

Louvain School of Management

Nexus between unemployment and non-performing loans: evidence from the euro area

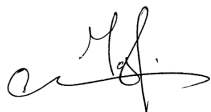
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Declaration

No AI tool has been utilized by the author during the preparation of this master's thesis.

By signing this declaration, we affirm that the content of this master's thesis reflects our original work.

26.05.2024

A handwritten signature in black ink, appearing to be 'M. J.', written over a horizontal line.

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Abstract

This paper examines the relationship between unemployment and non-performing loans. Recognized as a major threat to bank financial stability, non-performing loans are closely monitored by the European Central Bank as they can have a significant impact on the soundness of the European banking system. Meanwhile, unemployment is argued to be associated with lower income, leading borrowers to face difficulties in servicing debt obligations. We use econometric methods to examine this relationship on panel data from 20 euro area countries for the period 2008-2021 while controlling for several macroeconomic variables. We analyze both long-run dynamics, using pooled OLS with year-fixed effects and short-run dynamics, using two-way fixed effects. We found a positive and significant relationship between unemployment and non-performing loans. However, due to potential endogeneity bias, we cannot establish a causal relationship between unemployment and NPLs, and a further methodological approach is needed to address this issue.

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List of abbreviations

AR	Arellano-Bond
ECB	European Central Bank
EES	European Employment Strategy
EU	European Union
FE	Fixed effects
FSI	Financial Soundness Indicator
GDP	Gross domestic product
GMM	Generalized Methods of Moments
GFC	Great Financial Crisis
ILO	International Labour Organization
IMF	International Monetary Fund
NPLs	Non-performing loans
OLS	Ordinary Least Square
RE	Random effects

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1. Introduction

Non-performing loans (NPLs), characterized by the failure of borrowers to meet their repayment obligations, have been recognized as a major concern for financial stability in many countries around the world (Goyal et al., 2023). Asset quality, a major criterion for assessing the financial stability of the entire banking sector (Ciukaj & Kil 2020) is closely monitored by regulators due to the significant impact it can have on banks. The effects of NPLs go beyond just affecting individual banks, they spread throughout the entire economy (Naili & Lahrichi, 2022).

NPLs have been studied in the context of different phases of the economic cycle. It is suggested that asset quality is strongly correlated with macroeconomic conditions. When economic conditions worsen, borrowers' creditworthiness weakens. During recessions and periods of weak economic growth, households and corporations are more likely to experience difficulties in repaying their loans. These difficulties often result in a higher proportion of NPLs appearing on bank's balance sheets (Messai & Jouini, 2013). One of the factors that is likely to influence the level of NPLs is unemployment, which is a key indicator of labour market health. Higher unemployment is suggested to be translated into less income and borrowers may face difficulties in repaying their debt which could, therefore affect the level of NPL.

We extend the existing literature by focusing on the relationship between unemployment and non-performing loans by using aggregate data from 20 euro area countries over the period 2008 to 2021, while controlling for several macroeconomic variables that are likely to have an impact on NPLs based on the literature. Our empirical evidence suggests that there is a positive and statistically significant association between unemployment and NPLs.

The rest of the paper is organized as follows: In the first chapter, we discuss the importance of non-performing loans. The second briefly introduces the concept of financial stability and the link between asset quality and bank stability. Chapter 3 focuses on unemployment, empirical evidence regarding the relationship between NPLs, and unemployment and the evolution of the rate in the euro area. We finish the literature review by mentioning other potential factors that may impact non-performing loans,

which will be included as control variables in our regressions. In the methodology section, we present the steps used to conduct our analysis, and the results obtained.

2. Literature review

2.1 Chapter 1: Non-performing loans

The topic of asset quality has gained growing attention in the last few decades. They pose a significant risk to the banking sector in nearly every country worldwide (Goyal et al., 2023). Given that banks play a significant role in driving the economy, any disruptions within the banking system can lead to ripple effects throughout the economy (Naili & Lahrichi, 2022; Syed & Tripathi, 2020). Ciukaj and Kil (2020) explain that high credit risk and bank losses can restrict the level of lending activities, which adversely affects economic activity. One of the indicators used to assess asset quality is non-performing loans (NPLs) (Meeker & Gray, 1987). In addition to the deterioration in the quality of bank portfolios caused by the rising volume of NPLs, it also restricts household consumption and business investment, with a further negative effect on the banking sector (Szarowska, 2018). The ratio of NPLs is even accentuated after periods of crisis. For example, Anastasiou et al. (2019) investigate the causes of non-performing loans in the euro area between 2003Q1 and 2016Q1 and conclude that after 2008, non-performing loans were much higher in the EU periphery countries, mostly related to the worsening of macroeconomic conditions in these countries. Naili & Lahrichi (2022) highlight the need for authorities to closely monitor variables that contribute to NPLs, as these can serve as leading indicators of future problematic loans.

A loan is considered performing when the borrower pays the agreed instalments and interest as scheduled. However, there is a risk that the borrower will not be able to repay within the agreed timeframe. Therefore, loans that are subject to late repayment or are unlikely to be repaid by the borrower are called non-performing loans. There is no internationally accepted standard for measuring NPLs. According to the European Central Bank (2016), a loan is categorized as non-performing when the borrower has failed to make scheduled payments for more than 90 days. Similarly, the International Monetary Fund (IMF, 2019, p59) defines NPLs as follows:

- *“Nonperforming loans (NPLs) are defined as those loans for which (1) payments of interest or principal are past due by 90 days or more; or (2) interest payments equal to 90 days or more have been capitalized or delayed by agreement; or (3) evidence*

exists to reclassify a loan as nonperforming even in the absence of a 90-day past due payment, such as when the debtor files for bankruptcy”.

2.1.1 Supervision of non-performing loans

Non-performing loans are closely monitored by the European Central Bank (ECB) supervisors as they can have a significant impact on the European banking system's soundness. The ECB provides guidance to banks on managing bad loans and provisioning adequately. Through the Supervisory Review and Evaluation Process (SREP), supervisors assess banks' lending standards and credit risk management to ensure they mitigate the risk of loans becoming non-performing. This regulatory framework aims to ensure sound lending practices and proactive NPLs management. It allows for a consistent assessment of banks' risk profiles and facilitates decisions on necessary supervisory actions, which are particularly important during economic downturns (ECB, 2024a). The 2023 SERP for ECB-supervised banks occurred during a period of significant economic uncertainty, including Russia's war against Ukraine, high inflation, rapid interest rate hikes and market turmoil following bank failures in the US and Switzerland. According to the ECB (2024b), despite these challenges, the banking sector showed strength, maintaining strong capital and liquidity positions. Moreover, asset quality remained stable, with the ratio of non-performing loans (NPLs) declining slightly from 2.4% in the second quarter of 2022 to 2.3% in the second quarter of 2023, despite a slight quarter-on-quarter increase in 2023.

2.2 Chapter 2: Financial stability

The concept of financial stability is broad, and its definition varies across studies. There is not yet a widely accepted model or analytical framework for assessing it (Schinasi, 2004). Some authors prefer speaking in terms of financial instability instead. Crockett (1996) defines financial instability as a scenario where economic performance is at risk due to fluctuation in the prices of financial assets or the inability of financial intermediaries to fulfill their contractual obligations. Threats arising from various shocks can propagate through contagion, leading to doubt about liquidity and the ability to fulfill contracts. He describes symptoms of instability as volatile and unpredictable changes in prices. Aertd et al. (2004) define it in terms of its ability to help the economic system

allocate resources, manage risk, and absorb shocks. Schinasi (2004) suggests that banks may build up imbalances and instability even in the absence of shocks, due to factors such as credit-risk concentrations or illiquidity. Banks can internalize the fragilities associated with the properties of liquidity and are therefore prone to instability themselves. Allen and Wood (2006) argue that financial stability can be achieved by preventing episodes of instability. According to Bindseil & Fotia (2021), financial instability arises from adverse shocks to asset prices, impacting the ability of debtors to remain solvent. Consequently, this can worsen access to credit and potentially lead to a liquidity crisis, setting off a damaging cycle of events. Even if experts define financial stability slightly differently, they largely agree on its importance, especially since financial crisis.

2.2.1 Asset quality and bank stability

Several studies have found a significant relationship between non-performing loans and bank stability and profitability. Crockett (1996) states that one of the reasons why banks get into trouble is because of deteriorating asset quality. This causes an erosion of confidence and can lead to financial instability. A study (Kadioglu et al., 2017) was conducted in Turkey over the period Q12005-Q32016 to assess the effect of the asset quality on the bank profitability¹. They use panel regression method and find a significant relationship between NPLs and bank profitability. Also, Albulescu (2015), while testing the influence of financial soundness indicator (FSI) on bank profitability at the macro level, concludes that NPLs have a negative impact on bank profitability. Moreover, Aliu & Çollaku (2021) point out that NPLs are usually used as an indicator to predict bank failure. Therefore, it is essential to analyze the credit risk as it can provide warning signs when the financial sector becomes vulnerable to shocks.

2.3 Chapter 3: Unemployment

The unemployment rate refers to the number of unemployed persons as a percentage of the labour force, based on the International Labour Office (ILO) definition. Before delving into the details, let's first clarify the key terms used in the context of unemployment, based on the ILO and Eurostat definition (Eurostat, 2021; ILO, 2019, p6):

¹ Profitability is measured by return on equity and return on asset.

- **Employment:** refers to all individuals of working age who, during a short reference period, were involved in activities aimed at producing goods or providing services for pay or profit.
- **Unemployment:** unemployed persons include persons aged 15 to 74 who fulfill three conditions. Persons being without work during the reference week, who are available for work within the next two weeks, and who have been actively seeking work in the past four weeks.
- **Labour force:** is calculated as the sum of employed and unemployed persons. It represents the current supply of labour to produce goods and services in exchange for pay or profit.

Unemployment is considered as a fundamental indicator of the health of the labour market and is widely used to communicate the performance of the labour market and the ability of the economy to generate sufficient employment opportunities. It is a widely used indicator by various labour market actors, including politicians, policymakers, business owners, researchers, and others. It provides insights into the imbalances between labour supply and demand, by highlighting the presence of the unused labour supply. In addition, the unemployment rate is a useful measure for tracking the business cycle, as the evolution of the unemployment rate is often closely linked to the performance of the economy and its fluctuations. It can reveal periods of recession and following signs of recovery (ILO, 2019). Moreover, Kilimova and Nishnianidze (2018) add that unemployment is a complex issue that is influenced by different socio-demographic factors. It is caused by a certain inconsistency in social indicators, which is further aggravated by globalization trends. They state that unemployment is a form of permanent contradiction between social needs and the needs of capital.

The relationship between the macroeconomic environment and non-performing loans has been studied in the context of different phases of the economic cycle. It appears that asset quality is strongly correlated with macroeconomic conditions. In other words, when economic conditions worsen, borrowers' creditworthiness weakens. During recessions and periods of weak economic growth, households and firms are more likely to

experience difficulties in repaying their loans. These difficulties often result in a higher proportion of NPLs appearing on bank's balance sheets (Messai & Jouini, 2013). The macroeconomic determinants of NPLs can be understood through the lens of life-cycle consumptions model such as Lawrence (1995, as cited by Ghosh 2015, p94). The theoretical framework suggests that borrowers with lower incomes are more likely to default due to increased risks associated with unemployment, which may prevent them from meeting their financial obligations. The author suggests that the likelihood of default depends on the current income levels and the unemployment rate, which is related to uncertainty about income and lending rates. Moreover, Louzis et al. (2012) state that higher unemployment is suggested to be translated into less income and therefore borrowers face difficulties repaying their debt which could, therefore, affect the level of non-performing loans.

2.3.1 Unemployment and non-performing loans

Several articles have been conducted to quantify the impact of different factors on the level of NPLs. Some of them find a positive relationship between unemployment and NPLs. For example, Szarowska (2018) examines the impact of macroeconomic determinants on NPLs in 11 Central and Eastern European (CEE) countries² between 1999 and 2015. According to the empirical evidence, unemployment emerges as one of the most influential macroeconomic factors³, explained by the fact that an increase in the unemployment rate increases the debt burden of households and decrease the production because of a drop in the effective demand. The empirical evidence of Mazreku et al. (2018) is conducted on transition countries (Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Kosova, Macedonia, and Romania) over the period 2006-2016 to analyze macroeconomic factors⁴ influencing NPLs. They use static panel estimations such as pooled Ordinary Least Square (OLS), fixed-effects (FE) and random-effect (RE), as well as Generalized Method of Moments (GMM) estimation. Authors confirm the hypothesis stating that a rise in unemployment affects households' ability to service their debts. The coefficient is significant in all but one case, the RE model. Also, the coefficient is positive

² CEE countries include Bulgaria, Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia.

³ Other macroeconomic variables are GDP, inflation, nominal effective exchange rate, lending rates, general government debt and a dummy variable of the GFC crisis.

⁴ Other macroeconomic variables are inflation, GDP growth and export.

in all models excluding in pooled OLS model. In the same line, (Messai & Jouini, 2013) conduct an analysis on 85 banks in three countries⁵, including Italy, Greece and Spain using the fixed effects model and find a positive relationship with the unemployment rate which is explained by a negative effect of the cashflow of households and increase in debt. Dimitrios et al. (2016) examine commercial banks for 15 euro area countries from 1990Q1 to 2015Q2 and conclude that unemployment contributes to a deterioration in asset quality.

2.3.2 Trends in unemployment

Looking at the fluctuation patterns of the unemployment rate in the euro area, as shown in figure 1, we can observe that there is an increase in the unemployment rate in the wake of macroeconomic events such as the Great Financial Crisis (GFC) and the COVID-19 pandemic. There is a significant increase from 7.55% in 2008 to 11.97% in 2013, and the rate declines until 2019, reaching 7.50%. We then observe another increase in the unemployment rates since the COVID-19 crisis, but with less intensity, rising from 7.50% in 2019 to 7.82% in 2020, followed by a downward trend, reaching 6.75% in 2022.

Figure 1: Euro Area unemployment rate from 2005 to 2022



Source: Graph compiled by the author using data sourced from Macrotrends (2024)

⁵ The choice of this country is not random as explained by the author, as it is a representative sample of countries facing financial problems after subprime crisis in 2008 and thus, experienced an important number of bank defaults.

Article 9 of the Treaty on the Functioning of the European Union (2012) states that the European Union (EU) should take account of the objective of a high level of employment when defining and implementing all its policies and activities. The EU countries have set a set of common objectives and targets, also known as the European Employment Strategy (EES), for employment policies to combat unemployment and to create more and better jobs in the EU (Eumonitor, 2023).

2.4 Chapter 4: Other macroeconomic variables impacting NPLs

In this chapter, we will highlight other variables that may affect the level of non-performing loans. Several studies have been conducted regarding the determinants of asset quality. The factors identified as significant in explaining the behavior of the NPLs ratio can be classified into two main groups. The first group focuses on external events, including overall macroeconomic conditions relative to the country the entity operates in, which are likely to impact the ability of borrowers to repay their loans. The second focuses on specific variables, internal to each entity, that result from their operations. In this paper, we mainly focus on macroeconomic variables. The relationship between the macroeconomic environment and non-performing loans has been studied in the context of different phases of the business cycle. According to several authors, credit risk is strongly linked to the state of the economy in the different business cycle phases (Koopman & Lucas, 2005; Pesaran et al., 2006).

2.4.1 Economic growth

Among many studies, empirical evidence links the macroeconomic environment to credit quality. Research mostly shows a negative relationship between the quality of assets and the dynamics of economic growth (Castro, 2013; Ciukaj & Kil 2020; Messai & Jouini 2013). During challenging times, firms and households are more likely to default on their loans. Inversely, during expansionary phases of the business, firms and consumers have sufficient income streams to service their debts, resulting in low NPLs (Louzis et al., 2012). A slowdown in the economy increases NPLs, while growth in gross domestic product (GDP) creates employment opportunities, leading to rise in income of borrowers and therefore, reduces NPLs (Koju et al., 2018). Kozarić & Dzelihodzic (2020) state that

improvements in macroeconomic conditions such as GDP growth is associated with improved credit quality. Mazreku et al. (2018) and Beck et al. (2015) both suggest GDP as having a strong relationship with NPLs. The empirical study of Cortés and Soriano (2024) also suggests that GDP is related to household's ability to meet their obligations, given that expansionary phase of the economy is associated with higher incomes to repay debts and lower NPLs levels.

2.4.2 Government debt

In the literature, it was argued that higher public debt also is associated with an increase in non-performing loans (Louzis et al., 2012). Koju et al. (2018) explain that higher public debt reduces the supply of loans in the market, causing interest rates to rise. This increases the cost of borrowing and reduces the likelihood that loans will be repaid on time, leading to higher NPLs. In line with these studies, the empirical evidence of Ghosh (2015) suggests that public debt in the US significantly contributes to higher NPLs. In the same line, Makri et al. (2014) find a positive relationship correlation between NPLs and public debt, highlighting that fiscal problems in Eurozone countries could lead to a significant increase in problem loans.

2.4.3 Exports

One of the variables that can affect the level of NPLs is the level of exports. According to Clichici and Colesniova (2014, as cited by Mazreku et al., 2018, p6), decline in exports should lead to a fall in company revenues and therefore companies face a lower ability to repay their credit. Inversely, with the increase in exports, economic activity in the country increases resulting in stable cash flows for individuals, firms, and banks. Festic et al., (2011) conduct an analysis on Central and Eastern Europe and conclude that an increase in the exports of these economies improves the NPLs ratio, while the slowdown in growth in export-oriented industries contributes to economic contraction with a direct impact on the sustainability of banking sector results in these countries.

2.4.4 Housing prices

Another variable that is likely to affect the level of non-performing loans is housing prices. When house prices increase, the value of their collateral also increases, which reduces the likelihood of a default (Castro, 2013). Ghosh (2015) points out that changes in the state of US housing price index reduce NPLs. Another paper (Tajik et al., 2015) studies the impact of house price fluctuations and credit risk, measured by NPLs, using a panel of US banks. Authors find that the quality of loan portfolios is extremely sensitive to house price fluctuations, highlighting that falling house prices are closely associated with higher default rates. The authors explain this by suggesting that house prices improve borrowers' ability to service debt, while falling house prices may reduce the value of underlying collaterals and lead to higher default rates.

2.4.5 Inflation

The relationship between non-performing loans and inflation is not straightforward in the literature. On the one hand, some studies suggest that inflation may reduce NPLs by reducing the real value of debt, making it easier for borrowers to service their loans. (Dimitrios et al., 2016; Mazreku et al., 2018; Szarowska 2018). For example, Koju et al. (2018) analyse 30 Nepalese banks over the period 2003-2015 and find a negative relationship between inflation and NPLs, attributing it to the decrease in the real worth of loans, facilitating borrower repayment.

On the other hand, other studies support the opposite view. (Skarica, 2014) find that inflation negatively affects banks' asset quality. The author confirms her hypothesis that high inflation may pass through to nominal interest rates, which can make debt repayment challenging due to the reduced real income of borrowers when wages do not adjust quickly in response to changes in prices. In the same line, Ghosh (2015) finds a positive impact of inflation on NPLs for commercial banks in the US suggesting that without matching increases in nominal income, inflation reduces borrowers' income, which may adversely affect their ability to repay loans.

3. Methodology

3.1 Hypothesis

The following hypothesis has been drawn for this study:

- *There is a positive relationship between unemployment and non-performing loans.*

In the literature, we mentioned that higher unemployment suggested to be translated into less income, therefore, borrowers are more likely to face difficulties in debt servicing which could affect the level of non-performing loans. Given these considerations, variation we expect a positive relationship between unemployment and NPLs.

3.2 Data and sample

This study aims to examine the relationship between unemployment and non-performing loans. We use panel data from 20 euro area countries including Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Greece, Germany, Italy, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Spain, Slovenia, and the Slovak Republic based on annual frequency for 2008-2021. Initially, we gathered data starting from 2004 to 2022. However, due to several missing data regarding the dependent variable, NPLs, we had to remove years between 2004-2007, as well as 2022. We extract the data on the dependent variable, NPLs, from the World Bank data, which offers time series data that allows for cross-country comparison. The indicator of asset quality is modeled at the macroeconomic level from the consolidated balance sheet of each country's banking sector. The data for the rest of the variables is obtained from World Bank data and OECD. A description of the variables and data source can be found in table 1.

There is no standardized approach to analyze factors influencing NPLs in the literature. Authors use both aggregate and disaggregated data for similar investigations. Nevertheless, we consider aggregated data on NPLs. The choice is motivated by the fact that data on NPLs for individual banks are available for a few economies. In addition, according to Boudriga et al. (2009), aggregate data for the whole banking system of each country reflects best the level of NPLs because of the reduced risk of non-representativeness of the sample, compared to individual data because they suffer from the problem of representativeness bias as selecting some individual banks may not accurately represent the overall banking sector. According to Ghosh (2015) Studies based on bank-by-bank, while very useful in a micro-prudential context, cannot study the impact

of cross-state differences concerning structural characteristics on asset quality. Moreover, exploiting cross-state variation in NPLs trends is likely to yield more robust results than an analysis of bank-level data or individual states. Hence, my analysis will focus on a macro-level perspective.

Table 1: Description of variables and data sources

Variable	Description	Source
<u>Dependent variable</u>		
NPL	Share of non-performing loans to total bank loans (loans more than 90 days past due).	World bank data
<u>Explanatory variable</u>		
Unemployment	Share of the labour force that is without work but available for and seeking employment, expressed as a percentage.	World bank data
<u>Control variables⁶</u>		
GDP growth	Annual percentage growth rate of gross domestic product.	World bank data
Inflation	Consumer price index (expressed as an annual percentage).	World bank data
Exports	Export of goods and services expressed as percentage of GDP.	World bank data
House price	Real house price ⁷ , adjusted to inflation, is the ratio of the nominal house price index to the consumers' expenditure deflator in each country from the OECD national accounts database.	OECD
Government debt	General government debt ⁸ measures the gross debt of the general government as a percentage of GDP	OECD

Source: summary of data source used by authors based on World Bank and OECD.

In the countries under study, the descriptive statistics (table 2) show an average rate of 7.275% for the dependent variable, NPLs. This rate varies significantly across countries so it is important to highlight that this rate is not representative of the sample. For instance, some countries' NPLs are almost 0%, while others like Cyprus or Greece, indicate having serious problems with NPLs, reaching up to 47.75%. Regarding the key

⁶ The justification of all the control variables is explained in the literature review.

⁷ Similarly used as (cortés & Soriano, 2024).

⁸ Similarly used as (Naili & Lahrachi, 2022; louzis et al., 2012; Dimitrios et al., 2016).

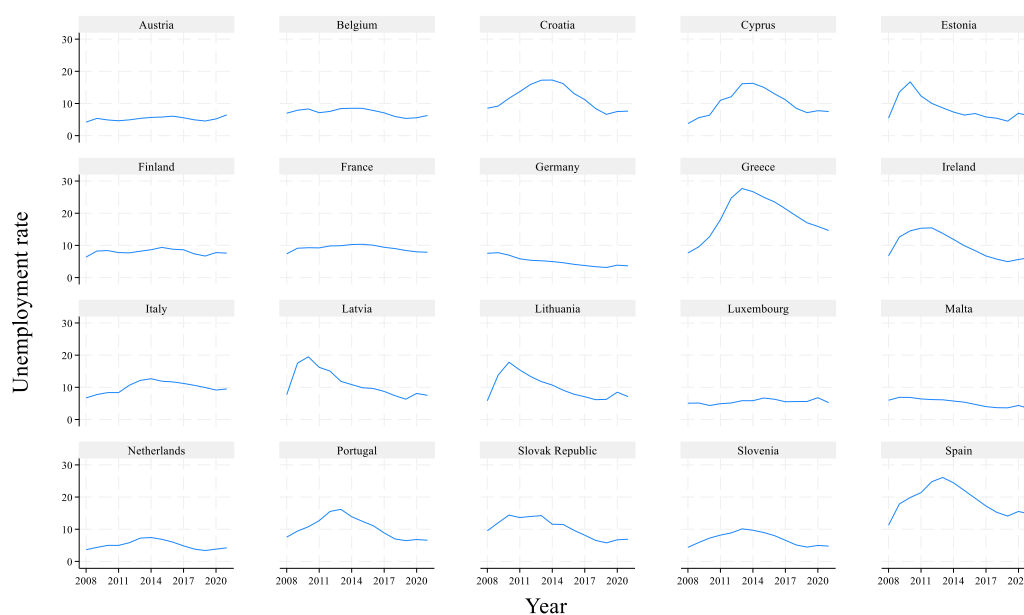
explanatory variable, unemployment, the average rate is 9.356%. Similarly to NPLs, unemployment rates vary across selected countries with a minimum of 4.484% and a maximum of 27.69%. Regarding control variables, inflation, GDP growth, exports, government debt, and house price index, the descriptive statistics show an average of 1.584%, 1.320%, 69.13%, 90.93%, and 110.4%, respectively. In addition, tables 3 and 4 shows patterns related to unemployment and non-performing loans for selected countries separately.

Table 2 : Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
NPL	271	7.275	8.575	0.150	47.75
Inflation	280	1.584	1.866	-4.480	15.40
GDP growth	280	1.320	4.506	-14.84	24.48
Unemployment	280	9.356	4.848	3.140	27.69
Exports	280	69.13	41.62	19	213.2
Government debt	224	90.93	42.35	17.10	237.4
House price index	238	110.4	16.92	77	164.9

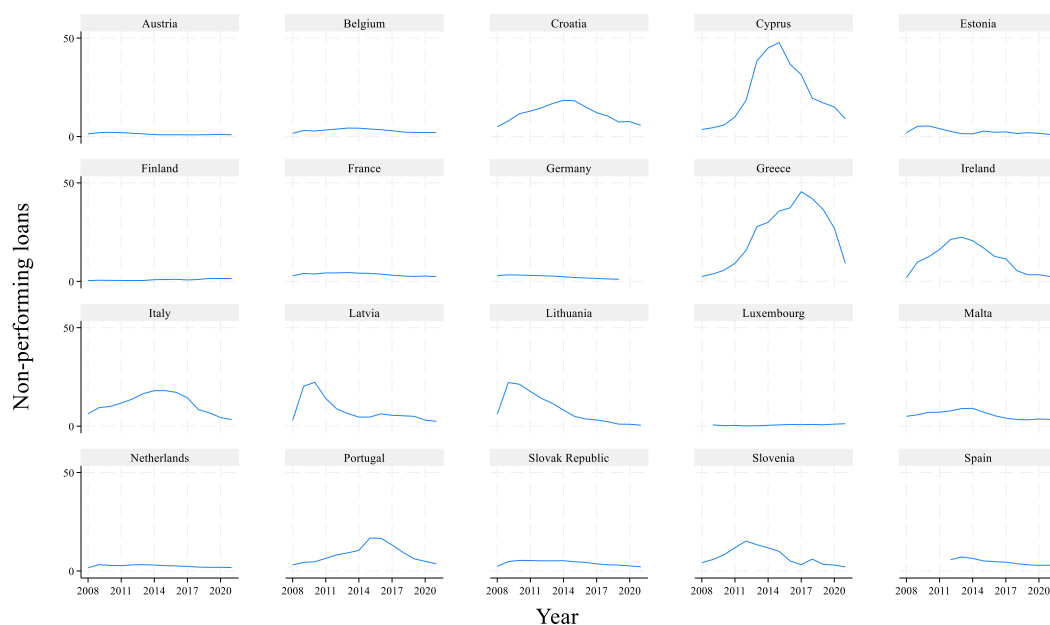
Source: compilation of author on Stata

Figure 2: Patterns of unemployment



Source: compilation of author on Stata

Figure 3: Patterns of non-performing loans



Source: compilation of author on Stata

3.3 Empirical framework

The purpose is to find to what extent the level of aggregate NPLs varies with the unemployment level. We conduct our analysis by considering traditional panel data estimators, similarly used by Skarica, (2014) and Messai & Jouini (2013). We start with a regression analysis using pooled OLS with year-fixed effects, followed by the two-way fixed effects (2FE) model. The methodological steps are explained below. All the regressions are conducted in STATA.

3.3.1 Tests

Before proceeding with regressions, we use robust standard errors clustered at the country level to control heteroskedasticity and autocorrelation in the error term. To see details regarding p-values, see appendix 3, 4, 5, and 6 for the following tests respectively:

- To see whether economic cycles (years) play a role in our regression we use the joint test for years-fixed effects. We obtain a p-value below 5%, which means that we reject the null hypothesis that years do not affect the relation we are estimating. Therefore, we will consider the year-fixed effect in our models.

- Next, we use the Breusch-Pagan test to determine whether the variance of the error term is constant (homoscedastic). We obtain a p-value of less than 0.05, so we reject the null hypothesis, indicating that the variance of the error term is constant. As it is not our case, it means that heteroskedasticity is present in our data.
- To test for serial correlation, we use Wooldridge's test, as used by Naili and Lahrichi (2022). The null hypothesis tells us that there is no autocorrelation. After conducting Wooldridge's test, we obtained a p-value below 5%, leading us to reject the null hypothesis, which indicates the presence of autocorrelation.
- I assess multicollinearity as well using Variance Inflation Factor (VIF), to examine whether explanatory variables are correlated with each other. VIF value below 5 is acceptable to indicate that multicollinearity is not problematic (James et al., 2021). We obtain a low correlation coefficient, of less than 5, between the different explanatory variables meaning that we can include all variables in our regression.

3.3.2 Pooled OLS with year-fixed effects

I start by estimating the long-run association between unemployment and NPLs using pooled Ordinary Least Squares (OLS) regression, with year-fixed effects to focus on cross-country and historical variation while controlling for time-related shocks. Using the pooled OLS without year-fixed effects does not control economic cycles, this is why we chose to use year-fixed effects to obtain more robust estimations. We present the result through three regression models. First, we start by including only the explanatory variable, unemployment, in our equation (1). Then, to enhance the robustness of the coefficient, we add three control variables notably, GDP growth, inflation, and exports (2). Finally, we add the last two control variables, notably house price, and government debt, separately from the previous three control variables. We include these control variables separately because of the omission of four countries⁹ from the analysis due to missing data. The equation of the pooled OLS model is as follows:

⁹ Omitted countries for house prices and government debt are Cyprus, Croatia, Estonia, and Malta.

$$NPL_{it} = \beta_0 + \beta_1 Unemployment_{it} + \mathbf{z}_{it}\boldsymbol{\phi} + \delta_t + \varepsilon_{it}$$

i denotes individuals¹⁰, cross-section dimension whereas t denotes time¹¹, time-series dimension. NPL_{it} is the dependent variable representing non-performing loans. β_0 is the intercept term. β_1 represents the coefficient of the explanatory variable, unemployment. \mathbf{z}_{it} is a vector that includes control variables, notably, GDP growth, inflation, exports, house prices, and government debt. $\boldsymbol{\phi}$ corresponds to the vector of coefficients corresponding to the control variables in \mathbf{z}_{it} . δ_t represents the time-fixed effects, capturing time-specific influences. ε is the error term.

Next, we conduct two additional tests, the Chow test to decide between pooled OLS with year-fixed effects and two-way FE, and the Hausman test to determine whether country-fixed effects are correlated with explanatory variables. To see details regarding p-values, see appendix 7 and 8 for the following tests respectively:

- We use the Chow test to determine if time-invariant, unobserved heterogeneity exists at the country level by indicating whether intercepts are identical across countries (Pineda-Hernandez et al. 2022). It helps to decide between choosing pooled OLS and fixed effects. The null hypothesis suggests that there is nothing specific to countries that could influence the regression in the short run so we can use the pooled OLS. We obtain a p-value below 5%, meaning we reject the null hypothesis. Therefore, the preferred model for our analysis is the fixed effect which enables to capture time-invariant information specific to each country.
- To confirm our model choice between random effects and fixed effects, we conduct the Hausman (1978) test. Although the random effect model is statistically more efficient than the fixed effects model, it requires two conditions to be met (Clarke et al., 2010). First, in our case, the correlation between unemployment and the country's fixed effect must be 0 (Baltagi, 2018). Second, the country-fixed effects must follow an

¹⁰ 20 countries from the euro area.

¹¹ From 2008-2021.

empirical homogenous distribution¹². Since neither condition is met, we can not choose the RE model, so we opt for fixed effects.

3.3.3 Two-way Fixed Effects

Heterogeneity may play a significant role in panel data analysis and if it is not addressed, results may be biased. A useful model that controls heterogeneity across countries is the fixed effects (FE) model, allowing us to focus on country-level variations. The FE model assumes that the omitted variable effects in the model are correlated with the included variables (endogeneity). To address the omitted-variable bias problem, the FE model allows the absorption of unobserved effects, capturing time-constant (time-invariant) individual heterogeneity (Brüderl & Ludwig, 2015). In addition, the joint test indicated that economic cycles (years) can impact our results, therefore, we use a two-way fixed effects 2FE model which allows us to account for both country-specific effects and time-fixed effects. The equation of the 2FE model is as follows:

$$(NPL_{it} - \overline{NPL}_i) = \beta_1(Unemployment_{it} - \overline{Unemployment}_i) + (\mathbf{z}_{it} - \overline{\mathbf{z}}_i) \boldsymbol{\phi} + \delta_t + (\varepsilon_{it} - \overline{\varepsilon}_i)$$

i denotes individuals, cross-section dimension, whereas t denotes time, time-series dimension. NPL_{it} is the dependent variable representing non-performing loans. β_1 is the coefficient of the explanatory variable, unemployment. \mathbf{z}_{it} is a vector that includes control variables, notably, GDP growth, inflation, exports, house price, and government debt. $\boldsymbol{\phi}$ corresponds to the vector of coefficients corresponding to the control variables in \mathbf{z}_{it} . ε is the error term. δ_t represents the time-fixed effects, capturing time-specific influences. The country-specific is captured by the subtraction of the mean, so \overline{NPL}_i , $\overline{Unemployment}_i$, $\overline{\mathbf{z}}_i$ and $\overline{\varepsilon}_i$ corresponds to the average values of the dependent variable, explanatory variable, control variables, and error term respectively.

4. Results

Regarding the pooled OLS with year-fixed effects estimation results (table 2), we observe that when we include only unemployment in the regression (1), in the long-run, when the unemployment increases by one percentage point, the NPLs increase by 1.152 percentage points. It is positively and significantly (at 1%) correlated with the level of NPLs. We mentioned in the literature review that there might be other macroeconomic variables

¹² See appendix 8.

that may influence the level of NPLs. Therefore, In the second equation (2), we add three control variables to limit bias notably, GDP growth, inflation, and exports. After including these variables, the coefficient has slightly increased (1.161), is still significant (at 1%), and is positively correlated with NPLs. Finally, in the last equation (3), we added two additional variables for which four countries, notably Croatia, Cyprus, Estonia, and Malta have been omitted due to missing data. The coefficient has decreased (0.925) but is still positively and significantly (at 5%) correlated with NPLs.

Table 3: Long-run dynamics: Pooled OLS with year-fixed effects

VARIABLES	(1)	(2)	(3)
	Percentage of non-performing loans		
Unemployment	1.152*** (0.391)	1.161*** (0.402)	0.925** (0.393)
<u>Control variables</u>			
Inflation		-0.940 (0.676)	0.285 (0.401)
GDP growth		-0.019 (0.171)	0.094 (0.181)
Exports		0.018 (0.020)	0.045 (0.028)
Government debt			0.076* (0.036)
Real house prices			-0.004 (0.061)
Observations	271	271	215
Adjusted R-squared	0,39	0,41	0,52
Number of countries	20	20	16
Year FE	Yes	Yes	Yes

Notes: Robust standard errors in parentheses, which are clustered at the country level. ***

p<0.01, ** p<0.05, * p<0.1. In column (3), the following countries are not included due to missing data for debt and house prices: Croatia, Cyprus, Estonia, and Malta. Definitions of all variables used in this regression analysis are presented in table 1.

Nevertheless, we cannot say the reason why the coefficient has decreased. It can either be due to the inclusion of control variables or missing observations due to omitted countries. In conclusion, we conclude that unemployment in the long run is positively and significantly associated with non-performing loans. In other words, higher unemployment is linked to higher NPLs which can be explained by the fact that as unemployment can be translated by less income, households may have more difficulties servicing their debt, which can therefore lead to higher NPLs, as suggested in the literature (Louzis et al., 2012; Messai & Jouini, 2013). Government debt is also positively and significantly (at 10%) correlated with NPLs in the last equation (3). When the debt increases by one percentage point, NPLs increase by 0.076 percentage points. Suggesting that higher debt can reduce the supply of loans in the market, causing interest rates to rise which increases the cost of borrowing and reduces the probability that the loan will be repaid on time, as stated by Koju et al. (2018). The adjusted R squared for the three regressions are 40%, 41%, and 52% respectively. This means that in the last equation, 52% of the variance of NPLs is explained by the model. The definitions of all the variables used in this regression analysis are presented in table 1.

However, we must be cautious regarding the interpretation of pooled OLS estimations. It is important to remind that this model does not address heterogeneity across the country as it does not consider pre-existence differences, so any unobserved heterogeneity was averaged (Greene, 2020). It considers the endogenous variable to be homogeneous for all countries in the sample, meaning that they have the same intercept and slopes (Boudriga et al., 2009). This is not the case for the NPLs variable, which differs across countries and years. Therefore, it may not be good to capture the relationship between a dependent variable and predictor variable when heterogeneity across countries is present. The results of this model may be based on the difference between countries and not on the variation across countries. So, comparing different countries in the long term may be problematic and results may be biased and inconsistent.

Table 4: Short-run dynamics: Two-way Fixed-effects

VARIABLES	(1)	(2)	(3)
	Percentage of non-performing loans		
Unemployment	1.515*** (0.301)	1.515*** (0.295)	1.130*** (0.195)
<u>Control variables</u>			
Inflation		-0.052 (0.321)	0.403 (0.286)
GDP growth		0.019 (0.161)	0.062 (0.144)
Exports		-0.006 (0.054)	0.052 (0.047)
Government debt			0.123*** (0.039)
Real house prices			-0.023 (0.067)
Observations	271	271	215
Within R-squared	0.529	0.529	0.582
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

Notes: Robust standard errors in parentheses, which are clustered at the country level. *** p<0.01, ** p<0.05, * p<0.1. In column (3), the following countries are not included due to missing data for debt and house prices: Croatia, Cyprus, Estonia, and Malta. Definitions of all variables used in this regression analysis are presented in Table 1.

Regarding the two-way fixed effects (table 4) results, we can see that the coefficient of unemployment is positive and statistically significant at 1% in the three equations. When unemployment increases by one percentage point from one year to the next, NPLs increase by 1.515 percentage points in the first equation (1). Then, we add control variables in the second equation (2) that are suggested to also influence the level of NPLs

based on the literature, notably GDP growth, inflation, and exports. The coefficient of unemployment is still positive and significant (at 1%) with a value of 1.515. This means that when unemployment increases by one percentage point from one year to the next, the dependent variable NPLs increase by 1.515 percentage points. Regarding the third equation (3), when we include the last two additional control variables, house prices, and government debt, we see that the coefficient of unemployment decreases slightly (1.130), suggesting that there was an omitted variable bias in the first two equations, so the coefficient was overestimated. In this case, unemployment is positively and statistically (at 1%) associated with the level of NPLs when explanatory variables increase from one year to the next. We confirm our hypothesis stating that higher unemployment makes debt repayment challenging due to less income associated with unemployment, as suggested in the literature (Louzis et al., 2012; Messai & Jouini, 2013). Once again, we must be prudent in the interpretation of the last equation (3) because we do not know if the decreased coefficient of unemployment is due to the inclusion of additional control variables or missing observation of house prices and government debt. Government debt is also positively and significantly correlated with NPLs at 1% in equation (3). A one percentage point increase in debt corresponds to a 0.123 percentage point increase in NPLs from one year to the next. This relation can be explained by the fact that rising debt may restrict loan availability on the market, leading to higher interest rates and increased borrowing costs. Consequently, there is a higher likelihood of loan default, as noted by Koju et al. (2018). Also, the within R-squared for the last equation (3) is 0.582 indicating that the model explains 58.2% of within-country variations of the dependent variable, NPLs.

The 2FE estimation is more appropriate than pooled OLS as heterogeneity differs across countries (Greene, 2020). However, it's important to note that caution is needed when interpreting the final results. The estimations may still be affected by potential endogeneity issues. The fixed effects model assumes the hypothesis of strict exogeneity meaning that regressors are uncorrelated with the error term and that the error term is not correlated with any past value of regressors (Brüderl & Ludwig, 2015). But most of the time this is not the case. The explanatory variable is most of the time correlated with the error, so we are likely to have endogeneity. So, if we have endogeneity, it means that there might still be other omitted variables in the regression equation or it can be due to

reverse causality, meaning that the dependent variable, NPLs may affect unemployment too (Bruna, et al., 2022). Therefore, a causal relationship between unemployment and NPLs cannot be concluded because of the endogeneity bias. We can only claim that from one year to the next there is a positive association between unemployment and NPLs.

5. Conclusion

High levels of non-performing loans are considered as a threat to the financial stability of banks. Regulators need to ensure the soundness of banks, as they can affect the entire economy due to their lending activities. Meanwhile, unemployment is likely to result in lower incomes, causing borrowers to face difficulties in servicing their debt obligations and increasing the likelihood of default, which can lead to higher levels of NPLs. Therefore, it is important for regulators to continue to fight against unemployment and to stimulate employment growth.

In this paper, we extended the existing literature by examining the relationship between a specific variable, unemployment, and non-performing loans, while controlling for other macroeconomic variables in the euro area over the period 2008-2021. We assessed both the long-run relationship, pooled OLS with year-fixed effects, and the short-run relationship, two-way fixed effects. Although both estimations provided similar results, based on various tests, we give more consideration to the second model, the two-way fixed effects, which is more appropriate in our case as it control heterogeneity across countries and economic cycles.

The empirical evidence confirms our hypothesis that unemployment is positively associated with NPLs. We can conclude that when unemployment increases by one percentage point from one year to the next, NPLs increase by 1.130 percentage points. It is positively and statistically significantly associated at 1% with the level of NPLs. This relationship can be explained by the fact that a higher level of unemployment is associated with less income. Therefore, borrowers who face more difficulties in servicing their debts are more likely to default, leading to a higher probability of higher NPLs, as suggested in the literature (Louzis et al., 2012; Mazreku et al., 2018; Messai & Jouini 2013).

6. Limitations

It is important to mention limitations of our study. One of the assumptions for consistency of the fixed effects estimator is the strict exogeneity, meaning that regressors are uncorrelated with the error term, and the error term must not be correlated with any past value of regressors (Brüderl & Ludwig, 2015). However, this is not true in most cases, so

there might be a violation of these conditions leading to endogeneity issues. Endogeneity may be caused by missing control variables in the regression equation or by reverse causality, indicating that the NPLs may affect unemployment too (Bruna, et al., 2022). Therefore, we cannot conclude that there is a causal relationship between unemployment and NPLs because fixed effects models are subject to endogeneity and results may be biased. Our analysis only indicates that from one year to the next, when unemployment increases by one percentage point, NPLs increase by 1.130 percentage points. Ullah et al. (2018) explain that the cause-and-effect relationship of a phenomenon can be dynamic over time. Meaning that it may not be the current year's explanatory variable that is affecting the dependent variable, but the previous year's independent variable that could have a significant impact on it.

A method we could use in future research to better control sources of endogeneity, particularly unobserved heterogeneity, simultaneity (inverse causality), and dynamic endogeneity, is the General Method of Moments (GMM) model, introduced by Manuel Arellano and Stephen Bond (1991), a model that further extends the fixed effects estimations. This model addresses endogeneity by using lagged values of both dependent and exogenous variables as instruments Beck et al. (2015).

7. Bibliography

- Albulescu, C. T. (2015). Banks' Profitability and Financial Soundness Indicators: A Macro-level Investigation in Emerging Countries. *Procedia Economics and Finance*, 23, 203–209. [https://doi.org/10.1016/S2212-5671\(15\)00551-1](https://doi.org/10.1016/S2212-5671(15)00551-1)
- Aliu, M., & Çollaku, B. (2021). Impact of Non-Performing Loans on Bank s Profitability: Empirical Evidence from Commercial Banks in Kosovo. *Journal of Accounting, Finance and Auditing Studies*, 7(3), 226–242. <https://doi.org/10.32602/jafas.2021.027>
- Allen, W. A., & Wood, G. (2006). Defining and achieving financial stability. *Journal of Financial Stability*, 2(2), 152–172. <https://doi.org/10.1016/j.jfs.2005.10.001>
- Anastasiou, D., Louri, H., & Tsionas, M. (2019). Nonperforming loans in the euro area: Are core–periphery banking markets fragmented? *International Journal of Finance and Economics*, 24(1), 97–112. <https://doi.org/10.1002/ijfe.1651>
- Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, 58(2), 277–297. <https://doi.org/10.2307/2297968>
- Baltagi, B. H. (2018). Fixed Effects and Random Effects. In *The New Palgrave Dictionary of Economics* (pp. 4786–4790). Palgrave Macmillan UK. https://doi.org/10.1057/978-1-349-95189-5_2713
- Beck, R., Jakubik, P., & PiloIU, A. (2015). Key Determinants of Non-performing Loans: New Evidence from a Global Sample. *Open Economies Review*, 26(3), 525–550. <https://doi.org/10.1007/s11079-015-9358-8>
- Bindseil, U., & Fotia, A. (2021). *Introduction to Central Banking* (1st Edition 2021, pp. xxiii–128). Springer Nature. <https://doi.org/10.1007/978-3-030-70884-9>

- Boudriga, A., Boulila Taktak, N., & Jellouli, S. (2009). Banking supervision and nonperforming loans: a cross-country analysis. *Journal of Financial Economic Policy*, 1(4), 286–318. <https://doi.org/10.1108/17576380911050043>
- Brüderl, J., & Ludwig, V. (2014). Fixed-Effects Panel Regression. In *The SAGE Handbook of Regression Analysis and Causal Inference* (pp. 357–357)
- Bruna, M. G., Ben Lahouel, B., & Gaies, B. (2022). Dans les brumes de l'endogénéité. Une étude critique des relations entre performance sociétale et performance économique. *Management & Sciences Sociales*, N° 33(2), 99–115. <https://doi.org/10.3917/mss.033.0099>
- Castro, V. (2013). Macroeconomic determinants of the credit risk in the banking system: The case of the GIPSI. *Economic Modelling*, 31, 672–683. <https://doi.org/10.1016/j.econmod.2013.01.027>
- Ciukaj, R., & Kil, K. (2020). DETERMINANTS OF THE NON-PERFORMING LOAN RATIO IN THE EUROPEAN UNION BANKING SECTORS WITH A HIGH LEVEL OF IMPAIRED LOANS. *Economics and Business Review*, 6(1), 22–45. <https://doi.org/10.18559/ebr.2020.1.2>
- Clarke, P., Crawford, C., Steele, F., & Vignoles, A. (2010). The Choice Between Fixed and Random Effects Models: Some Considerations for Educational Research. *IDEAS Working Paper Series from RePEc*.
- Cortés, D., & Soriano, P. (2024). Analysis of macroeconomic determinants of non-performance in consumer and mortgage loans. *Finance Research Letters*, 61, 104939. <https://doi.org/10.1016/j.frl.2023.104939>
- Crockett, A. (1996). The theory and practice of financial stability. *De Economist (Netherlands)*, 144(4), 531–568. <https://doi.org/10.1007/BF01371939>

Dimitrios, A., Helen, L., & Mike, T. (2016). Determinants of non-performing loans: Evidence from Euro-area countries. *Finance Research Letters*, 18, 116–119.

<https://doi.org/10.1016/j.frl.2016.04.008>

European Central Bank (2016). *What are non-performing loans (NPLs)*. on

<https://www.ecb.europa.eu/ecb-and-you/explainers/tell-me/html/npl.en.html>

consulted 17 February 2024

European Central Bank (2024a). Non-performing loans. *European Central Bank*. Online

<https://www.bankingsupervision.europa.eu/banking/priorities/npl/html/index.en.html#:~:text=ECB%20supervisors%20therefore%20closely%20monitor,structures%20and%20processes%20in%20place>

consulted on 4 May 2024

European Central Bank (2024b). Aggregated results of SREP 2023. *European Central Bank*. Online

https://www.bankingsupervision.europa.eu/banking/srep/2023/html/ssm.srep202312_aggregatedresults2023.en.html

consulted on 3 April 2024

EU Monitor (2023). Reducing unemployment : EU policies explained. *Eu Monitor*. Online

<https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vkzoneq2mdzh?ctx=vg9id54xf7rx>

consulted on 3 May 2024

Eur-Lex (2012). CONSOLIDATED VERSION OF THE TREATY ON THE FUNCTIONING OF

THE EUROPEAN UNION. *Official Journal of the European Union*. Online [https://eur-](https://eur-lex.europa.eu/resource.html?uri=cellar:2bf140bf-a3f8-4ab2-b506-fd71826e6da6.0023.02/DOC_2&format=PDF)

[lex.europa.eu/resource.html?uri=cellar:2bf140bf-a3f8-4ab2-b506-](https://eur-lex.europa.eu/resource.html?uri=cellar:2bf140bf-a3f8-4ab2-b506-fd71826e6da6.0023.02/DOC_2&format=PDF)

[fd71826e6da6.0023.02/DOC_2&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:2bf140bf-a3f8-4ab2-b506-fd71826e6da6.0023.02/DOC_2&format=PDF) consulted on 3 May 2024

Eurostat (2021). Euro area unemployment at 7.5%. *Eurostat*. Online

[https://ec.europa.eu/eurostat/documents/2995521/11563287/3-30092021-](https://ec.europa.eu/eurostat/documents/2995521/11563287/3-30092021-AP-EN.pdf/82040a37-de8f-4112-2f9c-65645098cb2a)

[AP-EN.pdf/82040a37-de8f-4112-2f9c-65645098cb2a](https://ec.europa.eu/eurostat/documents/2995521/11563287/3-30092021-AP-EN.pdf/82040a37-de8f-4112-2f9c-65645098cb2a) consulted on 28 April

2024

- Festić, M., Kavkler, A., & Repina, S. (2011). The macroeconomic sources of systemic risk in the banking sectors of five new EU member states. *Journal of Banking & Finance*, 35(2), 310–322. <https://doi.org/10.1016/j.jbankfin.2010.08.007>
- Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, 20, 93–104. <https://doi.org/10.1016/j.jfs.2015.08.004>
- Goyal, S., Singhal, N., Mishra, N., & Verma, S. K. (2023). The impact of macroeconomic and institutional environment on NPL of developing and developed countries. *FUTURE BUSINESS JOURNAL*, 9(1), 45–15. <https://doi.org/10.1186/s43093-023-00216-1>
- Greene, W. H. (2020). *Econometric analysis* (Eighth, Global edition). Pearson.
- Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica*, 46(6), 1251–1271. <https://doi.org/10.2307/1913827>
- Houben A., Kakes J & Schinasi G (2004). Toward a Framework for Safeguarding Financial Stability. *IMF Working Paper*, 4(101), 1. <https://doi.org/10.5089/9781451852547.001>
- International Labour Organization (2019). QUICK GUIDE ON INTERPRETING THE UNEMPLOYMENT RATE. *Department of Statistics*. https://webapps.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_675155.pdf
- International Monetary Fund. Statistics Dept. (2019). *Financial Soundness Indicators Compilation Guide 2019*. USA: International Monetary Fund. Retrieved May 1, 2024, from <https://doi.org/10.5089/9781484396209.069>

- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning: With Applications in R* (Second edition.). Springer.
<https://doi.org/10.1007/978-1-0716-1418-1>
- Kadioglu, E., Telceken, N., & Ocal, N. (2017). Effect of the Asset Quality on the Bank Profitability. *International Journal of Economics and Finance*, 9(7), 60.
<https://doi.org/10.5539/ijef.v9n7p60>
- Kilimova, L., & Nishnianidze, O. (2017). Socio-demographic characteristics as indicators of the unemployment rate. *Ekonomichnyĭ Chasopys*, 168(11-12), 82–85.
<https://doi.org/10.21003/ea.V168-17> Kilimova 2018 [ea-V168-17.pdf](https://doi.org/10.21003/ea.V168-17)
- Koju, L., Koju, R., & Wang, S. (2018). Macroeconomic and Bank-Specific Determinants of Non-Performing Loans: Evidence from Nepalese Banking System. *Journal of Central Banking Theory and Practice (Podgorica)*, 7(3), 111–138.
<https://doi.org/10.2478/jcbtp-2018-0026>
- Koopman, S. J., & Lucas, A. (2005). Business and default cycles for credit risk. *Journal of Applied Econometrics (Chichester, England)*, 20(2), 311–323.
<https://doi.org/10.1002/jae.833>
- Kozaric, K., & Dzelihodzic, E. Z. (2020). Effects of Macroeconomic Environment on Non-Performing Loans and Financial Stability: Case of Bosnia and Herzegovina. *Journal of Central Banking Theory and Practice*, 9(2), 5–17.
<https://doi.org/10.2478/jcbtp-2020-0011>
- Lawrence, E. C. (1995). Consumer Default and the Life Cycle Model. *Journal of Money, Credit and Banking*, 27(4), 939–954. <https://doi.org/10.2307/2077781>
- Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of

- mortgage, business and consumer loan portfolios. *Journal of Banking & Finance*, 36(4), 1012–1027. <https://doi.org/10.1016/j.jbankfin.2011.10.012>
- Macrotrends (2024). Euro Area Unemployment Rate 1960-2024. *Macrotrends*. Online [Euro Area Unemployment Rate 1960-2024 | MacroTrends](#) consulted on 4 May 2024
- Makri, V., Tsagkanos, A., & Bellas, A. (2014). Determinants of non-performing loans: The case of Eurozone. *Panoeconomicus*, 61(2), 193–206. <https://doi.org/10.2298/PAN1402193M>
- Mazreku, I., Morina, F., Misiri, V., Jonathan, & Grima, S. (2018). Determinants of the Level of Non-Performing Loans in Commercial Banks of Transition Countries. *European Research Studies*, XXI (Issue 3), 3–13. <https://doi.org/10.35808/ersj/1040>
- Meeker, L. G., & Gray, L. (1987). A note on non-performing loans as an indicator of asset quality. *Journal of Banking & Finance*, 11(1), 161–168. [https://doi.org/10.1016/0378-4266\(87\)90028-8](https://doi.org/10.1016/0378-4266(87)90028-8)
- Messai, A. S., & Jouini, F. (2013). Micro and Macro Determinants of Non-performing Loans. *International Journal of Economics and Financial Issues*, 3(4), 852–860.
- Naili, M., & Lahrichi, Y. (2022). Banks' credit risk, systematic determinants and specific factors: recent evidence from emerging markets. *Heliyon*, 8(2), e08960–e08960. <https://doi.org/10.1016/j.heliyon.2022.e08960>
- OECD (2024). General government debt. Online <https://data.oecd.org/gga/general-government-debt.htm> consulted on 24 April 2024
- OECD (2024). Housing prices (indicator). Online <https://data.oecd.org/price/housing-prices.htm> consulted on 24 April 2024

OECD (2024). Trade in goods and services (indicator). Online

<https://data.oecd.org/trade/trade-in-goods-and-services.htm> consulted on 24 April 2024

Pesaran, M. H., Schuermann, T., Treutler, B.-J., & Weiner, S. M. (2006). Macroeconomic Dynamics and Credit Risk: A Global Perspective. *Journal of Money, Credit and Banking*, 38(5), 1211–1261. <https://doi.org/10.1353/mcb.2006.0074>

Pineda-Hernández, K., Rycx, F., & Volral, M. (2022). How collective bargaining shapes poverty: New evidence for developed countries. *British Journal of Industrial Relations*, 60(4), 895–928. <https://doi.org/10.1111/bjir.12693>

Schinasi, G. (2004). *Defining Financial Stability*. IMF Working Paper (04/187). International Monetary Fund.

Skarica, B. (2014). Determinants of non-performing loans in Central and Eastern European countries. *Financial Theory and Practice*, 38(1), 37–59. <https://doi.org/10.3326/fintp.38.1.2>

Syed, A. A., & Tripathi, R. (2019). Non - Performing Loans in BRICS Nations : Determinants and Macroeconomic Impact. *Indian Journal of Finance*, 13(2), 22. <https://doi.org/10.17010/ijf/2019/v13i2/141684>

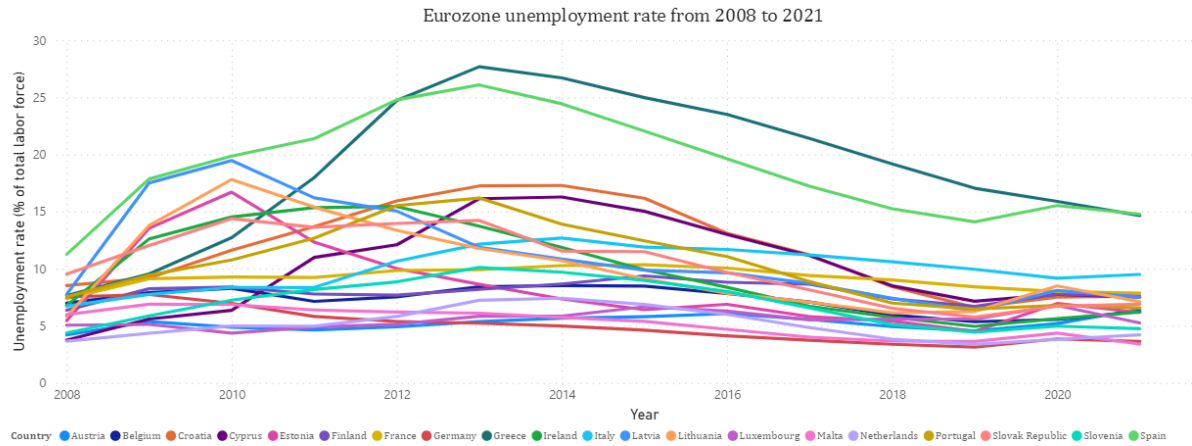
Szarowska, I. (2018). Effect of macroeconomic determinants on non-performing loans in Central and Eastern European countries. *International Journal of Monetary Economics and Finance*, 11(1), 20–35. <https://doi.org/10.1504/IJMEF.2018.090564>

Tajik, M., Aliakbari, S., Ghalia, T., & Kaffash, S. (2015). House prices and credit risk: Evidence from the United States. *Economic Modelling*, 51, 123–135. <https://doi.org/10.1016/j.econmod.2015.08.006>

- Ullah, S., Akhtar, P., & Zaefarian, G. (2018). Dealing with endogeneity bias: The generalized method of moments (GMM) for panel data. *Industrial Marketing Management*, 71, 69–78. <https://doi.org/10.1016/j.indmarman.2017.11.010>
- Wang, C.-J. (2010). The Instrument Variable Approach to Correct for Endogeneity in Finance. In *Handbook of Quantitative Finance and Risk Management* (pp. 1357–1369). Springer US. https://doi.org/10.1007/978-0-387-77117-5_90
- World Bank (2024). Bank nonperforming loans to total gross loans (%). Online <https://data.worldbank.org/indicator/FB.AST.NPER.ZS> consulted on 19 April 2024
- World Bank (2024). GDP growth (annual%). Online <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?view=chart> consulted on 20 April 2024
- World Bank (2024). Inflation, consumer prices (annual %). Online <https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG> consulted on 20 April 2024
- World Bank (2024). Unemployment, total (% of total labor force) (modeled ILO estimate) – Belgium. Online <https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?locations=BE&start=2008> consulted on 27 February 2024

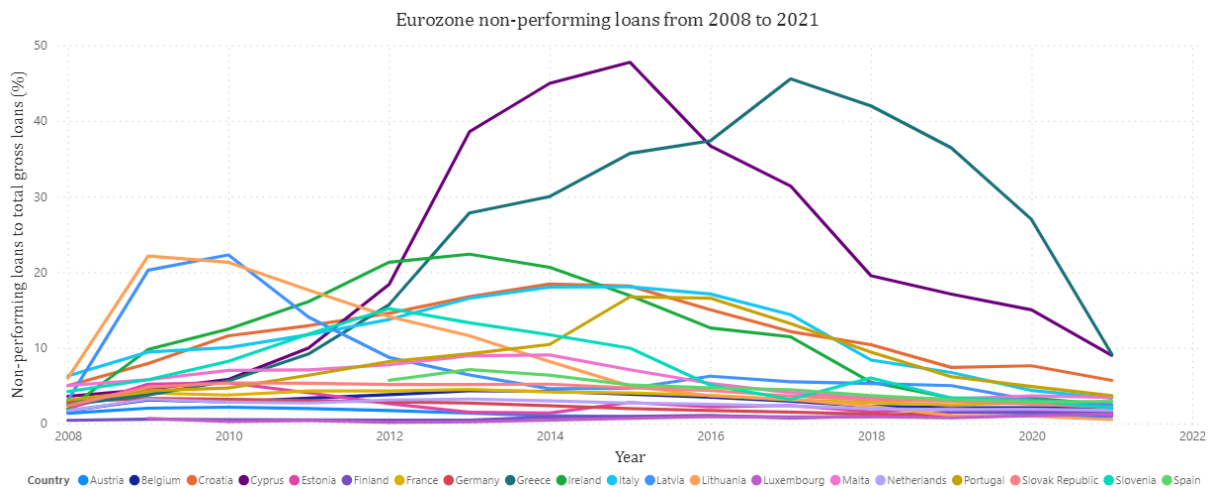
8. Appendix

Appendix1: Euro area unemployment rate from 2008 to 2021



Source: Author compilation based on World Bank data source

Appendix2: Euro area non-performing loans from 2008 to 2021



Source: Author compilation based on World Bank data source

Appendix3: Joint test for time-fixed effects

H0: Years do not have an impact in the regression model.

H1: Years do have an impact in the regression model.

F (13, 180)	2.02
Prob > F	0.0211

Appendix4: Breusch-Pagan test for heteroskedasticity

H0: Variance of error is identical for each observation (homoscedasticity). (constant variance)

H1: variance of error differs for each observation (heteroskedasticity).

Chi-square	181.12
Prob > Chisquare	0.0000

Appendix5 : Serial correlation, Woolridge test

H0: no autocorrelation

H1: autocorrelation

F (1,15)	88.078
Prob > F	0.0000

Appendix 6: Multicollinearity

VIF=1 complete absence of collinearity

VIF value exceeding 5 or 10 is considered as problematic (James et al., 2021)

Mean VIF	2.55
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Appendix 7: Chow test

H0: fixed effects are identical across countries (same intercepts).

H1: fixed effects are not identical across countries (different intercepts).

F (19, 234)	18.14
Prob > F	0.0000

Appendix 8: Hausman test

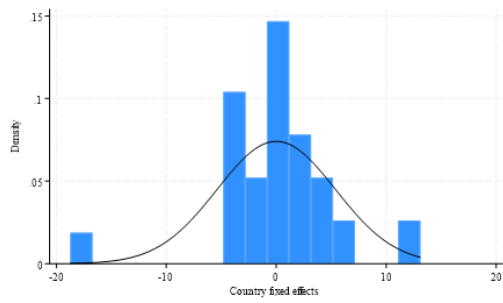
The random model is better than the fixed effects if 2 conditions are met:

- H0: no correlation between country-specific error and regressors. In our case, $\text{corr}(\text{Unemployment}, \text{country fixed effects}) = 0$

H1: correlation between country-specific error and regressors

	Un	FE
Un	1.0000	
FE	-0.2888	1.0000

- Country-fixed effects follow an empirical homogenous distribution.



The black line represents homogenous distribution.

Abstract:

This paper examines the relationship between unemployment and non-performing loans. Recognized as a major threat to bank financial stability, non-performing loans are closely monitored by the European Central Bank as they can have a significant impact on the soundness of the European banking system. Meanwhile, unemployment is argued to be associated with lower income, leading borrowers to face difficulties in servicing debt obligations. We use econometric methods to examine this relationship on panel data from 20 euro area countries for the period 2008-2021 while controlling for several macroeconomic variables. We analyze both long-run dynamics, using pooled OLS with year-fixed effects and short-run dynamics, using two-way fixed effects. We found a positive and significant relationship between unemployment and non-performing loans. However, due to potential endogeneity bias, we cannot establish a causal relationship between unemployment and NPLs, and a further methodological approach is needed to address this issue.

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