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Determinants of NPLS Revisited: The Aftermath of Two Crises and the Case of Greece*

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Abstract

Building on previous research contributions on the macroeconomic determinants of NPLs, this paper aims at assessing the cumulative impact of the two recent crises which, although based on different fundamentals, both resulted in a turbulent macroeconomic environment: first, the global financial crisis originating from the US financial system in 2007 (which soon became an economic crisis culminating in a debt crisis for some countries) and then the most recent outbreak of the COVID-19 pandemic—a health crisis, albeit with very significant economic repercussions (some of which are not yet apparent, while the impact of others cannot yet be fully extrapolated). In this research endeavor we use an extended set of OECD countries for a time span of 16 years including the most recent data available (2020). Apart from evaluating the explanatory power of new variables and variables only recently introduced (and used so far only to a limited extent, such as housing prices), this model provides useful insights also on the possible directions of economic policy interventions to alleviate the impact of the most recent crisis, which is still unfolding. Using our preferred specification, we then proceed to study the case of Greece, which was the country probably hardest hit by the financial crisis, with NPLs approaching 50% of total loans. While still recovering from the previous crisis, Greece has to deal with the repercussions of the pandemic; as a result, interesting conclusions can be drawn from this specific case study.

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1. Introduction: Motivation of the Research

The problem of non-performing loans[1] (NPLs) has been the focus of many research endeavors in the recent past but all the more so during (and after) the global financial crisis originating from the sector of subordinated loans in the US financial market (in 2007 or even earlier, see (Anil et al., 2020), for an excellent survey). At the same time, interest was rekindled for regulatory reforms concerning the capital adequacy ratios of financial institutions, resulting in further adjustments and qualifications regarding the Basel Committee provisions. This should not come as a surprise at a time of a global recession feeding back to the fundamentals of financial institutions which, in turn, necessitated further massive borrowing from the part of states.[2]

Apart from taking into account potential regulatory failures, it has become now more than apparent (if not crystal clear) that the macroeconomic environment is closely interwoven with developments in NPLs.[3] In particular, the inability to service loans can easily be translated to falling economic activity or even failing firms and increased unemployment feeding back to NPLs.

At a time when the financial crisis seemed to have been resolved at the global level (albeit not for every single country and leaving many "loose ties" at the regulatory level), the COVID-19 pandemic started unfolding, causing concerns (initially) about macroeconomic stability in many advanced economies. As the pandemic continues with an indefinite resolution date, these concerns have culminated in serious risks and uncertainties about the macroeconomic environment, with slowing economic activity (and recession in most cases), rising unemployment and rapidly increasing indebtedness, resulting in governments more often than not adopting a countercyclical economic policy stance (see, for example, (IMF, 2022) and (OECD, 2022)).

This seems to be a perfect time for academic researchers to revisit the relationship between the macroeconomic environment and NPLs with the latter re-emerging as a potential by-product of the pandemic.[4] Using a very extensive

[1]This is the term used by our World Bank data source, though "non-performing exposures" is also widely used, e.g., by EU countries.

[2]It is also not a surprise that the term "macroprudential supervision" was introduced at the same time, both in the academic discussion and the debates of policymakers and regulators alike.

[3]Also, measures such as foreclosures and auctions taken to deal with NPLs influence macroeconomic and fiscal variables that may adversely impact on social cohesion (see (Sfakianakis et al., 2020)).

[4]For most countries and not only countries such as Greece (see below, Section 4.2), for which the problem has been "lurking in the shadows" all along since the previous crisis.

sample of countries (all OECD countries and EU countries not yet members of the OECD, along with EU and OECD aggregates) and a time span reaching 2020,[5] we use previous insights of the literature[6] to evaluate the combined effect of the two almost consecutive crises.

Moreover, and taking into account that NPLs were still a standing problem for some countries even before the pandemic, we chose to focus on Greece as a case-study in order to determine whether individual countries with specific characteristics are differentiated from "the average" as far as empirical estimates are concerned.

The sample of countries, the use of specific variables and the inclusion of the first critical years of the pandemic (thus allowing for *prima facie* policy recommendations) are the main contributions of the paper at hand, to be complemented by statistical tests for the existence of possible structural breaks in the panel estimates of NPLs determinants from a macroeconomic perspective. To the best of our knowledge and belief, this is quite novel in the relevant literature with recent data.

The paper is structured as follows: Section 1 consists of a selective literature review, while Section 2 includes descriptions of the data and potential regressors and a discussion of their potential impact. Section 3 provides an explanation of the methodology, and Section 4 presents the empirical results. Conclusions and relevant policy implications are presented in the last Section of the paper.

2. Selective Literature Review

While non-performing loans had been a topic of increasing interest to researchers, policy-makers and regulators even before the onset of the last financial/economic crisis, that interest peaked during the crisis and the succeeding recovery period. Moreover, while the problem of NPLs was still a significant risk for the financial system of many countries, the COVID-19 pandemic again brought the issue to the foreground of academic and economic policy discussions because of increasing macroeconomic instability at the global level.

Literature on the determinants of NPLs can be classified into three main types. Some researchers focus on macroeconomic (often called "systemic") factors, while others opt to elaborate on microeconomic (often termed "idiosyncratic") factors related to banking systems or individual institutions. A third category is literature contributions which attempt to derive unified models combining both macroeconomic and microeconomic factors.

Earlier literature on macroeconomic factors includes King & Plosser (1984), Kiyotaki & Moore (1997) and Bernanke et al. (1998). This was indicatively followed by Jimenez & Saurina (2005), Pesaran et al. (2006) and Klein (2013), while

[5]This is the last year for which data are currently available. Admittedly, as fresh data become available, new and interesting insights may emerge. This is all the more so as geopolitical tensions surrounding Ukraine cause additional risks and uncertainties; however, policy action would probably be needed sooner than later.

[6]Mostly Sfakianakis et al. (2020).

Lawrence (1995) and Rinaldi & Sanchis-Arellano (2006) investigated implications of the life-cycle hypothesis. Espinoza & Prasad (2010) and Klein (2013) considered exchange rate to be a potential determinant; and around the same time, Louzis et al. (2012), Beck et al. (2013), Klein (2013) and Nkusu (2011) examined the cost of credit and inflation. Beck et al. (2013) added share prices; and in an influential paper, Reinhart & Rogoff (2011) related banking crises to sovereign debt crises and individual fiscal factors.

The microeconomic literature starts with Keeton and Morris (1987), Berg et al. (1992), Hughes & Mester (1993), Rajan (1994) and Berger & De Young (1997). These were followed by Stern & Feldman (2004), Salas & Saurina (2002), Čihák (2007) and Jakubík & Sutton (2011).

Significant contributions to the literature combining macroeconomic and microeconomic factors include (again only indicatively) De Lis et al. (2000), Louzis et al. (2012), Fofack (2005), Espinoza & Prasad (2010), Boudriga et al. (2009) and Anastasiou et al. (2016).

Excellent surveys on NPL determinants include those conducted by Manz (2019) and Nikolopoulos & Tsalas (2017).

The empirical literature features important papers by Castro (2013), Louzis et al. (2012), Baltagi (2001) and Quagliariello (2007), as well as papers centering on specific countries or country groups (e.g., Rinaldi & Sanchis-Arellano (2006) on the Eurozone and Glen & Mondragón-Vélez (2011) with a 22-country sample and Çifter (2014) for 10 Central and East European countries). Sfakianakis et al. (2020) is a recent contribution to the empirical literature with an extensive panel of 41 countries also featuring the inclusion of variables (such as housing prices) which allow for interesting interpretations about the decision-making process of borrowers, while Giannopoulos (2018) is also referring to Greece.

3. Data and the Variables

Based on the rationale explained in the Introduction, this paper focuses on assessing the effect of the macroeconomic environment on NPLs. This approach benefits from data availability and comparability for large samples of countries, whereas microeconomic data, if available, are scarce for large samples of countries and extensive time periods, while comparability is a standing issue.

Our panel includes all OECD countries, along with EU members Bulgaria, Cyprus, Malta and Romania which are not yet OECD members. It also includes aggregates such as the Euroarea, EU and OECD totals for which reliable data were readily available. The cross-section panel dimension totals 51 units.

The time span of the empirical estimates is the 2005-2020 period, thus allowing us two important pieces of analysis as per our time sample:

1) We have included enough years related to the financial crisis, both for the period preceding the crisis as well as the period after its resolution (resolution referring at least to the majority of countries and certainly at the global level).

2) The initial years of the COVID-19 pandemic are also included, enough at

least to have preliminary[7] evidence as to its repercussions on the macroeconomic environment and, thus, NPLs.

Based on previous research findings, we chose the following variables to try as potential determinants of NPLs:

- Real GDP (negative correlation with NPLs expected).
- Real GDP growth (negative correlation with NPLs expected).
- The unemployment rate (rising unemployment associated with higher NPLs expected).
- Total burden of tax and social security obligations (see below for expected impact). In the literature, most often only the tax burden is used, so the use of this variable is a contribution of this paper.
- Inflation (which may increase willingness for loan repayment since inflation decreases the value of loan installments in real terms).
- Housing prices as a proxy for the value of loan collateral. The literature contains two views on the effect of these prices on NPLs: one featuring that increases in house prices raise collateral value, thus reducing NPLs; the other based on the argument that increasing housing prices give rise to issues of moral hazard and adverse selection, eventually increasing NPLs and adding to the bulk of risky assets in the financial statements of banks ((Chen & Ku Fan, 2019) provide a comprehensive analysis).
- Lending interest rates (negative correlation with NPLs expected, mainly due to increased amortization payments for variable-rate loans).
- Market capitalization of listed domestic companies as a ratio to GDP (negative correlation with NPLs expected since this variable is a proxy for the financial development of a country).
- Domestic credit to private sector as a ratio to GDP (an alternative proxy for the financial development of a country and thus expected to behave as market capitalization).
- Public debt as a percent of GDP (see below for discussion of expected impact).
- Public sector net lending (+)/net borrowing (−) as a percent of GDP (see below for discussion of expected impact).
- The real effective exchange rate can be used to capture how a change in a local currency's exchange rate could affect the dynamics of NPLs.[8]

Some of the variables are to be used interchangeably rather than simultaneously. For instance, as mentioned above, in the literature the variables of market capitalization of listed domestic companies and domestic credit to the private sector are both used as potential proxies for a country's level of financial development. To a certain degree, this could be the case for GDP/GDP growth rate and the unemployment rate, which both the economic activity trend and fluctuation (with unemployment additionally capturing individual borrower cha-

[7]Whether it is also sufficient, remains to be found out.

[8]This variable was tested in our specifications and was found to be statistically insignificant, at least in those we chose to present.

racteristics). Also, public sector debt (as well as its annual change) and borrowing requirements can be expected to reflect the extent of a potential fiscal stimulus. The effect of a fiscal stimulus on NPLs is unclear: it could alleviate pressure on NPLs by resulting in higher incomes; or it could contribute to crowding out the private sector by increasing pressure on the money market and leading to higher lending rates. The impact of the tax burden[9] is also unclear as lowering it could serve as a fiscal stimulus but could also bring about higher public sector borrowing requirements and interest rate pressure. For these two fiscal stimulae, a potential Ricardian equivalence effect could feed back to decisions of economic agents by way of expectations, as perceptions of a discretionary expansion could give rise to expectations of higher future public debt payments, and thus higher taxes and/or interest rates.

For comparability, the source for all variables except housing prices is the World Bank database. Housing prices were extracted from the OECD database.

4. Methodology

The empirical analysis consists of three interconnected parts. We first identify the determinants of NPLs and the valence of their impact, particularly for variables ambiguously characterized in the relevant literature. Section 4.1 presents model specifications chosen with statistical/econometric criteria to explain NPL variability. We note that before concluding, we tried various alternatives in the combination of variables and econometric methods.

Regarding methods, the equations were eventually estimated using panel EGLS[10] with country weights, cross-section fixed effects and diagonal correction of standard errors for heteroscedasticity and autocorrelation using the methodology of White. While we tried specifications without fixed effects and including random effects, their performance was inferior based on statistical/econometric criteria. Also, except for permitting a different residual variance for each cross section, which is captured by country weights, there is no indication of the data structure being characterized by period-specific heteroskedasticity, contemporaneous covariances and between-period covariances (given the relatively small time dimension).

Based on one of our chosen specifications on the determinants (the one including housing prices) we then proceed to work on our case study, estimating whether each single determinant had a differentiated influence in the case of Greece.

Last but not least, we use the Hansen (1999) methodology/test in order to detect possible structural breaks in the panel estimates of NPLs determinants.

5. Empirical Results

Section 4.1 presents results of the panel data estimations, while section 4.2 re-

[9]Which is part of the variable we are using in this paper, also including social security contributions.
[10]See Baltagi (2005) for a relevant analysis.

ports results for the case study on Greece, and section 4.3 provides results of tests for structural breaks of the dependent variable.

5.1. Panel Estimation Results

Here we present our two preferred specifications, their main difference being the inclusion or not of housing prices (as well as in some cases choosing different variables from the "pairs" referred to in Section 3). As mentioned previously, housing price is one of the most recent additions to the list of determinants, but data are not available for all sampled countries or years, in either case restricting the total number of available observations. However, we present one specification including housing prices as we consider it important to provide relevant empirical evidence to contribute to the debate about the impact of this variable—namely, whether the "collateral effect" prevails over the "moral hazard effect" or the other way round.

Table 1 presents results for the specification with housing prices. The overall fit of the model is very good, with the combination of independent variables explaining a significant portion of the dependent variable's variance (as indicated by the corrected R^2 and the F-statistic tests on its significance). All but one of the estimators are significant at conventional significance levels (specifically, the 1% level[11]). As for the impact of each one, rising unemployment (resulting to inability to conform to obligations), lending rates (increasing the cost of servicing loans) and the burden of rising tax and social security contributions (resulting to decreasing disposable income) seem to contribute to higher NPLs. Economic growth reduces NPLs (by increasing, on average, disposable income and, thus the ability to service loans) and inflation favors borrowers as previously explained. As for the fiscal stimulus, the proxy we opted for—Borrowing Requirements of the Public Sector *vs.* the change in central government debt—indicates that the intervention of the public sector tends to reduce NPLs. We should also note that the development of the financial system tends to lower NPLs as a ratio to total lending (using the proxy "market capitalization as % of GDP"). There are two explanations for this: banks would tend to exercise greater due diligence on granting loans and/or the possibility of avoiding moral hazard issues would be enhanced. For example, an increased ease of tracking down borrowers who are able but not willing to repay their loans may be the case.

Finally, regarding the direction of the Housing Prices variable, the "collateral effect" seems to be dominating over the "moral hazard effect."[12]

[11]The Public Sector Borrowing Requirements variable is marginally significant (i.e., not at the 1% significance level) probably, and among other reasons, because it is highly correlated with the tax and social security contributions variable. However, apart from the corrected R^2 criterion, more specific tests (such as the omitted variable likelihood ratio test) drove us to keep the variable in the specification.

[12]This result is different from the one in Sfakianakis et al. (2020) with a similar (but not identical) specification. However, we should take into account that some variables (such as the Tax and Social Security Contributions Burden) are defined in a different way, while many more countries are included in the sample along with additional years.

Table 1. Panel data estimation on the determinants of NPLs.

Variable	Coefficient	t-Statistic
Constant	3.570671	3.919182
Unemployment	0.418294	8.057874
Rates	0.048596	2.247687
Inflation	−0.143790	−3.385360
Market Capitalisation	−0.008301	−3.853127
Housing Prices	−0.011499	−2.456830
Growth Rate of Real GDP	−3.851483	−1.994806
Borrowing Requirements of Public Sector	−0.008418	−1.930236
Tax and Social Security Contributions Burden	0.003130	2.769028
R-squared	0.854492	
Adjusted R-squared	0.831473	
S.E. of regression	1.507779	
F-statistic	37.12231	
Prob(F-statistic)	0.000000	

Table 2 presents results for the specification excluding housing prices. Apart from housing prices, the level of GDP (in logs) performs better than the growth rate of real GDP. Again, the model's overall fit is very good, with all but one estimator being statistically significant at levels less than 5%. Again, the marginal statistical significance of the fiscal stimulus (proxy: Borrowing Requirements of the Public Sector) could be explained by the correlation with the Tax and Social Security Contributions variable. We should note, however, that although marginally significant, the sign of the estimator points to the direction of a "crowding out" effect (possibly by way of lending rates, which are included, but also through expectations and a possible "Ricardian equivalence" effect—see Section 2). The impact of unemployment, lending rates, tax burden and level of financial intermediation (financial development) are as indicated in the previous specification.

5.2. Results for Greece as a Case Study

In this section, based on the first of our preferred specifications (comprising all accepted variables, i.e., including housing prices), we attempt to determine whether Greece, the country hardest hit by the international financial crisis, can be described by estimated regressors which are statistically different from those estimated for the sample of countries as a whole. We deemed Greece as an interesting case study because in this country, the financial/economic crisis culminated in a debt crisis with Greece resorting to ad-hoc external financing mechanisms. Despite the fact that the fundamentals of the financial system in

Table 2. Panel data estimation on the determinants of NPLs (*cont.*).

Variable	Coefficient	t-Statistic
Constant	0.349229	0.457086
Unemployment	0.612782	8.983096
Rates	0.074018	2.114424
Tax and Social Security Contributions Burden	0.000958	1.964386
Inflation	−0.145567	−3.408652
Market Capitalisation	−0.012466	−4.430061
Real GDP (in logs)	−2.33E-16	−2.999984
Borrowing Requirements of the Public Sector	0.004622	1.842577
R-squared	0.868366	
Adjusted R-squared	0.849196	
S.E. of regression	1.702460	
F-statistic	45.29831	
Prob (F-statistic)	0.000000	

Greece did not at first point in the direction of failing institutions[13], the deep and lasting recession as a result of the "internal devaluation" policy mix that was implemented deeply affected the stability of the financial system; even more so when the impact of the PSI Programme became apparent and massive capital injections were required for all systemic banks. NPLs as a ratio to total debts soared (approaching 50%), and even now specific schemes are being implemented in order to tackle the problem. Still, in our view, Greece stands out as an example where, regarding NPLs, macroeconomic factors are at play while microeconomic ones (pertaining to the characteristics of individual financial institutions) are more or less in the background.

In order to perform our analysis, we constructed dummy variables for all independent variables "representing" the incremental effect of the relevant estimators in the case of Greece.

Table 3 presents results only for the dummy estimators for each determinant.

As we can see, with the exception of the growth rate of real GDP and inflation, the estimates for the dummy variables for Greece show that, indeed, Greece differs from the "average" of the panel as a whole. This result is also verified by an overall LR test on the inclusion of the entire set of dummies, showing that all should be included in the regression (Table 4).

5.3. Results from Testing for the Existence of Breaks in the Dependent Variable

In this section, we attempt to determine whether structural breaks in the panel

[13]For example, exposure to what was later termed as "toxic" products was minimal.

estimates of NPLs determinants exist using threshold regression methods developed by Hansen (1999) for non-dynamic panels with individual-specific fixed effects. Least squares estimation of the threshold and regression slopes was proposed using fixed-effects transformations, and a non-standard asymptotic theory of inference was developed allowing construction of confidence intervals and testing of hypotheses (such as the existence of breaks). Both tests[14] for the existence of one threshold (*vs.* the alternative of no threshold) and the existence of two thresholds (*vs.* the alternative of one threshold) reject the hypothesis of the existence of either one or two thresholds.

Test for 1 threshold

Sum of Squared Residuals 1.529024e+32

F Test vs 0 Threshold 7.785677e-01

Test for 2 thresholds

Sum of Squared Residuals 1.517511e+32

F Test vs 1 Threshold 1.585702e+00

6. Conclusions and Policy Implications

In this paper, using a panel of OECD countries (complemented by EU member states not yet members of the OECD, as well as aggregates for the OECD and the EU) for a span of 16 years (2005-2020), we attempted to revisit the macroeconomic determinants of NPLs. The main focus of the paper is the turbulent macroeconomic environment, both at the level of individual countries and at the global level, resulting from the two international crises characterizing this specific period: first, the financial crisis originating from the financial system in the USA (then spreading at the global level), to be followed by the COVID-19 pandemic which is still unfolding.

Table 3. A case study for Greece.

Variable	Coefficient	t-Statistic
C	4.334863	3.130131
Unemployment	−0.447280	−2.055951
Tax and Social Security Contributions Burden	0.095623	3.425131
Inflation	1.184664	1.140584
Market Capitalisation	0.298674	2.344442
Housing Prices	−0.460831	−3.481598
Borrowing Requirements of the Public Sector	−0.581190	−2.743898
Growth Rate of Real GDP	64.56247	1.061802

[14]As the required threshold variable, unemployment was used following Sfakianakis et al. (2020) who, using a similar specification and additionally dominance analysis, determined this variable as the most "influential" one regarding NPLs. Other variables were also tested as threshold variables with identical results (and are available upon request).

Table 4. Results of the LR test on the inclusion of the dummies for Greece.

	Value	df	Probability
F-statistic	40.61082	(7, 350)	0.0000
Likelihood ratio	217.0110	7	0.0000

Our results show that during this period the main determinants identified in previous contributions are still well at play; i.e., unemployment, economic activity measures, the degree of financial intermediation, lending rates, the burden of tax and social security contributions, the fiscal stimulus and housing prices.

We then proceeded to examine Greece as a case study regarding NPLs in the sense that, due to its specific characteristics which resulted in the country being an "outlier" during the financial crisis,[15] it could be the case that the determinants of NPLs could operate in different ways (and varying "strengths") for Greece. Our results verified that, indeed, Greece seems to differ from the "average" of the panel estimates. Finally, we used the test proposed by Hansen (1999) for panel data in order to identify whether a break or breaks exist in the panel NPLs series only to conclude that no such break exists.

One of the contributions of the paper at hand could be that, as the COVID-19 crisis has not yet been resolved, potential insights for policymaking purposes/economic policy recommendations could be derived from the analysis herein: unemployment should be a priority but mainly through structural reforms (resulting in a more efficient functioning of the labour market) and not necessarily through fiscal stimulae which may have ambiguous effects as our results show.[16] Also, a more efficient functioning of the money and capital markets (via enhanced financial intermediation due to institutional, regulatory and legislative interventions) could work through two supplementary channels: on one hand through promoting better screening of borrowers and/or alleviating moral hazard phenomena and, on the other, through lower interest rates resulting from enhanced competition among banking institutions.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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[15]See section 4.2.

[16]Although dealing with Structural Unemployment is more a medium to long-run goal, the benefits from the structural policies outlined above are far more guaranteed compared to the (possibly transitory) effects of countercyclical/expansionary policies in the short run.

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