2010), Touny and Shehab (2015), Khandelwal et al. (2016), and Abdelbaki (2019), among others, have documented similar conclusions.

Regarding bank-specific factors, the estimated model indicates that rapid credit growth accelerates NPLs although statistically insignificant. The insignificant impact of credit growth can be attributed to the guarantee schemes implemented in Saudi Arabia. In other words, personal loans are linked to a portion of salaries that are used as collaterals; likewise, the private sector heavily depends on government projects, so the government typically avoids late arrears enabling the private sector to repay their debts. Furthermore, private sectors focusing on certain sectors like manufacturing or agriculture access subsidized credits from governmental specialized credit institutions; hence, it is rare to default on these loans. This finding is consistent with the findings of Miyajima (2016) and Khandelwal et al., (2016), confirming an insignificant impact of credit growth on NPLs.

In addition, we find statistically significant evidence showing that a higher ROA has a positive impact on NPLs by approximately 8 percent. This particular result goes against the common findings in the literature. However, higher ROA generally means that banks are able to create higher value from assets, which may have given banks higher risk-taking incentives leading to higher NPLs in Saudi Arabia; this concept is in line with an IMF study conducted by Xu et al., (2015).

By considering the spillover of the global oil market, the estimated parameter of oil price has recorded a negative impact on NPLs with about 1.6 percent. This can be justified by the fact that higher oil prices have a positive impact on oil-exporting countries like Saudi Arabia through higher oil revenues. Ultimately, higher government revenues are then

distributed into the economy through expenditure and investments, leading to higher economic growth, which is expected to reduce NPLs as explained earlier. This result is in parallel with the results reported by Espinoza and Prasad (2010), Touny and Shehab (2015), Miyajima (2016), Khandelwal et al. (2016), and Al-Khazali and Mirzaei (2017). Likewise, we find evidence suggesting a negative impact of global financial market volatility on NPLs, in which falling prices in global markets by one percent would increase NPLs by roughly 0.1 percent in the long run. This is expected as falling prices would increase NPLs through the wealth effects channel leading borrowers to be unable to repay the borrowed loans.

To this end, the estimated error correction coefficient measuring the speed of adjustment to steady-state conditions as shown in Table 5 implies that the speed of adjustment to long-run equilibrium is 6 percent. The short run dynamic appears to be in general statistically insignificant because those NPLs materialize over the long run rather than the short run.

Table 5. Parameter Estimates of VECM

Panel A: Long run estimates				
	GDP	CPI	$TASI$	$SAIBOR$	$Credit$
Estimates	-1.76**	6.77**	2.33**	-0.19**	-3.99
t-statistics	2.86	-5.91	-25.98	8.88	19.19
	ROA	ROE	Oil	VIX	Adj. coefficient
Estimates	7.59**	-0.79**	-1.63**	0.05	-0.06
t-statistics	-54.57	56.44	27.04	-0.76	-0.73
Panel B: Short run estimates				
	$\Delta NPL\,(-1)$	$\Delta NPL\,(-2)$	$\Delta NPL\,(-3)$	$\Delta GDP\,(-1)$	$\Delta GDP\,(-2)$
Estimates	0.21	0.11	-0.12	-0.90	-1.32
t-statistics	1.22	0.58	-0.59	-1.12	-1.54
	$\Delta GDP\,(-3)$	$\Delta CPI\,(-1)$	$\Delta CPI\,(-2)$	$\Delta CPI\,(-3)$	$\Delta TASI\,(-1)$
Estimates	-1.87**	-0.48	-2.16	5.03**	0.21
t-statistics	-2.50	-0.21	-1.02	2.31	0.59
	$\Delta TASI\,(-2)$	$\Delta TASI\,(-3)$	$\Delta SAIBOR\,(-1)$	$\Delta SAIBOR\,(-2)$	$\Delta SAIBOR\,(-3)$
Estimates	0.38	0.09	0.08	0.09	-0.09
t-statistics	1.09	0.31	1.51	1.98	-1.77
	$\Delta Credit\,(-1)$	$\Delta Credit\,(-2)$	$\Delta Credit\,(-3)$	$\Delta ROA\,(-1)$	$\Delta ROA\,(-2)$
Estimates	0.54	0.07	-2.01	0.30	-0.47
t-statistics	0.27	0.03	-1.21	0.39	-0.80
	$\Delta ROA\,(-3)$	$\Delta ROE\,(-1)$	$\Delta ROE\,(-2)$	$\Delta ROE\,(-3)$	$\Delta Oil\,(-1)$
Estimates	0.89	-0.05	0.06	-0.12	-0.15
t-statistics	1.58	-0.47	0.75	-1.55	-0.70
	$\Delta Oil\,(-2)$	$\Delta Oil\,(-3)$	$\Delta VIX\,(-1)$	$\Delta VIX\,(-2)$	$\Delta VIX\,(-3)$
Estimates	-0.06	-0.39**	0.12	-0.11	-0.24
t-statistics	-0.34	-2.14	0.94	-0.78	-1.92
Note: * and ** indicate the significance level at 1% and 5% respectively.				

5. Conclusion

This study attempted to ascertain the determinants of NPLs in Saudi Arabia by analyzing the macro, bank-specific, and external factors using a time series quarterly dataset over the period 2010Q1-2023Q3. The empirical analysis supports the view that macro-factors, such as real non-oil private GDP growth, inflation, interest rates, and stock market performance explain NPLs dynamics in Saudi Arabia. In particular, we found that real non-oil private GDP growth has a negative association with the levels of NPLs suggesting that better economic conditions translate into lower NPLs. We also found evidence of a significant positive relationship between inflation and NPLs. This means that higher inflation typically reduces disposable income, particularly in the medium and low-income households leading to higher chances of loan default on aggregate levels. Additionally, the estimated model also shows that the impact of stock market performance and interest rates is significant and has a positive relationship with NPLs, however, with a relatively low impact. On the other hand, by looking at the bank-specific variables, our model shows that "banks' return on assets (ROA) has a positive and significate relationship with NPLs. Particularly, higher ROA generally means that banks are more profitable, which may have given banks higher risk-taking incentives leading to higher NPLs in Saudi Arabia. Finally, our model shows that NPL levels in Saudi Arabia are affected by external factors such as oil prices and global stock market volatility. Among the external factors, oil prices have the most impact on NPLs. This can be justified by the fact that higher oil prices leads to higher oil revenues. Ultimately, higher government revenues are then distributed into the economy through expenditure and investments, leading to higher economic growth, which is expected to reduce NPLs.

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