INSTITUTO POLITÉCNICO DE LISBOA
INSTITUTO SUPERIOR DE CONTABILIDADE
E ADMINISTRAÇÃO DE LISBOA

THE IMPACT OF NEGATIVE INTEREST RATES AND COVID-19 ON THE PROFITABILITY OF EURO AREA BANKS

Inês Nunes Faria

Lisboa, janeiro de 2023

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Dissertação submetida ao Instituto Superior de Contabilidade e Administração de Lisboa para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Análise Financeira, realizada sob a orientação científica de Especialista Mestre José Nuno Teixeira de Abreu de Albuquerque Sacadura, professor adjunto convidado.

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Mais acrescento que tenho consciência de que o plágio - utilização de elementos alheios sem referência ao seu autor - constitui uma grave falta de ética, que poderá resultar na anulação da presente dissertação.

"Unprecedented times call for unprecedented measures"

President Russel M. Nelson

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RESUMO

Com dados bancários anuais de 37 bancos da Zona Euro, supervisionados diretamente pelo Mecanismo Único de Supervisão do Banco Central Europeu, esta dissertação estuda o impacto da Política de Taxas de Juro Negativas na rendibilidade dos bancos da Zona Euro e analisa se a recente pandemia tem influência nesse mesmo impacto. Os nossos dados compreendem o período entre 2010 e 2021, abrangendo o período antes e após a introdução das taxas de juro negativas e o surgimento da pandemia do COVID. Esta dissertação utiliza uma metodologia de efeitos fixos, usando a Rendibilidade Líquida dos Ativos como medida de rendibilidade bancária. Os resultados sugerem que os bancos aparentam estar a compensar as suas perdas com juros, embora seja também sugerido que o sentimento de mercado aponte para um aumento das taxas de juro e para uma recessão económica no horizonte. Embora os resultados desta dissertação estejam de acordo com vários estudos prévios na área, demonstrando evidências mistas sobre o impacto das taxas de juro negativas na rendibilidade dos bancos, os mesmos revelam que o COVID-19 não teve nenhum impacto significativo.

Palavras-chave: Taxas de Juro Negativas; COVID-19; Rendibilidade Bancária; Área Euro

ABSTRACT

Using annual bank level data for 37 Euro Area banks directly supervised by the Single Supervisory Mechanism from the European Central Bank, this dissertation studies the impact of the Negative Interest Rate Policy on the profitability of the Euro Area banks and analyses if the recent pandemic has an influence on this impact. Our data set comprehends the period of 2010 to 2021, covering the period before and after the introduction of negative interest rates and the appearance of the COVID pandemic. This dissertation uses a fixed-effects methodology with Return on Assets as a proxy to bank profitability. Our findings suggest that banks seem to have been compensating their interest losses, although it is hinted that market sentiment is that interest rates will increase, and an economic recession will follow. While our results are in line with other studies and provide mixed evidence regarding the impact of the negative interest rates on bank profitability, it revealed that COVID-19 did not have a significant impact.

Keywords: Negative Interest Rates; COVID-19; Bank Profitability; Euro Area

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LIST OF ABBREVIATIONS AND ACRONYMS

Table 1 - List of abbreviations and acronyms

Abbreviation/ Acronym	Meaning
ABS	Asset Backed Securities
APP	Asset Purchase Program
DFR	Deposit Facility Rate
ECB	European Central Bank
GDP	Gross Domestic Product
GFC	Global Financial Crisis
NIRP	Negative Interest Rate Policy
ROA	Return on Assets
ROE	Return on Equity
DFR	Deposit Facility Rate
TLTRO	Targeted Long-Term Refinancing Operations

INTRODUCTION

Since the global financial crisis, many European banks have been struggling with low profitability, while the economy has been facing low levels of inflation.

Following Danmarks Nationalbank, the European Central Bank took a striking move in June 2014 aiming at battling low inflation and lowered its deposit facility rate into negative territory for the first time. Further rate cuts followed, reaching its bottom of -0.5 on September 2019.

Although these monetary decisions were complemented with several complementary policies, the discussion of its impact on the financial system and on bank profitability is still cause of some dispute. While negative interest rates can fuel the economy and increase inflation, the transmission channels might be compromised if interest rates are kept negative for long. Furthermore, negative interest rates put pressure on banks' interest margins, which might compromise banks' profits that were already low in the Euro Area.

In March 2020, the new health pandemic reached Europe and rapidly spread, locking down countries and strangling economies. Uncertainty became a constant, as the disease progressed, and new variants kept appearing. The problematic of economic recovery became more urgent due to the persisting uncertainty, and further questions regarding the potential consequences for banks emerged (OECD, 2021).

The aim of this dissertation is to shed further lights on the impact of negative interest rates on Euro Area bank profitability and ascertain if COVID-19 has worsened or improved this impact. We firstly contribute to the existing literature on bank profitability, but also to two recent branches: negative interest rates and COVID-19 impact on the banking system, respectively.

With a dataset of 37 banks from 12 Euro Area countries over the period of 2010 to 2021, this dissertation uses a panel data method to analyse the impact of negative interest rates and COVID-19 on the profitability of Euro Area banks. Our analysis provided some mixed evidence of negative interest rates impact on banks' profits and revealed that COVID did not have a significative impact.

A remainder of this dissertation proceeds as follows: contextualization chapter provides a general overview of the implementation of the negative interest rates policy and the appearance of COVID-19 and its impacts on the economy. Past studies chapter reviews

several past studies on bank profitability, the impact of negative interest rates on banks' profits and the impact of COVID-19 on the banking system. The Methodology chapter outlines the data, variables and model used, followed by the Results chapter, in which we describe this dissertation main findings. Finally, the last chapter presents the main conclusions and provides some ideas for future research.

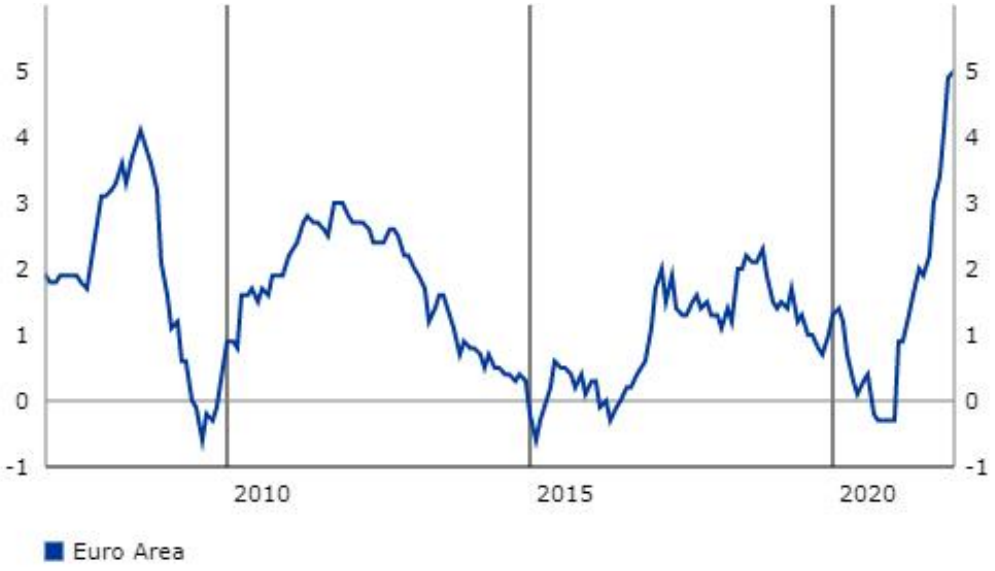
CONTEXTUALIZATION

IMPLEMENTATION OF NEGATIVE INTEREST RATES POLICY AND ITS IMPACT ON THE FINANCIAL SYSTEM

European Central Bank (ECB) role is to keep prices stable, as it is crucial for sustainable economic growth. To do so, ECB influences inflation by setting interest rates. By definition, an interest rate is the amount charged by a lender to a borrower, as a percentage of the amount loaned, for the use of an asset. As such, if inflation has been high, ECB would increase interest rates, in order to influence an increase in savings by making borrowing more expensive. Contrarily, if the goal is to increase inflation, ECB cuts interest rates.

Since the global financial crisis, the Euro Area has been struggling with low inflation (Figure 1) and to counteract this, in June 2014 ECB took an unprecedented move cutting its deposit facility rate (DFR) by 10 basis points into negative territory. This decision was part of a combination of a set of measures, such as an asset purchase programme (APP), aiming to ensure price stability over the medium term. Since then, further cuts of 10 basis points have been made, having a DFR of -0.5 since 18th of September 2019. Figure 2 in Appendix I shows the yearly interest rate environment in the Euro Area from 2010 to 2021.

Figure 1 - Euro Area Inflation rate from January 2007 to December 2021



Source: European Central Bank, Statistical Data Warehouse

Danmarks Nationalbank was the first central bank that lowered its policy rate into negative territory back in July 2012. Others central banks soon followed interest rate cuts into negative territory, such as Sweden, Switzerland, Japan, and the Euro Area. The reasons for the adoption of NIRP are however different between central banks. Some decided to cut their rates in order to address currency appreciation pressures (Denmark and Switzerland), while others adopted NIRP to increase inflation (Euro Area, Japan and Sweden) (Jobst & Lin, 2016).

Negative interest rates may seem counterintuitive, as it penalizes savers by paying the bank to keep their money, and benefit borrowers, since borrowing money is cheaper. Normally, commercial banks hold deposits at their central bank to settle interbank transactions and to meet the legal minimum reserve requirements and receive interests or a "deposit rate" for their excess reserves. During NIRP, commercial banks are instead being charged by their central banks for hoarding cash.

However, it is expected real economic growth and therefore an increase in inflation through the combination of the four main channels of monetary transmission, presented below:

- Interest rate channel: cutting policy rates reduces the rates at which banks manage their borrowing and lending activities, reducing money market rates and bond yields. Keeping rates low for long could also flatten the yield curve. These effects might encourage household and firms to increase spending and investment, through loans, as real interest rates and borrowing costs are expected to decrease (Arteta & Stocker, 2016; Honda & Inoue, 2019; Scheiber et al., 2016; Urbschat, 2018);

- Portfolio (or wealth) channel: interest rates and asset prices are inversely correlated. Therefore, lowering interest rates will increase asset prices, which in turn can prompt wealth effects, supporting investment and growth (Arteta & Stocker, 2016; Scheiber et al., 2016; Urbschat, 2018).

- Exchange rate channel: with a decline on domestic interest rates relative to foreign rates, euro's exchange rate is expected to depreciate, discouraging capital inflows and encourage external demand (Arteta & Stocker, 2016; Jobst & Lin, 2016; Scheiber et al., 2016; Urbschat, 2018);

- Credit channel: as NIRP amounts to a tax on excess liquidity hoarding, making it more expensive for banks to have high reserves, it is expected an increase in lending (Arteta

& Stocker, 2016). Moreover, with the expected positive economic outlook created, credits should have lower probability of default (Urbschat, 2018).

Despite the possible negative consequences on bank profits, the changes in interest rates are expected to significantly improve the economic conditions, such as lower unemployment rates, higher house prices and faster GDP growth that it will outweigh the negative impact on banks (Genay & Podjasek, 2014).

Nonetheless, there are some risks associated with NIRP if rates drop substantially below zero or if NIRP is employed for a prolonged period of time, as the transmission channels of monetary policy may have limitations under NIRP.

Those risks include the decrease of profitability of banks and other financial intermediaries and an imprudent increase of risk-taking, which could contribute to the formation of asset prices bubbles. Banks may try to maintain their interest margins, as well as hesitate to pass-on negative rates to their clients, to prevent a shift to cash or other assets, which would lower their deposit base. Lastly, banks may charge higher lending rates to compensate their expected losses with negative interest rates (Arteta & Stocker, 2016).

To mitigate these risks, ECB implemented complementary policies, such as favourable refinancing conditions for banks and expanded asset purchases, as per Table 2 below. The Targeted Long-term Refinancing Operations (TLTRO) program seems to be the most relevant for banks' profitability, as it can be seen as subsidized borrowing. TLTRO program allows banks to borrow at zero or negative fixed interest rates, depending on their expansion of credit to the private sector. Depending on banks' size of excess reserves and new refinancing operations, if banks increase their lending enough to get full interest rate discount on their TLTRO borrowing, the effect of the negative DFR can be evened out (Arteta & Stocker, 2016).

Table 2 - NIRP announcements and complementary measures

DATE	DFR	COMPLEMENTARY POLICIES ANNOUNCED
JUNE 2014	-0.1	2-year TLTRO. Preparation for ABS (Asset Backed Securities) Purchase Program.
SEPTEMBER 2014	-0.2	Modification of some ABS Purchase Program requirements.
DECEMBER 2015	-0.3	APP extension. Reinvestment of the principal payments on the securities purchased under the APP.
MARCH 2016	-0.4	Monthly purchases under APP expansion. TLTRO II with 4-year maturity.
SEPTEMBER 2019	-0.5	Net purchases restarted under APP. Continuing the reinvestments of the principal payments from maturing securities purchased under the APP. Improved TLTRO III. Two-tier system for reserve remuneration to be introduced.

Source: European Central Bank

COVID-19 PANDEMIC

In December 2019, the first known case of Coronavirus disease was identified in China and has since then spread rapidly worldwide, creating the most recent and unprecedented health crisis. In less than 50 days since the first positive case found in Europe, the World Health Organization declared Europe as the epicentre of the pandemic (Nebehay, 2020), with Italy being the first country to introduce a national lockdown.

Due to its easy transmission, severe symptoms, mortality rate and novelty, governments started implementing measures to help contain the disease and ease the strains on the health system. Such measures ranged between travel bans, mandatory confinement, or even complete shutdown of cities.

Unsurprisingly, COVID has had an immensely negative impact on the world's economy and the consequential global recession is already expected to be the greatest setback since the Great Depression (OECD, 2021). Euro Area countries had a significant decline of its GDP, especially the most affected countries, such as Italy and Spain (Table 3).

Table 3 - Real GDP growth rate

	2019		2020		2021	
EURO AREA - 19 COUNTRIES	1,6		-6,4		5,3	
BELGIUM	2,1		-5,7	p	6,3	p
GERMANY	1,1	p	-4,6	p	2,9	p
ESTONIA	4,1		-3,0		8,3	
IRELAND	4,9		5,9		13,5	
GREECE	1,8	p	-9,0	p	8,3	p
SPAIN	2,1	p	-10,8	p	5,1	p
FRANCE	1,8	p	-7,9	p	7,0	p
ITALY	0,5		-9,0		6,6	
CYPRUS	5,3		-5,0		5,5	p
LATVIA	2,5		-3,8		4,7	
LITHUANIA	4,6		-0,1		5,0	
LUXEMBOURG	3,3		-1,8		6,9	
MALTA	5,9		-8,3		9,4	
NETHERLANDS	2,0		-3,8	p	5,0	p
AUSTRIA	1,5		-6,7		4,5	
PORTUGAL	2,7		-8,4	p	4,9	p
SLOVENIA	3,3		-4,2		8,1	
SLOVAKIA	2,6		-4,4		3,0	
FINLAND	1,2		-2,3		3,5	
LEGEND						
(P) PROVISIONAL						

Source: Eurostat, 2022.

The pandemic has created high instability and volatility in global capital markets. Banking stocks suffered huge drops on price: Euro STOXX banks index had a decline of 40% in 2020. Moreover, the uncertainty has raised the price of market funding for banks in the euro area and has complicated their access to funding (Koskinen, 2020).

Although the banking system has entered this pandemic with greater resilience to shock due to the reforms implemented since the global financial crisis (Berger et al., 2021), OECD's report from 2021 alerts the banking sector's vulnerabilities prior to the pandemic: low capital ratios and profitability (OECD, 2021).

Firstly, it is expected that banks with a regulatory capital ratio marginally above the minimum regulatory requirements may need to replenish their the capital buffer, to avoid the risk of bank deleveraging, which could restrict credit intermediation, as erosion of the capital base is expected due to the increase of loan losses not covered by reserves (OECD, 2021). Secondly, low profitability has been a persistent issue in the European banking system since the global financial crisis (GFC), suggesting that banks will have less income available to offset losses during this crisis (OECD, 2021).

Nonetheless, the gained resilience from the measures put into place following the GFC has been improved since the pandemic due to governmental interventions through fiscal and monetary policies, that have supported businesses and individuals and reduced the pandemic impact on the banking system (Berger et al., 2021), by ensuring that households and companies have sufficient funds available, by encouraging spending and investment. These relief measures include buying bonds directly from banks, increasing their funds available for lending, and from companies, providing them with more credit, and offering long-term loans at favourable conditions to banks that keep lending and less strict rules on the assets banks give as collateral (European Central Bank, 2020). A timeline for the monetary policy measures can be found on Appendix II Figure 3.

Although vaccinations are already in place, new strains of coronavirus keep appearing, maintaining the uncertainty for the future. It is, therefore, expected that COVID, along with the negative interest rate scenario, is further reducing the banking profitability. It is therefore of the essence to assess the impact of the COVID-19 pandemic on the banking system.

LITERATURE REVIEW

DETERMINANTS OF BANK PROFITABILITY

The literature on the determinants of bank profitability is quite broad. Since the early work of Short (1979) and Bourke (1989), many empirical studies have tried to identify and measure the main drivers that influence the profitability of banks, differentiating between cross-country evidence (Abreu & Mendes, 2002; Albertazzi & Gambacorta, 2009; Borroni et al., 2016; Bourke, 1989; Demirgüç-Kunt & Huizinga, 1999; Elekdag et al., 2020; Gambacorta et al., 2014; Kok et al., 2015; Kryeziu & Hoxha, 2021; Martinho et al., 2017; Molyneux & Thornton, 1992; Petria et al., 2015; Short, 1979; Staikouras & Wood, 2004) and others regarding individual countries' performances (Athanasoglou et al., 2008; Barros & Borges, 2011; Dietrich & Wanzenried, 2011; Garcia & Guerreiro, 2016; Mota et al., 2019; Pires et al., 2021).

Scholars proxy bank performance as the return on equity (ROE) and the return on assets (ROA). While ROE represents the net return of capital invested by the shareholders, but disregards the risks derived from leverage, the latter measures how much profit a bank is generating from its capital. Nonetheless, ROA does not consider the existence of the off-balance-sheet assets, which are an important source of profit for European banks (Athanasoglou et al., 2008; Petria et al., 2015).

Bank profitability is regularly expressed as a function of internal and external determinants. Internal determinants refer to factors that are influenced by the bank's management decision and policy objectives, while external are influenced by events outside the influence of the bank and reflect the economic and legal environment that also affects the performance and operation of banks (Athanasoglou et al., 2008; Staikouras & Wood, 2004).

Results tend to differ significantly upon data, sample, period, and estimation model used. Nonetheless, below will be presented some important results found by the existing literature.

INTERNAL DETERMINANTS OF BANK PROFITABILITY

Although it may be discussed that larger banks may benefit from economies of scale, the impact of size on bank profitability is not consensual. Short (1979) defends that bank size is closely related to its capital adequacy, raising cheaper capital, therefore appearing more profitable. (Demirgüç-Kunt & Huizinga, 1999) also found evidence that supports a positive

impact on profitability. Other empirical studies have found a negative (Kok et al., 2015) or even insignificant effect (Athanasoglou et al., 2008; Petria et al., 2015; Pires et al., 2021).

Capital ratio is considered an important driver of bank profitability, as it measures capital adequacy and captures the soundness of banks (Staikouras & Wood, 2004). Not surprisingly, the capital ratio is associated with higher profitability, since well-capitalized banks are able to pursue business opportunities more efficiently (Athanasoglou et al., 2008; Kok et al., 2015). However, Petria et al. (2015) found that capital adequacy impact is not statically significant on ROE, but it positively impacts ROA, although with low significance.

Efficiency, oftentimes measured by the cost-to-income ratio, is another important determinant of bank profitability. The lower the ratio, i.e., as lower bank's operating costs are compared to their income, the more efficient a bank is. As such, the ratio is considered to be negatively related to profitability (Garcia & Guerreiro, 2016; Kok et al., 2015; Petria et al., 2015), as empirical evidence suggests that efficiency is positively linked to profitability (Athanasoglou et al., 2008; Elekdag et al., 2020; Mota et al., 2019; Petria et al., 2015).

With data from 98 internationally active banks over the period of 1994 to 2012, Gambacorta et al. (2014) found that income diversification is positively correlated to bank profitability, although only up to a certain point. Notwithstanding, others have argued that diversification has a negative relationship with profitability, implying that banks who rely more on non-interest income have lower profitability (Garcia & Guerreiro, 2016; Kok et al., 2015; Mota et al., 2019).

According to Athanasoglou et al. (2008), low levels of liquidity and poor asset quality are the major causes of bank failure, therefore risk management is of high importance in the sector. Considering this, risk can be split up into credit and liquidity risk.

Using a panel regression and a quantile regression analysis focusing on large euro banks, Elekdag et al. (2020) findings suggest that one of the most reliable determinants of bank profitability is the non-performing loans ratio, proxy to credit risk. The literature suggests that credit risk negatively affects banks' profitability, since banks exposed to higher-risk loans may incur in higher loan losses (Athanasoglou et al., 2008; Kok et al., 2015). With a data set of 18 major banks in Portugal over the period of 2015-2018, using loan loss impairment over overdue loans as a proxy for credit risk, Pires et al. (2021) has found credit risk not to be statistically relevant.

Banks with proper liquidity levels should meet their obligations as well as withstand possible stress events that can appear. Considering this, Molyneux & Thornton (1992) found a negative, but weak, relationship of liquidity ratios with profitability, as liquidity holdings may represent a cost to banks. Contrarily, Bourke (1989), Kryeziu & Hoxha (2021) and Pires et al. (2021) found a positive effect, which suggests that banks that are more liquid can provide opportunities for greater returns.

Using loans to customer deposits ratio as a proxy to liquidity risk, Petria et al. (2015) finds a negative relationship with profitability, defending that the more the ratio increases, i.e., when banks use less deposits to concede loans or concede more loans without increasing their deposits, the more profitability declines.

EXTERNAL DETERMINANTS OF BANK PROFITABILITY

Analysing 60 banks from Canada, Western Europe and Japan, Short (1979) found evidence that suggests that the higher the concentration, the greater the profitability. Bourke (1989) and Molyneux & Thornton (1992) also found that concentration is positively related to pre-tax ROA, however this relationship changes to negative when one of the measures of value added are used as dependent value in the equations. Studying the factors affecting 19 Euro Area countries, Kryeziu & Hoxha (2021) have found Herfindhal-Hirschman Index, a proxy of market concentration, to be insignificant, while Athanasoglou et al. (2008) finds concentration to negatively affect bank profitability, but with insignificant effect.

Unlike Short (1979) and Bourke (1989) that found that state-owned banks are negatively correlated with profitability, Molyneux & Thornton's (1992) findings suggest that banks owned by the government are more profitable, but argues their sample includes a larger proportion of government-owned banks than Bourke (1989) and Short's (1979) analysis. With a bank data for 80 countries over the period of seven years, Demirgüç-Kunt & Huizinga (1999) found that ownership of banks impacts significantly bank profitability, claiming that foreign banks have higher profitability in developing countries, and are less profitable in industrial countries. More recently, Athanasoglou et al. (2008) and Dietrich & Wanzenried's (2011) results suggest that ownership is irrelevant.

Higher expected inflation rates increase bank profitability due to the increase of the loan interest rates, while unexpected rises of inflation might increase the financing costs and

therefore has the opposite effect. Demirgüç-Kunt & Huizinga (1999) finds the relationship to be positive with profitability; profitability increases more with inflation than bank costs. Their results are consistent with Albertazzi & Gambacorta (2009) and Athanasoglou et al. (2008), while Kok et al. (2015) and Petria et al. (2015) results suggest that inflation is insignificant.

Economic growth, expressed by the GDP *pc* growth, is a factor that naturally affects bank profitability. Some empirical evidence shows that GDP growth is positively related to profitability (Albertazzi & Gambacorta, 2009; Athanasoglou et al., 2008; Demirgüç-Kunt & Huizinga, 1999; Dietrich & Wanzenried, 2011; Kryeziu & Hoxha, 2021; Martinho et al., 2017; Mota et al., 2019; Petria et al., 2015), while other argue that the relationship is negative (Garcia & Guerreiro, 2016; Staikouras & Wood, 2004) or insignificant (Pires et al., 2021). Alongside with credit risk, Elekdag et al. (2020) finds economic growth to be one of the most reliable long term drivers of Euro bank's profitability. Even so, when studying the impact of macroeconomic variables on European banks' profitability between 2001 and 2015, Martinho et al. (2017) results suggest that the decrease in bank profitability since 2007 is greatly explained by the interest rates, considering that GDP growth has improved over the years.

According to Borio et al. (2015), monetary policy is primarily operated through the short-term rate, controlled by central banks, and more indirectly influencing the yield curve. Interest rates tend to have a relevant impact on bank profitability, although it may differ between banks depending on their level of interest rate risk and their exposure to short and long-term interest rates (Martinho et al., 2017).

Using nominal interest rates as a proxy for capital scarcity, Short (1979) found a positive relationship with profitability. Later on, Bourke (1989) suggested that the use of real interest rates might have been more appropriate and with them, confirmed the positive relationship. Several other studies (Demirgüç-Kunt & Huizinga, 1999; Molyneux & Thornton, 1992; Staikouras & Wood, 2004) have also confirmed this positive relationship between the level of short-term interest rates and profitability.

According to Kok et al. (2015) the slope of the yield curve is expected to have a positive relationship with bank's profitability due to higher interest income from maturity transformation activities. Exploring the link of monetary policy on bank profitability, Borio et al. (2015) found that both short-term rate and the slope of the yield curve have a positive effect on net interest income, loan loss provisions and return on assets, while having a negative impact on non-interest income.

Analysing Portuguese bank's profitability, Garcia & Guerreiro (2016) found interesting results: the yield curve had a negative impact during 2002 and 2011, and a positive impact during the crisis period (2008 to 2011), concluding that Portuguese banks have adapted well and corrected previous errors.

Nonetheless, recent literature has been discussing how changes in interest rates affect banks' performance as since the global financial crisis, interest rates have been low for many advanced economies.

Although low short-term interest rates and a flat yield curve decrease bank profitability, it is expected that the better economic outcomes that it fuels (such as faster GDP growth) will outweigh the negative impact and their net effect is expected to be positive on bank profitability (Genay & Podjasek, 2014), low interest rates for a long period of time may erode bank's performance, as low interest rates are commonly associated with lower margins. By analysing a sample of 3385 banks from 47 countries from the period of 2005 to 2013, Claessens et al. (2018) results confirm this association: low levels of interest rates decreases net interest margins and profitability (although impact is less strong) and that this negative effect is greater the longer the interest rates are kept at low levels.

With a dynamic panel model, Bikker & Vervliet (2018) studied the impact of low interest rates on both bank profitability and risk-taking for the United States banking sector, from 2001 to 2015, partially confirming that low interest rates erode bank profitability. Bikker & Vervliet (2018) found that although net interest margins are compressed under low interest rates, US banks were able to maintain their level of profits. As such, it is found that banks did not increase their risk-taking as there was no need to compensate the reduced net interest income. Nevertheless, they also found that US banks lowered their lever of credit loss provisioning, denoting that their buffer against credit losses is lower.

While some results may be contradictory, these are only regarding normal times, with positive, and in some cases, low (but positive) interest rates. In the next section, we will present empirical evidence regarding the impact of negative interest rates on bank profitability.

IMPACT OF NIRP ON BANK PROFITABILITY

Granted negative interest rates are unprecedented and therefore raise questions about their potential side effects not only on the economy, but also on the banking system, Scheiber et al. (2016) explored it risks by investigating the development of banks in Denmark, Sweden and Switzerland. Hitherto, ultra-low and negative interest rates did not result in a significant fall in profitability or net interest income, noting that banks decrease in interest expenses was greater than in interest income. Scheiber et al. (2016) warns however, that if negative interest rates are employed for a long period of time, banks profitability may decrease.

In order to perceive if in fact banks operate differently in times of negative policy rates compared to positive, Demiralp et al. (2017) used a panel fixed-effect regression with monthly individual euro area bank balance sheet information, with results confirming that banks negatively reacted to the NIRP and that their reaction depends on their business model. As such, banks that heavily rely on deposit funding reduce their excess liquidity in order to fund more loans; investment banks use their excess liquidity, and some even adjust using loans, to minimize their use of wholesale funding, while wholesale funded banks increase their government bond portfolios.

With a dataset of 1600 German banks, Urbschat (2018) also found that business model plays a crucial role on how banks behave under negative interest rates territory, stating that although German banks have performed well during the first years, as banks have not faced a huge cost burden from negative interest rates, but have benefited from lower refinancing costs and lower loan loss provisions, NIRP has only had a mild effect on profits. Moreover, Urbschat (2018) finds evidence that banks do not increase their risk-taking strategy by reducing their lending standards or granting excessive amounts of credit. Nonetheless, most German banks do not benefit from increased fees income nor from capital gains due to its country conservative accounting law, noting that only some larger banks may have profited from capital gains following the increase of asset prices. As such, Urbschat (2018) concludes that if interest rates remain negative and the yield curve continues to flatten, banks will be negatively affected and an indicator for this is that banks with high deposit ratios have decreased their lending.

Using a difference-in-difference methodology, Molyneux et al. (2019) find that bank margins and profits decreased in countries that adopted NIRP compared to countries that did not adopt this policy, and this adverse effect is stronger for banks that lend within national

borders, weakly hedge against interest rate risk, operate in competitive systems and where floating loan rates predominate, that have "interest-oriented" business models, are real estate and mortgage specialists, well capitalised and small banks, as results suggest that larger banks can mitigate the negative effect of NIRP on their margins and profits by switching their business models, hedging and lending diversification, while it is far harder for smaller banks to do the same. Results also elucidate that the low inflation since the global financial crisis affects positively bank performance.

In order to compare the period of low but positive interest rates with the period of negative ones on the net interest rate margin of euro area banks, Stráský & Hwang (2019) use quarterly bank level data for 50 banking groups supervised by the Single Supervisory Mechanism from 1999 to 2018. As such, Stráský & Hwang (2019) find weak evidence of negative impact of NIRP on bank profitability, as the negative effect is stronger on the components of interest income but tend to disappear when conditioned by macroeconomic variables.

With a differences-in-differences methodology, investigating the impact of NIRP on banks from 27 European and Asian countries, Lopez et al. (2020) found that, thus far, bank profitability has not been affected by NIRP, having even a weak evidence of a positive effect of negative nominal interest rates on bank profitability. While bank's net interest income decrease, with losses on both lending income and "other" interest income, these losses are compensated by the significant increase in net non-interest income, including fees and commissions. At the same time, larger banks reduced other interest expenses and banks that rely less on deposits have greater results under NIRP compared to banks with banks that have high deposits.

Analysing the impact of low (but positive) and negative market interest rates on euro banks' NIM, Klein (2021) findings support the theory that persistent low interest rates are detrimental to NIM. Furthermore, Klein (2021) finds that the short-term market rate is positively related to NIM but only up to an interest rate level of about 2%. In a negative market rate environment however, this relationship changes, as a decrease of 1% of short-term interest rates reduces the monthly NIM by over 3%.

With a fixed effect estimator and a dataset of 2596 banks operating in 29 European countries, of which six central banks adopted NIRP, López-Penabad et al. (2022) found that a short-term interest rate cut when interest rates were already negative decrease net interest margins, but did not affect profitability, as banks compensated with a significant increase in net fees

and commissions. Contrarily, a short-term interest rate cut when interest rates were positive leads to an increase in profitability, although no impact on net interest margins, due to lower loan loss provisions. Nonetheless, no evidence is found to support the theory that NIRP adopters would increase their risk-taking willingness. Similar to Demiralp et al. (2017) and Lopez et al. (2020), conclude that NIRP has different effects depending on their business model, proving that retail banks are more affected.

COVID-19 AND THE BANKING SYSTEM

Due to its novelty, the literature on COVID's impact on bank profitability is still growing. With lockdowns and the Corona crisis, investment, productivity, and real GDP growth continued to decelerate, and the ECB has warned that interest rates will be kept low until inflation is higher (Belz et al., 2020).

With a differences-in-differences methodology and bank-data from 125 countries, Çolak & Öztekin, (2021) investigates the impact of the pandemic on global lending, while also looking to identify if its impact is amplified or weakened by certain country and bank factors. Results show firstly that while loan growth decreases globally, the effect of the COVID-19 virus on bank loan growth depends on bank and country-characteristics. As such, Çolak & Öztekin (2021) find that small, foreign, government-backed banks and banks with lower returns on assets, as well as countries with less developed intermediaries, credit and bond markets exhibit weaker bank lending.

Studying how European banks have adjusted lending since the COVID pandemic depending on their capitalization and their exposure to the virus outbreak, Neef & Schandlbauer (2021) found that while banks decreased their loans, banks that were more affected with the pandemic had on average a significantly smaller reduction in loan demand. Using a bank-level COVID-19 exposure measure, Neef & Schandlbauer (2021) results are in line with the zombie lending literature, as their results prove that the higher the exposure to the virus, worse-capitalized banks had a significantly less reduction of loans compared to better-capitalized banks.

Aiming at understanding the impact of the pandemic on bank systemic risk, Duan et al. (2021) studied over 1500 banks from 64 countries since February through December 2020. Results prove that the pandemic had an adverse effect on systemic risk and that banks with high

leverage, volatility, loan-to-assets ratio, that are large, undercapitalized and that have low network centrality show higher systemic risk. Moreover, the banks that are able to mitigate the systemic risk are deposit insurance and foreign and government-owned banks (Duan et al., 2021).

Demir & Danisman (2021) analyse how bank-specific factors and variations in governmental policies influence the banking sector with a sample of 1927 banks from 110 countries during the period of January to May 2020. With a fixed-effects technique, Demir & Danisman (2021) results show that banks with higher capital and deposit share, less non-performing loans, larger size and more diversification are more resilient. COVID-19 negatively impacts the bank stock performances to banks that had weaker pre-pandemic financial conditions and in countries that are more exposed to the pandemic. Lastly, Demir & Danisman (2021) findings confirm that the monetary, fiscal and regulatory responses combined with the governmental restrictions helped alleviate the negative reaction in bank stock prices.

METHODOLOGY

DATA AND VARIABLES

Our study uses bank-level data from several sources for a group of directly supervised Euro Area banks to ascertain the effect of NIRP, and the additional effect of COVID, on bank profitability. Annual bank-level data is retrieved from Refinitiv-Datastream, our primary source of data, from which bank-specific variables were built. Macroeconomic variables were retrieved from OECD Data, Eurostat, and Statistical Data Warehouse from the ECB.

The period for this analysis was chosen to comprehend the period with positive but low interest rates, the period after the introduction of negative interest rates and the emergence of the COVID-19 pandemic. The frequency was simply chosen due to data availability restrictions.

The original dataset included 39 banks, but due to inconsistencies, two of them were removed, thus arriving at our final sample which contains 37 banks from 12 countries and covers the period of 2010 to 2021, resulting in t=11, n=37 and a total of 323 observations. The banks in this study were the available Euro Area banks on Datastream that are supervised banks by the ECB.

While our data is well balanced in terms of number of banks used per year, it is irregular in terms of banks used per country, having significantly more banks Italy and Spain in relation to the remaining countries. The full list of the banks used and their reason for significance can be found on Table 8 Appendix III and the number of banks used per country and year on Figure 4 and Figure 5 in Appendix III, respectively.

Aiming to address the research questions, return on asset, measured by the ratio of net income to total assets, is used to measure bank profitability, as commonly used by many previous bank profitability studies (Abreu & Mendes, 2002; Athanasoglou et al., 2008; Borroni et al., 2016; Dietrich & Wanzenried, 2011; Elekdag et al., 2020; Gambacorta et al., 2014; Garcia & Guerreiro, 2016; Kok et al., 2015; Kryeziu & Hoxha, 2021; Martinho et al., 2017; Mota et al., 2019; Petria et al., 2015; Staikouras & Wood, 2004).

Our control variables are the bank-specific and macroeconomic variables. The choice of these control variables is also due to their use in the revised literature in bank profitability.

The variables in study are all interaction dummies, to analyse the effect of the negative interest rates in the variables in interest: short-term interest rates, slope of the yield curve and if COVID-19 has worsened or eased this effect.

Two dummy variables were created in order to distinguished between the period of positive and negative interest rates NIRP, in which NIRP equals 1 if interest rates are negative, and zero otherwise, and to separate pre- and post-covid-19 periods, COVID, being equal to 1 in 2020 onwards and zero otherwise.

To build our NIRPslope interaction variable, we firstly had to calculate the slope of the yield curve, which is given by the difference of the long-term and the short-term interest rate, to then multiply with the NIRP dummy.

From the exported bank-level data, the following new variables are calculated: bank size, as the natural logarithm of total assets, inefficiency as the ratio of operating expenses over operating income, capitalization as the ratio of equity over total assets, income diversification as non-interest income over total revenues and credit risk as the ratio of provision for loan losses over total assets.

The following Table 4 summarizes the dependent and independent variables and reports the mean, standard deviation, minimum, 25th percentile, median, 75th percentile and the maximum of each variable in the sample.

Table 4 - Summary Statistics of the variables

				QUANTILES				
VARIABLE	n	Mean	S.D.	**Min**	**.25**	**Mdn**	**.75**	**Max**
ROA	378	0.29	1.35	-12.42	0.22	0.52	0.81	4.99
SIZE	440	18.85	1.46	15.58	17.84	18.62	20.18	21.69
INEF	422	1.97	44.36	-452.63	1.12	5.45	10.22	178.15
CAP	440	0.07	0.03	-0.04	0.05	0.07	0.08	0.26
DIVER	438	0.34	0.16	-0.19	0.24	0.33	0.44	0.92
CREDRISK	428	0.01	0.01	-0.02	0.00	0.00	0.01	0.08

GDPG	456	0.89	4.24	-10.80	0.00	1.30	2.30	25.20
NIRPIT	456	-0.19	0.20	-0.55	-0.34	-0.14	0.00	0.00
NIRPSLOPE	456	0.95	1.54	-0.08	0.00	0.46	1.43	9.69
NIRPCOVID	456	0.17	0.37	0.00	0.00	0.00	0.00	1.00

Source: author's creation

The profit rates have a mean of 0.29% of total assets and a standard deviation of 1.35%. While inefficiency has a mean of 1.97%, it has the highest variability, of 44.36%. Size has a mean value of 18.85% with a standard deviation of 1.46%. GDP growth and NIRPslope have similar levels of mean value, but the GDP growth has a higher variability.

Table 5 presents the correlation matrix for the variables used. Return on assets has a negative correlation with credit risk, NIRPit, NIRPslope and NIRPcovid, and a positive correlation with the remaining variables. There is a strong negative relationship between ROA and credit risk and NIRPit and NIRPcovid, and a strong positive relationship between capitalization and NIRPslope.

Table 5 - Correlation Matrix

	ROA	**SIZE**	**INEF**	**CAP**	**DIVER**	**CRED RISK**	**GDP G**	**NIRP IT**	**NIRP SLOPE**	**NIRP COVID**
ROA	1.00									
SIZE	0.09	1.00								
INEF	0.05	0.02	1.00							
CAP	0.22	-0.33	-0.02	1.00						
DIVER	0.17	0.20	-0.10	-0.22	1.00					
CRED RISK	-0.62	-0.24	-0.06	0.18	-0.35	1.00				
GDPG	0.28	0.02	0.01	0.24	0.08	-0.26	1.00			
NIRP IT	-0.06	0.03	0.09	-0.18	-0.16	0.21	-0.11	1.00		

NIRP SLOPE	-0.09	-0.23	-0.05	0.49	-0.06	0.27	0.09	-0.28	1.00	
NIRP COVID	-0.03	-0.01	-0.11	-0.01	0.11	-0.08	-0.17	-0.66	-0.06	1.00

Source: author's creation

While a positive moderate relationship is found between ROA and capitalization, ROA and GDP growth, size and diversification, capitalization and GDP growth, credit risk and NIRPit and credit risk and NIRPslope, a negative moderate relationship is found between size and credit risk, size and NIRPslope and NIRPit with NIRPslope.

Inefficiency only appears to have very weak relationship with the variables.

MODEL

As profitability tends to persist overtime (Berger et al., 2000), a dynamic model is used to analyse the impact of NIRP and COVID on Euro Area banks' profitability.

We regress the profitability measure on the lagged dependent variable and other macroeconomic and bank-specific variables. Similar to Stráský & Hwang (2019) a NIRP dummy variable was created, that equals 1 if i_t<0 and zero otherwise.

Additionally, a COVID dummy was generated which equals 1 since 2020 and is zero otherwise, to represent the periods since the start of the pandemic. Both dummies are used as interaction dummies – NIRP to ascertain the effect of interest rates and slope of the yield curve on bank profitability when interest rates are negative, while COVID is used to examine if pandemic has worsened or eased the NIRP effect on bank profitability.

Equation 1

$$Y_{i,c,t} = \beta_0 + \beta_1 Y_{i,c,t-1} + \beta_2 size_{i,t} + \beta_3 inef_{i,t} + \beta_4 cap_{i,t} + \beta_5 diver_{i,t} + \beta_6 credrisk_{i,t} + \beta_7 GDPg_{c,t} + \beta_8 NIRPi_t + \beta_9 NIRPslope_t + \beta_{10} NIRPCOVID_t + \varepsilon_{i,c,t},$$
$$i = 1, \ldots, N, \qquad c = 1, \ldots, 12 \text{ and } T = 1, \ldots, T$$

where:

- $Y_{i,c,t}$ is the ROA of bank *i* in country *c* in year *t*;
- $Y_{i,c,t-1}$ is the ROA of bank *i* in country *c* in year *t-1*;
- $size_{i,t}$, $inef_{i,t}$, $cap_{i,t}$, $diver_{i,t}$ and $credrisk_{i,t}$ are the bank-specific variables of bank *i* in year *t*;
- $GDPg_{c,t}$ is the macroeconomic variable of country *c* in year *t*;
- $NIRPi_t$ and $NIRPslope_t$ variables are the interaction between *NIRP* dummy and the short-term interest rates and the slope of the yield curve in year *t*;
- $NIRPCOVID_t$ is the interaction between *NIRP* dummy and *COVID* dummy in year *t*;
- $\varepsilon_{i,c,t}$ is the error term.

The model in study was developed on STATA15, a statistical program commonly used for econometric analysis.

Following Dougherty's (2011) method of regression model choice and aiming at determining the best method between fixed and random-effects, both models are regressed and the Hausman test is conducted, with the null hypothesis being that difference in coefficients is not systematic. Results reject the null hypothesis, determining that the use of the fixed-effects model is the most appropriate. The possible use of pooled OLS model is not tested, as the Hausman test indicates differences in the coefficients, the use of pooled OLS would not be fitting.

In order to address the potential heteroskedasticity problem in fixed-effects model, an heteroskedasticity test is also run, with results confirming that a robust model should be used.

Aiming at reducing the endogeneity bias, we run both Arellano-Bond and dynamic System Generalized Method of Moments (S-GMM). As these methodologies assume no autocorrelation, we run tests for zero autocorrelation. Results led to forgo the Arellano-Bond due to autocorrelation in the first differences and using only the S-GMM methodology.

The following Table 6 illustrates the predicted effects of each independent variable, according to academic knowledge and the revised literature.

Table 6 - Expected effects in the dependent variables

VARIABLE	DEFINITION	EXPECTED EFFECT
DEPENDENT VARIABLE		
RETURN ON ASSETS	Net income to total assets	N/A
INDEPENDENT VARIABLES		
SIZE	Natural logarithm of total assets	+/-
INEFFICIENCY	Operating costs over operating income	-
CAPITALIZATION	Equity over total assets	+
DIVERSIFICATION	Non-interest income over total revenues	+/-
CREDIT RISK	Provision for loan losses over total assets	-
GDP GROWTH	Real GDP growth	+
NIRPIT	NIRP dummy times short-term interest rate	+/-
NIRPSLOPE	NIRP dummy times the slope of the yield curve	+/-
NIRPCOVID	NIRP dummy times COVID dummy	-

Source: Author's creation

RESULTS

Table 7 contains the model results - column (1) for the robust fixed-effects and column (2) for the System Generalized Method of Moments (S-GMM) estimations.

Table 7 - Model results

ROA	ROBUST FIXED-EFFECTS	SYSTEM-GMM
ROA.L1	-0.4300236 ***	-0.4833898 ***
	(0.0563686)	(0.0608656)
SIZE	1.331811	0.4279276
	(0.5299169)	(0.5566066)
INEF	-0.0000328	-0.0009722
	(0.0010141)	(0.0013015)
CAP	51.74104 ***	55.72421 ***
	(6.91026)	(8.908901)
DIVER	1.639683 *	-0.3036429
	(0.8523506)	(1.748548)
CREDRISK	-75.17726 ***	-70.86053 ***
	(7.544189)	(6.715011)
GDPG	0.0212117 *	0.02583 ***
	(0.01234729)	(0.0095602)
NIRPIT	1.473608 ***	1.725699 **
	(0.4177822)	(0.7009903)
NIRPSLOPE	-0.2113081 **	-0.291986 ***
	(0.0810603)	(0.1006753)
NIRPCOVID	0.046157	0.131379

	(0.046157)		(0.2416155)
_CONS	-27.79054	***	-10.15947
	(9.97636)		(10.42059)

Robust standard errors in parentheses
Significance codes: ***p<0.01, ** p<0.05 and *p<0.10

Source: Author's creation

In line with reviewed literature on the determinants of bank profitability, (Athanasoglou et al., 2008; Petria et al., 2015) results indicate that bank size does not influence profitability, as it has a positive but insignificant impact on profitability. While inefficiency presents a negative relationship with bank profitability as expected, our results show that this effect is not significant.

Capitalization and GDP growth effect on banks' ROA is significant and positive, in agreement with past studies. Both estimations results demonstrate that higher capitalization is positively and significantly linked to higher bank profitability (Athanasoglou et al., 2008; Kok et al., 2015). A one percentage point increase in GDP is associated with an approximately 2 basis points increase in the bank' return on assets, *ceteris paribus*. This result is in line with the related literature of (Albertazzi & Gambacorta, 2009; Athanasoglou et al., 2008; Demirgüç-Kunt & Huizinga, 1999; Dietrich & Wanzenried, 2011; Kryeziu & Hoxha, 2021; Martinho et al., 2017; Mota et al., 2019; Petria et al., 2015) and could be explained by the improvement on the overall Euro Area economy that results in more business for banks.

Also in line with the reviewed literature (Athanasoglou et al., 2008; Kok et al., 2015), evidence show that credit risk is significantly and strongly negatively related to banks' profitability. Everything else constant, a one percentage point increase in credit risk accrue in a more than 70 basis point decrease in Euro Area's banks return on assets.

There is not a clear relationship between income diversification and bank profitability, as results for the robust fixed-effect model show a significant positive effect on ROA, while the results for the S-GMM model appear to be negative and insignificant. This unclear relationship does not come as a surprise, as the reviewed literature also does not come to a consensus on the effect of income diversification on bank's return on assets.

Short-term interest rates in a negative interest rate environment show a significantly positive effect on bank's results, in line with Claessens et al. (2018) and Stráský & Hwang (2019) and could potentially be explained with banks trying to offset their lower-interest margins with an increase of their fees and commissions.

The regression results show that ROA is negatively related to the slope of the yield curve, with a coefficient between -0.21 and -0.29 in both regressions, respectively. This result implies that the decrease of the level of the slope of the yield curve in one percentage point, lowers the ROA by about between 21 and 29 basis points, with all else constant. By this negative relationship, it can be inferred that short-term interest rates are greater than long-term interest rates. An inverted yield curve is usually associated with a pending economic recession, as it suggests that investors are pessimistic about economic growth and expect an increase in interest rates. While this result is in line with Stráský & Hwang (2019) fixed effects results, it is contrary to Claessens et al. (2018).

Lastly, our interaction variable *NIRPCOVID* shows a positive, yet non-significant, effect on Euro Area's ROA. This translates to COVID not having an additional significant effect on banks' profitability, hinting that the banks used in this study have adjusted well to the pandemic.

CONCLUSIONS AND FUTURE RESEARCH

This dissertation studies the link between negative interest rates, COVID-19 and bank profitability. Using a dataset of 37 banks over the period of 2010 to 2021 from 12 Euro Area countries, we analyse the additional effect of negative interest rates on the impact of short-term interest rates, the slope of the yield curve and the pandemic on banks' return on assets.

Our control variables have the expected effects and agree with the reviewed literature on the determinants of bank profitability. Our variables in study present opposite results: short-term interest rates show a positive and significant effect on banks' return on assets, while the yield curve has a negative significant effect. While banks seem to be able to compensate their interest losses in the negative interest rate environment, the negative effect of the slope implies that market sentiment is that interest rates will eventually increase, and an economic recession is imminent.

There is no evidence that suggests that the pandemic had a negative impact on Euro Area banks' returns. On the contrary, there is a weak and insignificant evidence of positive effect. This result was unexpected and implies that banks have adapted well to the recent pandemic.

For future research, it would be interesting to increase the data sample, to better understand the whole impact of the negative interest rates on the banking system and study how banks have been offsetting the negative interest rate environment and pandemic, especially in terms of countries in the sample, as this study only comprehend 12 out of the 19 Euro Area countries, and a more balanced number of banks per country.

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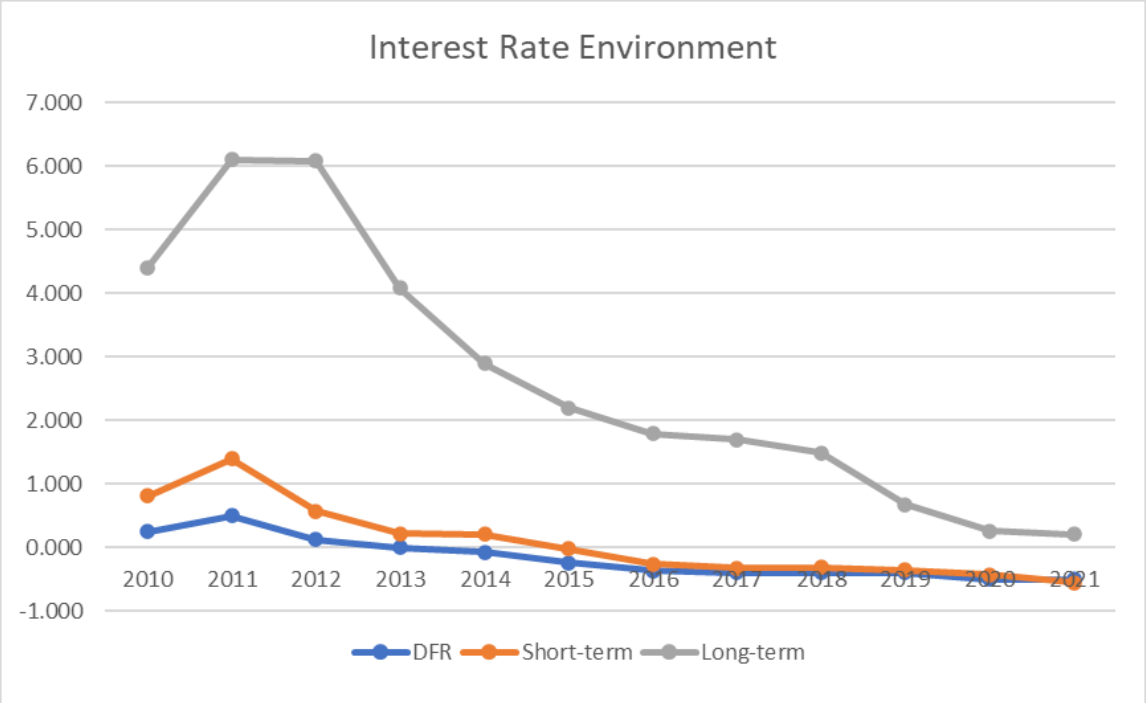
APPENDIX

APPENDIX I

Figure 2 - Interest Rate Environment, Yearly average, Euro Area 12 countries

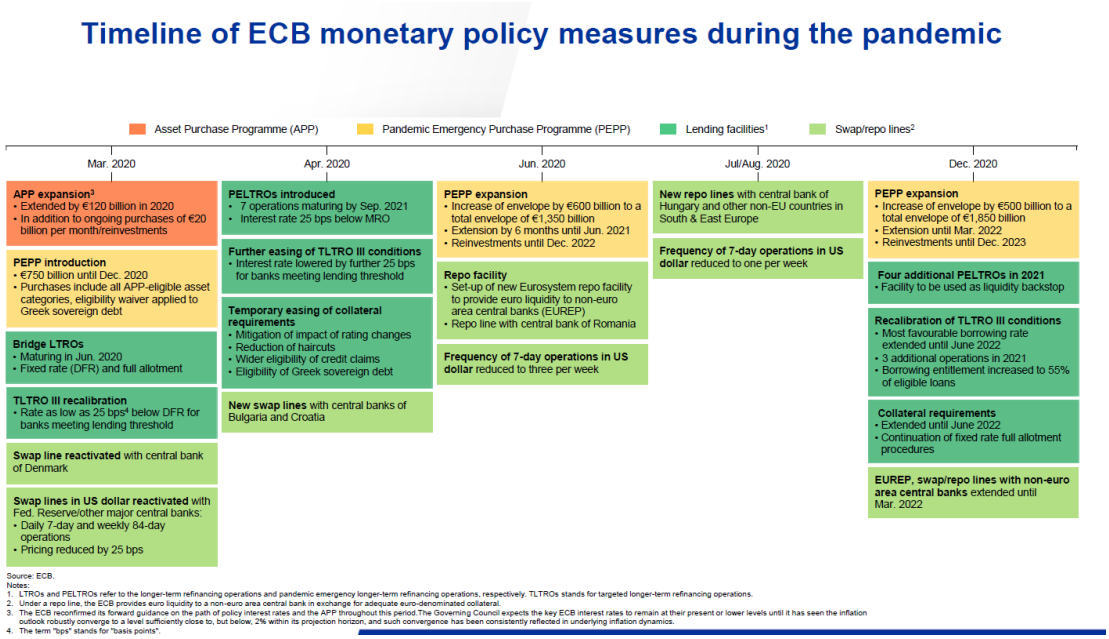


Source: Author's creation, with data retrieved from Eurostat, ECB and OECD data.

All data is a yearly average. Short-term interest rate is the 3-month market rate. The long-term rate is the yearly average of the 12 countries in the study.

APPENDIX II

Figure 3 - Timeline of ECB monetary policy measures during the pandemic



Source: European Central Bank

APPENDIX III

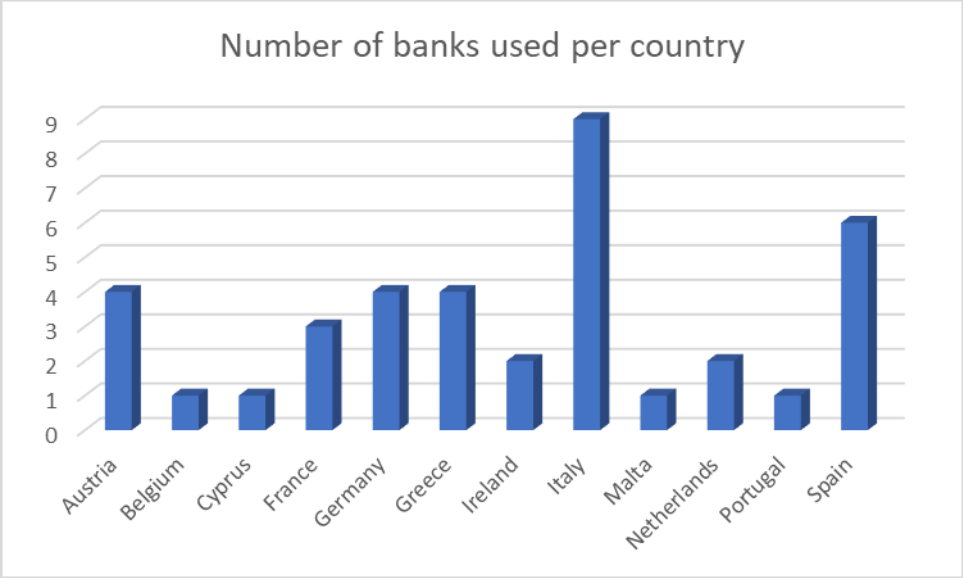
Table 8 - List of banks and reason for their significance

COUNTRY	NAME	GROUNDS FOR SIGNIFICANCE
AUSTRIA	**BAWAG Group AG**	**Size (total assets EUR 30-50 bn)**
AUSTRIA	**Erste Group Bank AG**	**Size (total assets EUR 150-300 bn)**
AUSTRIA	**Raiffeisen Bank International AG**	**Size (total assets EUR 150-300 bn)**
BELGIUM	**KBC Group NV**	**Size (total assets EUR 150-300 bn)**
CYPRUS	**Bank of Cyprus Holdings Public Limited Company**	**Total assets above 20% of GDP**
FRANCE	**BNP Paribas S.A.**	**Size (total assets above EUR 1,000 bn)**
FRANCE	**Crédit Agricole S.A.**	**Size (total assets above EUR 1,000 bn)**
FRANCE	**Société Générale S.A.**	**Size (total assets above EUR 1,000 bn)**
GERMANY	**Aareal Bank AG**	**Size (total assets EUR 30-50 bn)**
GERMANY	**Commerzbank Aktiengesellschaft**	**Size (total assets EUR 300-500 bn)**
GERMANY	**Deutsche Bank AG**	**Size (total assets above EUR 1,000 bn)**
GERMANY	**Deutsche Pfandbriefbank AG**	**Size (total assets EUR 50-75 bn)**
GREECE	**Alpha Services and Holdings S.A.**	**Size (total assets EUR 50-75 bn)**
GREECE	**Eurobank Ergasias Services And Holdings S.A.**	**Size (total assets EUR 50-75 bn)**
GREECE	**National Bank of Greece S.A.**	**Size (total assets EUR 50-75 bn)**
GREECE	**Piraeus Financial Holdings S.A.**	**Size (total assets EUR 50-75 bn)**
IRELAND	**AIB Group plc**	**Size (total assets EUR 75-100 bn)**
IRELAND	**Bank of Ireland Group plc**	**Size (total assets EUR 100-150 bn)**
ITALY	**Banca Carige S.p.A. - Cassa Di Risparmio Di Genova E Imperia**	**Article 6(5)(b) of regulation (EU) no. 1024/2013**

ITALY	**Banca Monte Dei Paschi Di Siena S.p.A.**	**Size (total assets EUR 100-150 bn)**
ITALY	**Banca Popolare Di Sondrio, Società Cooperativa Per Azioni**	**Size (total assets EUR 30-50 bn)**
ITALY	**Banco Bpm S.p.A.**	**Size (total assets EUR 150-300 bn)**
ITALY	**BPER Banca S.p.A.**	**Size (total assets EUR 75-100 bn)**
ITALY	**Credito Emiliano Holding S.p.A.**	**Size (total assets EUR 30-50 bn)**
ITALY	**Finecobank S.p.A.**	**Size (total assets EUR 30-50 bn)**
ITALY	**Intesa Sanpaolo S.p.A.**	**Size (total assets EUR 500-1,000 bn)**
ITALY	**Unicredit S.p.A.**	**Size (total assets EUR 500-1,000 bn)**
MALTA	**Bank Of Valletta plc**	**Total assets above 20% of GDP**
NETHERLANDS	**ABN AMRO Bank N.V.**	**Size (total assets EUR 300-500 bn)**
NETHERLANDS	**ING Groep N.V.**	**Size (total assets EUR 500-1,000 bn)**
PORTUGAL	**Banco Comercial Português, S.A.**	**Size (total assets EUR 75-100 bn)**
SPAIN	**Banco Bilbao Vizcaya Argentaria, S.A.**	**Size (total assets EUR 500-1,000 bn)**
SPAIN	**Banco De Sabadell, S.A.**	**Size (total assets EUR 150-300 bn)**
SPAIN	**Banco Santander, S.A.**	**Size (total assets above EUR 1,000 bn)**
SPAIN	**Bankinter, S.A.**	**Size (total assets EUR 75-100 bn)**
SPAIN	**Caixabank, S.A.**	**Size (total assets EUR 300-500 bn)**
SPAIN	**Unicaja Banco, S.A.**	**Size (total assets EUR 50-75 bn)**

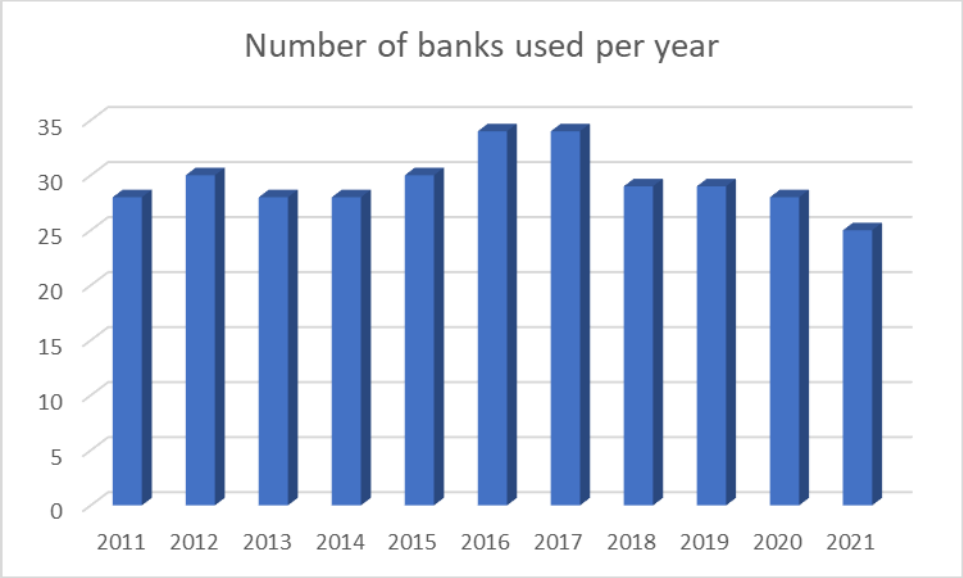
Source: European Central Bank

Figure 4 - Number of banks used per country



Source: Author's creation

Figure 5 - Number of banks used per year



Source: Author's creation