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MASTER THESIS TITLE:

**Macroeconomic and bank-specific determinants of non-performing loans:  
Panel Data Evidence for Europe**

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MSc. Mathematical Modeling in Modern Technologies and Finance  
*Master thesis*



**MSc. Mathematical Modeling in Modern Technologies and Finance**  
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**“Macroeconomic and bank-specific determinants of non-performing loans: Panel Data Evidence for Europe.”**

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**CERTIFICATION OF MASTER THESIS PREPARATION**

“I hereby declare that this particular master thesis has been written by me, in order to obtain the Postgraduate Degree in Mathematical Modeling in Modern Technologies and Financial Engineering, and has not been submitted to or approved by any other postgraduate or undergraduate program in Greece or abroad. This master thesis presents my personal views on the subject. All the sources I have used for the preparation of this particular master thesis are mentioned explicitly with references being made either to their authors, or to the URL’s (if found on the internet).”

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## Abstract

The European Union ([EU27](#)) is a political and economic union of 27 member states. The EU policies aim to ensure the free movement of people, goods, services and capital within the European internal market. However, EU does not have a unified monetary policy and one of the main reasons is that not all EU member states have joined the euro and, thus, do not have the same currency. In this context, this master thesis attempts to consider the Non-Performing Loans ([NPLs](#)) problem in the Euro system. The Euro system includes the national central banks of the 19 member states that have adopted the Euro currency. At the same time, EU has founded the European System of Central Banks ([ESCB](#)), which consists of the European Central Bank ([ECB](#)) and the National Central Banks ([NCBs](#)) of all 27 member states of the EU. The European Banking System is a highly regulated system, which is supervised by one authority, namely the ECB. However, many banking issues are not faced directly by the ECB, since each country follows its own fiscal policy. Thus, they plan their own strategy and they implement it in cooperation with the ECB. A representative banking problem is the handling of NPLs in the Eurosystem. The objective of this master thesis is to examine the impact of non-performing loans on the European banking system. For this purpose the last two decades are split in the era of high growth (2000-2008 on average [2,06%](#) GDP annual growth) according to the World Bank, in contrast with the era of European fiscal crisis in the countries (2009-2015 on average [0,21%](#)) and the recent period of Brexit (2016-2018 on average [2,08%](#)). Additionally, this master thesis tries to explore the potential resolution instruments and policies that each country can use in order to encounter their NPLs problem, based on the unique characteristics of their economy. The increase of NPLs has put into question the robustness of the majority of banks and the stability of the whole financial sector, after 2009. It still remains a serious challenge, since a few banks suffer from inadequate “equity capital”. Using econometric models, it can be estimated which macroeconomic and bank-specific conditions affect NPLs. To this end, a number of relevant econometric techniques are employed such as: LLC tests, Hausman test, Dynamic Panel Data analysis, etc. Based on our findings, the Government Debt, the Total Bank Deposits and the Structural Debt crisis are the statistically significant variables and were found to affect the Non-Performing Loans.

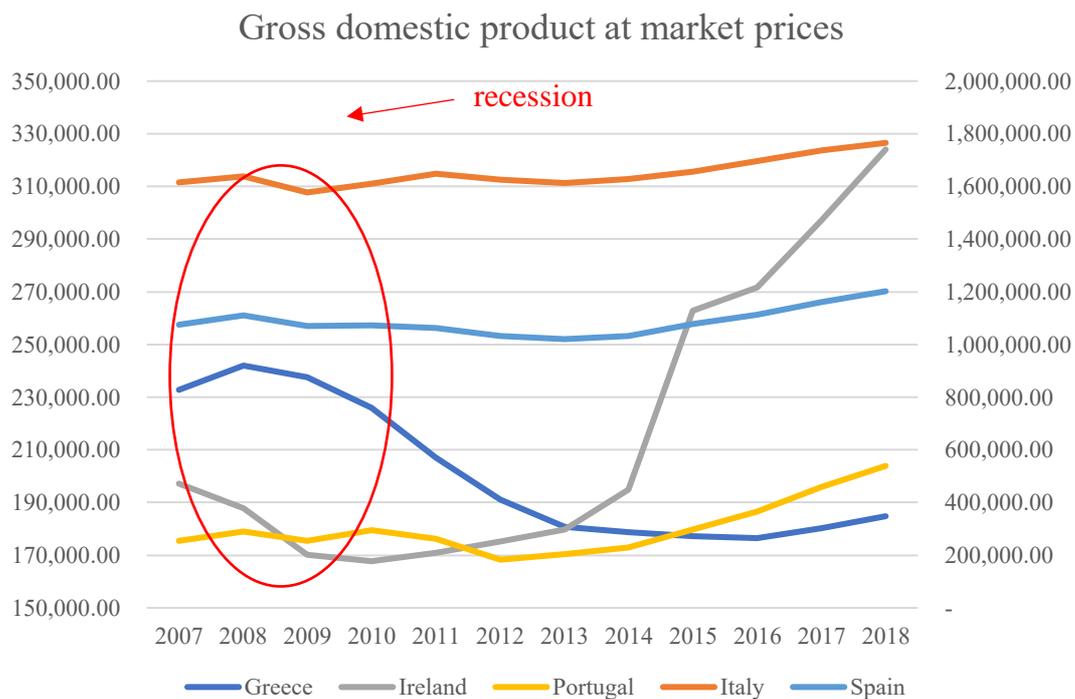
**KEYWORDS:** Non-Performing Loans, macroeconomic determinants, Europe, Greece





## Chapter 1: Introduction

On the 15<sup>th</sup> of September 2008, Lehman Brothers' filed for bankruptcy and led the whole world to a new financial crisis, which was emanated by a real estate bubble market in USA. This was a bubble of \$15 trillion in the mortgage market (according to [FED](#)), which hit the U.S. economy with catastrophic effects and spread to the whole developed world. In the aftermath of this crisis, Europe faced a deep recession during which some members collapsed such as Latvia (February 2009) and a number of EU members, the so-called PIIGS or GIPSI (alphabetically: Greece, Italy, Ireland, Portugal and Spain) were hailed to be among the most prominent victims of this recession. This deep recession has had a negative effect on their economies - GDP ([Figure 1](#)).



**Figure 1:** Author's elaboration: timeseries TEC00001, Eurostat.

While in the period between 2000 and 2007, the European economy witnessed high economic growth, on average about 2,49% per year (according to Eurostat), between June 2008 and June 2009, it faced a dramatic downturn: its GDP fell by 4.55%.



In the face of this major economic downturn, European governments were confronted by a big problem, namely they had to choose, between two fiscal policy options: (i) counter – cyclical (ii) a-cyclical/ pro-cyclical.

The most frequently used policy is *counter-cyclical*. According to macroeconomic literature and the majority of macroeconomic researchers, it is the most efficient method (Auerbach [2009](#); Arestis and Sawyer [2010](#)). Thus, the central government can either allow the automatic stabilizers to work or undertake expansionary-discretionary fiscal policy. These measures can be summarized as stimulus packages entailing: (i) increased government spending, (ii) decreased taxes, (iii) both aforementioned options, (iv) financed from accumulated reserves or loans.

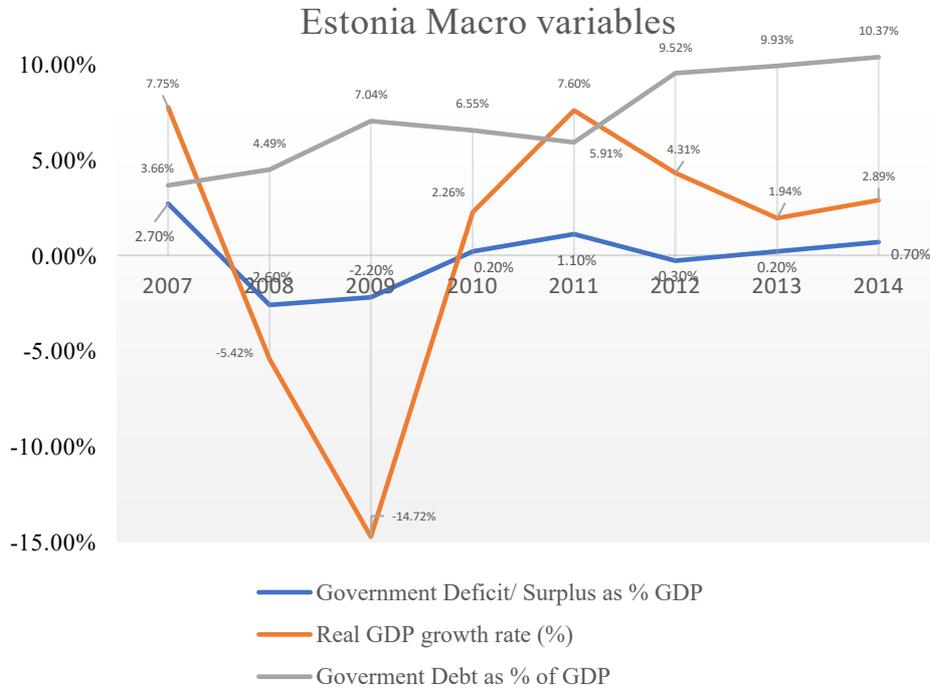
Diversely, according to the *pro-cyclical* fiscal policy the government can: (i) save costs/expenditures, (ii) raise taxes, to face the falling tax revenues without having to incur loans. The International Monetary Fund ([IMF](#)) was the principle promoter of pro-cyclical (Spilimbergo [2008](#)) measures to stabilize economies during crisis.

However, during this recent sovereign crisis many governments did not directly follow IMF's recommendations and they decided to tackle the issue through a combination of measures. Several economies implemented expansionary fiscal policies by increasing both government investment and consumption while decreasing taxes. Other economies chose to deploy internal devaluation coupled with structural reforms. Representative examples of these policies were seen in Estonia, Poland, Czech Republic, Slovenia and Slovakia. In [Figure 2](#), we can see the performance of three basic macroeconomic variables for the Estonian economy.

On the other hand, Latvia, Hungary and Romania decreased their public expenditures during the crisis. These countries had to follow a counter-cyclical fiscal policy, an approach that was agreed based on the memorandum signed among the IMF and these countries individually, since their government debt level as a percentage of GDP was increasing in an exponential and non-



sustainable pace. For example, Hungary's government gross debt is estimated to be equal to 78,21% of GDP in 2009.



**Figure 2:** Author's elaboration: timeseries GGNLEND, OECD.

The high level of debt was a key determinant for the following sovereign crisis, but there were many other evolving crises, which occurred depending on the characteristics of each country. Generally, one of the most important is the currency crisis.

Lehman Brothers' bankruptcy increased the likelihood of recession in the euro area and caused financial markets to re-evaluate their risk. Thus, countries that had not solid currencies, faced an immediate problem, raising the perceived risk. For instance, Hungary had a weak currency and at the same time the majority of loans in the individuals, households (household debt reached an all-time high of 43.7 % of GDP in December 2010, according to National Bank of Hungary) and the corporate sector were denominated in foreign currency due to the high spread that prevailed between the domestic and foreign lending rates, raising indirectly the risk to the banking system.



Generally, Europe faced a deep crisis and the majority of its members followed restrictive fiscal measurements. The European economy started contracting at the end of 2007 (-4,34% of GDP in 2009, according to [Eurostat](#)). As a result, tax revenues undershot the projected levels and the forecasted budget deficit rose significantly (i.e., General government deficit of Greece stood at -15,1% of GDP in 2009 and respectively was 13,8% for Ireland, according to [Eurostat](#)).

In addition, some countries were forced to initialize a memorandum of understanding between themselves and the IMF - European Commission – ECB troika. These were Ireland, Greece, Portugal and Cyprus.

European banks held sovereign debt and these bonds were extremely volatile, so the fluctuation of the bond's price affected banks' balance sheets and directly threatened the solvency of the whole financial system, since a large-scale bank failure was very costly for everyone. Thus, this situation destabilized the entire European banking system and, in turn, increased sharply the Non-Performing Loans, especially in these four countries.

This was a vicious circle, which is called “diabolic loop” according to Brunnermeier et al. ([2016](#)), because an increase a of country's risk entails an even more dramatic increase of NPLs and respectively this follows to deteriorate the financial and economic stability.

It is important to give a clear definition of what a Non-Performing Loan is. Actually, it is a loan in which the borrower is in default, since they have not made the scheduled payments (either principal or interest) for a specified period. The specified period also varies, depending on the industry and the type of loan. In the current literature two terms can be found: NPLs or NPEs<sup>1</sup> (Non-Performing Loans and Non-Performing Exposures respectively) and they are generally used interchangeably but technically NPLs sit within NPEs which is a broader definition.

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<sup>1</sup> This term is used only in the European banking system.  
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The presence of a harmonized EU benchmark for asset quality also encouraged banks to assess more conservatively their impaired and defaulted assets. These main harmonized drivers of NPL's include the following risk metrics: (i) a 1-year cure period to exit the NPL status; (ii) an NPL categorization of > 90 days past due that is strictly applied for NPLs; (iii) an NPL categorization due to second forbearance or 30 days past due of a performing forbore in probation; (iv) NPL categorization due to the 20% "pulling effect".

In the contemporary financial world, the banking system is the cornerstone of the whole economy and it is a crucial sector for an economy when it starts to recover. Therefore, it is urgent for the European banking system to resolve the NPL problem and give viable perspective for the future. A remarkable example of banking crisis due to NPLs was Iceland, during 2007.

Through this example, the importance of NPLs as a leverage for a country's economic recovery is easily shown. At those times, Iceland the household debt stood at 130% of GDP (according to IMF [database](#)) and corporate debt at 350%, NPLs were at the highest level of 18% of total gross loans (according to ECB [database](#)).

The consequence of this crisis was three systemic banks to be nationalized by the Icelandic government and, as a result, its private economy to be paralyzed. The same problem of high NPLs level was faced by the Euro-area, in general. The following table ([Table 1](#)) depicts this trend for the majority of the European countries. It is remarkable that the European NPL's were equal to 12% of total gross loans in 2015 (according to ECB [database](#)). Southern European countries, such as Italy and Cyprus, had the highest level of NPLs, which hiked at 20% during the corresponding period.



**Table 1:** The level of NPLs in Europe, Gross Non-Performing loans (% GDP).

Year:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Balkan	4,22%	7,08%	10,42%	12,62%	14,63%	16,50%	15,58%	14,50%	13,31%	12,49%
N. & Central Europe	1,65%	3,43%	4,18%	6,29%	4,48%	7,77%	7,37%	7,04%	6,05%	6,14%
East Europe	8,27%	12,21%	10,39%	10,81%	10,87%	9,25%	9,25%	9,47%	10,77%	13,30%
South Europe	4,14%	5,75%	5,31%	8,93%	12,10%	17,21%	18,74%	19,63%	19,12%	12,92%
France	2,82%	4,22%	3,76%	4,29%	4,29%	4,50%	4,16%	3,98%	3,64%	3,84%
Italy	6,28%	9,45%	1,28%	11,74%	13,75%	16,54%	18,33%	18,64%	17,12%	14,38%
Spain	2,88%	4,12%	4,67%	6,73%	7,48%	9,39%	8,45%	6,16%	5,64%	4,46%
Greece	4,67%	6,95%	9,12%	14,43%	23,27%	31,90%	33,78%	36,65%	36,30%	45,57%
Portugal	3,60%	5,13%	5,37%	7,47%	9,74%	10,62%	11,96%	17,48%	17,18%	13,27%
Cyprus	3,59%	4,59%	5,82%	9,99%	18,37%	38,56%	44,97%	47,75%	48,68%	41,17%
Malta	5,12%	5,78%	7,15%	7,89%	7,75%	8,95%	9,50%	6,77%	5,32%	4,72%

**Figure 3:** Author's elaboration: consolidated banking data, ECB.

[https://ec.europa.eu/eurostat/cache/metadata/en/tipsbd\\_esms.htm](https://ec.europa.eu/eurostat/cache/metadata/en/tipsbd_esms.htm).

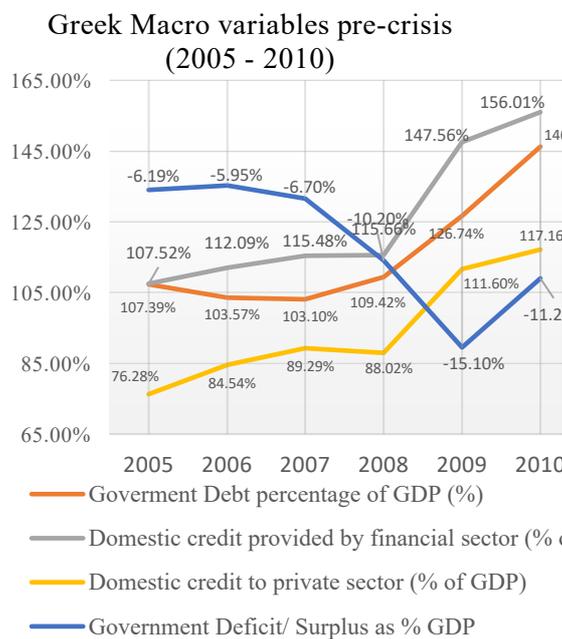
Managing this problem may be of vital importance for the whole European banking system, nowadays, because if NPLs rate recovers, then this recovery amounts could be the main source of new capital that could provide liquidity in the total economy.

It is remarkable to note that the recent financial crisis, was the catalyst which revealed the "black sheep" of Eurozone, Greece. At those times, the Greek economy faced a triplet "Fiscal Balance", "Current Balance" and "Balance of Payment" deficit at the same time. Also, it had a significantly high private debt. Although, Greece traditionally had a very low private debt, for instance, the "household private debt" stood at 12% of GDP (according to [OECD](#)). Greece's household debt accounted for 61.0 % of the country's Nominal GDP in December of 2019.

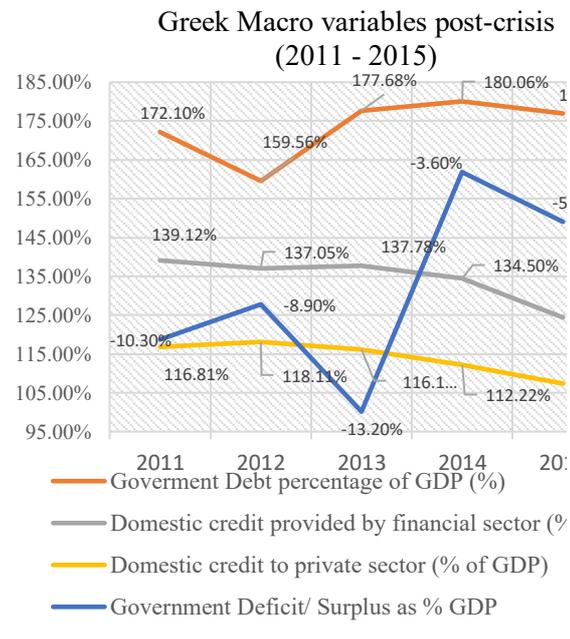


The corresponding “business debt” at 37% in 2000 (according to [OECD](#)). [Figure 4](#) depicts an upward trend for these fiscal variables during the first decade of the twentieth century, but they stood at viable levels.

Since 2010, “private debt” soared to 61% of GDP according to [OECD](#) (140 billion EUR) and “business debt” approximately doubled to 145 billion EUR (64% of GDP). In addition to this, sovereign debt increased (almost 50% of GDP), as is depicted in [Figure 5](#).



**Figure 4:** Author’s elaboration: Eurostat dataset <https://ec.europa.eu/eurostat/igm/table.do?tab=table&init=1&plu gin=1&language=en&pcode=teina200>



**Figure 5:** Author’s elaboration: Eurostat dataset <https://ec.europa.eu/eurostat/igm/table.do?tab=table&init=1&plu gin=1&language=en&pcode=teina200>

The crucial difference of the recent decade compared to the previous one, is the severe sovereign debt crisis. This is the reason why Greek household and businesses were also heavily indebted.

The high-level debt (both household and businesses) led the Greek economy to an “explosive situation”. Greek government, businesses and households were over-indebted and their creditworthiness sharply declined. This situation led to the undertaking of higher credit risk and Greek NPLs reached their historical upper bound of 45,57% (according to [BoG](#)) in 2017.



Due to a high level of NPLs, the banks incurred great losses which reduced their equity capitals, creating an urgent need for recapitalization and in turn the credit provision of the economy was constrained.

Greek government imposed twice the Greek banks to recapitalization in 2012 (€50 billion) and 2015 (€20 billion) and this was highly unpopular with the general public. The Greek Government allocated between 2009 and 2012 a total of €48.2 billion for the recapitalization of the banks. Regarding the last recapitalization, around €25 billion of overall capital was needed. The Greek government disbursed a total of €5.4 billion to the banks and aimed to raise the remaining amount from the private investor. The main objective of the comprehensive banking sector strategy is to secure a well-capitalized and viable banking sector.

The high rate of non-performing loans additionally caused a vicious circle of undermining confidence, which destabilized the Greek banking system and led to a further decline of deposits, reducing the short-term viability as well as the intermediation power of banks, which entailed further reduction of their equity adequacy.

Greek NPLs have generally both common and unique characteristics in relation to the rest of Europe. This problem is a very deep one as the Greek banking system has not been able to resolve this issue for roughly a decade.

There is a rich literature on the subject of the interactions between the following three pillars: real economy, banking system and non-performing loans. It is obvious that a banking system is affected by many variables also interrelated with other countries. It is often said that banks are a proxy for risk within a regime.

The financial crisis of 2008 fed the developed countries to an economic recession; despite the fact that the governments of the USA, Europe, Japan and China took unprecedented steps to protect their financial systems. In turn, this recession directly affected the quality of assets/loans and deteriorated the balance sheets of the respective banks. Therefore, it is doubtless that



macroeconomic factors are the main determinant of NPLs, this is also referred in the majority of the theoretical and empirical research. This master thesis attempts to shed some light on the macroeconomic determinants, focusing also on bank-specific determinants of NPL in the EU economies.

The relevant literature suggests that bank assets (Berge and De Young [1997](#)) is an important determinant of NPLs, while a number of studies examine the impact of “cost efficiency” (Berger and De Young [1997](#); Podpiera & Weill [2008](#); Chang Shu [2004](#)), namely Net Interest Margin, on a set of key banking variables and in turn revealed a causal relationship between NPLs and “cost efficiency”.

Also, many papers have been published on the impact of public debt variables on NPLs fluctuations (e.g., Louzis, Vouldis and Metaxas [2011](#)) However, relatively limited studies focus on the impact of shadow banking.

In this framework, on the one hand, there is a widespread agreement that macroeconomic variables and GPA growth are attributed to the impact of NPL’s variables (see, for example, Markus Arpa [2001](#); Louzis, Vouldis and Metaxas [2011](#) etc.).

Hence, a question of great importance is whether banking variables are indeed related to NPLs in the context of a banking union or the specific macroeconomic characteristics of each country separately are more important.

The present master thesis will attempt to provide an analytic framework for the conceptualization of Non- Performing loans, bringing together macroeconomic variables and the two main pillars of finance sector, which are core and shadow banking.

It is important to explain further the main characteristics of a financial system, which is separated in two pillars. The first pillar is the core financial system (which is usually identified as the banking system) can be defined as a back-end system that processes daily banking transactions



and posts updates to accounts and other financial records. The core system typically includes deposit, payments, loans and credit processing capabilities.

The shadow banking system is the group of financial intermediaries facilitating the creation of credit across the global financial system, but whose members are not subject to regulatory oversight. The shadow banking system mainly consists of lenders, brokers, other credit intermediaries, hedge funds, private equity funds, unlisted derivatives, and other unlisted instruments. These financial institutions and products fall outside the realm of traditional regulated banking, namely not subject to regulation but with the same kinds of risk, liquidity, and capital restrictions as traditional banks are. However, they are regulated institutions. The shadow banking system played a major role in the expansion of credit in the run up to the 2008 financial crisis but has grown in size even since then (Figure 6).

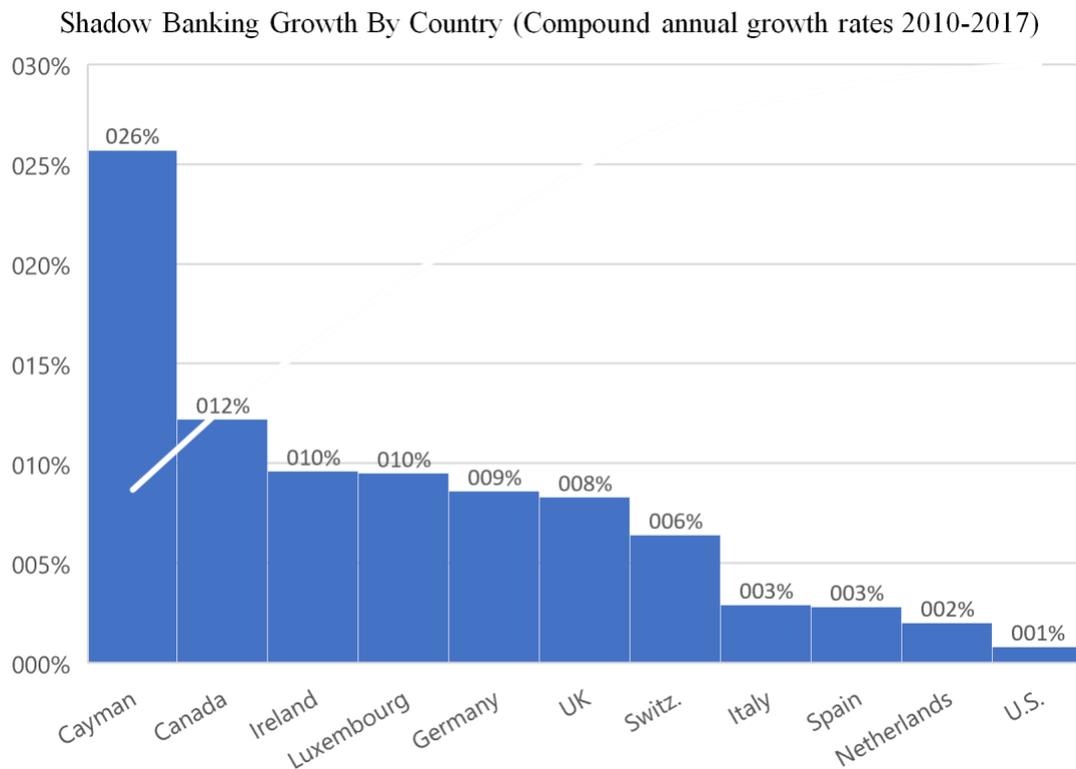


Figure 6: Fitch Ratings, 'Global Monitoring Report on Non-Bank Financial Intermediation 2018'.



Analytically, in this work we attempt to shed light on the macroeconomic determinants of NPLs in the EU economies by acknowledging their direct and indirect key roles. In this context, we also consider the impact of two recent crises (Sovereign crisis and Brexit).

This master thesis contributes to the NPLs research in the following ways:

- i. First, it directly relates macroeconomic variables (i.e. GDP, Government debt) and bank variables (i.e. domestic credit, bank deposits) as key determinants of NPLs.
- ii. Second, to the best of our knowledge, it is the first that relates the financial variable of shadow banking as a key determinant of NPLs. At the same time, there needs to be a clear distinction between the core financial system and the shadow banking system, which are the two components of the whole credit line in an economy.
- iii. Third, it uses a wide dataset in quarterly format, which includes the main European Union (EU) countries such as Italy, France, Germany, Netherlands Belgium, Luxemburg, Denmark, Ireland, Greece, Portugal, Spain, Austria, Finland, as well as the economies of UK, Sweden and Denmark (these countries belong to the EMU<sup>2</sup> but do not participate in the common currency), in the period 2000–2018, fully capturing the last two recent crises of sovereign debt and Brexit;
- iv. Fourth, it provides a consistent and robust econometric framework based on advanced techniques, such as Dynamic Panel Data Analysis, in order to tackle the research questions.

The Master Thesis is organized as following: Chapter 2 offers a detailed review of the literature regarding NPLs. Chapter 3 sets out the methodological framework. Chapter 4 presents the empirical results. Chapter 5 describes the policy implications and, finally, Chapter 6 concludes the thesis.

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<sup>2</sup> EMU: Economic and Monetary Union  
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## Chapter 2: Previous Literature

NPLs are a recurrent feature of any financial crisis or financial stress episodes and are typically build up as a credit boom that eventually busts. Also, high rates of NPLs are usually correlated with protracted low growth and structural imbalances in the whole banking system.

### Economic / Business Cycle

One of the earliest studies that tried to study the determinants of NPLs was conducted by Williamson (1987) and it was an *empirical study*. He highlighted the countercyclicality of credit risk and business failures. During the same year a similar *empirical study* was conducted by Keaton and Morris (1987). The authors investigated the determinants of loan losses in a large sample of U.S. banks. They introduced one of the earliest empirical studies on NPLs and investigated the causes of loan loss diversity on a sample of 2,470 banks in the USA. Based on the sample results they came to the conclusion that the loan losses emanated from:

- i. poor and unusual low profitability of particular sectors of the economy, such as agriculture and energy,
- ii. different factors among local economies in the country,
- iii. only a minor part of the remaining variation in losses can be attributed to high propensity of some banks to provide risky loans compared to the others.

A more recent research that unveiled the relationship between profitability and NPLs was conducted by Ozili (2019), who investigated the behavior of non-performing loans, focusing on the relationship between non-performing loans (NPLs) and the economic cycle for European systemic and non-systemic banks. He found that NPLs of systemic banks are positively correlated with: (i) bank profitability (ii) and loan supply. On the other hand, the NPLs of non-systemic banks are positively associated with banks profitability for non-systemic banks in the post-2007 financial crisis period.



On the other hand, Bernanke and Gertler ([1989](#)) conducted a *theoretical survey* which was the most prominent one. More specifically, they introduced the notion of “financial accelerator”. This concept of “financial accelerator” can combine the following elements that:

- i. credit markets are “procyclical”,
- ii. information asymmetries between lenders and borrowers play a key role to reinforce and spread the credit market shocks to the whole economy.

Another *theoretical study* of Kiyotaki & Moore ([1997](#)) revealed how small shocks can explain business cycle fluctuations, since credit markets are imperfect. In addition to that, there are many *empirical studies* that link the credit risk and in turn the Non-Performing loans with the state of the economy. These studies such as Salas and Saurina ([2002](#)), Ruckes ([2004](#)) and Fofack ([2005](#)) show that in good economic times, banks extend credit to low quality debtors in order to generate higher revenue because the risk of financial distress is usually low during booming years. However, when a recession sets in, non-performing loans are expected to increase for banks. The *empirical research* of Quagliariello ([2007](#)) led to the same results, since he observed that the state of the economy is a determinant of non-performing loans for Italian banks. These studies obtain outcomes akin to the ones which were obtained by Ghosh ([2015](#)). Actually, he found that NPLs are related to the alterations in the state-level economic conditions.

A similar research made for the Chinese banking system used a sample of commercial banks. This was conducted by Zhang, Cai, Dickinson and Kutan ([2016](#)) and found evidence of cyclical instability that fed into NPLs.

Also, the *empirical research* of Klein ([2013](#)) is in contrast to the previous ones. He documented a strong negative relationship between non-performing loans and the economic cycle (for banks in CESEE<sup>3</sup> countries).

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<sup>3</sup> CESEE: Central, Eastern and South- Eastern Europe.  
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## Bank-specific Variables

A seminal study on how bank specific variables can impact NPLs, was conducted by Berger and De Young (1997), who tried to investigate the determinants behind NPLs. They used a sample of US commercial banks between 1985 and 1994. They applied different techniques (e.g. Granger-causality) in order to test some hypotheses concerning the relationship between: (i) bank capital, (ii) cost efficiency (iii) and loan quality. These hypotheses were described as “bad luck”, “bad management”, “skimping”, “moral hazard”. They tried to examine which of the aforementioned hypotheses were consistent and robust with the data. Their conclusion was that “bad management” was superior to the others. A more recent research was conducted by Dash and Kabra (2010). They focused on explaining differences in NPL across banks within specific countries highlighting the role of the management quality and policy choices.

Sinkevicius and Greenawalt (1991) showed that banks with adequate capital ratio had significantly lower rates of NPLs. The research of Khan, Siddique and Sarwar (2020) concluded that capital adequacy had a negative association with NPLs<sup>4</sup> and also that operating efficiency and profitability indicators<sup>5</sup> had a negative impact on NPLs.

A relevant study of Podpiera and Weill (2008) immersed in other hypotheses; more specifically they revealed a causal relationship between NPLs and “cost efficiency”. In addition, they detected that another cause of increasing NPLs was the fact that bank capital ratios were broadly low. Hence, there was “moral hazard”; namely bankers pursued to increase the capital of their banks and pushed inadequately capitalized banks towards taking a high portfolio risk. This is in line with Zhang, Cai, Dickinson and Kutan (2016), who found evidence that moral hazard affect and increase the NPLs.

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<sup>4</sup> This negative association were statistically insignificant.

<sup>5</sup> These indicators was statistically significant.



## Banking Quality Variables

What is also worth pointing out is that there are quality variables that are also determinants of NPLs. According to Boudriga, Taktak and Jellouli (2010): (i) collaterals (ii) bankruptcy laws, (iii) the degree of corruption and the quality of courts have a significant impact on the rate of NPLs. Also, they found that higher legal rights are associated with a lower NPL level.

On the other hand, stronger creditor rights might also be expected to increase default rates and in turn deteriorate the NPL ratio, according to Jappelli, Pagano and Bianco (2005). Increasing judicial efficiency increases mortgage default rates.

A more recent research which is related to bankruptcy laws is conducted by Cucinelli, Battista, Marchese and Nieri (2017). They found that the effectiveness of the insolvency procedures and creditors' protection (RR) has a negative relation with NPLs. This means that banks which are operating in such a jurisdiction is less costly and less-time consuming manner.

Another quality variable is how fragmented the banking industries. Specifically, Breuer (2006) found a small but significant positive association between banking industry concentration and NPLs. In contrast, Çifter (2015) concluded that "bank concentration" may not affect systemic stability in the CEE<sup>6</sup> countries. He examined this relationship both in the long run and in the short run.

Another interesting research which investigated the issue of the interaction between NPLs and banking quality characteristics was addressed by Ghosh (2015). He found that: (i) bank inefficiency, (ii) capitalization needs, (iii) and banking industry concentration can cause an increase in the NPL ratio.

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<sup>6</sup> CEE: Central and Eastern European countries.  
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## Associated Banking variables

Other studies also use bank variables as a measure of non-performing loan. A representative example of *empirical research* was conducted by Pesaran (2006). According to this, he examined the link between changes in a credit portfolio and the macroeconomy. Also, he observed that loan default probabilities are strongly driven by the link between firms and the economic cycle.

Implying that historical data on default probabilities can help predict the likelihood of future NPLs. Another *empirical research* came to the same conclusion about default probabilities (DF). This was authored by Beck, Jakubik and Piloiu (2013) who also confirmed that data on default probabilities are largely publicly unavailable. Another major driver of NPLs is stock prices according to Beck, Jakubik and Piloiu (2013). They found that reductions in stock prices negatively affected the asset quality of banks. However, it was less obvious that stock prices have a direct effect on NPLs.

## Microeconomic

According to *theoretical study* and *empirical research*, a lot of macroeconomic variables affect NPLs. However, another strand of the NPL literature examined on top of macroeconomic performance the role of micro-economic factors. Specifically, Ghosh (2006) concluded that corporate leverage is a significant determinant of NPLs.

## Macroeconomic

Analyzing Gambera's (2000) *empirical research*, some macroeconomic variables, as depicted below: (i) bankruptcy filings, (ii) state annual product, (iii) housing permits, (iv) and unemployment, can predict the problematic loan ratios with relative accuracy.

Some other researchers added new macroeconomic variable in this list; for example, Nkusu (2011) found that (i) sluggish growth, (ii) decreasing asset prices (iii) or higher unemployment, is related to NPLs. On the contrary, an improving macroeconomic environment implies a decrease



in debt service problems. Also, Chang Shu (2004) found a high positive correlation between NPLs ratio and: (i) nominal interest rates, (ii) number of bankruptcies. On the other hand, he found a negative correlation between NPL ratios and: (i) higher CPI inflation, (ii) economic growth (iii) property price inflation. Brooks, Dicks, and Pradhan (1994) were in the same line since they highlighted the role of rising inflation in increasing mortgage defaults.

It is also important to take into account other macroeconomic variables which are related to fiscal variables. Kauko (2012) examined (using a sample of 34 developed economies) the relationship between the current account balance and the development of non-performing loans, especially in the recent financial crisis. His main result was that credit expansion could be considered as an important risk factor only if combined with ‘Current deficit’, this is a sign of the loss of competitiveness. A pioneering research that was conducted by Anastasiou (2016) examined the determinants of NPLs and concluded that taxes as well as the output gap are found to significantly affect NPLs.

A research of Louzis, Vouldis and Metaxas (2011) shows that all categories of Greek NPLs (consumer, business loans and mortgages) can be explained by the following macroeconomic variables: (i) GDP growth, (ii) unemployment, (iii) interest rates, (iv) public debt, (v) as well as management quality. Regarding the last variable of “management quality”, Louzis, Vouldis and Metaxas (2010) concluded to the same results that management inefficiency is positively associated with NPL. This result is in line with Espinosa and Prasad (2010).

A more recent research of Messai (2013) used a sample of 85 banks from the Greek, Italian and Spanish banking systems for the period 2004-2008. These countries had higher NPLs compared to the rest of Europe. She found a significant positive relationship of the unemployment rate with NPLs.

A respective research was conducted by Bofondi and Ropele (2011) for Italian banks (period 1990-2010) which specifically explored the macro factors affecting impaired business and



household loans. Their results showed that Italian household loans before the crisis recorded a positive relationship between NPLs and (i) unemployment (ii) and interest rates but a reverse relationship for (i) GDP growth (ii) and real estate prices. This result is in line with Espinosa and Prasad ([2010](#)), since they found that the NPL ratio worsens as economic growth weakens and interest rates increase.

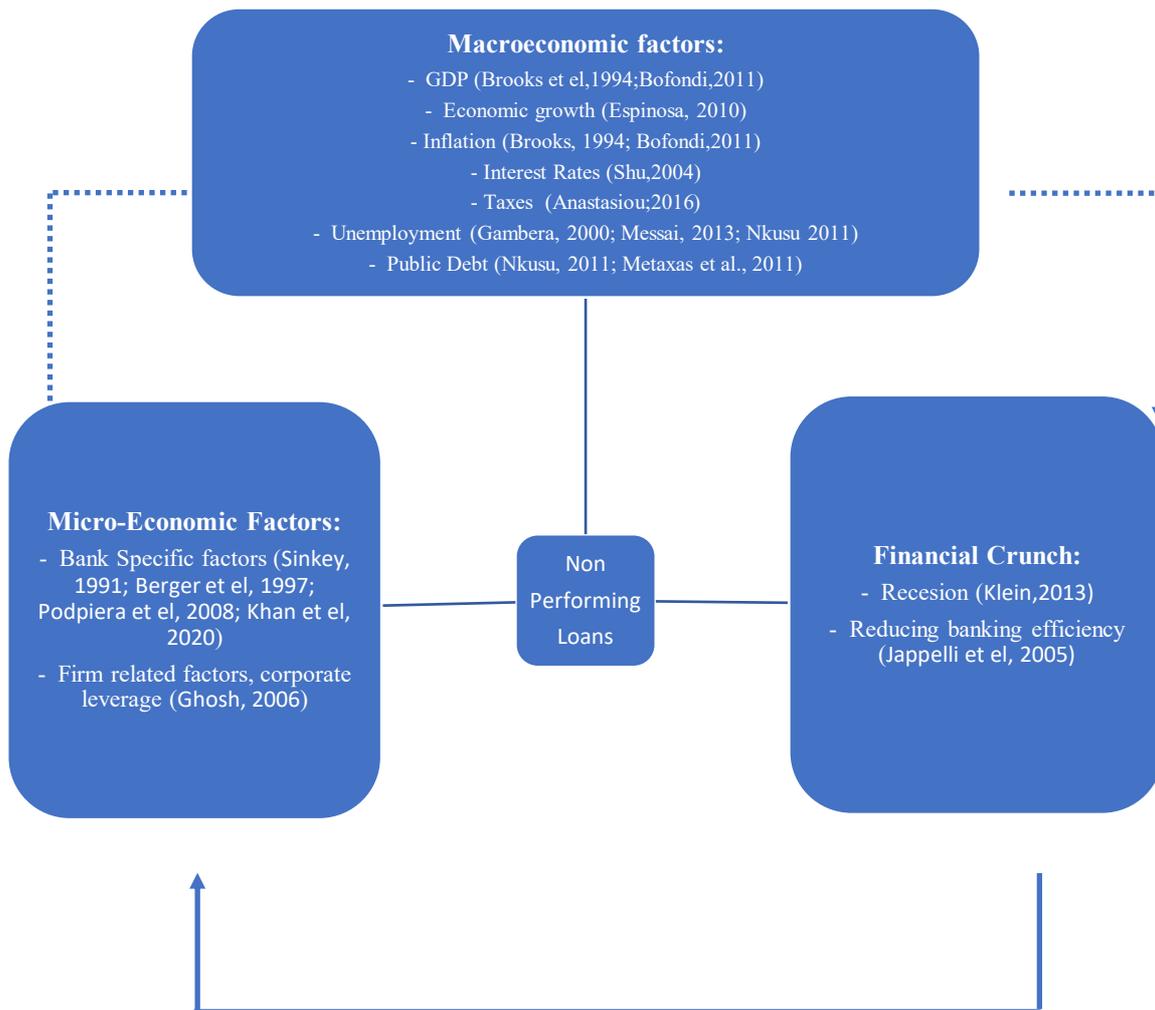
#### Feedback effects

It is notable to mention that the aforementioned studies examined the direct effect of different macroeconomic variables on NPLs. However, an inverse study was conducted by Klein ([2013](#)). The author examines the feedback effects of NPLs on the aforementioned macroeconomic conditions. Specifically, the study found that NPLs have a significant response to macroeconomic conditions and demonstrated that there were strong feedback effects from the banking system to the real economy.

Based on the thorough review of the relevant literature, we summarize the results in [Figure 7](#), which depicts the framework drawn from the *empirical* findings and *theoretical survey* and exhibits the causal nexus of NPLs.

This master thesis is based on a broad literature, which contains determinants which were also presented in the previous *theoretical* and (mainly) *empirical studies* about NPLs. By conducting research at a cross country level with time dimension trends can be extracted that are more reliable than an analysis of individual countries. Simultaneously, even though the majority of researches that are based on bank-by-bank analysis, are very useful in a micro-prudential context, these are available only for a small number of economies. For this reason, the differences between countries have a significant impact on the structural characteristics of asset quality and therefore need to be taken into consideration. These characteristics can be summarized in the following chart ([Figure 7](#)).





**Figure 7:** Author's elaboration.



## Chapter 3: Methodology

The variables are in quarterly format and the period under investigation is 2001 (Q4) - 2018 (Q4). The variables consist of a balanced panel of 3 macroeconomic variables and 5 bank-specific variables. In the first step of the analysis, we examine the panel time series properties of our data. To do so, we employed panel unit root testing to assess the order of integration of the panel time series variables.

The analysis is conducted in an aggregated manner by classifying all loan categories (i.e. mortgages, business and consumer loans) in a total portfolio and subsequently the aggregate portfolio of all domestic banks into an aggregate amount for each country. The dependent variable is the NPL ratio which is defined as the value of total loans denominated in Euro currency.

Our analysis builds on the following model, where the relationship between NPLs and a set of fundamental macroeconomic variables, which are: (i) Gross Domestic Product ([GDP](#)), (ii) Government Debt, and (iii) the 10-year rate Bond is investigated.

Subsequently, the baseline model is further extended by the inclusion of additional bank variables, which are: (i) the Domestic Credit provided to the total economy by the shadow banking system (ii) Bank Assets (iii) Bank Net Interest margin, (%) (iv) Bank Deposits.

Finally, it is important to note that we have included two dummy variables in our model. These dummy variables are (0 or 1) used in our analysis to represent subgroups of the sample.

The first subgroup which is represented by the first dummy is the Structural EMU Debt Crisis, capturing the period of the breaking out of the sovereign crisis in Europe. Also, we have another dummy, which is the Brexit event. This refers to the period following the UK-wide referendum in June 2016. The purpose was the withdrawal of the United Kingdom (UK) from the European Union.



## 3.1 Panel Times series Tests

### 3.1.1 Unit root test panel test LLC

We begin by testing for the existence of unit roots. The Levin, Lin and Chu ([2002](#)) is widely used and is designed to test the null (existence of a common unit root in the panel) against the alternative (the panel is stationarity when the cross-sectional dimension is independent).

The starting point for the test can be expressed by Equation (1):

$$\Delta y_{it} = \phi_l y_{i,t-1} + Z'_{it} \gamma_i + \varepsilon_{i,t} \quad (1)$$

To mitigate the possibility of serial correlation of  $\varepsilon_{i,t}$ , additional lags are added by LLC.

$$\Delta y_{it} = \phi_l y_{i,t-1} + Z'_{it} \gamma_i + \sum_{j=1}^p \theta_{ij} \Delta y_{i,t-j} + u_{it} \quad (2)$$

Once the appropriate lag order in (2) has been determined, the auxiliary regressions (2.1) and (2.2) can be estimated through the least squares method:

$$\Delta y_{it} = \sum_{j=1}^p \phi_{ij} \Delta y_{i,t-j} + \alpha_l d_\tau + u_{it} \quad (2.1)$$

$$y_{it-1} = \sum_{j=1}^p \phi_{ij} \Delta y_{i,t-j} + \alpha_l d_\tau + u_{it-1} \quad (2.2)$$

If the lags are specified correctly,  $\Delta y_{it}$  in (2) will become white noise. Under the null (existence of unit root),  $y_{it}$  will be nonstationary and as a result, standard OLS regression will produce a nonstandard distribution for  $\phi$  which will be depended on the term  $Z_{it}$  (Nickell, [1981](#)).



### 3.1.2 Hausman test for fixed and random effects

As is common practice in the panel data literature, we employ the Hausman test to decide between estimating a random effect model or a fixed effect. In this test, the null hypothesis is that the random effects is preferred to fixed effects, while the alternative states that the random effects model is accepted. This way the test checks whether the unique errors ( $u_{it}$ ) have any type of association with the regressors. Finally the null hypothesis implies that unique errors ( $u_{it}$ ) and regressors are not correlated.

The test is based on the difference between two estimates  $b_1$  and  $b_2$ . Under  $H_0$ ,  $b_1$  is assumed to be a consistent and efficient estimate with an asymptotic covariance matrix  $V_1$ . The alternative estimator  $b_2$ , with an asymptotic covariance matrix  $V_2$ , is consistent - but usually inefficient - both under  $H_0$  and the alternative hypothesis  $H_a$ . A large difference  $b_1 - b_2$  between the estimates is seen as evidence against  $H_0$  and it is measured by the Mahalanobis distance, thus:

$$H_0 = \text{Var}(b_1 - b_2) = V_1 - V_2$$

and the Hausman statistic is:

$$H = (b_1 - b_2)^T (V_1 - V_2)^{-1} (b_1 - b_2)$$

which is asymptotically chi-square distributed with  $k = \text{rank}(V_1 - V_2)$  degrees of freedom under  $H_0$  (Hausman and McFadden [1984](#); Amemiya 1985).



## 3.2 Model Specification

After determining empirically that a fixed effect estimation is the preferred one, the paper continues by estimating the models. The following sections (a-e) describe the individual properties of each model.

### i. Arellano–Bond linear dynamic panel-data estimation

A linear dynamic Arellano- Bond takes the form depicted in (3) :

$$y_{it} = \sum_{j=1}^p a_j y_{i,t-j} + X_{it}\beta_1 + W_{it}\beta_2 + v_i + \varepsilon_{it} \quad i = 1, \dots, N \quad t = 1, \dots, T_i \quad (3)$$

where

$a_j$  are the parameters to be estimated,  $X_{it}$  is the exogenous covariates vector,  $\beta_1$  is its parameter's vector,  $W_{it}$  is the endogenous covariates vector,  $\beta_2$  is its parameter's vector,  $v_i$  are the panel effects (fixed) and  $\varepsilon_{it}$  is the i.i.d. (independent and identically distributed random variables) error term.

### ii. Arellano–Bover/Blundell–Bond linear dynamic panel-data estimation

The Arellano-Bover method builds on (3) and shows that under autoregressive persistence (or large idiosyncratic errors against panel effects), the Arellano-Bond estimator becomes weak. Their proposed fix is a system estimator, where lagged differences are used as instruments. This assumption holds only the case of  $E[v_i \Delta y_{i2}] = 0$  for all  $i$ <sup>7</sup>. The basic model can be described by (4).

$$y_{i,t} = \lambda y_{i,t-1} + X'_{it}\beta + f'_{it}\gamma + e_{i,t} \quad (4)$$

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<sup>7</sup> See Blundell and Bond (1998) and Blundell, Bond and Windmeijer (2000) for more information.  
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### iii. Linear dynamic panel-data estimation

This type of model takes the form presented in (5) :

$$y_{it} = \sum_{j=1}^p a_j y_{i,t-j} + X_{it}\beta_1 + W_{it}\beta_2 + v_i + \varepsilon_{it} \quad i = \{1, \dots, N\}; \quad t = \{1, \dots, T_i\} \quad (5)$$

Based on Anderson and Hsiao (1982) and Holtz-Eakin, Newey, and Rosen (1988), Arellano and Bond (1991) use a one and two step GMM estimator, where predefined variables are used as instruments.

### iv. The Pesaran (2006) Common Correlated Effects Mean Group estimator (CCEMG)

Equation 5 can be consistently estimated by approximating the unobserved common factors with cross section means  $\bar{x}_t$  and  $\bar{y}_t$  under strict exogeneity. It takes the form:

$$y_{i,t} = \beta_i X_{i,t} + \delta_i \bar{x}_t + \eta_i \bar{y}_t + \varepsilon_{i,t} \quad (6)$$

With Mean Group Estimates

$$\bar{x}_t = \frac{1}{N} \sum_{i=1}^N x_{i,t} \quad \bar{y}_t = \frac{1}{N} \sum_{i=1}^N y_{i,t}$$

### v. Pesaran and Smith (1995) Mean Group estimator

All Mean Group methodologies begin with the estimation of a group-specific regression and continue by averaging the estimated coefficients across groups.

$$y_{i,t} = a_i + \gamma_1 Y_{i,t-1} + u_{i,t} \quad (7)$$

The long run parameter  $\theta_i$  is:

$$\theta_i = \frac{\beta_i}{1 - \gamma_1}$$



Mg estimators:

$$\hat{\theta} = \frac{1}{N} \sum_{i=1}^N \theta_i \hat{a} = \frac{1}{N} \sum_{i=1}^N a_i$$



## Chapter 4: Empirical Results

### 4.1 Data and Variables

We use a quarterly balanced panel dataset covering the period 2000(Q4) – 2018(Q4) for the economies of Italy, France, Germany, Netherlands Belgium, Luxemburg, Ireland, Greece, Portugal, Spain, Austria, Finland, as well as for the economies of the UK, Sweden and Denmark, that belong to the EMU. The following table ([Table 2](#)) summarizes the data and variables used in the analysis.

The data were quarterly and the related period is between 2001 (Q4) and 2018 (Q4). These data were transformed into Euros in order to be comparable. This conversion was based on the respective currency exchange at the time. The data were sourced from Reuters, Bloomberg, European Central Bank ([ECB](#)), Bank of Greece ([BoG](#)), Bank of England ([BoE](#)), Central Bank of Belgium ([NBB](#)), Central Bank of Sweden ([Riksbank](#)), Central Bank of the Kingdom of Denmark ([Nationalbanken](#)), Eurostat, World Bank, Organization for Economic Co-operation and Development ([OECD](#)), International Monetary Fund ([IMF](#)), Bank for International Settlements ([BIS](#)), Federal Reserve Bank of St. Louis ([FRED](#)) and International Financial Statistics ([IFS](#)).

We employ a sample of 15 countries over the period 2001-2018 to investigate the macroeconomic and bank industry determinants of Non-Performing loans and the role of shadow banking. [Table 2](#) provides further details on variables and sources of information.



**Table 2: Data and Variables**

Variable	Description	Source	Time Period
Government Debt	Gross Domestic Product (GDP) is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period;	IMF	
10 Year Bond	The 10-year government bond is a debt obligation issued by a government with a maturity of 10 years upon initial issuance. The spread is expressed as ISMA Bid Yield	Reuter	
Domestic credit Shadow Banking	Domestic credit provided by the financial sector is credit that is extended to various sectors. The financial sector includes monetary authorities such as the central bank (the entity which controls the supply of a country's currency), deposit money banks (commercial "main street" banks), and other financial institutions (Shadow Banking).	World Bank Data	
Bank Assets	Total assets of all domestic banking groups and stand alone banks, foreign (EU and non-EU) controlled subsidiaries and foreign (EU and non-EU) controlled branches	Euro Stat	
Bank Net interest margin	Net interest margin (NIM) is a measurement comparing the net interest income a bank generates from credit products like loans and mortgages, with the outgoing interest it pays holders of savings accounts and certificates of deposit (CDs). Expressed as a percentage.	World Bank	2001 (Q4) – 2018 (Q4)
Total Bank Deposits	Demand, time and saving deposits in deposit money banks as a share of GDP, calculated using the following deflation method: $\frac{\{ (0.5) * [F_t/P_{e,t} + F_t - 1/P_{e,t} - 1] \}}{[GDP_t/P_{a,t}]}$ where F is demand and time and saving deposits, P <sub>e</sub> is end-of period CPI, and P <sub>a</sub> is average annual	World Bank	
Structural Debt Crisis	Structural Debt Crisis refers to a dummy variable that accounts for sovereign debt crisis in each European country, taking the value of 1 in a year that a sovereign crisis took place and 0 elsewhere.		
Brexit	Brexit refers to a dummy variable. Brexit is an abbreviation for "British exit," referring to the U.K.'s decision in a June 23, 2016 referendum to leave the European Union. Taking the value of 1 in Brexit year and 0 elsewhere.		



## 4.2 Analysis

To begin with the result analysis, the unit root properties of the various macroeconomic and banking variables have been checked ([Table 3](#)).

The LLC test was applied both on the original variables as well as on their first differences, where relevant. Under the null (existence of unit root),  $y_{it}$  will be nonstationary and a result, standard OLS regression will produce a nonstandard distribution for  $\phi$ . In all cases the null hypothesis is rejected (no unit root). All variables are found to be stationary (Government Debt, 10 Year Bond, Domestic credit Shadow Banking, Bank Assets, Bank Net interest margin, Total Bank Deposits, Non-Performing loans).

In addition to this, they are found to be stationary (Government Debt, 10 Year Bond, Domestic credit Shadow Banking, Bank Assets, Bank Net interest margin, Total Bank Deposits, Non-Performing loans) in their first differences i.e.  $I(1)$ , as presented in the following [Table 3](#).

**Table 3:** LLC Stationarity test (original & first differenced variables)

Variable	$p$ -value	Stationary
Government Debt	0.0059	Yes
10 Year Bond	0.0084	Yes
Shadow Banking	0.0009	Yes
Bank Assets	0.0002	Yes
Bank net interest margin	0.0000	Yes
Total Bank Deposits	0.0059	Yes
NLPs	0.0084	Yes

Unit root tests for the estimated models



[Table 4](#) reports the estimation of a random effect model.

**Table 4: Random effect model**

Random effects	Coef.	Std. Err.	Z	P> z	[95%_L Conf.Interval]	[95%_U Conf.Interval]
Government Debt	0.044346	0.0048808	9.09	0	0.0347799	0.0539122
10 Year Bond	360.1765	281.8951	1.28	0.201	-192.3278	912.6808
Domestic credit						
Shadow Banking	-0.0039115	0.0028125	-1.39	0.164	-0.0094239	0.001601
Bank Assets	0.0012549	0.0016392	0.77	0.444	-0.0019578	0.0044677
Bank net interest margin	533.635	1279.887	0.42	0.677	-1974.897	3042.168
Total Bank Deposits	-0.0080183	0.0049093	-1.63	0.102	-0.0176403	0.0016037
Structural Debt						
Crisis	7585.216	2214.642	3.43	0.001	3244.598	11925.83
Brexit	9542.19	2443.879	3.9	0	4752.275	14332.1
_cons	7887.045	5194.641	1.52	0.129	-2294.264	18068.36



While [Table 5](#) reports the results of a fixed effects estimation.

**Table 5:** Fixed effects estimation

Fixed effects model	Coef.	Std. Err.	Z	P> z	[95% L Conf.Interval]	[95% U Conf.Interva]
Government						
Debt	0.0229461	0.0053437	4.29	0	0.0124592	0.0334331
10 Year Bond	314.9458	276.6148	1.14	0.255	-227.9051	857.7968
Domestic credit						
Shadow Bank	-0.0000756	0.0031837	0.02	0.981	-0.0063236	0.0061724
Bank Assets	0.0041543	0.0033805	1.23	0.219	-0.0024799	0.0107885
Bank net interest margin						
	-1277.237	1264.857	1.01	0.313	-3759.493	1205.02
Total Bank						
Deposits	-0.0076544	0.0050982	-1.5	0.134	-0.0176595	0.0023506
Structural Debt						
Crisis	10837.83	2186.842	4.96	0	6546.198	15129.47
Brexit	10811.18	2343.396	4.61	0	6212.312	15410.05
_cons	12311.25	9381.744	1.31	0.19	-6100.235	30722.74

Following the standard econometric procedure, the two different estimations are tested through a Hausman test. The results are reported in [Table 6](#) and the p-value (0.00) indicates that a fixed effect model is preferred to a random effects model.



**Table 6: Hausman Test results**

Hausman test				
	Random effects	Fixed Effects	Difference	S.E
Government Debt	0.044346	0.0229461	-0.0214	-0.0209
10 Year Bond	360.1765	314.9458	-45.2307	0.0021
Domestic credit Shadow Bank	-0.0039115	-0.0000756	0.003836	-91.534
Bank Assets	0.0012549	0.0041543	0.002899	0.0041
Bank net interest margin	533.635	-1277.237	-1810.872	-5E-05
Total Bank Deposits	-0.0080183	-0.0076544	0.000364	-1735.5
Structural Debt Crisis	7585.216	10837.83	3252.614	-0.0019
Brexit	9542.19	10811.18	1268.99	3405.4
_cons	7887.045	12311.25	4424.205	1087.88
Test: Ho: difference in coefficients not systematic				
Chi-squared	89.55			
P-value	0.00			

The results, according to [Table 7](#), indicate that the following variables:

- i. Government Debt
- ii. Total Bank Deposits
- iii. Structural Debt Crisis

play a statistically significant role in the explanation of NPLs, since these variables are statistically significant in most of the estimated models.

As for the rest, “Brexit” and “10 Year Bond” seem not to play an important role (the former is statistically significant in only one model and the latter in none), while the rest of the control variables also do not.



**Table 7:** Results of each panel model.

	Arrelano_Bond (a)	Arrelano_Bover (b)	Dynamic Panel (c)	Mean Group Average estimation (d)	Cross Correlated Mean Group Estimation (e)
NLPs	0.541*** (-16.52)	0.684*** (-28.64)			
Government Debt	0.00484 (-0.82)	0.0340*** (-*8.18)	0.0175*** (-5.05)	0.0374* (-2.39)	0.00861 (-0.92)
10 Year Bond	-571.5* (-1.71)	-547.1* (-1.75)	99.65 (-0.46)	-2538 (-1.39)	-449 (-0.69)
Domestic credit ShadowBank	0.00948 (-1.88)	0.00106 (-0.36)	0.000134 (-0.07)	-0.029* (-1.69)	-0.0449* (-2.16)
Bank Assets	0.00286 (-0.9)	-0.00714*** (-5.36)	0.00388* (-1.65)	0.0408 (-1.14)	-0.000273 (-0.02)
Bank net interest margin	-1105.9 (-0.98)	690.6 (-0.61)	293.9 (-0.3)	-21.16 (-0.01)	1592.5 (-1)
Total Bank Deposits	0.0127** (-2.89)	0.0106** (-2.64)	-0.00946** (-2.81)	-0.0748 (-0.98)	-0.0262 (-1.10)
Structural Debt Crisis	12466.4*** (-3.83)	1999.4 (-0.77)	16542.7*** (-10.33)	10851.2* (-2.18)	1592.2* (-2)
Brexit	2822.7 (-0.87)	-3082.9 (-1.04)	14310.2*** (-9.14)	-529.9 (-0.17)	780.2 (-0.3)
Constant	-10566.3 (-1.10)	242.5 (-0.07)	12522.1* (-1.93)	30669.4 (-1.58)	20516.1 (-1.13)

Notes: Regression results were generated in Stata. T-student are reported in parenthesis. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively.



Finally, it is worth mentioning that some variables invert their signs from estimation to estimation. This is observed mainly in the mean group model (d), and Cross Correlated Mean Group Estimation (e), while the Dynamic Panel (c) models have similar results in most cases.



## Chapter 5: Policy implications and Recommendations

The results of a recent survey which was conducted by Aiyar (2015) showed that NPLs of the European banks had exceeded the 10% ratio of gross total loans during 2008-2014. NPLs in the EU stood at about €1 trillion (or over 9 percent of the region's GDP) at the end of 2014, more than double the level of 2009. The Southern part of the euro area was the one mostly negatively affected by this increase. This high persistence of NPLs led to (i) a reduction of bank profitability (ii) financial stability (iii) economic activity (iv) credit growth. As a result, funding costs raised and credit supply was dampened.

There are numerous options that have been suggested with the aim of improving the conditions in the European NPL market and cleaning of banks' balance sheets. Public intervention measures through asset management companies (AMC) or multi-investment strategies are deemed necessary to create an inverse trend in NPLs and reinforce investor confidence, in turn increasing market efficiency and growth in EU.

This master thesis presents several practical insights about the success factors behind NPLs' resolution strategies. The resolution toolkits, which have been used until nowadays by different authorities in the world, are fairly standard and unchanged for several decades. This can be easily noticed, if we observe the recent NPLs crisis in Europe or the recent crisis in the United States (US savings and loan - S&L 1980s), as well as the recent crisis in Asia (financial crisis of the 1990s).

There are many unique characteristics in the financial system of each country, so there is no single absolute solution to the NPLs problem, so the success of each resolution policy may vary. Public authorities should focus on the individual characteristics of their (i) banking system, (ii) financial system, (iii) local markets, (iv) judicial procedures, (v) civil law and based on these factors they should try to tackle this problem in a holistic way.



Generally, various countries have used plenty of resolution tools to address NPLs situations, which were often used in combination. The rule of thumb is that the NPLs problem is systemic risk because most of the times this situation cannot be solved through a bank-by-bank approach. Hence, it needs a coordinated and centralized response, which is usually taken over by public or monetary authorities.

If a country faces this problem through a decentralized approach, then it may be counterproductive, because each bank's individual strategies/activities may affect their peers. Thus, as has already been mentioned previously, these strategies are better to be coordinated at the country level.

When a bank suffers from NPLs problems and generally has financial difficulties, it usually faces the following consequences:

- i. fire sales of certain assets,
- ii. bank runs,
- iii. because of (i) and (ii) "contagion" of the rest of its assets or to other banks.

However, coordinated strategies may be more sufficient to tackle this problem. No matter which strategy is used, the main goal is to preserve the following fundamental principles: (i) protect insured depositors, (ii) preserve social cohesion - shareholders and the creditors take first losses, (iii) maintain financial stability. The deposit guarantee scheme<sup>8</sup> is a measure implemented in many countries to protect their financial systems and bank depositors from the impact of a bank's failure. Actually, it protects a large portion of the small depositors, also enforcing a trust in deposits and dissuade people from seeking to withdraw their savings at times of crisis. This way, authorities succeed to preserve the social cohesion.

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<sup>8</sup> Under ECB and EU rules, €100,000 per depositor is guaranteed.  
MSc. Mathematical Modeling in Modern Technologies and Finance  
Master thesis



Deposit insurance can be characterized as a key component of a financial system in developed countries since it promotes economic activities and preserves financial stability.

Banks are crucial to a country's economy, so when the majority of the banks in a country have high NPL rates, then it is crucial to deal with this problem as soon as possible, since a failure to resolve the problem in an orderly fashion may result in the spreading of the crisis to the whole system and to an increase in the systemic risk. The longer the crisis lasts, the more pressing the coordination problem becomes.

This master thesis presents the main resolution tools, which can be separated in two broad categories:

- i. bank-specific measures, such as:
  - a. individual bank restructurings,
  - b. bank-internal bad-bank units,
  - c. bank-specific asset management companies (AMCs).
- ii. system-wide solutions, such as: the creation of country-wide AMCs, which are managed centrally by the local authorities.

The other grouping of resolution instruments, which overlap with the previous categories are:

- i. debtor-focused solutions,
- ii. and bank-focused solutions.



## 5.1. Debtor focused resolution instruments

It is important to note that only a small number of policy instruments are applicable to debtor-focused resolution mechanisms. These mechanisms can be separated into three subcategories, which are: (i) debt restructuring, (ii) out-of-court workouts (iii) and hybrid approach.

- i. **Debt restructuring:** it is a standard way of restoring a creditor's repayment capacity. The restructuring can be either corporate or loan restructuring, involving the banks that are creditors to the same customer, but the new loans have lower Nominal Value.
- ii. **Out-of-court workouts:** it has a close procedure. It doesn't involve a judicial process, so it is cheaper and faster. Also, based on the fact that it is more flexible, it is better adapted to the needs of the specific business case. In addition, it is a viable solution so as to overcome the potential social losses from a possible liquidation of a viable company, according to Brierley and Vlieghe ([1999](#)).
- iii. **Hybrid approach:** it is an intermediate approach which combines both an out-of-court workout and a formal insolvency process in the judicial system. This is very popular and widely used in the United States and the United Kingdom; its abbreviation is "prepack" (prepackaged workout). It is very convenient for all parties because it is faster than a full judicial process. Specifically, creditors prepare a workout plan in advance, which contains the clauses, the exact amount of haircut etc. In this way, the court needs only to give its approval for this plan, without being involved in the design of the restructuring. Specifically, the E.U issued a recommendation ([2014/135/EU](#)) to make simpler the restructuring procedures simpler, through early activation of the restructuring itself and smaller involvement of the courts.



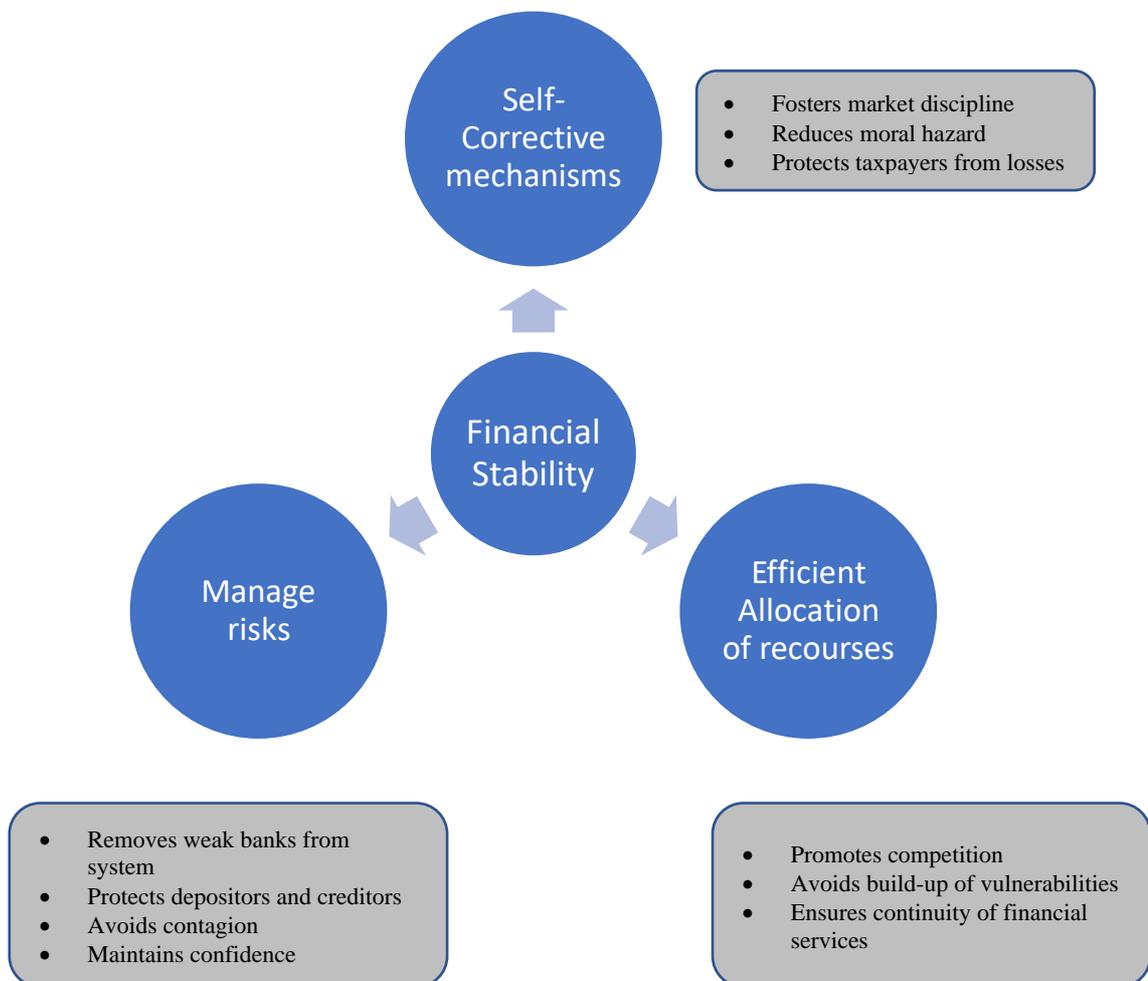
These instruments constitute a first priority in the banking toolkit, as banks prefer to implement these as a first step so as to help them preserve the value of their loans. However, banks should make sure that debt restructuring does not become a form of forbearance for any client. Banks should be very careful with these approaches, because they retain their credit exposure to insolvent customers (who have low creditworthiness) and in turn review their credit deterioration and financial ratios of balance sheet. It is also noticeable that if a debtor resolution instrument fails, banks will have to proceed to more drastic forms of debt restructuring, namely, by conducting a buyout plan and/or court receivership.

The major disadvantage of these methods is that although a bank can agree with its debtor to generally reschedule the loan, this entails that the bank will reclassify the category of this loan. However, the new one still remains in the broad field of NPLs and as a consequence banks are obligated to proceed to higher provisioning requirements. Thus, it is obvious that banks should try to avoid or postpone this step as much as possible.



## 5.2. Bank focused resolution instruments

The bulk of policy instruments is adopted and promoted by banks, country authorities and international organizations. Authorities, usually, are forced to proceed to some resolution instruments or a combination of them to minimize the banking market disruptions and avoid contagion of NPLs problem to the whole economy. In the European banking system, ESRB Expert Group is the responsible authority to develop ideas on possible macroprudential responses due to high levels of NPLs in the EU. The objective of an effective bank focused resolution regime is to make the restructuring of a bank institution feasible, avoiding the systemic disruptions and preserving the financial stability.



**Figure 8:** IMF, “Bank Resolution Powers and Tools”, by Oana Nedelescu.



At the same time, authorities have to take into careful consideration that the main purpose is to protect vital economic activities through the aforementioned mechanisms, so it very important to choose the suitable resolution instrument, based on both the circumstances and on the economic approach.

A representative example is that U.S.A. applied the instrument of asset protection scheme during the savings and loan crisis (S&L crisis) of 1980s, but they considered that this was not a proper manner for the global financial crisis (GFC) of 2008. [Table 8](#) presents the resolution instruments that each country followed in order to face different crises.

**Table 8:** NPL main resolution instruments in selected jurisdiction.

	Crisis episode	Type of resolution instrument:					
		Debt restructuring & out-of-court workouts	Write-offs	Direct sales	Securitization	Asset protection scheme	AMCs
U.S.A.	S&L crisis	√	√	√	√		√
	GFC	√	√	√	√	√	
Sweden	Nordic crisis		√	√			√
U.K.	GFC		√	√		√	√
Ireland	GFC		√	√			√
Italy	GFC		√	√	√		
Spain	GFC		√	√			√
Greece	GFC		√	√	√		√
Japan	Japan. crisis	√	√		√		√
Korea	Asian crisis	√	√	√	√		√

**Figure 9:** Author's elaboration and [Baudino \(2017\)](#)



The purpose of each strategy is to make all the market mechanisms functional and to increase the liquidity of banking market. It also important to normalize the functioning of secondary market for NPLs, this can be made through direct instruments such as public asset management companies or indirect instruments. The full toolkit is presented below: (i) write- offs, (ii) asset protection scheme (APS), (iii) direct sale, (iv) securitization and (v) asset management companies (AMC).

#### Write offs

The simplest bank focused resolution instrument is “write offs”. “Write offs” is actually an accounting treatment, namely, when the expected value of a loan cannot be recovered. Specifically, the bank that has this loan in its accounting books, it follows the reduction of its book value as the amount of unrecovered value. However, banks usually tend to postpone this action, because it has huge impact on their balance sheet and specifically on their equity, capital adequacy and profits. Thus, they tend to keep the full book value of these NPLs and hope that the macroeconomic conditions will improve so as to absorb these losses. This view is close a research, which was conducted by Bauze ([2019](#)).

In this view, some countries (U.S.A., Japan, Brazil) have set regulatory provisioning regime, so the banks are obligated to hold enough capital buffers through setting stringent and high provisions, in order to absorb future credit losses from non-performing loans during a possible crisis.



## Asset Protection Scheme (APS)

Asset Protection Scheme (APS) is actually an insurance scheme designed to help individual banks during the acute phase of a banking crisis, when they have big exposure to NPLs. Once a state agency insures banks against further losses and grants a guarantee on securitized non-performing loans, it practically covers a certain amount of the losses due to NPL's and charges a fee for the insurance it provides.

This scheme is designed to assist domestic banks in securitising and moving non-performing loans off their balance sheets. The viability of this instrument depends on the APS's management skills to cover these guarantees and return of confidence in the market. Representative example of an Asset Protection Scheme is an executive agency which was launched in 2009 in the United Kingdom by its Treasury Department<sup>9</sup> and had as a target to support two English banks (RBS, HBOS).

A more recent example is the GACS<sup>10</sup>, which was designed by Italian authorities and was approved by European Commission in 2016. The design of this scheme as presented in [Figure 10](#) is simple. A service provider (supported by Italian authorities) originated an SPV<sup>11</sup> that would buy NPLs from Italian banks and pool these loans in an Asset Pool. After that, it would issue a Note, which is covered by the Asset Pool, and sell this Note to investors as different tranches (i) senior (ii) mezzanine (iii) junior. In addition, the senior tranches have the benefit of State guarantee.

The objective is to attract a wide range of investors, improve the liquidity and support the domestic banks in their ongoing efforts to reduce the amount of NPLs on their balance sheets.

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<sup>9</sup> The Banking Act 2009 (c 1) is an Act of the Parliament of the U.K., 21 February 2009.

<sup>10</sup> GACS: Fondo di Garanzia sulla Cartolarizzazione delle Sofferenze

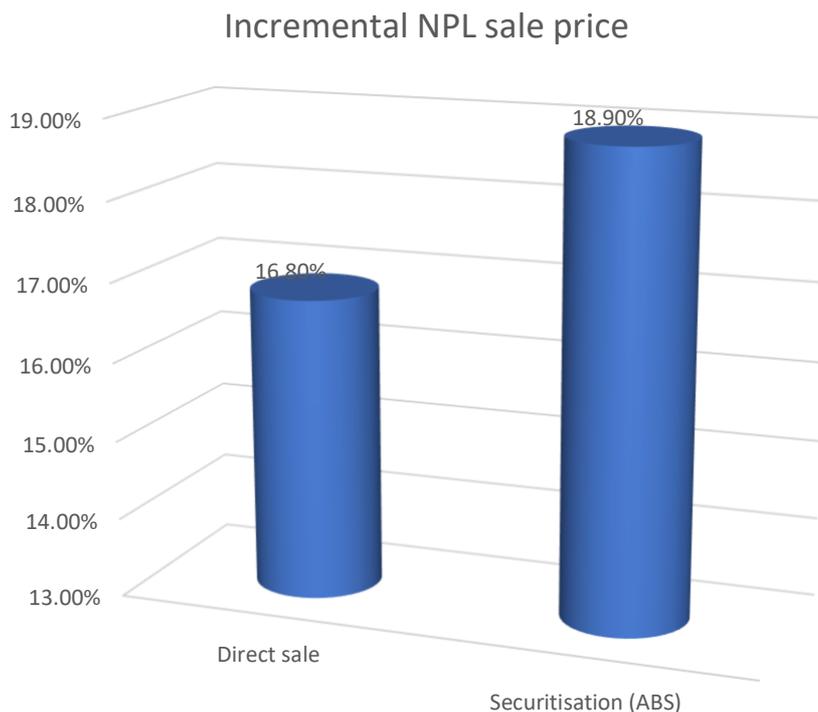
<sup>11</sup> SPV: Special Vehicle Purpose.





## Securitization

It is a very difficult procedure to sell a pool of NPLs, since this market is extremely volatile and illiquid. According to EBA<sup>13</sup> and European commission<sup>14</sup>, European banks should be encouraged to sell their NPLs using securitizations, and new rules should be put in place to make the process more attractive. This approach is an unattractive funding tool, since it is the most complex one and has higher funding and transaction costs. However, an efficient implementation and transaction can have a very significant impact on the main factors that determine NPL prices. According to Fell (2017) calculations, securitization can result in higher NPL prices than direct sales. Specifically, incremental NPL sale price achieved by using securitization is approximately 2% higher as a percentage of gross book value (Figure 11).



**Figure 11:** ECB calculations.

<sup>13</sup> EBA: European Banking Authority

<sup>14</sup> The securitization of NPL is welcomed by EBA, as reported in their Opinion in October 2019.



It is also complex to structure a securitization with its pool containing NPLs loans. The most frequent structure of securitization is to issue tranches or issue two kinds of tranches junior and senior one. Securitization assumes two tranches, with the senior tranche accounting for 90% of the NPL sale price to the special-purpose vehicle and the junior tranche for 10%. In addition, securitization has three main structure forms: (i) direct (e.g. a characteristic example is the RTC<sup>15</sup>, U.S.A), (ii) indirect (e.g. a characteristic example is the KAMCO<sup>16</sup>, Korea), (iii) and protection scheme (e.g. a characteristic example is the GACS<sup>17</sup>, Italy).

A typical structure of a securitization is presented in [Figure 12](#), but all structures share common characteristics.

In its most basic form, the securitization process involves two steps: (i) originating (ii) financing. In step one, bank —**originator**—identifies specific Non-Performing Loans, which it wants to remove from its balance sheet. Then a portfolio or Asset pool is originated and the selected NPLs are collected and transferred to this pool. Afterwards, the bank can sell the Asset pool to a special purpose vehicle (SPV)—**issuer**—that is an entity that are set up only for selling and transferring reasons.

A typical structure of this scheme can be showed in the following [Figure 12](#) and it is originated by Jobst (2008). In the next step, SPV finances the acquisition of the pool by issuing senior, mezzanine and subordinate/junior tranches, which are promoted to global markets and especially to capital market investors, in exchange for receiving fixed or floating rate payments.

Each investor can choose a tranche based on their risk appetite, because each tranche has a different risk-reward profile. The Internal Rate of Return required by investors is assumed to be

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<sup>15</sup> RTC: The Resolution Trust Corporation was a temporary federal agency established in 1989 to oversee non-performing loans. It was originated by Congress in 1980s because of Savings and Loans crisis.

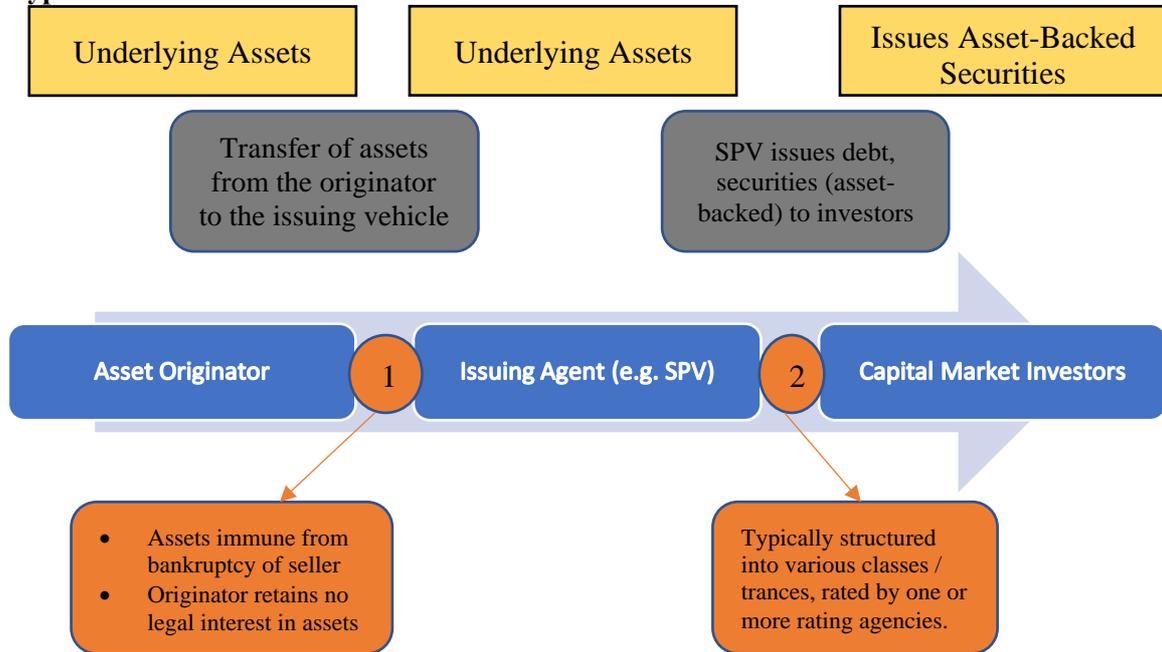
<sup>16</sup> KAMCO: The Korea Asset Management Corporation is a government-owned AMC in South Korea. It has purchased NPLs of financial institutions. Local authorities originated this scheme in August 1997 through the Act on the Efficient Disposal of Non-Performing Assets.

<sup>17</sup> GACS: The Garanzia Cartolarizzazione Sofferenze is a scheme which was enacted by Decree – Law on February 14, 2016.



approximately 20%<sup>18</sup> for the junior tranche and 5% for the senior tranche in the case of securitization, according to Fell et al. (2017) calculations.

**Typical structure of a securitization:**



*Figure 12: Jobst (2008).*

It is also important to present the scheme of a direct sale securitization, which was the most popular instrument until the recent financial crisis. A representative example is the RTC<sup>19</sup>, which is a massive American property-management company, and it can be characterized as temporary federal agency, under the supervision of Federal Deposit Insurance Corporation, U.S.A. Its purpose was to sell pools of Non-performing loans and assets at heavy discounts to private investors. This scheme involved the RTC and private entities. Thus, the authorities established a new entity, the RTC, and this entity raised a significant amount of money, but a major part of its principal funding came from an off-budget entity, which had public-private partnership.

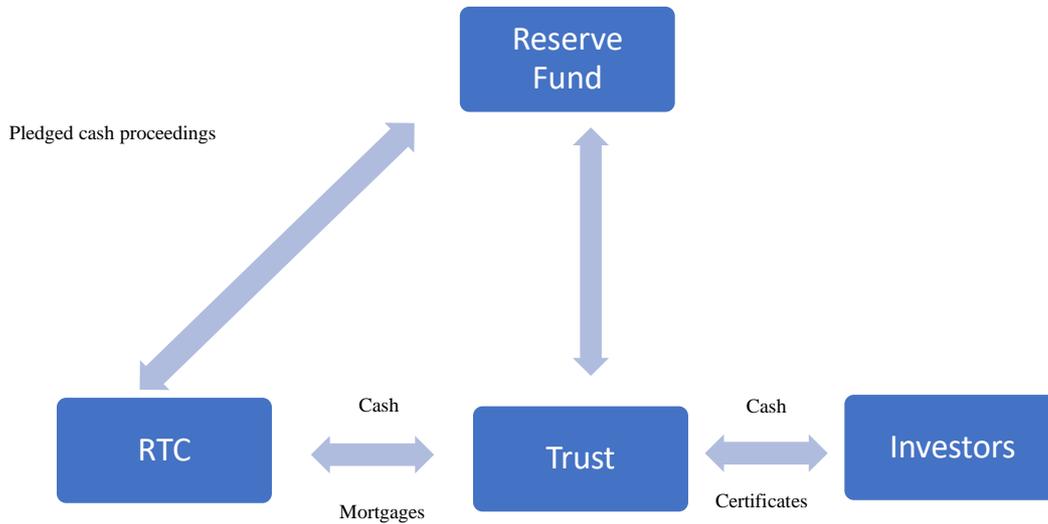
<sup>18</sup> The respective rate of direct sale is at 15%.

<sup>19</sup> RTC: Resolution Trust Corporation.



Subsequently, they used this amount to buy NPLs from American banks and in turn they sold a block of asset pools, backed by Non-Performing residential and commercial mortgages, to different investors.

Resolution Trust Corporation (RTC) – United States



**Figure 13:** source Congressional Budget office (1992).

In essence, securitization instruments represents a way to transfer the credit risk of NPLs from banks to investors. Also, according to our view and relative researches which was conducted Baudino (2017), Jobst (2015) and respectively Aiyar (2015), we can conclude to the following securitization’s additional benefits:

- i. higher bid-ask price of pool (if guarantees are provided to the Asset Pool, this usually entails higher NPL prices than direct sales),
- ii. cheaper financing,
- iii. diversification of risk away from a single credit name,
- iv. broadening the set of possible buyers,
- v. transfer of default risk,



- vi. economies of scale (if the asset pool contains residential or SMEs loans then securitization appears economies of scale versus the high transaction costs of selling such NPLs individually),
- vii. can be used as an eligible collateral for many central bank's programs.

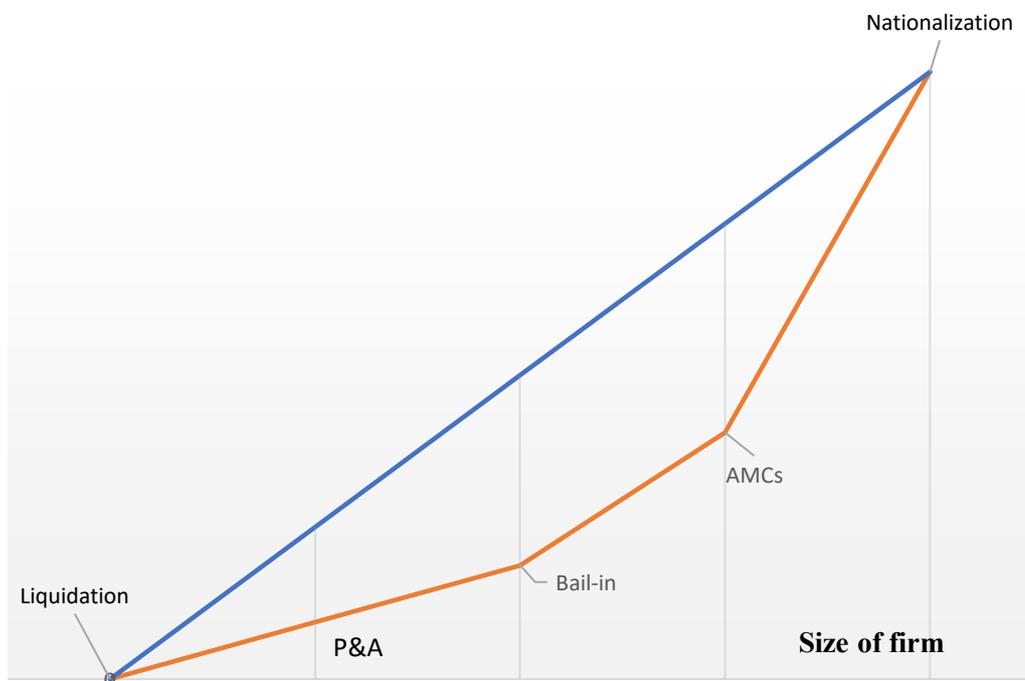
It is also important to notice that the provision of guarantees (by public authorities) has been used to improve the rating and to make more appealing the senior tranches. Through this way more investors can be attracted, the NPL global market and increase the liquidity of the market can be increased. Finally, the disposal of NPLs via securitization can be combined with other resolution instruments (e.g. public AMCs).



## Asset Management Companies (AMCs)

The most frequent resolution instrument, along with the direct sale, is the Asset Management Companies (AMCs). Resolution authorities or a financial institution should have the chance to transfer selected assets and liabilities, such as NPLs, from the failed financial institution to a third-party such as other financial institution, AMCs and in special circumstances to a newly established bridge institution. AMC buy NPLs from financial institutions with a tender offer at a high discount and then they try to collect the remaining cash flows from loans. AMCs are frequently used in systemic crises, because the fiscal costs is higher if state has to recapitalize participating firms, according to Nedelescu (2011). The reason is because selling loans to asset management firms enables the banks to keep the high-quality debts and immediately get rid of the bad debts, though this way the whole financial system is preserved and the fiscal cost of this solution is remarkable smaller (Figure 14).

### Fiscal cost



**Figure 14:** BIS “Resolution of Non Performing Loans”, by Patrizia Baudino and Hyuncheol Yun.



The AMC's can be categorized in: (i) private or public ownership, (ii) centralized or bank-specific (e.g., during Swedish banking crisis the local authorities set up single-bank AMC's). Centralized AMC's are more suitable for systemic problems and most of the times they are set up with public funds. The choice of the structure depends on the nature and extent of the financial crisis at the time the AMC's are set up. When a financial crisis is that deep, private AMC's are not able to manage and run these systemic-wide restructuring programs. An advantage of a centralized approach is that it has better capacity and expertise to handle similar types of NPL in comparison to banks.

An AMC accepts to buy assets whose price corresponds to their intrinsic value (market value < intrinsic value < book, in stressed market conditions). This value is identified as the expected discounted cash flows (Net Present Value of cash flow) of the underlying loans. Once the country's economy overcomes the crisis, then the expectations about the NPV asset pool of NPLs increase and this is a positive outturn for AMC's, therefore the strategy of postponing their disposals of bad assets tends to be profitable.

The success of an AMC depends only on its capacity to recover the NPLs pool value, namely their management skills. AMC's receive low-quality assets, which the originator banks had failed to keep at performing levels, so they try to (i) actively manage these loans, through contacting customers to convince them to pay back loans and negotiate with them (ii) try to resell these as soon as possible.

The long-term goal is to help expedite loan recovery, bank restructuring, preserving financial stability. The main benefits that are emanated from AMC's instruments are the following:

- i. stabilize the bank institution, such as restarting the provision of credit (by viable banks),
- ii. facilitate the sale to a buyer that is only interested in a partial acquisition,
- iii. clean up the banking sector's balance sheet,
- iv. resolving several institutions at the same time, which is very useful for large institutions,



- v. build a liquid market for NPLs.
- vi. provide high returns in the liquidation process of bad debts

Finally, as mentioned before, AMCs have a complex structure and their success is questionable; on the other hand, local authorities should immediately start solving the problem of NPLs, practically they are obliged to follow AMC instrument. Thus, authorities have to follow either of the two paths:

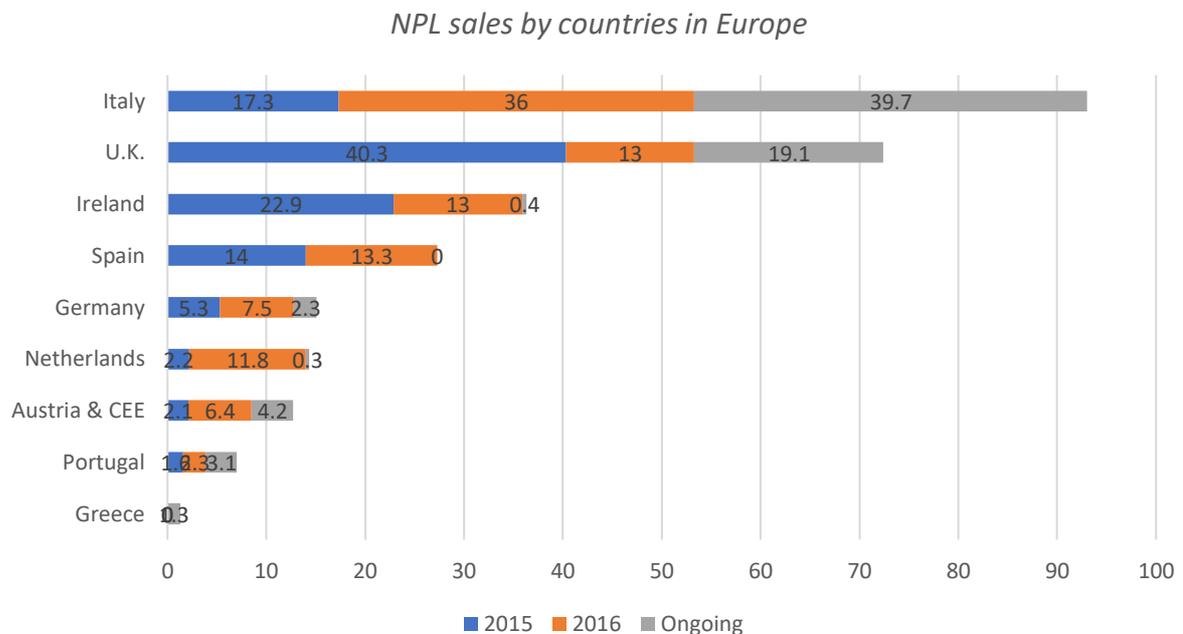
- i. either not participate in the setting up of an AMC and permit only private ones. However, in these circumstances an AMC may need to provide emergency capital to the local banks or may recapitalize particular banks,
- ii. or set up public AMCs, which will accept higher sales price than the market value. In this way, they can help the real economy, but the disadvantage is that they have losses in the AMC's balance sheets. This can also lead to higher fiscal costs.



## Direct sales

The most frequent and cost-efficient resolution instrument is through direct sales of NPLs to a third-party (e.g. bank, another financial institution and various types of investment funds), since this instrument helps banks to remove immediately the NPLs from their balance sheets. According to Ribeiro (2018) and Baudino (2017) this method allows to the banks to permanently remove these loans from balance sheets, avoiding any further cost, losses and capital impacts. It is also a popular instrument in recovery periods, not only in a period of crisis.

Direct sales procedure usually segregates a covered package of loans and in turn proceeds to sale of this asset pool (rather than individual loans) to counterparty. The major buyers for the European NPLs are US hedge funds and private equity funds. This strategy is a very effective asset allocation for these funds since their exposure in non-domestic loans can decrease the non-systemic risk because of diversification. However, some European countries have significant legal obstacles in the implementation of this resolution, so the proportion of direct sale varies in each country (Figure 15).



**Figure 15:** Deloitte Deleveraging Europe 2016 – 2017.



The direct sales instrument is a very effective choice for the buy side, namely funds, but also it has a lot of additional benefits to the sell side, the banks. The main benefits are that they (i) minimize disruption to bank customers, (ii) establish a benchmark and a floor price for NPLs, (iii) preserve financial stability.

It is also important to note that the efficiency of this instrument depends on the structural characteristics of the loan pool. Specifically, this instrument is not suitable for residential or small business NPLs loans, because such asset pool may contain thousands of loans. Thus, it is time-consuming and not cost-efficient (high transaction costs) to evaluate the loans one by one.

Direct sales can be promoted to counterparties through various approaches. The most popular ones are the sale of NPLs to global markets and through direct sale to specific Investment funds.

The majority of countries have underdeveloped NPL markets and their domestic buyers are unwilling to take this role because they do not have the expertise on this field (domestic markets are usually neither deep nor highly liquid). Therefore, local authorities usually promote the use of direct sales to specialized buyers in Global markets, who can help to overcome some of these obstacles.

**Table 9:** Main features of the Sale of Portfolio

	Italy	Spain	Ireland	Greece
Is the direct NPLs sales an obstacle to NPL resolution?	<b>YES</b>	<b>NO</b>	<b>NO</b>	<b>YES</b>
Is the current local NPLs market a developed?	NO	YES	YES	NO
Direct sales of loans without borrower's consent?	YES	YES	YES	YES
Direct sales of NPLs to non-banking institutions	YES	YES	YES	YES with legal restrictions.
Direct sales of NPLs to foreign investors	YES	YES	YES	YES with legal restrictions.

**Figure 16:** Author's elaboration.



A characteristic example of this approach was followed by Korea. During the recent financial crisis, Korean authorities tried to gain access to global NPL markets through conducting international auctions<sup>20</sup>.

Korea Asset Management Corporation (KAMCO) - Korea

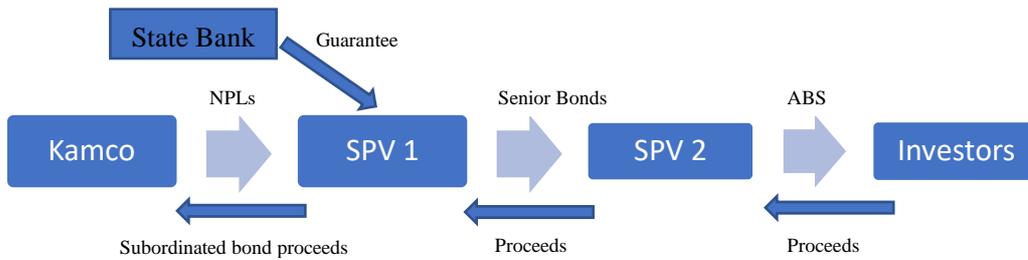


Figure 17: source KAMCO (2011).

Also, country authorities encourage and support the creation of Investment funds, which could be both public and/or private. The main purpose of an investment fund is to directly purchase the NPLs pool. This investment scheme demands sovereign funding and private interest/willingness. Representative paradigm of this scheme is the PPIP<sup>21</sup>, which was launched by US Treasury in response to the financial crisis of 2007.

The main purpose was to remove toxic assets from the balance sheets of troubled banks and investment banking firms. In this scheme the public authorities provided 50% of the equity capital. The PPIP is considered one of the most successful programs within the overall financial crisis that occurred following the mortgage meltdown.

It is noticeable that each form of direct sale is a very sound procedure for both sell side and buy side, since it demands a due diligence of the loan pool in advance.

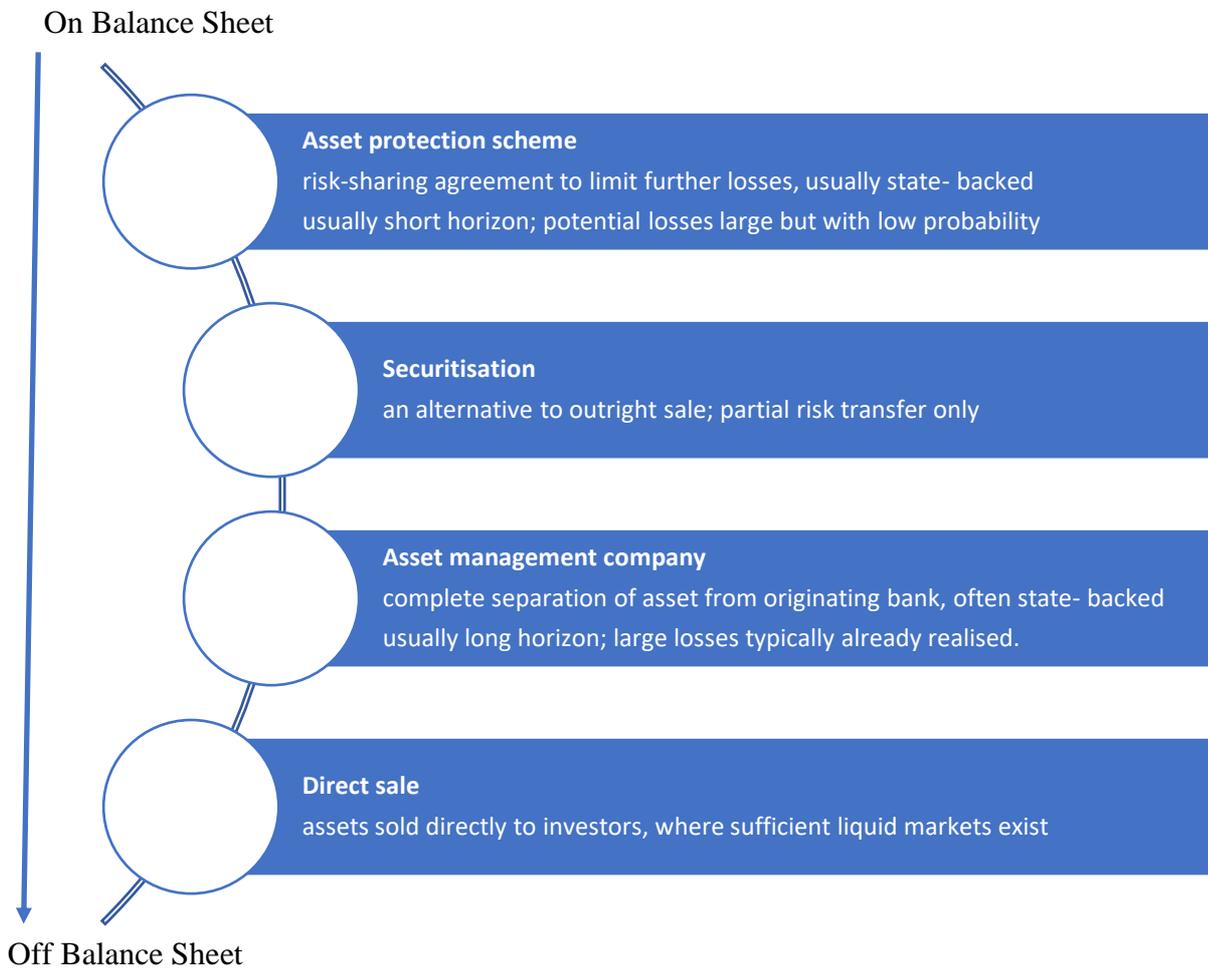
Specifically, the sell-side bank should provide all the necessary information for each loan of the

<sup>20</sup> Korea Asset Management Corporation – KAMCO, 2011.

<sup>21</sup> Public-Private Investment Program, 2010



pool separately so that all the specifications of each loan are at the disposal of the auditors and the buy side firm. In this way, the prospective buyers and an audit firm can review and confirm the loan specification's accuracy.



**Figure 18:** Fell et al. (2016)



### 5.3. Suitability of each resolution tool

This master thesis tries to shed some light on the suitability of each resolution instrument to the respective country characteristics, because each country has unique features, priorities and obstacles over time, so it has to choose the proper instruments from the general resolution toolkit. In addition, this master thesis immerses in the case study of Greek NPL crisis. As already mentioned, resolution options need to be tailored to the characteristics of each country's NPL problem. To guide this process, we have to overview the resolution tools (presented in Chapter 5.2.).

The competent authorities of each country have to follow certain steps in order to assess and conclude to a feasible strategy among various resolution policies. These steps are: (i) make an adequate recognition the extent of NPL problem, (ii) detect, specify and classify the types of NPL loans, (iii) estimate/measure Net Present Value of NPL Asset Pool, (iv) take into consideration unique constraints of each country (legal & fiscal), (v) appreciate country's macroeconomic environment and macroprudential, (vi) match the suitable resolution instruments for facing the problem in general, (vii) supervise the implementation of these instruments.

It is remarkable to notice that each country chooses its strategies with the view of guiding the resolution of NPLs and building market confidence. In addition, the resolution of NPLs is more likely to demand some actions that can be repeated over time, until the overall macroeconomic conditions improve. This is based on the fact that it is a rare phenomenon to resolve NPL problem with one-off activation. For example, securitization and/or direct sales of NPLs may be an option, but if the economy faces a protracted slow growth, then it makes it difficult to face this problem and the next step may be that country authorities have to proceed to set up AMCs.

The competent country's authority usually is the ministry of finance and it generally has a predefined (specific) budget under management, which is absolutely related to the country's fiscal space. If their guarantees are not backed by commensurate fiscal capacity, then the resolution



programs of the ministry don't have the potential to restore financial stability. Thus, all resolution tools (write-offs, private AMCs, direct sales and securitization) rely on some extent on the use of public intervention (e.g. directly through injections of new capital or indirectly through facilitating transfers to an AMC), so authorities need to be prepared and hold in advance fiscal buffer in order to be activated when the time comes.

Also, competent authorities have to scholastically supervise the implementation of establishing policies as the crisis develops. Crises have many phases which are strongly related to the respective tools. Especially, when the crisis is in a precocious phase and only a few financial institutions are distressed, then it is obvious that authorities should proceed to tailored measurements for these firms, such as direct sales or out-of-court workouts.

Crisis is a dynamic phenomenon and these resolution actions may not be sufficient to face this situation, as debt restructuring is too slow. Actually, during a period of crisis radical and coordinated actions are needed, such as establishing both APS and AMC.

At a later phase, when competent authorities begin to prepare and determine their strategy, it is quite possible that they firstly prefer to use securitization instruments. If this is not enough to improve real economy and confidence to participants, then it is better for the authorities to centralize and coordinate their responses using public or private AMCs, since through this way can cover the majority of the affected assets across the whole banking sector.

It is also very crucial to detect the types of NPL loans, because authorities have to face the situation in a holistic manner. Specifically, in the case of high homogeneous NPLs it is easier to evaluate the asset pool and it has considerable economies of scale, so it is preferable to follow two resolution methods: (i) securitization, (ii) direct sales.

In addition, they have to take into careful consideration the maturities of the underlying loans. For instance, if the majority of NPLs have long maturities (such as residential loans and SMEs),

then it is a mistaken action to transfer these to an AMC, because it is set up under strict time



mandates and this would provoke even further distress of asset pool selling prices. Thus, on this case it is better to use again the securitization resolution instrument.

On the other hand, since asset pool contains only a few loans, which are issued with high Nominal Value amount and have more narrow extension maturity (such as large corporate loans), then this may be a more appropriate instrument: the direct sale or work-out, instead of aggregated solutions such as securitizations and AMCs. The reason is that these loans have unique features and highly specialized underlying assets, so it is difficult to pool such assets. It is also important to note that SMEs loans will not have to be handled as large corporate loans, since they are smaller in Nominal amount and are more complex and this entails lacking economies of scale. Thus, proper resolution options are debt securitization, write- offs and debt restructuring. This table ([Table 10](#)) matches resolution policies to country characteristics on the basis of the relative degrees of complexity of each pairing:

**Table 10: Summary table of resolution instruments.**

NPL and country characteristics		Debt workout	Write-offs	Direct sales	Securitization	Asset protection schemes	Public AMCs
Macroeconomic conditions	Slow growth	√	√	√	√		
	Shock to asset quality	√	√	√	√	√	√
	Mortgages		√	√	√	√	√
Asset types	SME loans	√	√		√	√	
	Large corporate loans	√	√	√	√		√
	Unsecured loans		√	√	√		√
Fiscal space	Limited	√	√	√	√	√	
Legal constraints	Strong constraints		√			√	

**Figure 19: Baudino (2017)**





## Chapter 6: Conclusions

### 6.1. Main findings

The purpose of this master thesis was fourth-fold. First, it tried to answer some fundamental economic questions regarding the macroeconomic determinants of Non-Performing loans in the EU for the period 2000–2018. Second, it acknowledged the statistically significant role of banking characteristics and their role on NPLs in the EU. Additionally, it made an attempt to shed light on the dynamics of EU economies based on the fact that they were on a specific economic trend. The objective of this master thesis is to examine the impact of NPL's in Europe during the era of high growth (2000-2009), in contrast to the fiscal crisis (2009-2015) and the recent period of Brexit (2016-2018). Last but not least, it is the first paper in the literature -to the best of our knowledge that directly relates shadow banking credit with key NPLs determinants in the EU. Former US Federal Reserve Chair Ben Bernanke provided the following definition in November 2013 ([Speech 639](#)):

“Shadow banking, as usually defined, comprises a diverse set of institutions and markets that, collectively, carry out traditional banking functions—but do so outside, or in ways only loosely linked to, the traditional system of regulated depository institutions”

In this framework, we made use of a wide dataset in quarterly format referring to the time period 2000–2018, fully capturing the recent crises. Also, we provided a robust and consistent econometric framework based on a number of advanced techniques (such as LLC tests, Dynamic Panel Data etc.) in order to tackle the research question.



According to our results, we have concluded that the macroeconomic variable of Government Debt plays a significant role (is statistically significant in most of the estimated models) in explaining the NPL's. This is expected since each loan has set a specific credit risk which is provided by banks and this rate is usually calculated with the base rate as the rate of the 10-year government bond. A probable increase of government interest rate follows a respective increase in other types of individual loans and this deteriorates their credit score, entailing to increase the credit risk further. As a result, the probability of default had been high raise and this generates a wave of new Non-Performing loans.

Following the aforementioned conclusion, we have found an extra indication to this, since the dummy variable of "Structural Debt Crisis" is also statistically significant. This sovereign European debt crisis was a prolonged debt crisis that has been taking place in the EU by the end of 2009. Several eurozone member states such as Greece, Portugal, Ireland, Spain and Cyprus were unable to repay or refinance their government debt or to bail out over-indebted banks under their national supervision. This situation of the public economy also affected the real economy and deteriorated the disposable income, since the governments increased the direct and indirect tax rates. Thus, a remarkable interaction between the level of sovereign debt and NPL's was found.

In addition to this, it is important to note that NPL's are affected by the banking variable of "Total Bank Deposits", since according to our models it was statistically significant. Bank deposits consist of money placed into banking institutions for safekeeping. Declining deposits mean that household and businesses use this money to cover other expenses or for consumption use. Actually, the recent crisis led to a decrease in the purchasing power of the population, so many of them used money of their bank deposits in order to retain the same living standards. However, this decline generated the deterioration of banks creditworthiness even further and interest rates of banks went up. Consequently, banks transferred this increase to debtors, an action that created a vicious circle.



On the other hand, the results of this master thesis showed that “Brexit”, “10 Year Bond”, “Bank Assets” and “Bank Net interest Margin” seems to not play an important role.

Bank Net interest Margin is a measure of bank profitability. There are mixed views in the literature review about this issue, namely if profitability and NPLs have a strong relationship. As mentioned in Chapter 2, Ozili (2019) found out that NPLs of systemic banks are positively associated with bank profitability, instead Khan, Siddique and Sarwar (2020) showed that profitability indicators have a negative impact on NPLs. This master thesis found statistically insignificant so we cannot conclude to any direction.

Another indicator of how solid and sound a bank can be measured by Bank Assets. Nevertheless, our results found no relationship between NPLs and this variable. There is also a practical implication about this finding, since the top bank in Europe is French Bank BNP Paribas, which holds the largest volume of NPL’s among European Union banks, it had 36.5<sup>22</sup> bn Euro remaining on its balance sheet as of end-June 2019. In addition to this, the largest Greek bank which is Piraeus Bank has the largest absolute amount of NPLs (26.3bn<sup>23</sup> - 51.4% of its bank assets) in Greece and it came fifth among the highest NPL ratios in Europe.

Finally, our results indicate that shadow banking is not a statistically significant variable according to the majority of our models. As previously mentioned, the viability of the banking system moves in parallel with NPL’s. Therefore, it will be rational for the other pillar of the financial system to be treated in the same way, but this is not the case according to our results. Several factors can explain this seemingly counterintuitive result.

The shadow banking system is a group of financial institutions and intermediaries facilitating the creation of credit across the global financial system, but whose members are not subject to regulatory oversight. Representative examples of this financial pillar include hedge funds, private

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<sup>22</sup> Source: Debtwire analysis, data from the latest EBA Transparency Exercise.

<sup>23</sup> Source: Bank of Greece.



equities and other unlisted instruments. These companies and products are referred to unregulated activities with high risk. Respectively, individuals or institutional investors who invest in this industry are professionals and they have a deep knowledge of the risk that are undertaken. Thus, they are not directly affected by the volatility of real economy such as NPL's.

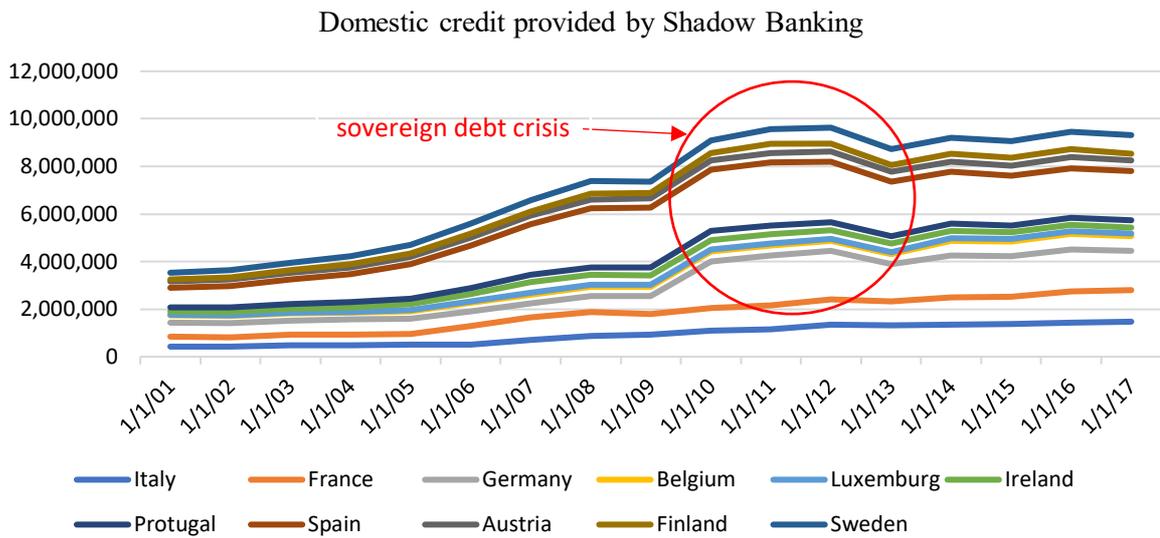


Figure 20: Author's elaboration: World Bank Data ([WB](#)).

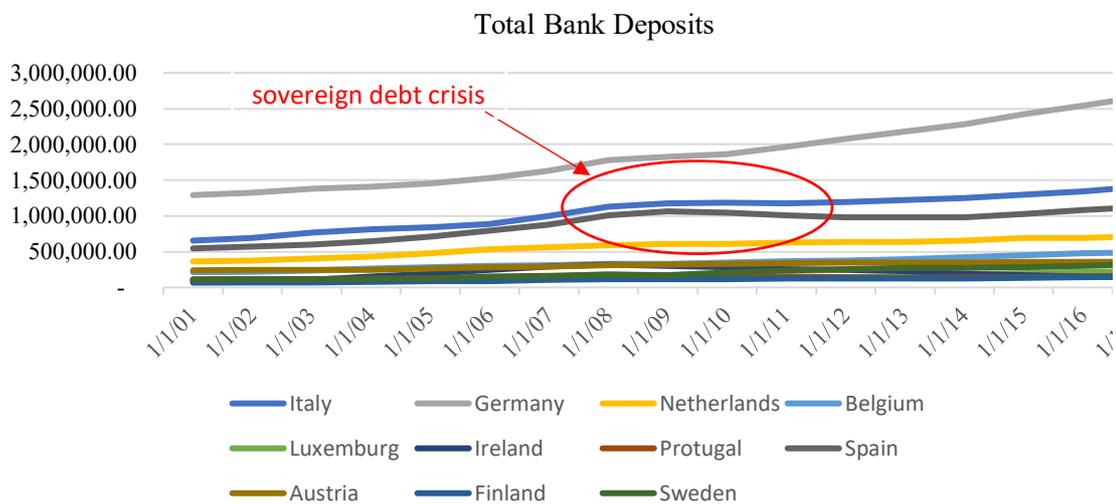


Figure 21: Author's elaboration: Federal Reserve Economic Data ([FRED](#)).

Using the above graphs also depicts this relation. We can notice that there are variables such as "Total Bank Deposits" that follow the fluctuations of the economy. During the sovereign debt crisis, the majority of European countries showed a declining trend in "Total Bank Deposits".

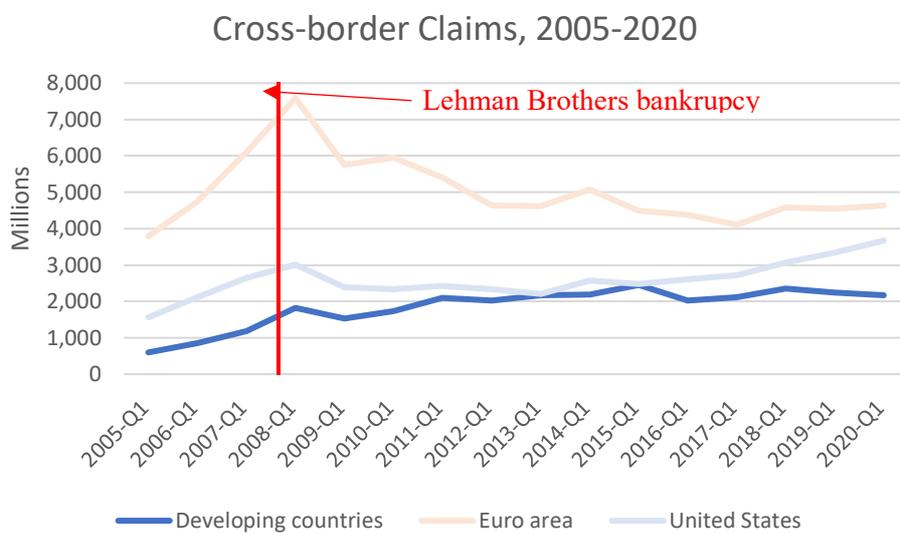


In conclusion, it is proven that Shadow Banking does not play any role whatsoever in the NPL market and the main factors that affect the NPL's are macroeconomic and banking variables.



## 6.2. Challenges and perspectives for European and Greek banks

In the aftermath of the international financial crisis 2007-2009, European banking system withdrew a large portion of cross border asset and its trend reversed for most banks. Actually, the influence of the financial crisis did not directly affect the European banks, but they were influenced more by the second leg of the global financial crisis – the euro sovereign and banking crisis. European banks reduced their overseas exposures between 2011-2016.



**Figure 22:** Author's elaboration: BIS data on consolidated basis.

Due to the prolonged period of the sovereign crisis, their asset size shrank as credit growth declined and faced a dramatic decline in cross-border claims (there are exemptions in this norm, such as Spain banks, Santander and BBVA experienced a growth in countries outside its domestic market, in Latin America). Also, their profitability continued to be under pressure, so the negative force of low profitability has dominated European bank valuations up to now.



Also, a very important determinant factor of the further deterioration of European banking system is the fact that European banking regulation is now stricter under the Basel III and ECB instructions. These regulations forced the banks to shy away from speculative trading and rely more on traditional lending activities, but this factor further reduced their profitability.

At the same time, the Greek banks followed a roughly similar path like the European ones, but they also faced a deep sovereign crisis, losing twice almost the whole of their market value in February 2012 and November 2015 because of recapitalization. In addition, Greek banks had similar challenged on profitability to the European ones and at the same time they faced an unusually large extra NPE burden. In contrast, for the majority of the European countries the tendency of NPLs ([Table 1](#)).

The increasing trend of the NPL market in some region of Europe (especially in peripheral European countries such as Greece) and the respective growth of NPL sales over the recent European crisis could be further enhanced through: (i) jurisdiction-level (ii) well designed (iii) and targeted public interventions.

The demand-side developments as well as supply-side (i.e. supportive legislative changes, schemes and supervisory guidance) contribute to persist NPLs disposals. In addition, effective implementation of recently passed legislation can be the fundamental key by which it can lead to higher valuations and even more direct sales of NPLs. Huge amount of NPLs remains on bank balance sheets in certain countries, such as Greece and Italy, increasing the externalities stemming from NPLs. These respective jurisdictions demand more targeted state intervention. One way is to decrease the outstanding amount of impaired loans across the euro area.



New measures could be added to the NPL toolkit. For example, guarantees on junior tranches of NPL securitizations. Collaboration of public and private sector could increase investors' interest for NPLs and increase the appealing for this asset class to a wider investor base, due to the fact that the risk/reward ratio for these tools appears particularly favorable.

An effective implementation and a holistic approach could increase the market confidence and accelerate the solution of the NPL problem. Actually, this situation would increase market confidence and hence attract further investors, price the NPL pool better and enhance sales.

The Lehman Brothers' demise brought the international financial world in the worst situation since 1929. Thus, an international regulatory reform is needed, such as the fact that EU Banking Union brings stricter provisioning rules on NPLs. These reforms should primarily focus on the banking system and mainly make the banking system safer and more resilient.

In conclusion, Greek economy cannot recover in a sustainable manner unless its banks recover. This can be achieved only if country risk come down, assuming that cost of risk for the banks decline in the same way. Also, demand for healthy lending needs to rise, since until recently the governments protected strategic defaulters and upcoming authorities should promise to reduce NPEs more quickly.



## References

- Aiyar, Bergthaler, Garrido, Ilyina, Jobst, Kang, Kovtun, Liu, Monaghan, and Moretti (2015), A Strategy for Resolving Europe's Problem Loans. *IMF staff discussion note*, SDN/15/19.
- Aiyar, S, Al-Eyd A., Barkbu B. and Jobst A. (2015), Revitalizing securitization for small and medium-sized enterprises in Europe. *IMF staff discussion note*, SDN/15/07, May.
- Anastasiou D., Louri H. and Tsionas M. (2016), Determinants of non-performing loans: Evidence from Euro-area countries. *Finance Research Letter*, Vol. 18: 116-119.
- Anastasiou D., Louri H. and Tsionas M. (2019), Non-performing loans in the euro area: are core-periphery banking markets fragmented?. *International Journal of Finance & Economics*, Vol. 24: pp. 97-112.
- Anderson W. and Hsiao C. (1981), Estimation of dynamic models with error components. *Journal of the American Statistical Association*. Vol. 76: pp. 598–606.
- Anderson, Wilbur and Hsiao (1982), Formulation and estimation of dynamic models using panel data. *Journal of Econometrics*, Vol. 18: pp. 47–82.
- Arellano M. and Bond S. (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, Vol. 58: pp. 277-297.
- Arestis P. and Sawyer M. (2010), The return of fiscal. *Journal of Post Keynesian Economics*, Vol 32: pp. 327-346.
- Arpa M., Giulini I., Ittner A. and Pauer F. (2001), The influence of macroeconomic developments on Austrian banks: implications for banking supervision. *BIS Papers*, Vol. 1: 91-116.
- Asif Khan M. , Siddique A. and Sarwar Z. (2020), Determinants of non-performing loans in the banking sector in developing state. *Asian Journal of Accounting Research*, Vol. 5: pp. 135-145.
- Auerbach and Gale (2009), The Economic Crisis and the Fiscal Crisis: 2009 and Beyond. *University of California – Berkeley*.
- Bank of Greece (BoG) Dataset: Evolution of loans and non-performing loans.



- Baudino P. and Yun H. (2017), Resolution of non- performing loans – policy options. *Bank for International Settlement*, FSI Insights No. 3.
- Bauze K. (2019), Non-Performing Loan Write-Offs: Practices in the CESEE region, *FinSAC Overview Paper*.
- Beck R., Jakubik P. and Piloiu A. (2013), Non-Performing loans: What matters in addition to the economic cycle? *European Central Bank*, Working paper series 1515.
- Beck, Demirg-Kunt, and Maksimovic (2008), Financing patterns around the world: Are small firms different?. *Journal of Financial Economics*, Vol. 89: pp. 467–487.
- Berger, A. N. and DeYoung, R. (1997), Problem loans and cost efficiency in Commercial Banks. *Journal of Banking and Finance*, Vol. 21: pp. 849-870.
- Bernanke B. (2013), The Crisis as a Classic Financial Panic. *At the Fourteenth Jacques Polak Annual Research Conference*.
- Bernanke B., Gertler M. and Gilchrist S. (1989), The financial accelerator in a quantitative business cycle framework. *Elsevier- Handbook of Macroeconomic*, Vol 1: p.p. 1341-1393.
- Blundell R. and Bond S. (1998), Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, Vol. 87: 115–143.
- Blundell R. and Bond S. (1998), Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, Vol. 87: pp. 115–143.
- Blundell R., Bond S. and F. Windmeijer (2000), Estimation in dynamic panel data models: Improving on the performance of the standard GMM estimator. In *Nonstationary Panels, Cointegrating Panels and Dynamic Panels models*. *New York: Elsevier*, Vol 11: pp. 53–92.
- Bofondi M. and Ropele T. (2011), Macroeconomic Determinants of Bad Loans: Evidence from Italian Banks. *SSRN Electronic Journal*, Occasional Paper No. 89.
- Boudriga, A., Taktak, N. B. and Jellouli, S. (2010), Bank specific, business and institutional environment determinants of banks nonperforming loans: Evidence from MENA countries. *Economic Research Forum*, working papers 547.



- Breuer J. (2006), Problem bank loans, conflicts of interest, and institutions. *Journal of financial stability*, Vol. 2: pp. 266-285.
- Brierley P. and Vlieghe G. (1999), Corporate workouts, the London approach and financial stability. *Financial Stability Review*, Vol. 7: pp. 83-93.
- Brookes M., Dicks M. and Pradhan M. (1994), An Empirical Model of Mortgage Arrears and Repossessions. *Economic Modeling*, Vol. 11: pp. 134–144.
- Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, Nieuwerburgh, Vayanos (2016), The Sovereign-Bank Diabolic Loop and ESBies. *American Economic Review*, Vol. 106: pp. 508-512.
- Charalambakis E., Dendramis Y. and Tzavalis E. (2017), On the determinants of NPLs: lessons from Greece. *Bank of Greece*, Working papers 220.
- Çifter A. (2015), Bank concentration and non-performing loans in Central and Eastern European countries. *Journal of Business Economics and Management*, Vol. 16: pp. 117-137.
- Claire Giordano (2011), Currency crises: the case of Hungary (2008 - 2009) using two stage least squares. *Bank of Greece*, special conference papers, Vol. 13.
- Cucinelli D., Di Battista M.L., Marchese M., and Nieri L. (2017), Credit risk in European banks: The bright side of the Internal Ratings Based approach. *Journal of Banking & Finance*, Vol. 93: pp. 213-229.
- Dash, Manoj K., and Gaurav Kabra (2010), The Determinants of Nonperforming Assets in Indian Commercial Banks: An Econometric Study. *Middle Eastern Finance and Economics*, Vol. 7: pp. 93 –106.
- Deloitte Touche (2016), Italian non-performing loans: state guarantee and securitization scheme: unlocking the NPL log-jam? Deloitte Touche Tohmatsu Limited.
- Espinoza R. and Prasad A. (2010), Nonperforming Loans in the GCC Banking System and their Macroeconomic Effects. *International Monetary Fund*, Working paper No. 10/224.
- European Central Bank (ECB), Eurostat database the statistical office of the European Union:



European Commission, 2014/135/EU (2014) Commission recommendation on a new approach to business failure and insolvency.

Eurostat (ESTAT), Eurostat dataset: General government deficit (-) and surplus (+) - annual data, percentage of gross domestic product (GDP).

Eurostat (ESTAT), Eurostat dataset: Gross domestic product at market prices [TEC00001].

Federal Reserve (FRED) Federal Reserve Economic Data: Deposit Money Bank Assets to GDP (discounted), Percent, Annual, Not Seasonally Adjusted.

Federal Reserve (FRED) Federal Reserve Economic Data: Mortgage Debt Outstanding, All holders (discounted).

Feldman R. and Phaup M. (1992), The RTC's loan securitization process. *Congressional Budget Office*.

Fell J., Moldovan C. and O'Brien E. (2017), Resolving non-performing loans: a role for securitization and other financial structures?, *ECB Financial Stability Review*, Vol. 1.

Fell, Grodzicki, Martin and O'Brien (2016), Addressing market failures in the resolution of non-performing loans in the euro area. *ECB Financial Stability Review*, Vol. 2.

Financial Stability Board (2014), Key Attributes of Effective Resolution Regimes for Financial Institutions.

Fofack H. (2005), Nonperforming Loans in Sub-Saharan Africa: Causal Analysis and Macroeconomic Implications. Policy. *World Bank Policy Research*, Working paper No. 3769.

Friedrich P. and Reiljan J. (2015), Estonian Economic Policy during global Financial Crises. CESifo Forum, Vol. 4.

Gambera M. (2000), Simple forecasts of bank loan quality in the business cycle. *Federal Reserve Bank of Chicago*, Series 3.

Gambera M. (2000), Simple forecasts of bank loan quality in the business cycle. *Federal Reserve Bank of Chicago*, issue series 3.

Garcia G. (1997), Protecting Bank Deposits. *IMF publications*, Working paper 96/83.



- Ghosh S. (2006), Does leverage influence banks' non-performing loans? Evidence from India. *Journal of Applied Economics Letters*, Vol. 12: 913-918.
- Ghosh S. (2015), Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, Vol. 20: pp. 93–104.
- Glen J. and Mondragón-Vélez C. (2011), Business cycle effects on commercial bank loan portfolio performance in developing economies. *Review of Development Finance*, Vol. 1: pp. 150–165.
- Gross non-performing loans, domestic and foreign entities - % of gross loans.
- Hausman, J. and McFadden, D. (1984), Specification Tests for the Multinomial Logit Model, *Econometrica*, Vol. 52: pp. 1219-40.
- Holtz-Eakin, Newey W. and Rosen H. (1998), Estimating vector autoregressions with panel data. *Econometrica*, Vol. 56: pp. 1371–1395.
- International Financial Statistics (IFS) dataset: Gross Domestic Product, Nominal value.
- International Monetary Fund (IMF), Global debt database: Household debt, loans and debt securities, (%) percent of GDP.
- Jappelli T., Pagano M., and Bianco M. (2005), Courts and Banks: Effects of Judicial Enforcement on Credit Markets. *Centre for Studies in Economics and Finance (CSEF)*, Working papers 58.
- Jappelli T., Pagano M., and Bianco M. (2005), Courts and Banks: Effects of Judicial Enforcement on Credit Markets. *Centre for Studies in Economics and Finance (CSEF)*, Working Papers 58.
- Jiri Podpiera and Laurent Weill (2008), Bad luck or bad management? *Journal of Financial Stability*, Vol. 4: pp. 135-148.
- Jobst A. (2008), What Is Securitization?. *Finance and Development*, Vol. 4, number 3.
- Jouini, F. and Messai, A. S. (2013), Micro and Macro Determinants of Non-performing Loans. *International Journal of Economics and Financial Issues*, Vol. 3: pp. 852-860.
- Kaskarelis L. and Siklós D. (2019), Completing NPL reduction in Europe, *European Stability Mechanism*, Discussion Paper 6.



- Kauko K. (2012), External deficits and non-performing loans in the recent financial crisis. *Economics Letters*, Vol. 115: pp. 196-199.
- Kauko K. (2012), External deficits and non-performing loans in the recent financial crisis. *Economics Letters*, Vol. 115: pp. 196-199.
- Keeton W. and Morris C. (1987), Why Do Bank's Loan Losses Differ?. *Economic Review*, Vol. 72: pp. 3-21.
- Khan M., Siddique A. and Sarwar Z. (2020), Determinants of non-performing loans in the banking sector in developing state, *Asian Journal of Accounting Research*, Vol. 5: pp. 135-145.
- Kiyotaki N. and Moore J. (1997), Credit Cycles, *Journal of Political Economy*, Vol. 105: pp. 211-248.
- Klein N. (2013), Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance. *IMF Working Paper*, No. 13/72.
- Konstantakis K., Papageorgiou T., Michaelides P. and Tsionas E. (2009), Economic Fluctuations and Fiscal Policy in Europe: A Political Business Cycles Approach Using Panel Data and Clustering (1996–2013), *Open Economies Review*, Vol. 26: pp. 971-998.
- Korea Asset Management Corporation (2011), The success story of KAMCO. *Gusang Publishing*, pp. 1-400.
- Laeven L. and Valencia F. (2012), Systemic Banking Crises Database: An Update. *International Monetary Fund*, Working Paper No. 12/163.
- Laeven L. and Valencia F. (2012), Systemic Banking Crises Database: An Update, *IMF Working Paper*, No. 12/163.
- Levin, Chien-Fu L. and Chia-Shang J. (2002), Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics*, Vol. 108: pp. 1–24.
- Ljung G. and Box G. (1978), On a Measure of a Lack of Fit in Time Series Models. *Biometrika*, Vol. 65: pp. 297–303.



Louzis D., Vouldis A. and Metaxas V. (2010), 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*, 2012, Vol. 36: pp. 1012-1027.

Marcello Bofondi and Tiziano Ropele (2011), Macroeconomic Determinants of Bad Loans: Evidence from Italian Banks. *Bank of Italy*, Occasional Paper No. 89.

Nedelescu O., Claessens, Stijn, Pazarbasioglu C., Laeven L., Dobler M., Valencia F. and Seal K. (2011), Crisis Management and Resolution: Early Lessons from the Financial Crisis. *IMF Staff*, Discussion Note 11/05.

Nickell S. (1981), Biases in dynamic models with fixed effects, *Econometrica*, Vol. 49: pp. 1417–1426.

Niklas P. (2010), Political cycles and economic performance in OECD countries: empirical evidence 1951–2006. *Public Choice*, Vol. 150: pp. 155–179.

Niklas P. (2010), Political cycles and economic performance in OECD countries: empirical evidence 1951–2006. *Public Choice*, Vol. 150: pp. 155–179.

Nkusu M. (2011), Non-performing loans and Macroeconomic Vulnerabilities in Advanced Economies, *IMF Working Paper*, No. 11/161.

Organization for Economic Co-operation and Development (OECD), Dataset: Financial Indicators – Stocks.

Organization for Economic Co-operation and Development (OECD), Dataset: National Accounts at a Glance.

Ozili P. (2019a), Nonperforming loans in European systemic and non-systemic banks. *Journal of Financial Economic Policy*, Vol 12: pp. 409-424.

Ozili P. (2019b), Non-performing loans and financial development: new evidence. *The Journal of Risk Finance*, Vol. 20: pp. 59-81.

Pesaran H. and Smith R. (1995), Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, Vol. 68: pp. 79-113.



- Pesaran H., Schuermann T., Treutler B. and Weiner S. (2006), Macroeconomic Dynamics and Credit Risk: A Global Perspective. *Journal of Money, Credit and Banking*, Vol. 38: pp. 1211-1261.
- Pesaran, M. H. (2006), Estimation and inference in large heterogenous panels with multifactor error structure. *Econometrica*, Vol. 74: pp. 967-1012.
- Pesaran, M. H. and R. Smith (1995), Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, Vol 68: pp. 79-113.
- Podpiera J. and Weill L. (2008), Bad luck or bad management? Emerging banking market experience. *Journal of Financial Stability*, Vol. 4: pp. 135-148.
- Quagliariello M. (2007), Banks' riskiness over the business cycle: a panel analysis on Italian intermediaries. *Applied Financial Economics*, Vol 17: pp. 119-138.
- Ramey G. and Ramey V. (1995), Cross-country evidence on the link between volatility and growth. *American Economic Association*, Vol. 85: pp. 1138–1151.
- Raudla R. and Kattel R. (2011), Why Did Estonia Choose Fiscal Retrenchment after the 2008 Crisis?. *Journal of Public Policy*, Vol. 31: pp. 163 – 186.
- Ribeiro R., Campos P. Fernandes M. (2018), The Non-Performing loans JIGSAW: pieces starting to fit?. *Oliver Wyman Insights*.
- Rinaldi L. and Sanchis-Arellano A. (2006), What explains household Non-Performing loans? *ECB Working paper series*, No. 570.
- Rogoff K. (1990), Equilibrium political budget cycles. *The American Economic Review*, Vol. 80: pp. 21–36.
- Ruckes M. (2004), Bank Competition and Credit Standards. *The Review of Financial Studies*, Vol. 17: pp. 1073–1102.
- Salas V. and Saurina J. (2002), Credit Risk in Two Institutional Regimes: Spanish Commercial and Savings Banks. *Journal of Financial Services Research*, Vol. 22: pp. 203-224.
- Shu C., Gerlach S. and Peng W. (2004), Macroeconomic conditions and banking performance in Hong Kong: a panel data study, *Bank for International Settlements*, Vol. 22: pp. 481-97.



Sinkey J. and Greenawalt M. (1991), Loan-loss experience and risk-taking behavior at Large Commercial Banks. *Journal of Financial Services Research*, Vol. 5: pp. 43-59.

Sirtaine S., Rosenberg C., Klingen C. and Castillo L. (2012), Working Group on NPLs in Central Eastern and Southeastern Europe. *European Banking Coordination "Vienna Initiative"*.

Williamson S. (1985), Financial Intermediation, Business Failures, and Real Business Cycles. *Journal of Political Economy*, Vol. 95: pp. 1196–1216.

World Bank (WB) World Bank national accounts data, and OECD National Accounts data files.

World Bank (WB) World Bank national accounts data: Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment.

Zhang D., Cai J., Dickinson D. and Ali Kutan (2016), Non-performing loans, moral hazard and regulation of the Chinese commercial banking system. *Journal of Banking and Finance*, Vol. 63: pp. 48–60.

