THE IMPACT OF NON-PERFORMING LOANS ON BANKS' LENDING

MASTER in FINANCE

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Resumo

Este estudo analisa o nível de impacto dos créditos não produtivos na concessão de crédito e, consequentemente, na gestão das políticas de concessão de crédito dos Bancos.
É apresentada uma perspetiva histórica dos desenvolvimentos económicos relacionados com a concessão e a qualidade do crédito, acompanhada por uma análise dos fatores determinantes dos créditos não produtivos, de forma a apurar a sua dinâmica nas políticas de crédito e na rendibilidade dos Bancos. Adicionalmente, é apresentada a evolução da regulamentação relativa a créditos não produtivos e do conceito ao longo do tempo, tendo em conta o alargamento das dimensões consideradas. Finalmente, é também realizada uma análise das medidas endereçadas pelos Bancos para lidar com os créditos não produtivos, de forma a aferir o estado atual dos Bancos e a necessidade de ajustamentos relativamente ao paradigma da gestão e dos modelos de negócio dos Bancos.
Através da utilização de dados de painel não balanceados e de um modelo de efeitos fixos juntamente com o estimador robusto Driscoll-Kraay, é analisada informação trimestral relativa a 111 Bancos da Área do Euro no período entre 2010 e 2015, concluindo-se que a variável relativa aos créditos não produtivos demonstra um comportamento diferenciado entre os intervalos temporais, o que sugere a existência de uma rigidez na definição da política de crédito. Apenas depois de algum tempo, em que o aumento do crédito coincide com o aumento de créditos não produtivos, existe uma alteração da política de crédito. Dividindo a informação em dois grupos – Países da Europa Central e de Leste e Países Periféricos (que estiveram sob pressão financeira no período em análise) – e aplicando a mesma abordagem permite-nos observar diferenças significativas de resultados entre os países considerados.

Classificações JEL: C23, G18, G21, G28, G32

Palavras-chave: crédito concedido, créditos não produtivos, dados de painel, efeitos fixos, Driscoll-Kraay

Abstract

This study analyzes the impact of non-performing loans (NPLs) on credit granted by banks and, consequently, on their management lending policies.

An historical review of recent developments in national economies in terms of credit granting and credit quality is presented in this document, along with an analysis of the macroeconomic determinants of NPLs in order to understand the impact of its dynamics in banks' lending policies and profitability. Furthermore, a perspective of the evolution of regulation on NPLs and the development of the NPLs definition overtime, with the enlargement of the dimensions considered, is also given. Finally, we analyze the measures undertaken by banks to tackle NPLs, in order to evaluate their current situation and the adjustment needed that should be taken regarding the paradigm of banks' management and the respective business models.

Using an unbalanced panel data of quarterly information of 111 banks of the Euro Area, covering the period from 2010 to 2015, and applying a fixed effects model estimated with the Driscoll-Kraay robust approach, we conclude that NPLs show different lagged effects on credit granting. Only after some time of coexistence of simultaneous increase in credit granting and in NPLs, a change in the credit policy occurs. Thus suggesting the existence of rigidity when setting credit policy. Dividing the data into two different groups - countries of Central and Eastern Europe and Peripheral countries (that suffered from financial stress in the period under analysis) – and applying the same approach, we observe significant differences in results between countries.

JEL Classification: C23, G18, G21, G28, G32

Key Words: Bank lending, non-performing loans, panel data, fixed effects, Driscoll-Kraay

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I would like to dedicate this thesis to my father who is no longer physically among us but always follows me in my heart and mind. All the values and hard work that he conveyed to me are reflected here.

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Acronyms

AT – Austria

BE - Belgium

BCBS – Basel Committee on Banking Supervision

BoE – Bank of England

CESEE – Central, Eastern and South-Eastern Europe

CMU – Capital Markets Union

CRD – Capital Requirements Directive

CRR – Capital Requirements Regulation

CY – Cyprus

DE - Germany

DK - Denmark

EBA – European Banking Authority

ECB – European Central Bank

EDF – Expected default frequency

EE - Estonia

ES - Spain

EU – European Union

EUR – Euro

FI – Finland

FR - France

GDP – Gross Domestic Product

GL – Gross loans

GR - Greece

HU – Hungary

IE - Ireland

IFRS - International Financial Reporting Standards

IMF – International Monetary Fund

INFL – Inflation

IRB – Internal Ratings Based Approach

IT – Italy

ITS – Implementing technical standards

LGD – Loss given default

LLP – Loan loss provision

LT - Lithuania

LU - Luxembourg

LV – Latvia

MT – Malta

NL – Netherlands

NO - Norway

NPE – Non-performing exposures

NPL – Non-performing loans

OLS – Ordinary least squares

PL - Poland

PT - Portugal

ROE – Return on Equity

RTS – Regulating technical standards

SE - Sweden

SI - Slovenia

SME – Small and Medium Enterprises

SNL – SNL Financial Database | Standard & Poor's Database

SK – Slovakia

SSM - Single Supervisory Mechanism

TARP - Troubled Asset Relief Program

TIER1 – Tier1 ratio

UK – United Kingdom

UNEMPL - Unemployment

US – United States of America

VIF – Variance Inflation Factor

1. Introduction

Bank credit has an extremely important role in the economy. The indebtedness level of corporates and households grew significantly over the last decades motivated by periods of "easy credit", backed by low credit standards and low interest rates. Paraphrasing Bholat et al. (2016: 3), "bad lending is the root of many banking crises". And the crisis indeed has arrived.

The financial crisis of 2007 and the following European sovereign debt crisis started in 2010 had a huge macroeconomic negative impact, which was not foreseen even by the most pessimistic economists when it started. The collapse of key financial institutions, the freezing of credit markets worldwide, the impairment in the global financial market, and the breakdown of monetary policy transmission mechanisms led to unprecedented Central Banks monetary intervention up to nowadays. Nonetheless, a huge economic recession, high levels of unemployment, the collapse of real estate prices and the huge stocks devaluations, as well as the materialization of the refinancing risk, led to the sudden rise of credit defaults. The Euro Area was in the center of the sovereign debt crisis, with four countries being rescued under the International Monetary Fund and the European Commission financial assistance programmes. The global fear of a systemic crisis reached a point where financial markets were pricing an unthinkable high redenomination currency risk in the Euro Area. Against this unique and adverse background, NPLs in the banking system became a reality in all countries, although with different magnitudes, and the impact of NPLs played a key role on dampening the banking activity and the European economic recovery.

One European key feature is the excessive dependency of the European economy on bank lending, especially for small and medium-size enterprises (SMEs). Another one is the incipient development of the European capital markets, and the asymmetric impact of finance funding according to the country of each firm, regardless of its specific credit risk. Here lies the foundation for the European Commission initiative, the Capital Markets Union (CMU), to promote deeper and more integrated capital markets, enabling the lowering of cost of funding and making the financial system more resilient. The CMU roadmap is quite ambitious in reshaping the European Capital Market by 2019, and suffered a significant setback with the results of the United Kingdom's referendum to leave the European Union.

Meanwhile, policy makers' efforts are on the short-medium horizon, to overcome the hurdles that inhibit bank lending, namely by addressing solutions to sustain banks' profitability. While de-risking and deleveraging in the last years has made banks more sound and robust, it also dampened their profitability levels. To restore profitability levels, banks will have to raise net interest margins, handle the NPLs and adjust their business model, incorporating the new regulation standards. Unsuccessful banks in this process run the risk of becoming "zombie banks", with no interest to seek and scrutinize new lending opportunities. Such banks constitute a heavy burden to the banking system and to the economy as a whole, as they misallocate financial resources. Nowadays, one of most difficult element to envisage a proper European solution are NPLs, especially taking into account the levels reached in the most stressed Euro Area countries. Because these NPLs are consuming a significant stake of banks' capital, they do not generate revenues and, therefore, they lower a Bank's profitability, policy makers are wide-open for insights on how to handle and solve this problem.

This dissertation seeks to determine if there is a feedback response from NPLs to credit growth, and to measure the impact and the reaction of banks in their lending policies. The analysis focuses on the Euro Area countries. To reach conclusions, we use quarterly data from 111 banks of the Euro Area that are representative of 18 countries for the period between 2010 and 2015. Bank specific (NPL, Tier1, return-on-equity and loan loss provisions) and macroeconomic (gross domestic product, unemployment and inflation) variables are taken into account in an unbalanced panel data. The results we obtain show that NPLs take time to negatively impact credit granting.

From a theoretical point of view, the NPL is used as a credit quality measure across the world, but carries many differences between countries. This definition suffered many changes during the past five years. Regulators and supervisors, namely the European Banking Authority (EBA), the Basel Committee on Banking Supervision (BCBS) and the European Central Bank (ECB), engaged several efforts to harmonize concepts, through the issuance of regulation/guidelines based on a common definition.

ECB established as the supervisory priorities for 2016 the assessment of banks' business model and profitability risk, and credit risk concerning heightened levels of NPLs. Both are deeply related as the former considers whether profitability is achieved through, among other things, a weakening of credit standards or an increase in risk exposures not commensurate with the bank's risk appetite and the latter is a consequence of the policies defined under the banks' strategy and macroeconomic conditions.

The resolution of NPLs plays an important role in unlocking the lending activity. Appropriate measures could be addressed to remove NPLs from banks' balance sheets, and to create room for maneuver to allow the banking system to engage into new lending and consequently to boost banks' profitability. These measures are particularly difficult to implement in peripheral countries that faced huge difficulties in raising fresh money. Therefore, although peripheral countries are the ones who bear the highest levels of NPLs, they show a reluctance to recognize accounting losses associated with heavy provisioning, loan write-offs and/or asset sales due to the levels of undercapitalization that they would end up with. Using quarterly data that allows to observe the dynamics of credit granting/NPLs, our analysis shows more expressive results for peripheral countries highlighting strong connection between the change of macroeconomic conditions and NPLs and supporting an analysis based in homogenous groups of countries.

This dissertation is organized as follows. Section 2 reviews the literature related to credit granting and NPL. In more detail, we do a retrospective analysis since before the financial crisis, and evaluate the impact of the crisis in credit granting and the subsequent raising of NPLs. The evolution of NPL regulation and the changes verified in the mindset concerning the credit risk indicators in Europe is also considered in this section. Section 3 formulates the hypotheses, whereas section 4 describes the data. Section 5 presents the econometric framework. Section 6 presents and discusses the results, section 7 does the robustness checks, and section 8 concludes.

2. Overview of NPL impacts – from pre-crisis to nowadays

2.1 Credit granting and NPL: historical overview and present dilemmas

The period before the global financial crisis of 2008 is characterized by ample liquidity, a credit boom, backed by low credit standards and low yields. It is also well-known for the accumulation of risks on and off the balance sheets of many banks, as well as for a substantial increase in public and private sector indebtedness in some countries. The excessive availability of liquidity and the continued macroeconomic growth originated a "cheap credit" fad, allied with low credit standards and low interest rates, leading to a rapid growth of banks' balance sheets.

As stated by Ayadi et al. (2011: 3), "over the last decades, signs of 'excessive financialisation' were manifested in numerous dimensions: the increasing role of banks in the financial intermediation process, a sharp rise in the assets of the banking system relative to GDP, the rapid growth and overall size of the financial system in the economy, the burgeoning leverage of banks and the overall debt-to-GDP levels in the economy, the degree of intra-sector leverage (the extent to which leverage increased within the financial sector as financial institutions became increasingly exposed to each other), the frenetic pace of financial innovation, the sharp rise in trading volumes of banks, the market capitalisation of banks relative to overall market capitalisation of stock market companies and the share of total profits in the economy accounted for by banks.".

After a period of excessive credit growth and leverage, there was a sudden stop in the aftermath of the financial crisis in 2007, which was followed by an European sovereign debt crisis, in 2010. On both sides of the Atlantic, the financial, economic, social and political repercussions were huge, and the public initiatives were massive. The response from the United States of America was faster and significantly more comprehensive than the one in Europe. The combined action between the Federal Reserve and the Treasury, backed by a fast legislative process, enabled the approval of a package worth initially $700 billion, the Troubled Asset Relief Program (TARP). TARP was a programme backed by the US Treasury funds that were used to address the NPLs and US banks' recapitalization due to the capital shortfall identified by the Federal Reserve exercises. Such programme in Europe was impossible to create due to the unwillingness from the 19 European Financial Ministers. Only Ireland, and at a later stage Spain, created an Asset Management Company (NAMA and SAREB, respectively) funded with (external) public

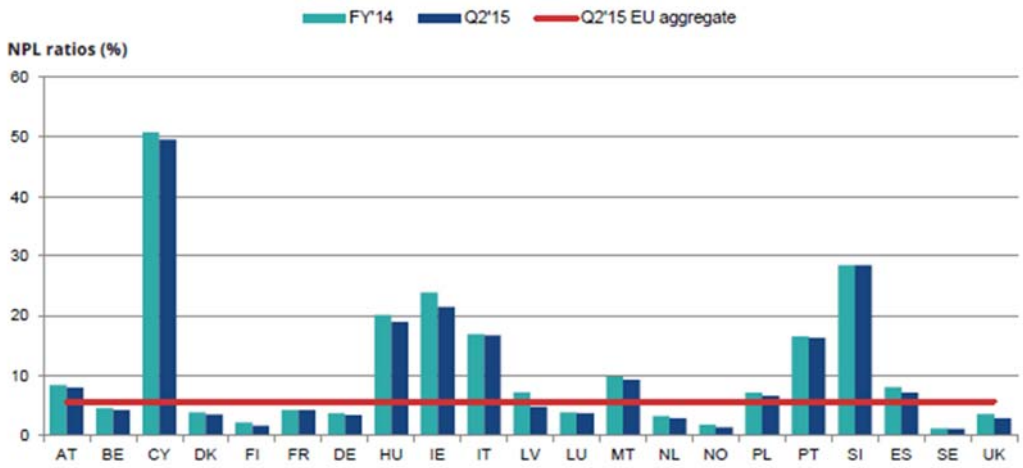
funds to deal with the high levels of domestic NPLs. These arrangements are no longer possible to replicate due to the changes in the regulation framework, namely with the implementation of the Bank Resolution and Recovery Directive. This legislative piece is one of several regulations regarding banks' capital position and asset quality that were issued, to prevent the repetition, in a near future, of a situation similar to the one observed before the crisis.

In Southern Europe the magnitude of the compound output losses recorded during the 2007 and 2010 crisis matches the one from the Great Depression of 1930's (Solomon, 2014). This macroeconomic adverse scenario in the peripheral countries was only possible because of the feedback effects between financial constraints and the deterioration of macroeconomic conditions. In fact, the historical high level of unemployment and high arrears in payments led to an increase of debtors in financial difficulties that could no longer fulfill their obligations with banks. This situation confirms the "moment of Minsky" (1986), which establishes that lending booms lead to NPLs, and that beyond a determined point of the lending cycle a further growth is only supported by a deterioration of asset quality.

Nowadays NPLs are one of the major problems of the banking system. They impact at a microprudential level by constraining Bank's profitability, and at a macroprudential level by considering that the increase of NPLs restrain credit granting (EBA, 2016).

Figure 1 summarizes aggregate NPL ratios for the 21 countries with banks participating in the EBA's 2015 EU-wide transparency exercise.

Figure 1: Aggregate asset quality indicators of European Banks, as of December 2014 and June 2015



Source: EBA 2015 EU-Wide transparency exercise, SNL Financial

The NPL ratios presented in Figure 1 are quite uneven between the European countries, with the highest ratios standing out in the peripheral countries worst hit by the financial crisis. Consequently, the decrease of banks' profitability damaged their ability to build capital buffers by retaining earnings, hampering their shock-absorption capacity and/or inducing high risk taking behavior in order to generate higher returns, which can lead to increased financial fragility going forward (ECB, 2015).

Figure 2: Total assets June 2012-2015

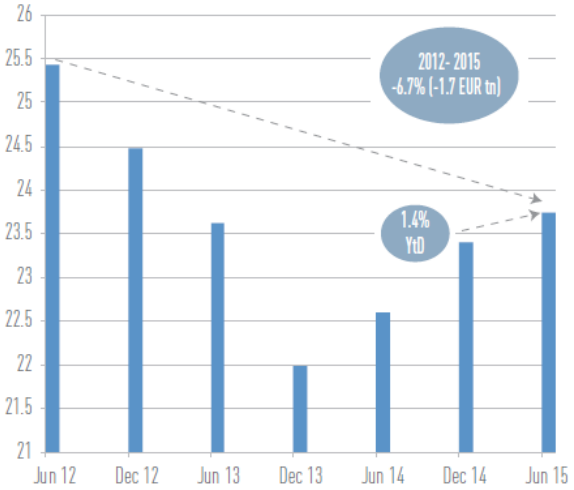
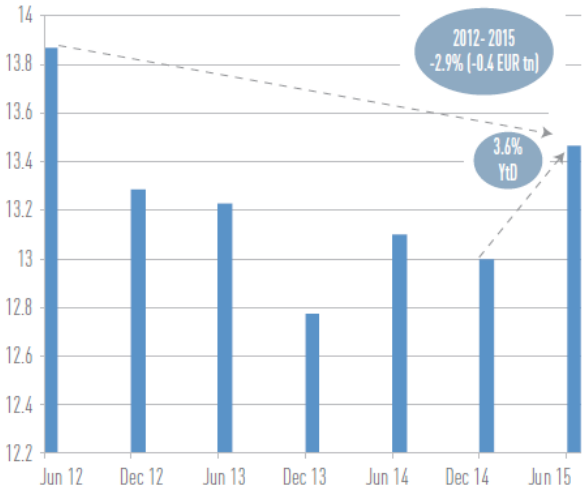


Figure 3: Total loan volumes June 2012-2015

In trillion of euros



Source: EBA KRI's and EBA calculations – EBA Risk Assessment of the European banking System, December 2015

As can be observed from Figure 3, from 2014 till June 2015, gross loans increased faster than total assets (3,6% compared to 1,4%). The declining trend of gross loans reversed in June 2015, indicating a turnaround of the deleveraging strategy followed by European Union (EU) banks in recent years (EBA, 2015). This growing demand mainly results from the SME's segment, to which many banks are still highly dependent. On one hand the aim to achieve satisfactory levels of returns, and on the other hand the very high NPL ratios of the SME loans comparing to other segments (large corporates and households) causes a policy dilemma. Also, from a macroprudential view this dilemma exists since all efforts are made to increase the lending capacity in order to contribute positively to the recovery of the economy, but if credit risk assessment is not properly done it can originate more NPLs in the near future. The right balance between macroprudential policy, monetary policy and fiscal policy is key to promote a sustainable, solid and consistent growth for the coming years. At this point in time, much work and cooperation between all stakeholders is still needed in Europe.

2.2 The NPL determinants

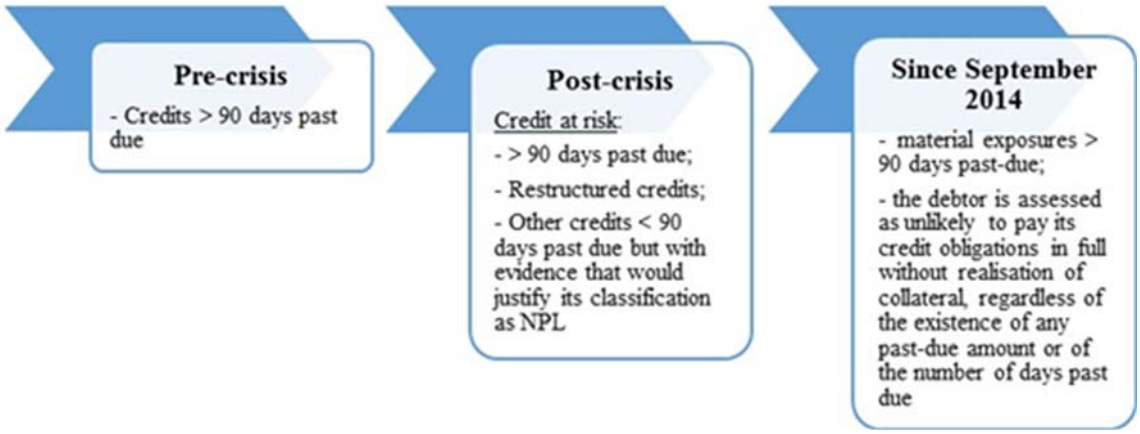
Given the increase of NPLs and their role in the amplification of the crisis, a growing economic literature started to intensively investigate the factors that are behind the NPLs. Beck, Jakubik and Piloiu (2013) analyse the empirical determinants of NPLs mainly by employing a unique data sample covering 75 countries from 2000 to 2010, and conclude that real GDP growth, share prices, the exchange rate and the lending interest rate significantly affect NPL ratios. Klein (2013) investigates the NPLs in Central, Eastern and South-Eastern Europe (CESEE) in the period of 1998–2011 and concludes that the level of NPLs can be attributed to both macroeconomic conditions and banks' specific factors, though the latter set of factors is found to have a relatively low explanatory power.

One common feature in most of the literature is that it is based on country specific studies. An example is Quagliariello (2007) who looks at the Italian banking sector by analyzing banks' behavior over the business cycle, and concludes that banks' risk and profitability are influenced by the evolution of the business cycle. Louzis, Vouldis and Metaxas (2010) examine the determinants of NPLs in the Greek banking sector and find that the credit quality of Greek banks is mainly explained by macroeconomic conditions, in this study represented by GDP, unemployment and interest rates, and also by management quality. Beck, Jakubik and Piloiu (2013) point out that a "common finding of these studies is the positive relationship between asset quality and economic growth", with the difference between them being the indicator chosen to reflect credit quality. Although some studies use expected default frequencies (EDF), loan loss provisions (LLP), loss given default (LGD) as measures of asset quality, the selection of NPLs as an alternative measure is sharply increasing, due to its importance in the current economic context and all the developments that are being discussed in many regulation forums. Today, EBA classifies NPL as a harmonized asset quality measure.

2.3 Evolution of regulation under NPL

The expression "Non-performing Loans" is commonly used by several entities across Europe as a credit quality measure, although there is not a unique comparable definition used by all of them. This definition arose after the financial crisis and suffered many modifications over the last years, as presented in Figure 4.

Figure 4: Evolution of NPL definition



Before the crisis, a simple metric was used. When the number of days past due exceeded 90 the credit granted was considered as being in default and, therefore, was considered a NPL. After the crisis, fostered by an abnormal growth of restructurings and insolvencies, many countries issued national regulation regarding NPLs in order to extend the definition to qualitative triggers, such as bankruptcy/insolvency or liquidation of the debtor, restructured loans and other credits with evidence that would justify their classification as a NPL. A definition of default[1] was settled by Basel II with regards to banks that calculate capital requirements for credit risk under Internal Ratings Based Approach (IRB) (Basel Committee on Banking Supervision, 2004). Later, Regulation (EU) No 575/2013 (CRR) spread this definition to all banks regardless of the method of capital requirements calculation for credit risk (IRB or Standard Approach).

In the meantime, many discussions were held regarding NPLs as a regulatory definition and thereby their relation with other definitions, firstly at a prudential level with default definition and then at the accounting level with "impaired" exposures under International

[1] Basel Committee on Banking Supervision (2004: 104) states that: "452. A default is considered to have occurred with regard to a particular obligor when either or both of the two following events have taken place. The bank considers that the obligor is unlikely to pay its credit obligations to the banking group in full, without recourse by the bank to actions such as realising security (if held). The obligor is past due more than 90 days on any material credit obligation to the banking group.82 Overdrafts will be considered as being past due once the customer has breached an advised limit or been advised of a limit smaller than current outstandings."

Accounting Standard (IAS) 39 (considering that impaired loans consume capital and, therefore, are an impediment to banks' profitability).

EBA has responded by developing definitions of forbearance and non-performing exposures (NPEs) that were reflected in the document "EBA Implementing Technical Standards (ITS) on Supervisory reporting on forbearance, and non-performing exposures under article 99(4) of Regulation (EU) No 575/2013"[2]. This document was published under Commission Implementing Regulation (EU) No 680/2014 on Supervisory Reporting. This regulation was projected to create harmonized definitions for the first time across Europe, with banks starting to report data on non-performing and forborne exposures in September 2014. At this point, for the sake of clarity, we must present the difference between NPEs and NPLs. As per EBA ITS, non-performing criteria are applied on "exposures" which include all debt instruments (loans and advances and debt securities) and off-balance sheet exposures, except those held for trading exposures. A NPL reflects the application of the mentioned criteria only to the component of loans and advances, thus being a subset of NPE. As loans are usually the most relevant part of a banks' asset structure, NPLs got even more emphasized than NPEs.

Nevertheless, according to the abovementioned regulation, NPEs satisfy either one or both of the following criteria:

(a) material exposures that are more than 90 days past due;
(b) the debtor is assessed as unlikely to pay its credit obligations in full without realisation of collateral, regardless of the existence of any past-due amount or of the number of days past due.

Additionally, forborne exposures are debt contracts in respect of which forbearance measures[3] have been extended.

As per EBA ITS on Forbearance and Non-Performing Exposures, the NPE definition encompasses other two concepts: i) exposures considered defaulted according with article 178 of CRR and ii) exposures considered impaired in accordance with IAS 39, excluding "incurred but not reported"[4] (IBNR) regarded as performing exposures. In addition, the

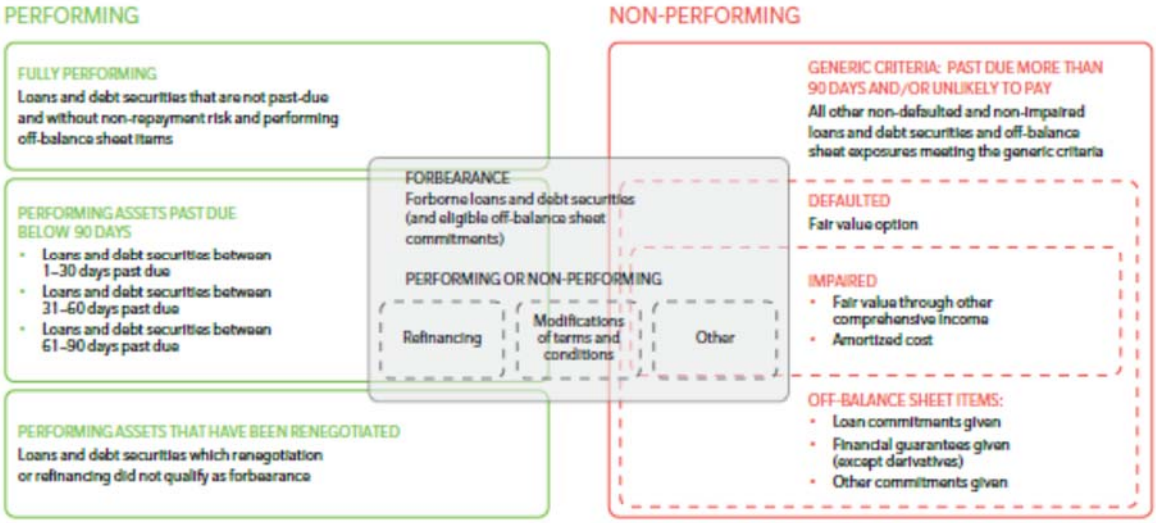
[2] https://www.eba.europa.eu/documents/10180/449824/EBA-ITS-2013-03+Final+draft+ITS+on+Forbearance+and+Non-performing+exposures.pdf

[3] Forbearance measures consist of concessions towards a debtor facing or about to face difficulties in meeting its financial commitments.

[4] Residual impairment calculated for situations that already occurred but were not yet reported to the bank as foreseen in IAS 39.

NPE definition may also comprise other additional risk criteria which the institution may deem relevant. In a nutshell, Figure 5 presents the definitions covered by EBA ITS.

Figure 5: EBA ITS - NPE definition



Source: EBA ITS on Forbearance and Non-Performing Exposures

The implementation of EBA ITS on Forbearance and Non-Performing Exposures raised even a more judgmental assessment of the unlikeliness to pay[5], the most subjective element of the NPE definition (EBA, 2016).

EBA published, in September 2016, the document "Guidelines on the application of the definition of default under Article 178 of Regulation (EU) No 575/2013" [6] to clarify the application of the default definition, particularly in what refers to the implementation of the unlikeliness to pay criteria, along with the Draft Regulatory Technical Standards (RTS) on materiality threshold[7]. Regarding the impairment model and its relation with default definition two documents were produced. The Basel Committee on Banking Supervision (BCBS) published in December 2015 the document "Guidance on credit risk and accounting for expected credit losses", and, in July 2016, EBA launched its consultation paper entitled "Draft Guidelines on credit institutions' credit risk management practices and accounting for expected credit losses".

Currently, different assumptions are made by banks regarding the interpretation and conciliation of the different National and European regulations available and the inherent

[5] See Appendix I.

[6] https://www.eba.europa.eu/documents/10180/1597103/Final+Report+on+Guidelines+on+default+definition+%28EBA-GL-2016-07%29.pdf/004d3356-a9dc-49d1-aab1-3591f4d42cbb

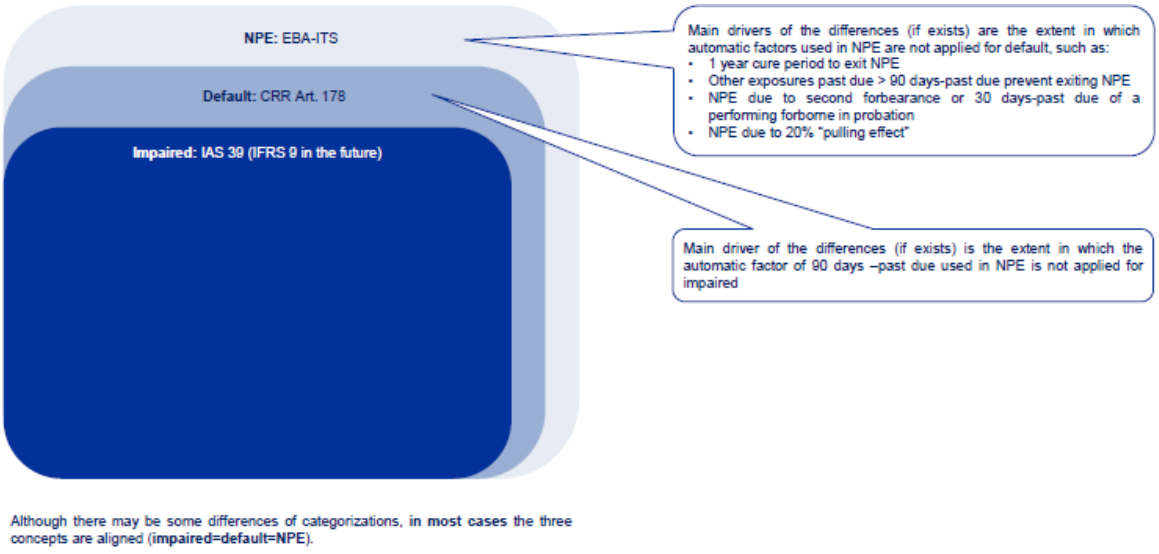
[7] https://www.eba.europa.eu/documents/10180/1597002/Final+draft+RTS+on+the+materiality+threshold+for+credit+obligations+%28EBA-RTS-2016-06%29.pdf/fe1db887-c6dc-4777-89c1-4f243584cafd

definitions, from which result non comparable NPL ratios. This situation is aggravated by the fact that banks outside European Union are not subject to a common definition of NPE.

In April 2016, in order to introduce higher comparability in the financial systems across the world, BCBS issued a global definition on NPE and Forbearance[8] that is aligned with EBA ITS. The implementation of this definition globally will allow its harmonization across countries and banks with businesses outside the European Union, and improve the comparability of the information disclosed to the markets.

Through the Single Supervisory Mechanism (SSM), the ECB has a key role in ensuring the level playing field across Euro Area countries. In September 2016, ECB launched a public consultation on the "Draft guidance to banks on non-performing loans". This document is based on EBA ITS, but provides wider guidance to banks in areas such as NPL strategy, governance and operations, forbearance, recognition, impairment measure and write-offs, as well as collateral valuation.

Figure 6: Illustrative connection between NPE, defaulted and impaired definitions



Source: ECB Draft guidance to banks on non-performing loans, September 2016

In this document, the ECB shows that a NPE is a broader concept than default and impaired exposures. All the recent publications regarding NPEs demonstrate the concerns of supervisors and regulators about this topic. As presented by Bholat et al. (2016: 2), "NPLs are a recurring feature of economic and banking crises. Hence their definition, valuation, and mitigation are a crucial and enduring policy issue for central banks.".

[8] Guidelines on Prudential treatment of problem assets – definitions of non-performing exposures and forbearance: http://www.bis.org/bcbs/publ/d367.pdf

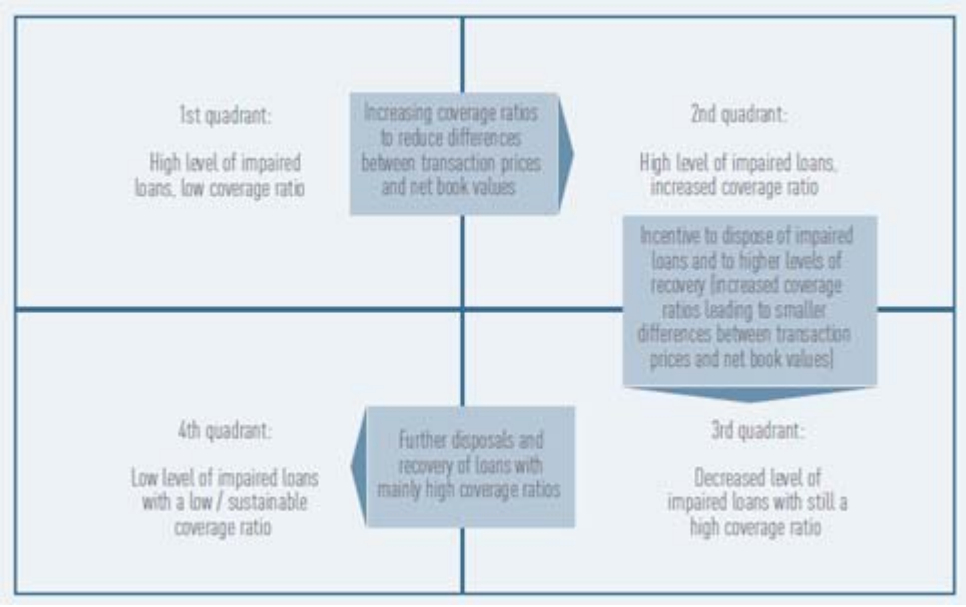
2.4 The measures undertaken by banks to tackle NPLs and consequent changes in banks´ lending models

The ultimate consequence of an excessive NPL ratio in banks is the bankruptcy which could lead to significant losses to the banking system, to the tax payer and to the economy in general. Thus, NPLs are considered one of the drivers of the current economic stagnation. Accordingly, a NPL resolution is necessary to improve the soundness of the banking sector.

The measures undertaken by banks to tackle a NPL severely impact the banks' business models, namely in portfolio compositions. The financial crisis created and highlighted the need to review and adjust the banks' business models in light of the new economic context (Roengpitya et al., 2014).

The ECB (2015) enhanced the key aspects of the operational environment for a NPL resolution and the different approaches to tackle the NPL problem. In turn, EBA established a close link between the level of impaired loans and its coverage ratio, being the current situation of each Bank either an impediment or a strength to solve a NPL issue. Depending on the condition of each Bank, certain measures shall be taken to address problematic loans, as presented in the Figure 7.

Figure 7: Virtuous circle of the relationship between NPL and coverage ratios



Source: EBA Risk Assessment of the European banking System, December 2015

EBA (2015) interprets this situation as a virtuous circle, where the first quadrant corresponds to an economic downturn and, therefore, NPL ratios are growing with

increased levels of impaired loans, but (still) coverage ratios are low. The displacement to the second quadrant occurs when banks start to increase coverage ratios. The higher the coverage ratios, the more willingness they have to dispose or restructure NPLs. Banks that take measures on NPLs move forward to the third quadrant (a decrease in NPL ratios). Finally, as soon as the quality of loans and collateral improve, the need for impairment is lower and there is a shift to the fourth quadrant.

Figure 8: NPL ratio vs. coverage ratio per country

Source: EBA Risk Assessment of the European banking System - Supervisory Reporting Q2 2015

As can be seen from Figure 8, the European countries are scattered across all quadrants with higher concentration on the second and fourth quadrants. The maintenance of high NPL ratios in the banks' balance sheets restricts credit granting and, therefore, dampers the economic activity. Hence, reducing NPL is crucial to support credit growth and to restore banks' profitability (European Parliament, 2016).

Promoting a favorable environment to reduce NPL ratios requires concerted actions by the government, tax authorities, regulators and supervisors with the full cooperation of Banks. Many issues, such as banks' arrears management governance processes and IT systems, judicial systems, asset management companies, securitizations and tax treatment, are pointed by EBA (2016) as being the next key action points. At this moment, the Italian solution seems to be an interesting case study, although it is too early to have a proper assessment. Nevertheless, in Italy, there were some public initiatives to

boost the market value of NPLs by producing legislation that reduces drastically the collateral possessions and liquidation timings (Jassaud & Kang, 2015). The securitization of a NPL is envisaged in order to have the derecognition of risks from the banks' balance sheet. In order to fund this structure, an investment fund, called Atlantes, was created and it is ready to buy mezzanine tranches while the senior tranches will have a credit enhancement from a state guarantee. In Portugal, the authorities acknowledge the NPL burden and some initiatives should be expected soon.

3. Hypotheses

Considering the issues raises in abovementioned literature, this study intends to answer the following hypotheses:

Hypothesis 1: Does a NPL negatively impact credit growth?
The results of some studies confirm this hypotheses in respect to individual countries. Here we are going to evaluate results using a different dataset pertaining to a group of banks within different countries of the Euro Area.

Hypothesis 2: Does the recognition of a NPL exhibit a seasonal pattern across the year?
Banks tend to assume different patterns regarding credit risk indicators. The models used in the previous literature consider yearly data, which limits the ability to capture the NPL behavior across the year (e.g., in different quarters).

Hypothesis 3: Is the model valid under a heterogeneous sample (Euro Area banks located in different countries bearing with asymmetric shocks and macroeconomic reality)?
Most of the studies analyze a single country, so they do not cover this issue.

Hypothesis 4: Does the model react better when applied to a more homogeneous sample?
The banks are subject to quite different economic conditions across Europe. Thus a more granular analysis based on homogeneous groups can be considered and could provide useful insights.

4. Data

Our analysis aims to find empirical evidence that allows us to confirm if NPLs restrict credit granting, determining the impact of this credit quality measure on credit granting, controlling the macroeconomic variables.

It should also be noted that the new definitions of NPE/NPL and default (in their full extent) are still in an early stage of implementation. This explains the relatively short time span selected for our analysis. The data set is a panel data of consolidated banks' balance sheets from SNL Financials[9], as well as macroeconomic indicators from Eurostat[10]. The sample consists of 111 banks of the Euro Area which are representative of 18 countries[11] (See Appendix II). Data is based on a quarterly frequency for the period 2010-2015, thus resulting in 24 quarters. As information on a few cross-sectional units is missing in some quarters, we are working with an unbalanced panel data.

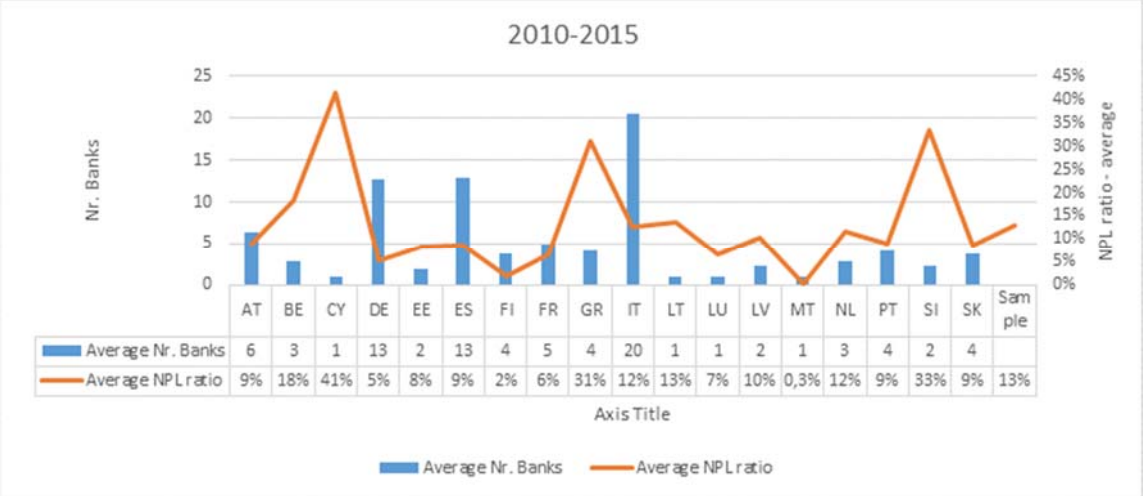
In order to maintain the maximum number of observations, the available database was improved by interpolating and completing some crucial data gathered from the financial statements of the respective banks. In total, the data comprehends 2047 observations which are almost evenly divided over the sample' period with a slight increase in the most recent quarters. Nevertheless, observations are not equally distributed by country (see Appendix II).

This work is supported by a "small T, large N panel"[12]. Due to the short length of the time series, the analysis on the dynamics of gross loans growth is necessarily limited.

Looking at the sample as a whole, the average NPL ratio is 13% for the period analyzed, with the average distribution per country shown in Figure 9.

[9] Standard & Poor's Database
[10] Statistical Office of the European Union
[11] No data is available regarding Ireland.
[12] Few time periods (5 years) and many individual units (111 institutions).

Figure 9: NPL ratio and average number of banks per country in the sample



	AT	BE	CY	DE	EE	ES	FI	FR	GR	IT	LT	LU	LV	MT	NL	PT	SI	SK	Sample
Average Nr. Banks	6	3	1	13	2	13	4	5	4	20	1	1	2	1	3	4	2	4	
Average NPL ratio	9%	18%	41%	5%	8%	9%	2%	6%	31%	12%	13%	7%	10%	0,3%	12%	9%	33%	9%	13%

The existence of a wide range (between 0,23% and 61%[13]) of NPL ratios highlights the dispersion across countries. In general, the highest NPL ratios belong to countries that had their financial systems under severe financial stress.

[13] Minimum and maximum values observed in the sample.

5. Econometric framework

This dissertation aims to estimate the relationship between the credit granting and NPLs in banks of the Euro Area. In order to do so, it takes into consideration the macroeconomic conditions prevailing in each quarter (from 2010 to 2015), as well as the performance of banks according to bank specific factors. Considering that we are analyzing the behavior on multiple variables of banks of the Euro Area and for several time periods, we use panel data. Using a panel data approach, allow us to capture the country-specific effects and the unobservable differences between countries, and we can control for the biases generated by potential heterogeneity and omitted variable problems (Beck, Jakubik, Piloiu, 2013). Additionally, as stated by Wooldridge (2012), data with cross-sectional and time series features can often shed light on important policy questions.

5.1 Variables

The dependent variable considered is gross loans (GL), which is measured by the growth of gross loans for each quarter, in line with Gambacorta and Mistrulli (2004), Curry et al. (2006), Berrospide and Edge (2010), Foos et al. (2010), Alessi et al. (2014) and Cucinelli (2015).

The explanatory variables are divided into two groups: macroeconomic and banks' specific variables. The macroeconomic variables selected – gross domestic product (GDP), unemployment rate (UNEMPL) and inflation rate (INFL) – reflect the economic conditions prevailing when granting loans, and they are commonly used in the literature (Beck, Jakubik, and Piloiu, 2013). Banks' specific variables are non-performing loans ratio (NPL) and loan loss provision on gross loans ratio (LLP), which express credit quality, and Tier 1 ratio (Tier1) that reflects the robustness of banks' capital and return-on-equity (ROE) as a measure of banks' profitability (Cucinelli, 2015). The variables used are also present in the literature and we consider that they provide a wide set of information that can explain the lending behavior. Table 1 shows the variables and the respective expected sign in the regression results.

Table 1: Expected sign of variables in regression results

Variables		
Variable	Description	Expected sign
GL	Gross loans	
NPL	Non-performing loans ratio	-
Tier1	Tier1 capital ratio	-
ROE	Return-on-equity	+
LLP	Loan loss provision on gross loans ratio	-
GDP	Gross domestic product	+
UNEMPL	Unemployment rate	-
INFL	Inflation rate	+

An increase of NPL and LLP ratio means a decrease of the quality of the credit portfolio, which originates a higher consumption of banks' capital that inhibits new lending; so, a negative sign is expected for both variables.

Tier1 ratio can change due to an increase of capital or to a decrease of capital requirements related to credit risk, the latter due to a decrease of banks' lending. Thus, we expect a negative sign.

Higher returns, here represented by ROE, can be applied on acquiring new lending; hence we expect a positive sign.

GDP and inflation are expected to positively impact credit granting, as both variables are linked to economic growth and therefore to a higher credit demand. On the contrary, the growth on the unemployment rate is expected to impact credit granting negatively because it is directly connected with a reduction of householders disposable income, which lowers the global demand and therefore the demand for credit.

All variables are expressed as a percentage points change quarter-on-quarter in order to standardize units in the different variables, and avoid a possible measurement error in the dependent variable. The descriptive statistics of the main variables are presented in Table 2.

Table 2: Main variables descriptive statistics (sample)

Variables descriptives				
Variable	Mean	Std. Dev.	Min	Max
GL	0,006	0,114	-0,795	3,802
NPL	0,229	1,623	-38,110	39,266
Tier1	0,207	1,391	-14,393	12,591
ROE	0,705	53,339	-633,664	758,663
LLP	0,102	0,730	-14,290	14,627
GDP	0,001	0,007	-0,038	0,037
UNEMPL	0,044	0,466	-1,700	2,200
INFL	0,184	2,487	-33,100	5,831

All variables are expressed in terms of percent points change

A comprehensive economic analysis may suggest that additional variables, such as management skills, risk appetite and policy changes, could also have explanatory power. However, these are not easily or accurately measurable and, therefore, are not included in the regression. Such missing characteristics may be reflected in the error term, and could be correlated with explanatory variables, causing a heterogeneity bias.

Lagged variables are considered because banks tend to implement changes in lending internal policies in consequence of shifts in credit quality and macroeconomic conditions. More specifically, four lags are included in order to consider a full year's lag assessment. Appendix III reports descriptive statistics of the all variables.

5.2 Estimation

We initially run a pooled OLS regression. The pooled OLS estimator is consistent if the pooled model is appropriate and regressors are uncorrelated with the error term (Cameron & Triverdi, 2005). As stated before, the model should capture individual effects.

The Hausman test (1978) is performed to decide between the use of fixed effects or random effects. Results presented in Appendix IV show that a fixed effects model should be used. Thereby, unobserved effects are allowed to be arbitrarily correlated with the explanatory variables in each time period (Wooldridge, 2012). The fixed effect component assumes time "invariant individual" specific effects, i.e. it captures unobserved heterogeneity across individuals that does not change over time. When the true model is the fixed effects, the pooled OLS is inconsistent (Cameron & Triverdi, 2005).

A global model is estimated, considering the wide set of variables abovementioned, and the respective fixed effects regression is as follows:

$$GL_{i,t} = \alpha + \mu_i + \sum_{j=1}^{4} \beta_{1,j}\ NPL_{i,t-j} + \sum_{j=1}^{4} \beta_{2,j}\, TIER1_{i,t-j} + \sum_{j=1}^{4} \beta_{3,j}\, ROE_{i,t-j} + \sum_{j=1}^{4} \beta_{4,j}\, LLP_{i,t-j} + \sum_{j=1}^{4} \beta_{5,j}\, GDP_{i,t-j} + \sum_{j=1}^{4} \beta_{6,n}\, UNEMPL_{i,t-j} + \sum_{j=1}^{4} \beta_{7,j}\, INFL_{i,t-j} + \varepsilon_{i,t} \quad (1)$$

We denote this as the global fixed effects model. In order to study significance of the variables of this model, a Wald test is used (see Appendix V). This test confirms that 18 of the 28 variables (including lags) initially selected are not significant.

To achieve a more parsimonious model, we remain only with the significant variables: NPL_lag1, NPL_lag2, Tier1_lag4, ROE_lag1, ROE_lag4, GDP_lag1, GDP_lag2, GDP_lag4, INFL_lag2 and INFL_lag3. A restricted version of the global model is estimated using:

$$GL_{i,t} = \alpha + \mu_i + \beta_1 NPL_{i,t-1} + \beta_2 NPL_{i,t-2} + \beta_3 TIER1_{i,t-4} + \beta_4 ROE_{i,t-1} + \beta_5 ROE_{i,t-4} + \beta_6 GDP_{i,t-1} + \beta_7 GDP_{i,t-2} + \beta_8 GDP_{i,t-4} + \beta_9 INFL_{i,t-2} + \beta_{10} INFL_{i,t-3} + \varepsilon_{i,t} \quad (2)$$

6. Results

The table below shows the results achieved using the OLS and the Fixed effects regressions within the global and restricted models.

Table 3: Regression results

	GLOBAL MODEL			RESTRICTED MODEL		
Variables	OLS	FE'	FE Driscoll-Kraay	OLS	FE'	FE Driscoll-Kraay
NPL_lag1	0.032***	0.035***	0.035***	0.030***	0.036***	0.036**
NPL_lag2	0.001	0.005	0.005	-0.001	0.004	0.004
NPL_lag3	-0.004*	-0.000	-0.000			
NPL_lag4	-0.005**	-0.002	-0.002			
Tier1_lag1	0.001	0.002	0.002			
Tier1_lag2	-0.002	-0.001	-0.001			
Tier1_lag3	-0.000	-0.000	-0.000			
Tier1_lag4	-0.004***	-0.004	-0.004	-0.004**	-0.004	-0.004*
ROE_lag1	0.000**	0.000*	0.000**	0.000*	0.000*	0.000**
ROE_lag2	0.000	0.000	0.000			
ROE_lag3	0.000	0.000	0.000			
ROE_lag4	0.000	0.000	0.000***	0.000*	0.000**	0.000***
LLP_lag1	0.002	0.003	0.003			
LLP_lag2	-0.006	-0.004	-0.004			
LLP_lag3	-0.006	-0.005	-0.005			
LLP_lag4	0.002	0.001	0.001			
GDP_lag1	1.019**	1.053**	1.053**	0.718*	0.882**	0.882**
GDP_lag2	0.867*	0.945*	0.945**	0.681	0.856	0.856
GDP_lag3	-0.055	0.031	0.031			
GDP_lag4	0.722	0.795	0.795	0.988**	1.038**	1.038**
UNEMPL_lag1	0.009	0.008	0.008*			
UNEMPL_lag2	0.005	0.004	0.004			
UNEMPL_lag3	-0.002	-0.003	-0.003			
UNEMPL_lag4	0.000	-0.004	-0.004			
INFL_lag1	0.001	0.001	0.001			
INFL_lag2	-0.008***	-0.008	-0.008***	-0.008***	-0.008	-0.008***
INFL_lag3	-0.004***	-0.005	-0.005*	-0.004***	-0.005	-0.005*
INFL_lag4	0.000	-0.000	-0.000			
_cons	0.001	-0.003	-0.003	-0.000	-0.003	-0.003
R-Squared	0.2351	0.2624	0.2624	0.2200	0.2176	0.2575
Adj R-squared	0.2245	0.2255		0.2162	0.1828	
Prob>F	0.000	0.000	0.000	0.000	0.0351	0.000

Asteriscs represent the significance of the coefficients *** 1% **5% *10%
Robust standard errors were used

Regarding the overall significance of the regression, we can see that the null hypothesis of zero coefficients is rejected in all models, showing that the independent variables contribute to explain the dependent variable (gross loans growth). The main conclusion we achieve is that NPLs take time to negatively impact credit granting, confirming hypothesis 1.

The NPL variable shows a different behavior across the lags. The first and second lags present a positive relation with the gross loans growth and the third and fourth lags present negative coefficients, which suggest the existence of a time lag between the variation of the NPL ratio and the reaction of banks reflected in credit granting policies, validating hypothesis 2.

At first, our analysis may seem to show contrary results, as the first two lags of NPL shows a positive and significant impact. That might be explained by the rigidity observed when setting credit policy rules. Only after some time of coexistence of credit and NPL growth there is a perception that something needs to be changed. The fundamental change of the credit policy occurs only in the third and fourth periods. This result is not so different from the ones achieved when working with yearly data[14]. However, working with quarterly data allows us to capture the time lag needed for the credit policy adjustment.

Another way to explain the sign in the first two quarters is that when banks are willing to boost their credit portfolio, the credit granting criteria became more permissive and, thereby, at a point in time they start lending to borrowers with lower credit quality.

Regarding the macroeconomic variables, GDP evidences generally in all models a strong and positive relation with the gross loans growth, supporting the historical evidences of periods of economic expansion. An increase of gross loans is related to an uplift of GDP growth.

Although the first lag of ROE has significance and shows a consistent behavior across models, its low coefficients demonstrate a low influence on GL. The Loan loss provisions variable is not found to have relevance, unlike what studies report. Unemployment is significant only in its first lag under the global model.

Globally, when comparing the statistics of the global model and those in the restricted model, using fixed effects regression, we conclude that the differences are trifling.

[14] Cucinelli (2015), European Investment Bank (2014) and Tracey (2011).

Additionally, we compare the model with the one using Driscoll-Kraay standard errors, with the cluster-robust standard errors (See Appendix VIII). The estimator Driscoll-Kraay seems to produces more appropriate standard error estimates.

Segmentation of countries

To further deepen the analysis, the data is divided into two different groups: countries of Central and Eastern Europe and Peripheral countries (that suffered from financial stress in the period under review). The first group includes: Austria, Belgium, Germany, Estonia, Finland, France, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Slovenia and Slovakia. The Peripheral group comprises Cyprus, Spain, Greece, Italy and Portugal. Although these groups do not constitute economically homogeneous groups, they are divided taking into account the recent financial aid interventions, admitting that countries in such situations have higher NPL ratios due to their abnormal difficult economic conditions.

We consider the variables under the restricted model to estimate both models. The results are presented in Table 4.

Table 4: Groups regression results

	ALL COUNTRIES			CENTRAL EASTERN EUROPE			PERIPHERAL		
Variable	OLS	FE'	FE Driscoll-Kraay	OLS	FE'	FE Driscoll-Kraay	OLS	FE'	FE Driscoll-Kraay
NPL_lag1	0.030***	0.036***	0.036**	0.007*	0.007	0.007*	0.041***	0.046***	0.046***
NPL_lag2	-0.001	0.004	0.004	-0.005	-0.005	-0.005	0.010***	0.015	0.015
Tier1_lag4	-0.004**	-0.004	-0.004*	-0.006***	-0.005	-0.005	-0.000	-0.000	-0.000
ROE_lag1	0.000*	0.000*	0.000**	0.000	0.000	0.000***	0.000	0.000	0.000
ROE_lag4	0.000*	0.000**	0.000***	0.000	0.000**	0.000	0.000	0.000	0.000
GDP_lag1	0.718*	0.882**	0.882**	0.180	0.124	0.124	1.812***	1.815***	1.815**
GDP_lag2	0.681	0.856	0.856	0.460	0.389	0.389	1.089	1.017*	1.017**
GDP_lag4	0.988**	1.038**	1.038**	0.732	0.708	0.708	1.787***	1.989*	1.989*
INFL_lag2	-0.008***	-0.008	-0.008***	0.000	-0.000	-0.000	-0.001	-0.005	-0.005
INFL_lag3	-0.004***	-0.005	-0.005*	0.001	0.000	0.000	-0.001	-0.004	-0.004
_cons	-0.000	-0.003	-0.003	0.002	0.003	0.003	-0.010	-0.011*	-0.011
R-Squared	0.2200	0.2176	0.2575	0.0175	0.0139	0.0139	0.3537	0.4123	0.4123
Adj R-squared	0.2162	0.1828		0.0078	0.0164		0.3472	0.3501	
Prob>F	0.000	0.0351	0.000	0.0553	0.0215	0.0014	0.000	0.000	0.0063

Asteriscs represent the significance of the coefficients *** 1% **5% *10%
Robust standard errors were used

Firstly, we conclude that the model applied to all countries together is valid, as the null hypothesis is rejected, with a R-squared of 25,75%. Thus validating hypothesis 3.

Additionally, we observe that the magnitude of the results is considerably distinct between groups. In the Central Eastern Europe group only the first lags of NPL and ROE reveal significance, nevertheless, the coefficients are minor. The null hypothesis is rejected and thereby a fixed effects model can be used to estimate the relationship between gross loans growth and the reported variables using data of the Central Eastern European countries. However, the R-squared is much lower when compared with the other groups.

The situation is completely different in what regards the group of Peripheral countries. Although several coefficients lose significance when compared with the restricted model applied to all countries, the results under fixed effects Driscoll-Kraay of Peripheral countries seem appropriate, with a noteworthy enhancement of the GDP coefficients. This result confirms hypothesis 4.

These differences can be explained by the constraints caused by the substantial impact of the difficult macroeconomic conditions in credit granting of banks belonging to financially distressed countries. Most important is the increase observed in the NPL coefficients and their significance, which supports greatly the importance of handle the NPLs in order to promote a sound economic recovery in the peripheral countries.

7. Robustness

Several checks are performed in the current study in order to assess the robustness of the analysis, so that biased estimates and conclusions are avoided. The high correlation among the explanatory variables can affect the regression coefficients. To analyze the level of multicollinearity, we estimate the Variance Inflation Factor (VIF). Regarding the global model, individually, the explanatory variables present values between 1 and 3,5 and a global mean of 2,13. The restricted model shows lower values, between 1 and 2, and exhibits a global mean of 1,23. Furthermore, the results of both models show only a moderate correlation between the covariates, thus implying no multicollinearity (see Appendix VI).

Additionally, as errors are potentially serially correlated and/or heteroscedastic, valid statistical inference requires controlling for both of these factors (Cameron & Triverdi, 2005). In order to check for heteroscedasticity, the Breush and Pagan / Cook-Weisberg, Cameron & Triverdi's (1990) and White's (1980) tests are performed (see Appendix VII). The null hypothesis is rejected in all regressions, thus pointing to the existence of heteroscedasticity.

The existence of autocorrelation within the periods included in the sample biases the standard errors and causes the results to be less efficient (Drukker, 2003 and Bertrand, Duflo and Mullainathan, 2004). According to Schmidheiny (2015), in practice, the idiosyncratic errors are often serially correlated when time periods used are higher than 2.

Moreover, microeconometric panel datasets are likely to exhibit complex patterns of mutual dependence between the cross-sectional units, which in our analysis, are the banks.

As some behavioral characteristics are considered in panel regressions as unobservable common factors, dependence may arise. Indeed, while some events do not affect observations individually, they may affect groups of observations within each group. We are assuming independence across institutions, but correlation within each institution. In order to make the standard assumptions of the fixed effects panel data model (strict exogeneity of all explanatory variables and independence of observations across institutions), and allowing for heteroscedasticity autocorrelation and cross-section dependence, our models are fitted with robust estimators. The type of estimator is deeply linked with the behavior of the variables considered. The Driscoll and Kraay (1998)

robust estimator is used in order to produce more appropriate standard error estimates that are robust to general forms of spatial and temporal dependence.

The normality assumption is tested through Cameron & Triverdi's (1990) test[15]. As skewness presents a high positive value, the distribution is positively skewed. Kurtosis is below 3, meaning that the tails are thicker than those of the Normal, i.e. the distribution is platykurtic. Although the normality assumption is not verified, we can rely on asymptotic approximations (Wooldridge, 2012). Appendix IX presents the plots.

[15] See Appendix VII. A normal distribution would have a skewness of 0 and a kurtosis of 3.

8. Conclusion

This study focuses on the impact of the NPLs on gross loans growth. To analyze this relationship, we use fixed effects estimation techniques with a Driscoll-Kraay robust estimator. The empirical results confirm that NPLs negatively impact on credit granting, which is in line with other work in this field. The contribution of our analysis is given by the use of quarterly data to observe the NPL/credit growth dynamics. Results suggest that the credit policy is rigid and does not respond immediately to the variation of NPLs. There is a time lag of about 2 quarters during which credit and NPLs simultaneously grow, and only after this period an adjustment in credit policy is observed. This may also imply a relaxation of the credit granting criteria, when banks are willing to boost their credit portfolio.

A strong and positive relation between GDP and the gross loans growth is also supported by the historical link between credit and the economic cycles. Contrary to other studies, the Loan loss provisions variable is not found to be significant.

In order to confront two considerably different realities that occurred during the sampling period, an application of the model is done to two groups of countries – on one hand the countries from Central and Eastern Europe and on the other hand those from Peripheral countries which suffered severe financial stress. The results are more expressive for the Peripheral countries group than for the Central and Eastern Europe countries group, indicating a close link between the variation of macroeconomic conditions and NPLs, and supporting an analysis based on homogeneous clusters of countries. Future analysis in this field should take this into account and subdivide the sample into homogeneous clusters of countries.

Policy makers' current analysis regarding credit risk indicators are more driven by European averages than by peer analysis. Does this make sense? Albeit the huge differences between countries specificities, the target values are equal across the European Union at all levels. Shall this approach be adjusted? The question remains to be further developed by supervisory entities.

9. REFERENCES

ALESSI, M., DI COLLI S., & LOPEZ, J. S. 2014. ***Loan Loss Provisioning and relationship banking in Italy: practices and empirical evidence***. Journal of entrepreneurial and organizational diversity, 3(1), 111-129.

AYADI (ET. AL). 2011. ***Business Models in European Banking A pre and post-crisis screening.*** Centre For European Policy Studies

BASEL COMMITTEE ON BANKING SUPERVISION. 2016. ***Guidelines on Prudential treatment of problem assets – definitions of non-performing exposures and forbearance***

BASEL COMMITTEE ON BANKING SUPERVISION. 2015. ***Guidance on credit risk and accounting for expected credit losses***

BASEL COMMITTEE ON BANKING SUPERVISION. 2004. ***International Convergence of Capital Measurement and Capital Standards A Revised Framework***

BECK, R.; JAKUBIK, P.; PILOIU, A. 2013. ***Non-Performing Loans What Matters in Addition to the Economic Cycle?.*** Working Paper Series no. 1515, European Central Bank

BERROSPIDE, J. M., & EDGE, R. M. 2010. ***The effects of bank capital on lending: what do we know, and what does it mean.*** Financial and economics discussion series. Federal Reserve Board. Washington, D. C.

BERTRAND, M., DUFLO, E., MULLAINATHAN, S. 2004. ***How much should we trust differences-in-differences estimates?***, Oxford Journals Volume 119, Issue 1 Pp. 249-275

BHOLAT, D., LASTRA, R., MARKOSE, S., MIGLIONICO, A., SEN, K. 2016. ***Non-performing loans: regulatory and accounting treatments of assets***, Bank of England - Staff Working Paper No. 594

CAMERON, A. C.; TRIVERDI, P. K. 2005. ***Microeconometrics Methods and Applications.***

CUCINELLI, D., 2015. ***The Impact of Non-performing Loans on Bank Lending Behaviour: Evidence from the Italian Banking Sector.*** Eurasian Journal of Business and Economics 2015 8(16), 59-71.

CURRY, T. J., FISSEL, G. S., & RAMIREZ, C. D. 2006. ***The effect of bank supervision on Loan Growth.*** FDIC Center for financial research working paper, 2006-12.

DRUKKER, D. M. 2003. ***Testing for serial correlation in linear panel-data models***, The Stata Journal 3, Number 2, pp. 168–177

EUROPEAN BANKING AUTHORITY, 2016. ***Guidelines on the application of the definition of default under Article 178 of Regulation (EU) No 575/2013***

EUROPEAN BANKING AUTHORITY, 2016. ***Draft Regulatory Technical Standards on materiality threshold of credit obligation past due under Article 178 of Regulation (EU) 575/2013***

EUROPEAN BANKING AUTHORITY, 2016. ***Draft Guidelines on credit institutions' credit risk management practices and accounting for expected credit losses***

EUROPEAN BANKING AUTHORITY, 2016. ***EBA Report on the dynamics and drivers of nonperforming exposures in the EU banking sector***

EUROPEAN BANKING AUTHORITY, 2015. ***EU-wide transparency exercise***

EUROPEAN BANKING AUTHORITY, 2015. ***Risk Assessment of the European Banking System***

EUROPEAN CENTRAL BANK. 2016. ***Draft guidance to banks on non-performing loans***

EUROPEAN CENTRAL BANK. 2015. ***ECB Banking Supervision: SSM priorities 2016***

EUROPEAN CENTRAL BANK. 2015. ***Financial Stability Review*** (May)

EUROPEAN CENTRAL BANK. 2015. ***Financial Stability Review*** (November)

EUROPEAN COMMISSION, 2014. ***Commission Implementing Regulation (EU) 2015/227 of 9 January 2015 amending Implementing Regulation (EU) No 680/2014 laying down implementing technical standards with regard to supervisory reporting of institutions according to Regulation (EU) No 575/2013 of the European Parliament and of the Council | EBA, Implementing Technical Standard on Supervisory Reporting - Forbearance and non-performing exposures***

EUROPEAN COMMISSION, 2013. ***Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012***

EUROPEAN COMMISSION, 2002. ***International Auditing Standard 39 - Regulation (EC) No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards***

EUROPEAN INVESTMENT BANK. 2014. ***Unlocking lending in Europe***

EUROPEAN PARLIAMENT. 2016. ***Non-performing loans in the Banking Union: stocktaking and challenges***

FOOS, D., NORDEN L., & WEBER, M. 2010. ***Loan growth and riskiness of banks.*** Journal of banking and finance, 34, 2929-2940.

GAMBACORTA, L., & MISTRULLI, P. E. 2004. ***Does bank capital affect lending behavior?*** Journal of financial intermediation, 13, 436-457.

JASSAUD, N.; KANG, K. 2015. ***A Strategy for Developing a Market for Nonperforming Loans in Italy***, Working Paper, International Monetary Fund

KLEIN, N. 2013. ***NonPerforming Loans in CESEE: Determinants and Macroeconomic Performance***, Working Paper no. 1372, International Monetary Fund

LOUZIS, D.; VOULDIS, A.; METAXAS, V. 2010. ***Macroeconomic and bank-specific determinants of non-performing loans in Greece: a comparative study of mortgage, business and consumer loan portfolios***, Working Papers 118, Bank of Greece

MINSKY, H., 1986. ***Stabilizing an Unstable Economy***, McGraw-Hill

QUAGLIARIELLO M., 2007. ***Macroeconomic uncertainty and banks' lending decisions: The case of Italy***, Economic working papers 615, Bank of Italy

ROENGPITYA, R.; TARASHEV, N.; TSATSARONIS, K. 2014. ***Bank business models***, BIS Quarterly Review

SOLOMON, D., 2014. ***The recovery from the global financial crisis of 2008: missing in action***

SCHMIDHEINY, K., 2015. ***Panel Data: Fixed and Random Effects***, Short Guides to Microeconometrics, Unversitat Basel

TRACEY, M., 2011. ***The impact of Non-performing Loans on Loan Growth: an econometric case study of Jamaica and Trinidad and Tobago***

WOOLDRIDGE, J.M. 2012. ***Introductory Econometrics Modern Approach***, 5th edition, McGrawHill

Appendixes

I. Criteria that may apply as Unlikeliness to pay

Under article 178 of CRR
Credit obligation on non-accrual status
Specific credit adjustment resulting from a significant perceived decline in credit quality
Sale of a credit obligation with material credit- related economic loss
Request for or current concession of forbearance measures as defined in EBA/ITS/2013/03 resulting in distressed restructuring of the credit obligation
Request by the institution for the obligor's bankruptcy
Submission of the obligor to bankruptcy or similar protection where this would avoid or delay repayment of a credit obligation

Under IAS 39
External or internal rating indicating default or near-default.
Request by the debtor of emergency funding from the Significant Bank
> 30 days past due
Maximum CDS spread for the debtor over the past 12 months.
A material decrease in turnover
Decline of EBITDA
Debt service coverage ratio
Leverage
Covenant breach not waived by the bank
ISDA Credit Event declared.
Any legal entity within the group of connected clients of the debtor (incl. subsidiaries of the debtor) has filed bankruptcy application.
The disappearance of an active market for the assets financed
A material decrease in debtor income
A material decrease in rents received on a buy-to-let property
A material decrease in the collateral value where the sale of the financed asset is required to repay the loan

II. Sample representativeness by period and by country

Period	# Observations	Weight
2010Q1	39	2%
2010Q2	44	2%
2010Q3	48	2%
2010Q4	50	2%
2011Q1	74	4%
2011Q2	77	4%
2011Q3	81	4%
2011Q4	82	4%
2012Q1	91	4%
2012Q2	92	4%
2012Q3	93	5%
2012Q4	93	5%
2013Q1	95	5%
2013Q2	94	5%
2013Q3	94	5%
2013Q4	94	5%
2014Q1	98	5%
2014Q2	98	5%
2014Q3	101	5%
2014Q4	101	5%
2015Q1	101	5%
2015Q2	102	5%
2015Q3	103	5%
2015Q4	102	5%
Total	**2047**	**100%**

Country	#Observations	Weight
Italy	491	24%
Spain	307	15%
Germany	306	15%
Austria	153	7%
France	117	6%
Portugal	100	5%
Greece	97	5%
Finland	88	4%
Slovakia	83	4%
Belgium	70	3%
Netherlands	68	3%
Slovenia	55	3%
Estonia	39	2%
Cyprus	20	1%
Luxembourg	20	1%
Malta	16	1%
Latvia	14	1%
Lithuania	3	0%
Total	**2047**	**100%**

III. Description of the explanatory variables

Variables descriptives					
Variable	#Observations	Mean	Std. Dev.	Min	Max
NPL_lag1	2046	0,229	1,624	-38,110	39,266
NPL_lag2	2045	0,230	1,624	-38,110	39,266
NPL_lag3	2044	0,230	1,624	-38,110	39,266
NPL_lag4	2043	0,230	1,625	-38,110	39,266
Tier1_lag1	2046	0,207	1,391	-14,393	12,591
Tier1_lag2	2045	0,207	1,392	-14,393	12,591
Tier1_lag3	2044	0,207	1,392	-14,393	12,591
Tier1_lag4	2043	0,207	1,392	-14,393	12,591
ROE_lag1	2046	0,706	53,352	-633,664	758,663
ROE_lag2	2045	0,708	53,365	-633,664	758,663
ROE_lag3	2044	0,706	53,378	-633,664	758,663
ROE_lag4	2043	0,708	53,391	-633,664	758,663
LLP_lag1	2046	0,102	0,730	-14,290	14,627
LLP_lag2	2045	0,102	0,731	-14,290	14,627
LLP_lag3	2044	0,102	0,731	-14,290	14,627
LLP_lag4	2043	0,102	0,731	-14,290	14,627
GDP_lag1	2046	0,001	0,007	-0,038	0,037
GDP_lag2	2045	0,001	0,007	-0,038	0,037
GDP_lag3	2044	0,001	0,007	-0,038	0,037
GDP_lag4	2043	0,001	0,007	-0,038	0,037
UNEMPL_lag1	2046	0,043	0,467	-1,700	2,200
UNEMPL_lag2	2045	0,044	0,467	-1,700	2,200
UNEMPL_lag3	2044	0,043	0,467	-1,700	2,200
UNEMPL_lag4	2043	0,044	0,467	-1,700	2,200
INFL_lag1	2046	0,200	2,376	-33,100	5,831
INFL_lag2	2045	0,201	2,377	-33,100	5,831
INFL_lag3	2044	0,200	2,377	-33,100	5,831
INFL_lag4	2043	0,201	2,378	-33,100	5,831

All variables are expressed in terms of percent change

IV. Hausman Test

Hausman Test

	Coefficients (b) FixedEffects	(B) RandomEffe~s	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
NPL_lag1	.0350396	.0315283	.0035113	.0006353
NPL_lag2	.0050496	.0012249	.0038247	.0006222
NPL_lag3	-.0002217	-.0041436	.0039219	.0005819
NPL_lag4	-.0023706	-.0054566	.003086	.0005975
Tier1_lag1	.0021733	.00101	.0011632	.0002119
Tier1_lag2	-.0011256	-.0020654	.0009398	.0001042
Tier1_lag3	-.0001735	-.0007501	.0005766	.0001968
Tier1_lag4	-.0036682	-.00429	.0006217	.0003429
ROE_lag1	.0001286	.0001199	8.69e-06	.0000121
ROE_lag2	.0000833	.000076	7.28e-06	.0000174
ROE_lag3	.0000856	.0000651	.0000205	.0000171
ROE_lag4	.0000984	.0000795	.000019	.0000114
LLP_lag1	.0033363	.0015351	.0018012	.0010273
LLP_lag2	-.0038405	-.006353	.0025125	.0006683
LLP_lag3	-.0054645	-.0056908	.0002263	.000673
LLP_lag4	.0013386	.0017716	-.000433	.001271
GDP_lag1	1.052782	1.018646	.0341356	.1368823
GDP_lag2	.9450152	.8671869	.0778283	.1134266
GDP_lag3	.0308545	-.0547522	.0856067	.0975252
GDP_lag4	.7953999	.7223862	.0730138	.0967043
UNEMPL_lag1	.0078955	.0092114	-.0013159	.0011155
UNEMPL_lag2	.0036536	.0048393	-.0011857	.0009137
UNEMPL_lag3	-.0031788	-.0017748	-.001404	.0008545
UNEMPL_lag4	-.0044642	.0002649	-.0047291	.001129
INFL_lag1	.0008545	.0012792	-.0004247	.0002102
INFL_lag2	-.0078732	-.0077987	-.0000745	.0002176
INFL_lag3	-.0049197	-.0044763	-.0004434	.0002355
INFL_lag4	-.0003658	.0002363	-.0006021	.0002368

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(24) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 108.51
Prob>chi2 = 0.0000

V. Wald test

Main variable: NPL

Joint significance

```
. test (NPL_lag1 NPL_lag2 NPL_lag3 NPL_lag4)

 ( 1)  NPL_lag1 = 0
 ( 2)  NPL_lag2 = 0
 ( 3)  NPL_lag3 = 0
 ( 4)  NPL_lag4 = 0

       F(  4,  1904) =   48.80
            Prob > F =    0.0000
```

Individual significance

```
. test (NPL_lag1)

 ( 1)  NPL_lag1 = 0

       F(  1,  1904) =  186.24
            Prob > F =    0.0000

. test (NPL_lag2)

 ( 1)  NPL_lag2 = 0

       F(  1,  1904) =    3.76
            Prob > F =    0.0527
```

```
. test (NPL_lag3)

 ( 1)  NPL_lag3 = 0

       F(  1,  1904) =    0.01
            Prob > F =    0.9315

. test (NPL_lag4)

 ( 1)  NPL_lag4 = 0

       F(  1,  1904) =    0.89
            Prob > F =    0.3446
```

Conclusion

Globally: H_0 rejected, thus is significant

Individually: NPL_lag1 and NPL_lag2 are significant

Main variable: TIER1

Joint significance

```
. test (Tier1_lag1 Tier1_lag2 Tier1_lag3 Tier1_lag4)

 ( 1)  Tier1_lag1 = 0
 ( 2)  Tier1_lag2 = 0
 ( 3)  Tier1_lag3 = 0
 ( 4)  Tier1_lag4 = 0

       F(  4,  1904) =    1.75
            Prob > F =    0.1360
```

Individual significance

```
. test (Tier1_lag4)

 ( 1)  Tier1_lag4 = 0

       F(  1,  1904) =    4.82
            Prob > F =    0.0282

. test (Tier1_lag1)

 ( 1)  Tier1_lag1 = 0

       F(  1,  1904) =    1.71
            Prob > F =    0.1905
```

```
. test (Tier1_lag2)

 ( 1)  Tier1_lag2 = 0

       F(  1,  1904) =    0.47
            Prob > F =    0.4949

. test (Tier1_lag3)

 ( 1)  Tier1_lag3 = 0

       F(  1,  1904) =    0.01
            Prob > F =    0.9163
```

Conclusion

Globally: H_0 not rejected, thus not significant (or no significance)

Individually: Tier1_lag4 is significant

Main variable: ROE

Joint significance

```
. test (ROE_lag1 ROE_lag2 ROE_lag3 ROE_lag4)

 ( 1)  ROE_lag1 = 0
 ( 2)  ROE_lag2 = 0
 ( 3)  ROE_lag3 = 0
 ( 4)  ROE_lag4 = 0

       F(  4,  1904) =    2.24
            Prob > F =    0.0624
```

Individual significance

```
. test (ROE_lag1)

 ( 1)  ROE_lag1 = 0

       F(  1,  1904) =    6.68
            Prob > F =    0.0099
```

```
. test (ROE_lag2)

 ( 1)  ROE_lag2 = 0

       F(  1,  1904) =    2.13
            Prob > F =    0.1447
```

```
. test (ROE_lag3)

 ( 1)  ROE_lag3 = 0

       F(  1,  1904) =    2.25
            Prob > F =    0.1341
```

```
. test (ROE_lag4)

 ( 1)  ROE_lag4 = 0

       F(  1,  1904) =    3.90
            Prob > F =    0.0483
```

Conclusion

Globally: H_0 rejected, thus is significant

Individually: ROE_lag1 and ROE_lag4 are significant

Main variable: LLP

Joint significance

```
. test (LLP_lag1 LLP_lag2 LLP_lag3 LLP_lag4)

 ( 1)  LLP_lag1 = 0
 ( 2)  LLP_lag2 = 0
 ( 3)  LLP_lag3 = 0
 ( 4)  LLP_lag4 = 0

       F(  4,  1904) =    0.48
            Prob > F =    0.7508
```

Individual significance

```
. test (LLP_lag1)

 ( 1)  LLP_lag1 = 0

       F(  1,  1904) =    0.36
            Prob > F =    0.5484
```

```
. test (LLP_lag2)

 ( 1)  LLP_lag2 = 0

       F(  1,  1904) =    0.46
            Prob > F =    0.4987
```

```
. test (LLP_lag3)

 ( 1)  LLP_lag3 = 0

       F(  1,  1904) =    0.93
            Prob > F =    0.3345
```

```
. test (LLP_lag4)

 ( 1)  LLP_lag4 = 0

       F(  1,  1904) =    0.06
            Prob > F =    0.8104
```

Conclusion

Globally and Individually: H_0 not rejected, thus no significance

Main variable: GDP

Joint significance

```
. test (GDP_lag1 GDP_lag2 GDP_lag3 GDP_lag4)

 ( 1)  GDP_lag1 = 0
 ( 2)  GDP_lag2 = 0
 ( 3)  GDP_lag3 = 0
 ( 4)  GDP_lag4 = 0

       F(  4,  1904) =    3.25
            Prob > F =    0.0115
```

Individual significance

```
. test (GDP_lag1)

 ( 1)  GDP_lag1 = 0

       F(  1,  1904) =    4.85
            Prob > F =    0.0277
```

```
. test (GDP_lag2)

 ( 1)  GDP_lag2 = 0

       F(  1,  1904) =    3.77
            Prob > F =    0.0524
```

```
. test (GDP_lag3)

 ( 1)  GDP_lag3 = 0

       F(  1,  1904) =    0.00
            Prob > F =    0.9487
```

```
. test (GDP_lag4)

 ( 1)  GDP_lag4 = 0

       F(  1,  1904) =    2.81
            Prob > F =    0.0940
```

Conclusion

Globally: H_0 rejected, thus is significant

Individually: GDP_lag1, GDP_lag2 and GDP_lag4 are significant

Main variable: UNEMPL

Joint significance

```
. test (UNEMPL_lag1 UNEMPL_lag2 UNEMPL_lag3 UNEMPL_lag4)

 ( 1)  UNEMPL_lag1 = 0
 ( 2)  UNEMPL_lag2 = 0
 ( 3)  UNEMPL_lag3 = 0
 ( 4)  UNEMPL_lag4 = 0

       F(  4,  1904) =    0.50
            Prob > F =    0.7324
```

Individual significance

```
. test (UNEMPL_lag1)

 ( 1)  UNEMPL_lag1 = 0

       F(  1,  1904) =    1.16
            Prob > F =    0.2813
```

```
. test (UNEMPL_lag2)

 ( 1)  UNEMPL_lag2 = 0

       F(  1,  1904) =    0.23
            Prob > F =    0.6291
```

```
. test (UNEMPL_lag3)

 ( 1)  UNEMPL_lag3 = 0

       F(  1,  1904) =    0.18
            Prob > F =    0.6729
```

```
. test (UNEMPL_lag4)

 ( 1)  UNEMPL_lag4 = 0

       F(  1,  1904) =    0.39
            Prob > F =    0.5341
```

Conclusion

Globally and Individually: H_0 not rejected, thus not significant

Main variable: INFL

Joint significance

```
. test (INFL_lag1 INFL_lag2 INFL_lag3 INFL_lag3 INFL_lag4)

 ( 1)  INFL_lag1 = 0
 ( 2)  INFL_lag2 = 0
 ( 3)  INFL_lag3 = 0
 ( 4)  INFL_lag3 = 0
 ( 5)  INFL_lag4 = 0
       Constraint 4 dropped

       F(  4,  1904) =   20.10
            Prob > F =    0.0000
```

Individual significance

```
. test (INFL_lag1)

 ( 1)  INFL_lag1 = 0

       F(  1,  1904) =    0.76
            Prob > F =    0.3838
```

```
. test (INFL_lag2)

 ( 1)  INFL_lag2 = 0

       F(  1,  1904) =   62.54
            Prob > F =    0.0000
```

```
. test (INFL_lag3)

 ( 1)  INFL_lag3 = 0

       F(  1,  1904) =   23.11
            Prob > F =    0.0000
```

```
. test (INFL_lag4)

 ( 1)  INFL_lag4 = 0

       F(  1,  1904) =    0.13
            Prob > F =    0.7214
```

Conclusion

Globally: H_0 rejected, thus is significant

Individually: INFL_lag1 and INFL_lag2 are significant

VI. Multicollinearity

Global model

Variable	VIF	1/VIF
LLP_lag2	3.44	0.290529
NPL_lag2	3.42	0.292000
LLP_lag3	3.42	0.292122
NPL_lag3	3.38	0.296204
NPL_lag1	3.31	0.301776
LLP_lag1	3.23	0.309313
LLP_lag4	3.20	0.312820
NPL_lag4	3.18	0.314958
UNEMPL_lag2	2.49	0.401659
UNEMPL_lag3	2.47	0.404553
UNEMPL_lag1	2.32	0.431797
GDP_lag2	2.26	0.442798
GDP_lag3	2.23	0.449079
UNEMPL_lag4	2.22	0.450297
GDP_lag4	2.19	0.457601
GDP_lag1	2.11	0.473524
ROE_lag3	1.72	0.582394
ROE_lag2	1.71	0.584941
ROE_lag4	1.36	0.735113
ROE_lag1	1.35	0.742459
INFL_lag4	1.14	0.875221
INFL_lag3	1.14	0.879069
INFL_lag2	1.08	0.923833
Tier1_lag1	1.06	0.939187
Tier1_lag2	1.06	0.939523
Tier1_lag3	1.06	0.946872
INFL_lag1	1.05	0.949647
Tier1_lag4	1.05	0.952238
Mean VIF	2.13	

Restricted model

Variable	VIF	1/VIF
GDP_lag2	1.75	0.570336
GDP_lag1	1.58	0.632324
GDP_lag4	1.52	0.656115
NPL_lag1	1.13	0.884845
NPL_lag2	1.10	0.908196
INFL_lag3	1.10	0.909780
INFL_lag2	1.05	0.950259
ROE_lag4	1.03	0.974186
ROE_lag1	1.02	0.976437
Tier1_lag4	1.01	0.993480
Mean VIF	1.23	

Considering:

VIF = 1 Non-correlated

1 < VIF < 5 Moderately correlated

VIF > 5 a 10 Highly correlated

VII. Homocedasticity

Global model

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of GL

         chi2(1)      = 43648.55
         Prob > chi2  =   0.0000
```

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(434)    =   1328.23
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	1328.23	434	0.0000
Skewness	346.30	28	0.0000
Kurtosis	2.21	1	0.1374
Total	1676.73	463	0.0000

Restricted model

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of GL

         chi2(1)      = 46434.35
         Prob > chi2  =   0.0000
```

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(65)     =   1076.00
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	1076.00	65	0.0000
Skewness	359.66	10	0.0000
Kurtosis	2.20	1	0.1376
Total	1437.87	76	0.0000

VIII. Comparison of regression results

	GLOBAL MODEL					RESTRICTED MODEL				
Variables	OLS	FE	FE'	FE clustered robust	FE Driscoll-Kraay	OLS	FE	FE'	FE clustered robust	FE Driscoll-Kraay
NPL_lag1	0.032***	0.035***	0.035***	0.035***	0.035***	0.030***	0.036***	0.036***	0.036***	0.036**
NPL_lag2	0.001	0.005**	0.005	0.005	0.005	-0.001	0.004**	0.004	0.004	0.004
NPL_lag3	-0.004*	-0.000	-0.000	-0.000	-0.000					
NPL_lag4	-0.005**	-0.002	-0.002	-0.002	-0.002					
Tier1_lag1	0.001	0.002	0.002	0.002	0.002					
Tier1_lag2	-0.002	-0.001	-0.001	-0.001	-0.001					
Tier1_lag3	-0.000	-0.000	-0.000	-0.000	-0.000					
Tier1_lag4	-0.004***	-0.004**	-0.004	-0.004	-0.004	-0.004**	-0.004**	-0.004	-0.004	-0.004*
ROE_lag1	0.000**	0.000***	0.000*	0.000*	0.000**	0.000*	0.000**	0.000*	0.000*	0.000**
ROE_lag2	0.000	0.000	0.000	0.000	0.000					
ROE_lag3	0.000	0.000	0.000	0.000	0.000					
ROE_lag4	0.000	0.000**	0.000	0.000	0.000***	0.000*	0.000	0.000**	0.000**	0.000***
LLP_lag1	0.002	0.003	0.003	0.003	0.003					
LLP_lag2	-0.006	-0.004	-0.004	-0.004	-0.004					
LLP_lag3	-0.006	-0.005	-0.005	-0.005	-0.005					
LLP_lag4	0.002	0.001	0.001	0.001	0.001					
GDP_lag1	1.019**	1.053**	1.053**	1.053**	1.053**	0.718*	0.882**	0.882**	0.882**	0.882**
GDP_lag2	0.867*	0.945*	0.945*	0.945*	0.945**	0.681	0.856**	0.856	0.856	0.856
GDP_lag3	-0.055	0.031	0.031	0.031	0.031					
GDP_lag4	0.722	0.795*	0.795	0.795	0.795	0.988**	1.038***	1.038**	1.038**	1.038**
UNEMPL_lag1	0.009	0.008	0.008	0.008	0.008*					
UNEMPL_lag2	0.005	0.004	0.004	0.004	0.004					
UNEMPL_lag3	-0.002	-0.003	-0.003	-0.003	-0.003					
UNEMPL_lag4	0.000	-0.004	-0.004	-0.004	-0.004					
INFL_lag1	0.001	0.001	0.001	0.001	0.001					
INFL_lag2	-0.008***	-0.008***	-0.008	-0.008	-0.008***	-0.008***	-0.008***	-0.008	-0.008	-0.008***
INFL_lag3	-0.004***	-0.005***	-0.005	-0.005	-0.005*	-0.004***	-0.005***	-0.005	-0.005	-0.005*
INFL_lag4	0.000	-0.000	-0.000	-0.000	-0.000					
_cons	0.001	-0.003	-0.003	-0.003	-0.003	-0.000	-0.003	-0.003	-0.003	-0.003
R-Squared	0.2351	0.2624	0.2624	0.2624	0.2624	0.2200	0.2575	0.2176	0.2575	0.2575
Adj R-squared	0.2245	0.2255	0.2255	0.2255		0.2162	0.2148	0.1828	0.2148	
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0351	0.000	0.000

Asteriscs represent the significance of the coefficients *** 1% **5% *10%
Robust standard errors were used at FE', FE clustered robust and FE Driscoll-Kraay

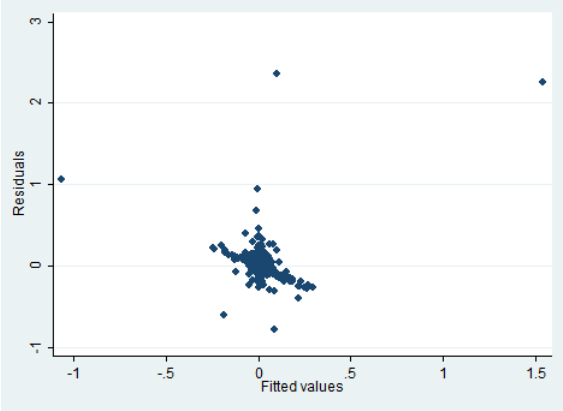
	RESTRICT MODEL					CENTRAL EASTERN EUROPE					PERIPHERAL				
Variable	OLS	FE	FE robust	FE clustered robust	FE Driscoll-Kraay	OLS	FE	FE robust	FE clustered robust	FE Driscoll-Kraay	OLS	FE	FE robust	FE clustered robust	FE Driscoll-Kraay
NPL_lag1	0.030***	0.036***	0.036***	.036***	0.036**	0.007*	0.007*	0.007	0.007	0.007*	0.041***	0.046***	0.046***	0.046***	0.046***
NPL_lag2	-0.001	0.004**	0.004	.004	0.004	-0.005	-0.005	-0.005	-0.005	-0.005	0.010***	0.015***	0.015	0.015	0.015
Tier1_lag4	-0.004**	-0.004**	-0.004	-.004	-0.004*	-0.006***	-0.005**	-0.005	-0.005	-0.005	-0.000	-0.001	-0.000	-0.000	-0.000
ROE_lag1	0.000*	0.000**	0.000*	.000*	0.000**	0.000	0.000	0.000	0.000	0.000***	0.000	0.000	0.000	0.000	0.000
ROE_lag4	0.000*	0.000	0.000**	.000**	0.000***	0.000	0.000	0.000**	0.000**	0.000	0.000	0.000	0.000	0.000	0.000
GDP_lag1	0.718*	0.882**	0.882**	.882**	0.882**	0.180	0.124	0.124	0.124	0.124	1.812***	1.815***	1.815***	1.815***	1.815**
GDP_lag2	0.681	0.856**	0.856	.856	0.856	0.460	0.389	0.389	0.389	0.389	1.089	1.017	1.017*	1.017*	1.017**
GDP_lag4	0.988**	1.038***	1.038**	1.038**	1.038**	0.732	0.708	0.708	0.708	0.708	1.787***	1.989***	1.989*	1.989*	1.989*
INFL_lag2	-0.008***	-0.008***	-0.008	-.008	-0.008***	0.000	-0.000	-0.000	-0.000	-0.000	-0.001	-0.005	-0.005	-0.005	-0.005
INFL_lag3	-0.004***	-0.005***	-0.005	-.005	-0.005*	0.001	0.000	0.000	0.000	0.000	-0.001	-0.005	-0.004	-0.004	-0.004
_cons	-0.000	-0.003	-0.003	-.003	-0.003	0.002	0.003	0.003	0.003	0.003	-0.010	-0.011	-0.011*	-0.011*	-0.011
R-Squared	0.2200	0.2575	0.2176	0.2575	0.2575	0.0175	0.0139	0.0139	0.0139	0.0139	0.3537	0.4123	0.4123	0.4123	0.4123
Adj R-squared	0.2162	0.2148	0.1828	0.2148		0.0078	0.0164	0.0164	0.0164		0.3472	0.3501	0.3501	0.3501	
Prob>F	0.000	0.000	0.0351	0.000	0.000	0.0553	0.1973	0.0215	0.0215	0.0014	0.000	0.000	0.000	0.000	0.0063

Asteriscs represent the significance of the coefficients *** 1% **5% *10%

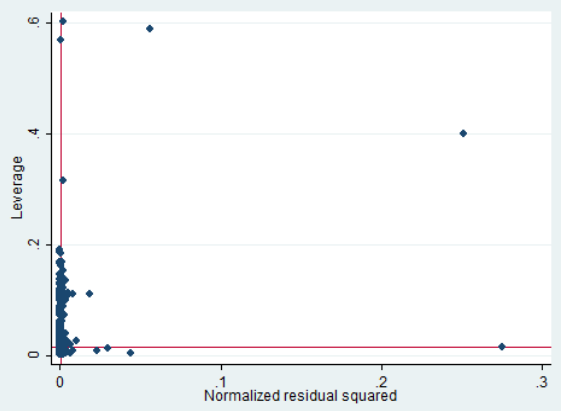
IX. Plots

Global model

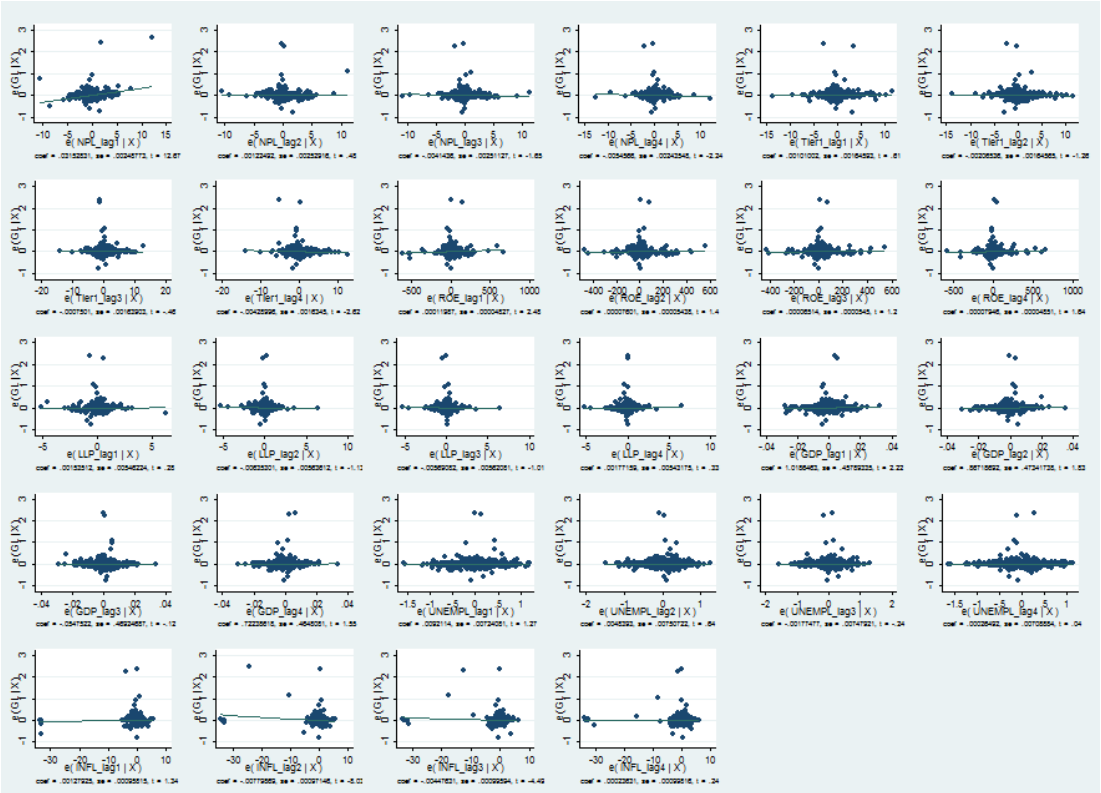
Residual-versus-fitted plot



Leverage-versus-residual-squared plot

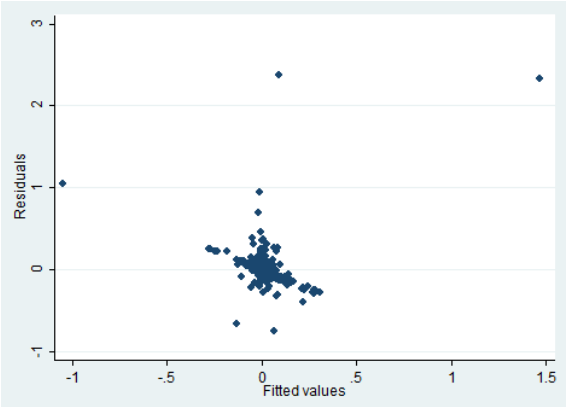


Added-variable plots

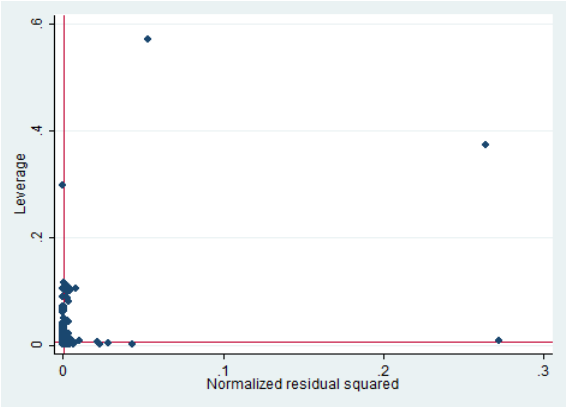


Restricted model

Residual-versus-fitted plot



Leverage-versus-residual-squared plot



Added-variable plots