



Macroeconomic and bank-specific determinants of NPLs in Greece

*A comparative study of mortgage, business and consumer loan
portfolios*

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Presentation outline

1. Studying NPLs
2. Data set
3. Macroeconomic (systematic) determinants
4. Sovereign debt and NPLs
5. Bank-specific determinants of NPLs
6. Conclusions



Introduction (1)

Studying the determinants of non-performing loans (NPLs).

- Measure of ex-post credit risk.

- The main risk in traditional banking (lending funds).
- Benchmark for the onset of a banking crisis (Reinhart & Rogoff, 2010)
- Literature on NPLs determinants:
 - Macroeconomic: business cycles, disposable income, unemployment, monetary conditions, lending rates.
 - Bank-specific: efficiency, capital adequacy, size.



Introduction (2)

Contribution to the NPLs literature.

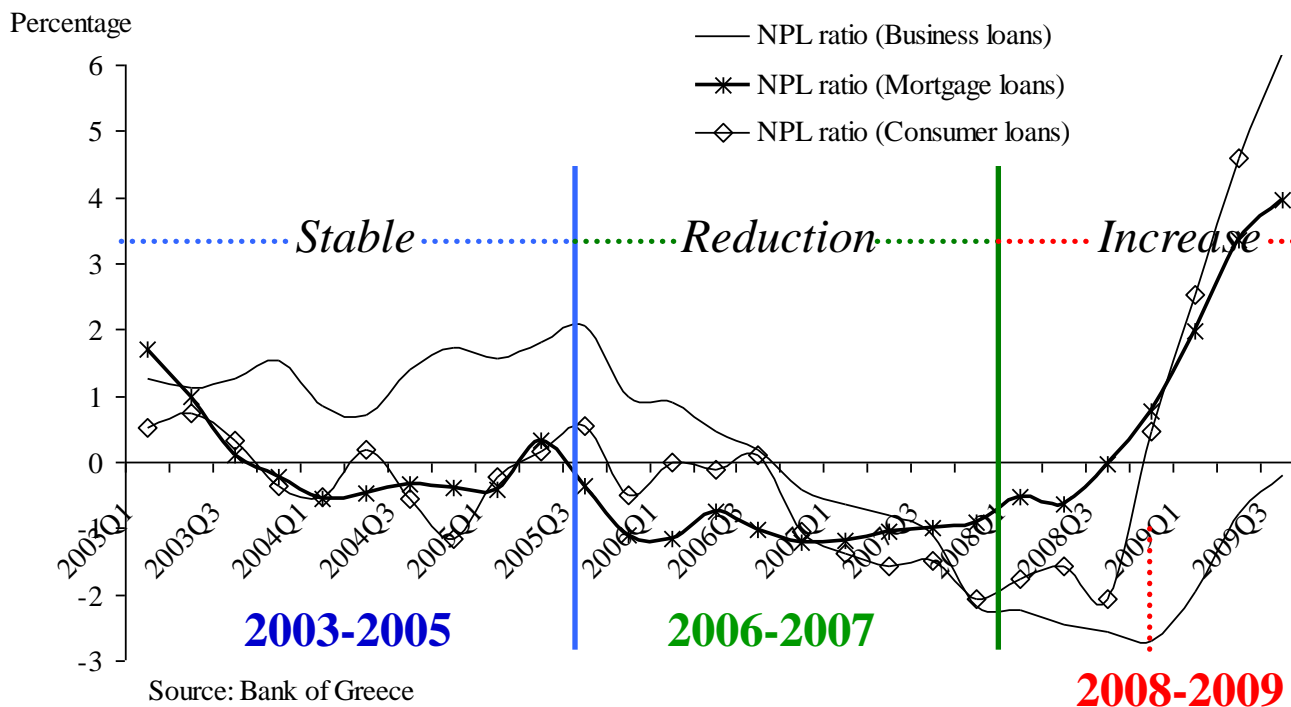
1. Different loan categories: business, mortgages and consumer.
 - Institutional settings → different incentives for each category.
 - Business cycles affect differently agents' cash flows and collaterals.
2. Greek banking system.
 - Fragile public finance → NPLs deterioration; Effect of public debt on NPLs.
3. Both macroeconomic and bank-specific determinants.
 - Various existing and new hypothesis tested.

Data set (1)

- Variable of interest:

$$NPL\ ratio\ (\%) = 100 \times [non-performing\ loans\ (+90\ days) / loans].$$

- Panel data: 9 commercial banks, 2003Q1 – 2009Q3.





Macroeconomic determinants (1)

- Macroeconomic environment and loan quality:

“the state of the economy...most important factor ...debt portfolio loss rates” (Carey, 1998).

- **GDP growth (-)**

- Expansion phase → sufficient income (consumers) and revenues (firms), but also, credit to lower quality debtors (collateral value).

- **Unemployment rate (+)**

- Households: negatively influences cash flows streams.

- Firms: increases in unemployment → reduction in production (due to drop in effective demand) → decrease in revenues → fragile debt condition.



- **Lending rates (+)**
 - Affect the difficulty in servicing debt.

- **Life cycle consumption models**
 - Low income borrowers → higher rates of default due to increased risk of unemployment.
 - Riskier borrowers → higher lending rates (in equilibrium).
 - Probability of default depends on current income, unemployment (uncertainty for future income) and lending rates (Lawrence, 1995; Rinaldi & Sanchis-Arellano, 2006).

Macroeconomic determinants (3)

- **Baseline model (primary macro determinants)**

Dynamic panel data model

$$\Delta NPL_{it}^h = a \Delta NPL_{it-1}^h + \sum_{j=1}^2 \beta_{1j}^h \Delta GDP_{t-j} + \sum_{j=1}^2 \beta_{2j}^h \Delta UN_{t-j} + \sum_{i=1}^2 \beta_{3j}^h \Delta RLR_{it-j}^h + \eta_i^h + \varepsilon_{it}^h$$

Business, mortgage and consumer credit

Long-run coefficients capture the impact of each explanatory variable.

Autoregressive term to

capture the persistence of NPL structure

Δ : first differences to account for non-stationarity (unit roots)

Macroeconomic determinants (4)

- **Estimation results (long-run coefficients)**

Generalized Method of Moments (GMM) (Arrelano & Bond, 1991)

	Mortgages	Business	Consumer
ΔGDP	-0.278** (-2.501)	-0.650*** (-3.534)	-0.466*** (-2.850)
ΔUN	0.134*** (3.065)	0.239** (2.208)	0.181* (1.893)
ΔRLR^h	0.166** (2.031)	0.199** (1.972)	0.442** (6.331)

Notes: ***,** and * denote significance at 1%, 5% and 10% respectively. t-statistics for the long run regression coefficients are reported in parenthesis.

- ✓ **GDPI is highly sensitive to changes in private credit, statistically significant.**
 - ✓ **Difficult to get loans for businesses (mortgages)**
Strong dependence to business cycles.
 - ✓ **Small size of Greek firms → less diversified → vulnerable to shocks (less likely to get employed)** (Mitrakos, 2005; Mitrakos and Simigiannis, 2009).
 - ✓ **Mortgages less sensitive.**



Sovereign debt and NPLs (1)

- Empirical evidence → banking crisis most often either precede or coincide with sovereign debt crisis (Reinhart & Rogoff, 2010).

“a casual chain from sovereign debt crisis to banking crisis...cannot be dismissed lightly” (Reinhart & Rogoff, 2010, p. 26).

- *“Sovereign debt hypothesis”: Rising sovereign debt leads to an increase in NPLs.*



Sovereign debt and NPLs (2)

- **Two channels of transmission:**

1. Deterioration of public finance → ceiling on banks' credibility → hard pressed for liquidity → cut lending → debtors cannot refinance their debts (Reinhart & Rogoff, 2010).

2. Fiscal measures: especially cuts in social expenditure and the wage component of government consumption (Perotti, 1996).

- **Econometric testing:**

- The variable *Central Government Debt / Nominal GDP* is added to the **baseline model** presented above.
- Empirical results indicate a **positive** and **statistically significant** link between all types of NPLs and sovereign debt.



Hypothesis tested (1)

- **“*Bad management*”**: Low cost efficiency is positively associated with increases in future NPLs.
 - Bad management → poor skills in credit scoring, appraisal of collaterals, monitoring (Berger & DeYoung, 1997).
- **“*Skimping*”**: High cost efficiency causes increases in future NPLs.
 - Trade-off between cost efficiency and allocating resources for underwriting and monitoring loans, i.e. less effort to ensure loan quality → cost efficiency → but, risk of higher future NPLs (Berger & DeYoung, 1997).



Hypothesis tested (2)

- **“Moral hazard”**: Low capitalization leads to increases to future NPLs.
 - Thinly capitalized banks → (managers) moral hazard incentives → increase the riskiness of the loan portfolio (Berger & DeYoung, 1997).

- **“Diversification”**: Banks size and non-interest income are negatively related to NPLs.
 - Diversification lowers credit risk.
 - Big size → more opportunities for diversification.
 - Non-interest income → other sources of income except for loan making.



Hypothesis tested (3)

- **“*Too-big-to-fail (TBTF)*”**: Bank’s leverage increases NPLs conditional on bank’s size.
 - Moral hazard of TBTF banks.
 - Big sized banks → government protection is expected → excessive risk taking through leverage → extend to lower quality borrowers
- **“*Bad management II*”**: Banks’ performance is negatively related with future NPLs.



Hypothesis tested (4)

- ***“Procyclical credit policy”***: Performance is positively related with NPLs.
 - Banks adopt a liberal credit policy (defined by Rajan (1994) as a ‘negative NPV extension of credit’) during the boom of the cycle, and a tight policy in the contraction phase (defined in an inverse manner).
- ***“Tight control”***: Ownership concentration is negatively related with NPLs.
 - Higher ownership concentration → tighter control of the banks management → prudent risk taking.



Variables used to test the hypothesis (1)

<i>Variable</i>	<i>Definition</i>	<i>Hypothesis tested</i>
Debt	$Debt_t = \frac{\text{Central Government Debt}_t}{\text{Nominal GDP}_t}$	“Sovereign Debt” (+)
Return on Equity	$ROE_{it} = \frac{\text{Profits}_{it}}{\text{Total Equity}_{it}}$	“Bad management II” (-) “Procyclical credit policy” (+)
Solvency Ratio	$SOLR_{it} = \frac{\text{Owned Capital}_{it}}{\text{Total Assets}_{it}}$	“Moral hazard” (-)
Inefficiency	$INEF_{it} = \frac{\text{Operating Expenses}_{it}}{\text{Operating Income}_{it}}$	“Bad Management” (+) “Skimping”

Variables used to test the hypothesis (2)

Size	$SIZE_{it} = \frac{\text{Total Assets}_{it}}{\sum_{i=1}^9 \text{Total Assets}_{it}}$	“Diversification” (-)
Non-interest income	$NII_{it} = \frac{\text{Non Interest Income}}{\text{Total Income}}$	“Diversification” (-)
Leverage ratio and Size	$LR_{it} = \frac{\text{Total Liabilities}}{\text{Total Assets}}, \quad SIZE_{it}$	“Too-big-to-fail” (+) LR_{it} conditional on $SIZE_{it}$
Ownership concentration	Three dummy variables, equal to 1 if the maximum percentage of ownership is greater than 10%, 25% and 50% respectively	“Tight control” (-)

Note: All ratios are expressed in percentage points. The expected coefficient signs are shown in parenthesis.

Econometric testing (1)

$$\Delta NPL_{it}^h = a\Delta NPL_{it-1}^h + \sum_{j=1}^2 \beta_{1j}^h \Delta GDP_{t-j} + \sum_{j=1}^2 \beta_{2j}^h \Delta UN_{t-j} + \sum_{j=1}^2 \beta_{3j}^h \Delta RLR_{it-j}^h + \sum_{j=1}^4 \beta_{4j}^h X_{it-j}^h + \eta_i^h + \varepsilon_{it}^h$$

Baseline model

Long-run coefficient testing

$$H_0 : \beta_4^{LR} = 0$$

$$H_1 : \beta_4^{LR} > or < 0 \quad , \text{ depending on the hypothesis testing}$$

Econometric testing (TBTF) (2)

$$\begin{aligned} \Delta NPL_{it}^h = & a\Delta NPL_{it-1}^h + \sum_{j=1}^2 \beta_{1j}^h \Delta GDP_{t-j} \\ & + \sum_{j=1}^2 \beta_{2j}^h \Delta UN_{t-j} + \sum_{j=1}^2 \beta_{3j}^h \Delta RLR_{it-j}^h + \\ & + \beta_4^h SIZE_{it} + \sum_{j=1}^4 \beta_{5j}^h LR_{it-j}^h + \sum_{j=1}^4 \beta_{6j}^h SIZE_{it} \times LR_{it-j}^h + \eta_i^h + \varepsilon_{it}^h \end{aligned}$$

Size conditions leverage → interaction terms

Inference is based on the statistical significance of the long-run marginal effect of the leverage on NPLs, i.e.:

$$H_0 : \beta_5^{LR} + \beta_6^{LR} SIZE = 0$$

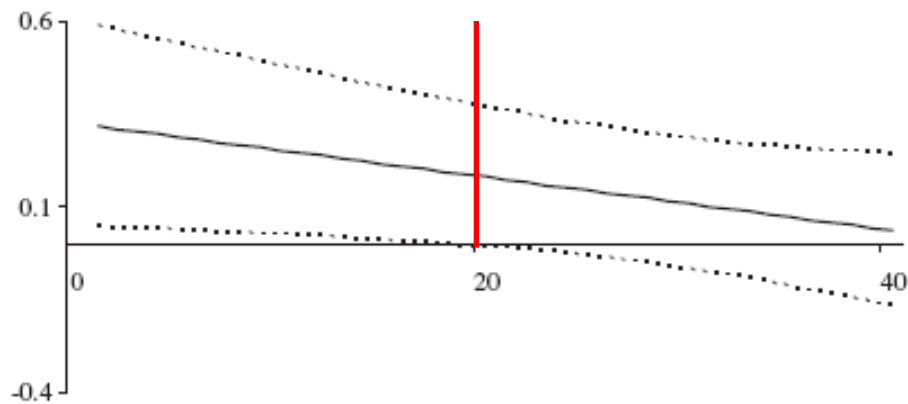
$$H_1 : \beta_5^{LR} + \beta_6^{LR} SIZE > 0$$

Empirical results (1)

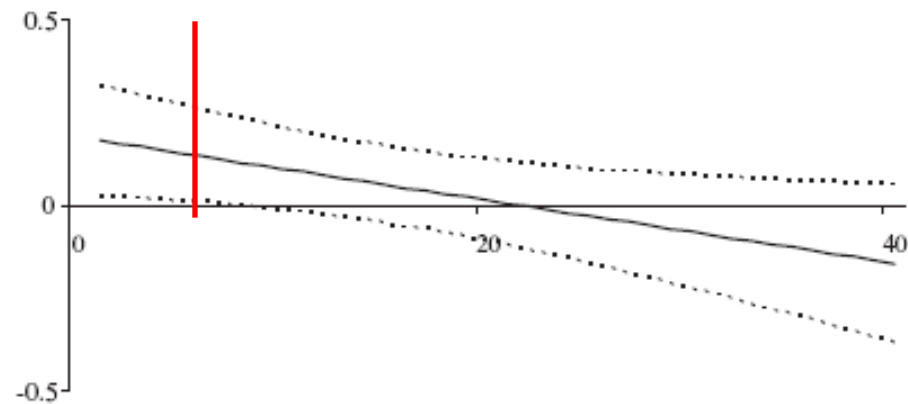
- ***Bad management (II)*** hypothesis is supported by the empirical evidence (in line with the findings of Berger & DeYoung, 1997; Podpiera & Weil, 2008).
 - ***Inefficiency index***: coefficient is positive and statistically significant for all types of NPLs.
 - ***ROE*** performance index: coefficient is negative and statistically significant for mortgages and consumer NPLs.
- ***Too-big-to-fail (TBTF)*** up to a certain size threshold for mortgage and consumer NPLs respectively.

Empirical results (2)

- *TBTF hypothesis*



Bank size as a percentage (%) of the total banking system



Bank size as a percentage (%) of the total banking system

- Present the impact of *leverage* index on mortgage and consumer NPLs as a function of the relative *size*.
- Dashed lines are the 95% confidence intervals



Empirical results (3)

Hypothesis Tested	Mortgages	Business	Consumer
1. Sovereign debt	Yes	Yes	Yes
2. Bad management	Yes	Yes	Yes
3. Skimping	No	No	No
4. Moral hazard	No	No	No
5. Diversification	No	No	No
6. Too-big-to-fail	Yes (up to a size threshold)	No	Yes (up to a size threshold)
7. Bad management II	Yes	No	Yes
8. Procyclical credit policy	No	No	No
9. Tight control	No	No	No

Note: The empirical evidence is based on the sign and the statistical significance of the long run coefficients. In the case of the too-big-to-fail hypothesis the empirical evidence is based on the long-run impact of leverage conditional on bank's size.



Conclusions

- **Macroeconomic environment** (GDP growth rate, unemployment, lending rates, public debt) strong impact on loan quality (NPLs).
- **Differential impact** of macro-variables depending on loan category (business → GDP; consumer → lending rates; mortgages → less sensitive).
- **Quality of management** (efficiency and performance indicators).
- **Too-big-to-fail** effect (up to a size level for consumer and mortgages).