BANK OF GREECE
EUROSYSTEM

Working Paper

Moral hazard and strategic default: evidence from Greek corporate loans

Ioannis Asimakopoulos
Panagiotis K. Avramidis
Dimitris Malliaropulos
Nickolaos G. Travlos

211

JULY 2016

BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

Printed in Athens, Greece
at the Bank of Greece Printing Works.

ISSN 1109-6691

MORAL HAZARD AND STRATEGIC DEFAULT: EVIDENCE FROM GREEK CORPORATE LOANS

Ioannis Asimakopoulos
Bank of Greece

Panagiotis K. Avramidis
ALBA Graduate Business School at the American College of Greece

Dimitris Malliaropulos
Bank of Greece, University of Piraeus

Nickolaos G. Travlos
ALBA Graduate Business School at the American College of Greece

Abstract

Using a unique dataset of corporate loans of 13,070 Greek firms for the period 2008-2015 and an identification strategy based on the internal credit ratings of banks, we provide evidence that one out of six firms with non-performing loans are strategic defaulters. Furthermore, we investigate potential determinants of firms' behavior by relating the probability of strategic default to a number of firm characteristics such as size, age, liquidity, profitability and collateral value. We provide evidence of a positive relationship of strategic default with outstanding debt and economic uncertainty and a negative relationship with the value of collateral. Also, profitability and collateral can be used to distinguish the strategic defaulters from the financially distressed defaulters. Finally, we find evidence that the relationship of strategic default risk with firm size and age has an inverse U-shape, i.e. strategic default is more likely among medium-sized firms compared to small and large firms and it is also more likely among middle-aged firms compared to new-founded and established firms.

JEL classification: G01, G21, G32, C23

Keywords: Strategic default, Non-performing loans, Corporate loans, Leverage

Acknowledgments: We are most grateful to S. Papagiannidou for assisting in making the dataset available for use in the present research. We would also like to thank A. Vlysidis, I. Tsikripis, A. Kallergi and G. Bourlos for valuable comments, clarifications and suggestions in using the dataset. We also thank H. Gibson for valuable drafting comments and suggestions. The views expressed in this paper are those of the authors and not necessarily those of either the Bank of Greece or the Eurosystem.

Correspondence:
Dimitris Malliaropulos
Economic Analysis and Research Department
Bank of Greece
21 El. Venizelos Av., 10250 Athens,
Greece
Tel.:0030-210-3202380
Fax: 0030-210-3203939
Email: dmalliaropulos@bankofgreece.gr

1. Introduction

1.1 The Greek economic and financial crisis

Following the Great Financial Crisis of 2007-2008, the Greek economy has entered a deep and protracted recession, during which real GDP has declined by 26% and the unemployment rate peaked at 27% in 2014 up from less than 8% in 2008 (Figure 1). The Greek crisis was essentially a sovereign debt crisis: global investors perceived Greek sovereign debt as unsustainable and were no longer willing to refinance maturing debt. In order to avoid default, the Greek sovereign received financial assistance from the International Monetary Fund and Eurozone member states in May 2010 in exchange for a bold economic adjustment program which aimed at restoring fiscal balance, improving competitiveness, eliminating the large current account deficit and conducting a set of structural reforms to improve long-term growth conditions.

The sovereign debt crisis in Greece soon turned into a banking crisis: banks were gradually excluded from the interbank market, suffered significant deposit outflows and losses to the value of their assets as the sovereign was downgraded by rating agencies. What started as a liquidity crisis for banks, turned into a solvency crisis following the Greek debt restructuring and debt buyback in 2012, with banks suffering losses of 38 bn euro, wiping out their entire capital base. Furthermore, the decline in GDP and the increase in unemployment impacted negatively on the income of households and businesses and therefore the ability of borrowers to service their debt obligations. As a result, non-performing loans (NPLs) increased by around seven times, from 5% in 2008 to more than 35% in 2015, with corporate NPLs, the focus of the current study, increasing from 4.2% in 2008 to 34.3% in 2015 (Figure 1).[1] Such a huge surge in NPLs, in conjunction with the losses from the PSI, has put significant pressure on the banking sector, which was forced to raise additional capital in three consecutive years (2013, 2014, 2015), exacerbating the conflicts of interest between creditors and borrowers.

[1] For the case of Greece the Bank of Greece has identified a strong relationship between the macroeconomic environment and the level of NPLs (see Annual Report of the Bank of Greece for Year 2014, pp. 169-172).

1.2 Economic environment and borrowers' behavior

Despite contributing significantly to the creation of NPLs, financial distress due to the adverse economic conditions is not the sole cause of non-performing loans. Some borrowers may find it economically more attractive not to pay off their liabilities or renegotiate the loan on better terms, in order to use the cash saved for other consumption or saving activity. This decision in credit markets is known as strategic default, a term that has been widely used following the global financial turmoil in 2007.

This study, to the best of our knowledge, is the first to use Greek data and one of the few that utilizes data from corporate loans as the majority of studies focus on strategic behavior on mortgages (Mayer et al., 2014). It aims to provide empirical evidence on the characteristics of strategic defaulters among Greek businesses during the recent recession. The Greek crisis offers a unique field for empirical observation of strategic default for two reasons. First, the growth of non-performing loans is so large that it should be possible to empirically observe a sufficiently large sample of strategic defaulters, allowing for more reliable statistical inference. Second, the institutional environment in Greece, mainly related to inadequate information sharing and cooperation between financial institutions, exacerbates the information asymmetry between lenders and borrowers which in turn increases strategic default.

Using a unique database on business loans and a combination of identification processes we aim, first, to assess the percentage of businesses that may be classified as strategic defaulters and second, to identify the potential determinants of such behavior. Our empirical results suggest that strategic defaulters, as a percentage of all borrowers, have consistently increased during 2009-2015; however, the percentage of strategic defaulters among all defaulters slightly declined during the same period, a development that is attributed to the prolonged recession and the liquidity constraints. In addition, we provide evidence of sectoral variation of strategic default.

Regarding the determinants of strategic default, we find evidence of a positive relationship between strategic default risk and outstanding debt, as higher values of outstanding debt increase the benefits from default, providing a strong incentive to the firm to walk away from its liabilities. The value of collateral has a negative effect on strategic default in support of the risk mitigating property of collateral that is well

documented in the literature. Further, we find evidence that the relationship between strategic default risk and size and age is an inverted U-shape, i.e. strategic default is more likely among medium-sized firms and middle-aged firms. Finally, profitability is identified as a factor that can be used to distinguish the strategic defaulters from the financially distressed defaulters, as retained profits are used for internal financing when the firm has no access to external financing.

The study is organized as follows: the next section provides a short review of the related literature. Section 3 describes data and methodology. Section 4 presents the empirical findings and section 5 concludes.

2. Literature review

Finance theory devotes considerable attention to the conflict of interest between shareholders and managers and between shareholders and creditors. We shortly review this literature in order to set up appropriate research hypotheses for our empirical analysis.

2.1 Debtholders vs shareholders

Based on Merton's (1974) structural model for corporate debt, shareholders hold a call option on firm's assets. If the value of the assets when debt is maturing exceeds the debt value, shareholders exercise the call option by paying off the debt and receiving back the ownership of the assets. If, however, the value of the assets drops below the debt value, they have the right to default and walk away from the firm leaving the assets to the lender. Due to their "option" right, the shareholders (firm's owners) and the debtholders (firm's lenders) have different incentives that generate conflicts of interests. Several authors have identified and discussed potential conflicts of interest between lenders (creditors/bondholders) and borrowers (shareholders). The following presentation is based on Jensen and Smith (1985) and on the references presented therein. Accordingly, there are at least four major sources of conflicts between these two groups of stakeholders:

Dividend policy: If bonds are priced assuming a constant dividend policy, their value will decline if dividends, financed either by borrowing or by reductions in planned investments, increase unexpectedly (Kalay, 1982).

Additional debt: If bonds are priced assuming the firm will not issue additional debt of the same or higher seniority their value will decline if the firm issues additional debt (Jensen and Smith, 1985).

Undertaking higher risk/asset substitution: If bonds are priced assuming the firm invests in certain assets with a given risk profile, their value will decline to the benefit of shareholders, if the firm substitutes a high-risk investment for a low risk one (Jensen and Meckling, 1976).

Underinvestment: As Myers (1977) demonstrates, if a major part of the value of a firm consists of growth opportunities, the firm – acting in the best interest of shareholders – may reject a positive net present value project if most of the benefits from accepting the project are captured by the bondholders.

As Jensen and Smith (1985) explain, rational debtholders recognize the incentives of shareholders in the above four cases and adjust debt prices accordingly. Consequently, debtholders do not suffer losses, unless they systematically underestimate the effects of such future selfish actions by shareholders. However, the firm and its shareholders suffer losses from the non-optimal pricing decisions. Such incentives are stronger when the companies are in financial distress, as is the situation of Greek companies in the current crisis.

2.2 Moral hazard and strategic default

In markets where information asymmetry is present, the phenomenon of using private information to benefit from an incomplete contract is known as moral hazard (Arrow 1963). The problem of moral hazard may arise when individuals engage in risk sharing under conditions where their actions affect the probability distribution of the outcome (Hölmstrom 1979).

One stream of the literature on strategic default has focused on the use of collateral as an incentive that induces the borrower into higher effort to stay solvent (Deng et. al. 2000, Fay et. al. 2002). These papers document a strong link between

negative home equity and default. Edelberg (2004) also finds strong evidence that loan terms may have a feedback effect on borrower's behavior. Similarly Karlan and Zinman (2009) find relatively strong evidence of economically significant moral hazard in the consumer credit market in South Africa. Adams et al. (2009) provide evidence of the underlying forces of moral hazard among subprime borrowers using auto loan data while Morse and Tsoutsoura (2013) show the importance of foreclosure, as a credible threat, for completing the mortgage market using Greek consumer loan data. Another stream of research investigates the strategic choice of defaults among different types of debts by the same borrower (Elul et. al. (2010), Jagtiani and Lang (2010)).

Other recent studies consider the effect of behavioral factors on the strategic default decision. Guiso et al. (2013) use the US consumer finance survey to conclude that strategic default is driven by economic, emotional and sociological factors (see also Fay et. al. 2002). Similarly, Gross and Souleles (2002) interpret the increase in credit card default among US consumers as evidence that the stigma associated with bankruptcy has fallen.

All the aforementioned empirical evidence comes from the consumer credit market where strategic default has been at the forefront. In the scarce corporate literature, Giroud et al. (2012) use the level of snow as an exogenous instrument to identify distress due to debt overhang (strategic defaulters) among a set of highly leveraged Austrian ski hotels. Furthermore, Hyytinen and Väänänen (2006) use Finnish survey data to find empirical evidence of moral hazard. They conclude that firm age is inversely related to moral hazard which corroborates the theoretical position of Diamond (1989; 1991) on the role of reputation in debt markets. In the Diamond (1991) model, borrowers rely on building positive reputations for repayment of debts in order to secure access to future credit.

3. Research hypotheses

The purpose of the study is to examine the determinants of strategic default. As such, we set out to compare strategically defaulted firms to non-defaulted firms in order to reveal the differences between firms that have exercised the option to strategically default and those that did not. In addition, we compare strategically

defaulted firms to defaulted firms that are not identified as strategic in order to highlight the differences between financially healthy but defaulted firms and financially distressed firms.

The value of the firm's shareholder's option to strategically default increases during periods of high economic uncertainty, since the benefits from walking away from the obligation will surpass the costs. By contrast, the percentage of strategic defaulters among the defaulted firms is expected to be negatively correlated to economic uncertainty as the number of financial distressed defaulters (i.e. the denominator of the ratio) will increase due to the deteriorating economic conditions. Hence, our first hypothesis *(H1) is that strategic default risk is positively related to economic uncertainty, but the percentage of strategic defaulters among defaulters is negatively related to economic uncertainty*.

In addition to the prevailing economic and financial conditions, there is substantial cross-firm variation in strategic default, which implies that there exist firm-specific characteristics that exacerbate, or mitigate, the phenomenon. In particular, strategic default risk is related to the size and the age of the firm in a complicated way. Very small and newly founded (e.g. start-ups) firms are financially dependent on their bank as they display higher information opacity (Petersen and Rajan 1994). The high bank switching costs in the sense of Sharpe (1990) means that these firms will prefer to avoid actions that could impair their relationship with the lender. This phenomenon is known in the literature as the hold-up effect and effectively mitigates the moral hazard. At the other end of the distribution, very large and established firms have built a strong reputation, which helps them to secure lower financing costs (Diamond 1989) and therefore they will also be reluctant to engage in actions that will tarnish this reputation and increase financing costs. Combining the two countervailing effects yields that the empirical relationship of strategic default risk with size and with age is expected to be non-linear. In particular, our second hypothesis *(H2) is that very small (newly-founded) and very large (established) sized borrowers will have lower strategic default risk compared to medium sized (aged) borrowers.* However, size and age are not expected to have any discriminatory power to strategic defaulters from non-strategic defaulters due to the effect of size and age on the denominator of the ratio i.e. on the financial distressed defaulters.

Another important factor that influences the decision to strategically default is the borrower's outstanding debt. In investment, the phenomenon of debt overhang (Myers 1977) predicts that companies with a large outstanding debt are more likely to pass profitable projects since the gains will primarily accrue to the debtholders. It follows that highly leveraged firms will find the option of strategic default more profitable. Our third hypothesis *(H3) is that borrowers with larger outstanding debt are more likely to strategically default*. Outstanding debt, on the other hand, is also high for financially distressed (non-strategic) defaulters and hence we do not expect it to have any discriminatory power among defaulted firms.

The literature recognizes that the collateral pledged to the loan provides an effective incentive to the borrower to remain solvent by increasing the cost of the option to strategic default (Deng et. al. 2000). Similarly, among defaulted firms, those with high collateral are less likely to be strategic defaulters. Hence, our fourth hypothesis *(H4) is that a higher percentage of loan secured by collateral will reduce strategic default risk and will distinguish strategic defaulters from financial distressed defaulters.*

Finally, we would expect that the strategic defaulters, compared to financially distressed defaulters, have some alternative source of funding that will help them to operate their business without external financing for a significant period of time following default. Firms' primary source of funding is retained earnings and, hence, we expect that among defaulted firms, those with high profitability are more likely to be strategic defaulters. On the other hand, for reasons related to reputation and access to low cost funding, profitable firms are expected to avoid becoming strategically defaulters. Hence, our fifth hypothesis *(H5) is that profitability reduces strategic default risk but defaulters with strong profitability are more likely to be strategic defaulters.*

4. Sample and methodology

4.1 Data and variables

For our empirical analysis we use a unique database of business loans, based on data submitted by commercial banks to the Bank of Greece. This database was combined with information retrieved from ICAP's database, a Greek business

information provider, regarding company specific information such as financial variables, geographical location, years of operation etc. For confidentiality purposes, the creation of the database was conducted by the Bank of Greece and any borrowers' identification tags were removed prior to the econometric analysis.

The loan database contains annual data over the period 2008 to 2015 on outstanding corporate loans that exceed 1 million euro in total[2] for companies domiciled in Greece, as well as information related to the servicing of these exposures (i.e. performing or 90 days past due), the value of associated collateral and the credit rating assigned by the banks for the respective borrower. For the purposes of the analysis, off-balance sheet items, such as letters of guarantee, are excluded. When the exposure of a borrower drops below 1 million euro, banks stop providing information on the borrower.

Finally, from the initial data set with all the reported exposures, we exclude those that are reported by non-banking financial institutions (leasing, factoring etc.) or subsidiaries. Hence the final data set consists of 70,390 firm-year observations that correspond to 13,070 unique firms.[3] In terms of coverage, our sample accounts for about 60% of total outstanding corporate loans in the Greek economy. The econometric analysis for the strategic default determinants is, nevertheless, performed on the sub-sample of firms with available financial information.

We define a loan as non-performing if its payment is delinquent for more than 90 days. In that case the total exposure of the borrower to the bank is assumed as non-performing and the borrower is considered as a defaulter. To mitigate the possibility of incorrect submission or potential overestimation of delinquent payments, if the non-performing exposure of the bank to a company is relatively small in comparison to the total exposure of the borrower (i.e. less than 3%), we assume that the whole exposure is performing.

Regarding firms' financial data, we measure the *size* of the company by the logarithm of total assets, *age* is measured from the year of establishment, *outstanding*

[2] Banks report total exposures per customer provided that they exceed 1 million euro. There are also cases where the exposure is less than 1 million euros. These include the exposures of connected borrowers, as defined in the relevant Bank of Greece's Governor Acts, irrespective of the size of exposure, when at least one of these borrowers has an exposure higher than 1 million euro.

[3] Our panel data set is unbalanced as some firms do not appear at the entire time period. Given the unbalanced data structure, direct annual comparisons require some caution.

debt is defined as the ratio of loan exposure to total assets, *collateral* is the ratio of the reported collateral value to the loan exposure, and profitability is measured by the firm's *return on assets (ROA)*. Moreover, we control for the financial strength of the firm using *interest coverage ratio*, measured by the ratio of the firm's EBITDA to interest expenses and *liquidity ratio*, measured by the ratio of current assets to current liabilities. We control for access to equity markets using a dummy variable for the firms that are listed in the Athens Stock Exchange.

4.2 Identification of strategic defaulters

Because strategic default is an unobservable event − in contrast to default, which is observable − the distinction between strategic defaulters and defaulters facing veritable financial distress is not straightforward. Therefore, a rigorous process is required in order to identify among the defaulters those who have the financial capacity to service their obligations but are not willing to do so.

A variety of different identification strategies have appeared in the literature. In consumer credit markets, existing studies have linked strategic default to the value of the house with respect to the outstanding mortgage debt (Deng et. al. 2000) or they have utilized the choice of consumers to selectively service other loan obligations (Morse and Tsoutsoura 2013) and consumers' *payment behavior* in general (Elul et. al. (2010)). Similarly, studies from the corporate literature have used exogenous variables to assess the *financial capacity* of firms (Giroud et. al. 2012), and in this way to group the defaulters into financially constrained (non-strategic) defaulters and financially unconstrained (strategic) defaulters.

In this study, we propose a novel identification process to distinguish between the financially distressed (non-strategic) defaulters and financially sound (strategic) defaulters, combining approaches from the consumer and corporate literature. In particular, the firm's financial capacity to service its debt is measured using the banks' internal credit evaluation scale. Since each bank follows its own credit scoring policy, a common credit evaluation scale is created that is divided into two buckets: a top tier one in which firms are highly rated and a lower tier in which firms are classified as highly risky or financially unable to repay their obligations. Note that in

between these two tiers, there is some grey area with some firms for which the internal evaluation is inconclusive as to which tier they belong to.

For the purpose of the study, a defaulted firm is characterized as a strategic defaulter if it is classified in the top tier bucket.[4] In order to avoid issues related to the timing of the banks' internal evaluation, as it is often the case that credit evaluations are updated with a lapse of time, we take into account the classification of the firms in the credit buckets both at the beginning and at the end of the year during which the firm defaulted on its loan. If the firm maintains a high quality internal score after its decision to default, this suggests that for some reason (e.g. deposits within the bank) the bank recognizes that the financial ability of the firm has not been significantly impaired and therefore the decision to default could be attributed to strategic choice.

In addition, for firms with loans from more than one bank whose average creditworthiness score is inconclusive (i.e. classified in the middle of the two tiers), we utilize an identification process similar to the one used in consumer credit market studies. In particular, we use the borrower's payment behavior towards all banks as additional information: if the borrower has two or more loans with different banks of which at least one of the loans is reported as performing, then we assume that his/her decision to default is less likely to be due to financial distress and more likely to be a strategic decision.

To ensure that the buckets used in the proposed strategic default definition capture the financial capacity of the firms, we compared the key financial ratios of firms assigned to the top and low buckets. We found significant difference in the interest coverage, leverage and profitability ratios between these two groups, which supports the use of banks' internal evaluation as an indicator of financial soundness.

Finally, in order to test the robustness of our identification process, we replaced the banks' internal creditworthiness scores with the interest expense coverage ratio and used a threshold of 1.1 to identify strategic defaulters – i.e. defaulted firms with an interest expense coverage ratio above this threshold were characterized as strategic defaulters.[5] We confirmed that the findings discussed below remain qualitatively

[4] For borrowers with loans from different banks and different creditworthiness scores, the average score is taken onto account for the credit rating classification.

[5] This threshold for interest expense coverage ratio was used as minimum impairment trigger for IAS 39 loss events in Phase 2 of the Asset Quality Review (AQR) of Greek banks.

equivalent. We therefore conclude that the identification process discussed above is robust to alternative specifications.

4.3 Methodology

Using the aforementioned definition of strategic default, we categorize the borrowers into three groups: strategic defaulters, financially distressed (non-strategic) defaulters and non-defaulters. We then define two binary dependent variables, one to compare the strategic defaulters to non-defaulters and the second to compare the strategic defaulters to (non-strategic) financially distressed defaulters.

Given the binary nature of the dependent variables we apply the probit regression model. In particular, the probability of observing a strategic default vs the reference group in year *t* by firm *i*, *P*(.) is the score of the annual economic uncertainty (which is captured by the *Year* dummies), *Size*, *Age*, *Outstanding Debt*, *Collateral*, profitability (measured by *ROA*), *Interest Coverage*, *Liquidity* and a dummy variable for listed companies (*Listed*):

$$\begin{aligned} P(DV_{i,t}=1) = \; & \Phi\big(\beta_0 + \beta_{1,t}Year_t + \beta_2 Size_{i,t-1} + \beta_3 Size_{i,t-1}^2 + \beta_4 Age_{i,t-1} + \beta_5 Age_{i,t-1}^2 \\ & + \beta_6 Out.Debt_{i,t-1} + \beta_7 Collateral_{i,t-1} + \beta_8 ROA_{i,t-1} + \beta_9 Int.Cov_{i,t-1} \\ & + \beta_{10} Liquidity_{i,t-1} + \beta_{11} Listed_{i,t-1} + R_i + I_i + \varepsilon_{i,t}\big) \qquad (1) \end{aligned}$$

where $\Phi(.)$ is the cumulative normal distribution function. All financial ratios are lagged to one year to easy the concern of simultaneity bias. In addition to the firm level variables, taking into account that strategic default shows heterogeneity across sectors and regions, we account for any unobservable industry factor using industry effects, I_i, and for any unobservable regional factor using regional effects, R_i. Year dummies are used to capture the economy-wide uncertainty that has increased the outset of the crisis and thereafter. We use robust clustered estimates of errors $\varepsilon_{i,t}$ (Wooldridge 2002) to curb possible biases of error heteroscedasticity and intra-firm correlation. Note that, to curb the impact of spurious extreme values on our findings, we winsorize the data at the 1st and 99th percentile.

Finally, we calculate the marginal effects that summarize how the change in the independent variable is related to the change in the dependent variable. In simple linear models, this effect is the estimated slope from the regression line. For non-

linear models like probit regressions, however, marginal effects are estimated as the change in probability when the independent variable increases by one unit. The marginal effects are estimated for the mean value of the independent variable holding all other covariates at their mean values.

5. Empirical evidence

5.1 Preliminary findings

Table 1 reports the descriptive statistics for the loan data along with the company information available. The "average" firm with available financial data in the sample has total assets of 30 million euro, total liabilities of 19 million, annual sales of 17.7 million, bank debt of 7.5 million of which 1.2 million is non-performing, across the observation period.

Table 2 presents the descriptive statistics for the loan exposures data sample over time. Total exposure for 2015 amounts to 56.8 billion euro, 18.7 billion of which are classified as non-performing, implying an NPL ratio of 32.9%. The total amount of loans is down by 20% from the peak of 71.6 billion in 2010 while the non-performing loans in 2010 were 5.8%. This implies a NPL-ratio growth of 440% for the period 2010 to 2015.

Table 3 reports the loan distribution in terms of size of the loans. The data suggest an inverse U-shaped relationship between the size of the loan and the NPL ratio: small loans (less than EUR 1 million) and large loans (more than EUR 50 million) have low NPL ratios, whereas medium-sized loans have high NPL ratios.

Table 4 reports annual the summary statistics of our estimates of strategic defaulters. The ratio of strategic defaulters to total borrowers has consistently increased during the Greek crisis. However, the ratio of strategic defaulters to total defaulters has slightly declined over the same period, from 21% in 2009 to 16% in 2015. This was not due to the decline in the number of strategic defaults but due to the deep recession and the liquidity crunch of the Greek economy that has led to the soaring of defaults due to liquidity constraints.

Table 5 reports estimates of the sectoral distribution of strategic defaulters. Sectors such as construction, manufacturing and information and communication have

the highest percentage of strategic defaulters among all borrowers. In addition to these sectors, real estate and administrative and support services have the highest percentage of strategic defaulters among all defaulters. We also estimated the regional distribution. Modest variation was observed and for parsimony the results are not reported.

5.2 Determinants of strategic defaulters

Specifications (1) and (2) in Table 6 report the findings that characterize the strategic defaulters from the non-defaulters and from the non-strategic defaulters respectively.

(H1) Strategic default risk is positively related to economic uncertainty, but the percentage of strategic defaulters among defaulters is negatively related to economic uncertainty.

Using 2008 as the reference year with the lowest economic uncertainty in Greece (the economic conditions in Greece in that year were not affected significantly by the subprime crisis in the US), the year effects capture the impact of increasing economic uncertainty in subsequent years. The coefficients from 2011 and onwards are positive and significant at the 1% level so there is evidence in support of the hypothesis that financial uncertainty increases the probability of strategic default.[6] In comparison to the non-strategic defaulters (specification 2), some year coefficients are negative and significant at the 1% level so there is partial evidence that the percentage of strategic defaulters among all defaulters decreases with economic uncertainty. As the strain on firms' financial positions grows due to the economic uncertainty and tighter credit rationing, more firms will default due to financial distress (non-strategic defaulters) rather than as a strategic decision.

H2: Very small (newly-founded) and very large (established) sized borrowers will have lower strategic default risk compared to medium sized (aged) borrowers.

The coefficients of the first order (β_2 =1.167) and second order effects of size ($\beta_3 = -0.029$) are positive and negative, respectively, and both are statistically

[6] In unreported results, we replaced the year effects with the annual volatility of the Athens Stock Index and found a positive and statistically significant effect that corroborates our hypothesis on the relationship of uncertainty and strategic default.

significant at the 1% level. The signs of these effects provide empirical evidence for a non-monotonic relationship between size and likelihood of strategic default. In particular, smaller and larger firms have a lower probability to strategically default compared to their medium-sized peers, assuming all else equal. This result is in line with the inverse U-shaped relationship between size of the loan and NPL ratio observed in the data (see Table 3). Similarly, the coefficients of the first order ($\beta_4 = 0$ .0192) and second order effects of age ($\beta_5 =$ -0.0003) are positive and negative respectively and both are statistically significant at the 1% level. Likewise, the signs of these effects provide empirical evidence of a non-monotonic relationship between age and likelihood of strategic default. Equivalently, start-ups and well-established firms have a lower probability to strategically default compared to their peers, assuming all else equal. Overall, our findings on the relationship of size and age with the probability of strategic default support the second hypothesis.

In contrast, we find no evidence that size or age distinguishes strategic defaulters from non-strategic defaulters. Equivalently, strategic defaulters do not differ from financially distressed defaulters in terms of size or age.

(H3) Borrowers with larger outstanding debt are more likely to strategically default.

The coefficient on outstanding debt ($\beta_6 = 0.935$) is positive and significant at the 1% level, providing empirical evidence in support of the third hypothesis that outstanding debt increases the probability of strategic default since the benefits from strategic default are more likely to exceed the implied costs. In contrast, we find no evidence that strategic defaulters differ from financially distressed defaulters on outstanding debt.

(H4) Higher percentage of loan secured by collateral will reduce the strategic default risk and will distinguish strategic defaulters from financial distressed defaulters.

The coefficients on collateral ($\beta_7 = -0.0534$ and β_7 = -0.0677) in specifications (1) and (2), respectively, are negative and significant at 1%. Hence, there is empirical evidence in support of the fourth hypothesis regarding the role of collateral as a risk mitigating mechanism, a finding that corroborates the negative effect of collateral on moral hazard documented in literature.

(H5) Profitability reduces strategic default risk but defaulters with strong profitability are more likely to be strategic defaulters.

The coefficient on ROA ($\beta_8 = -1.91$) in specification (1) confirms that profitability reduces strategic default risk. Strategic defaulters, however, differ from non-strategic defaulters in profitability since the coefficient of ROA ($\beta_8 = 1.92$) in specification (2) is positive and significant at 1%. This finding implies that defaulted firms with non-performing loans that report positive profits are more likely to be strategic defaulters compared to defaulted firms reporting losses. Since retained earnings provide an internal funding source, profitable companies will be able to operate for longer without external financing.

Finally, no differentiation was identified between listed and non-listed firms.

As argued earlier, the coefficient estimates from the probit regression model are not the direct effects due to the non-linear form of the model. The estimates in Table 7 Panel A are the marginal effects of the probit regression model of strategic defaulters vs non-defaulters. In particular, a one unit increase in outstanding debt will increase the probability of strategic default by 4.8% and a one unit increase in collateral will yield a 0.28% decrease in the probability of strategic default. Similarly, derived from the 2011 to 2014 year effects, economic uncertainty increases the probability of strategic default by about 4%. Finally, the non-monotonic marginal effects at different values of size and age are presented in Figures 2 and 3, respectively. A middle-sized firm has approximately a 30% higher probability of strategic default compared to a small or large firm, all else equal. Similarly, a middle-aged firm has approximately 0.60% higher probability of strategic default compared to the newly founded and 0.30% compared to old companies, all else equal. Note that a direct comparison between the absolute value of marginal effects of different factors is not possible as the units between those factors differ.

Similarly, from the estimates of the marginal effects in Table 7 Panel B for the probit regression model of strategic defaulters vs defaulters, we find that profitability increases the percentage of strategic defaults among defaulters by 62%, whereas a one unit increase in collateral is related to a 2.2% decrease in the percentage of strategic defaults among defaulters. Finally, economic uncertainty reduces the percentage of strategic defaults among defaulters by 11%.

6. Conclusions

Using loan payment data of Greek firms during the recent economic crisis, we propose a process that identifies strategic defaulters from financial distressed (non-strategic) defaulters. This distinction is crucial given the increased costs from non-performing loans incurred by banks' stockholders and by the government that provided additional capital in an effort to stabilize the banking system. We find that one out of six firms with non-performing loans are strategic defaulters and that in absolute terms, the number of strategic defaulters has grown considerably from the outset of crisis, though the percentage of strategic defaulters among all defaulters has declined. In addition, we report significant sectoral variation of strategic default with construction, manufacturing and information and communication sectors displaying the highest percentages of strategic defaulters among all borrowers and real estate and administrative and support services also displaying high percentage of strategic defaulters among the defaulters.

Furthermore, we find evidence of a positive relationship between strategic default and outstanding debt and economic uncertainty and a negative relationship with the value of collateral. Very small and newly founded firms face higher bank switching costs and therefore are less likely to strategically default, due to the impact that this decision will have on their relationship with the lenders. Similarly, very large and established firms are less likely to strategically default, because of the impact that this decision will have on their reputation. Finally, among defaulted firms, profitability and collateral can be used to distinguish the strategic defaulters from the financial distressed defaulters.

Bibliography

Adams, W., Einav, L., and Levin, J. (2009). Liquidity constraints and imperfect information in subprime lending. *American Economic Review*, (99:1), pp. 49–84

Arrow, K. J. (1963). Uncertainty and the welfare economics of medical care. *The American Economic Review*, (53:5), pp. 941-973.

Bank of Greece (2015). Annual Report for the Year 2014.

Deng, Y., Quigley, J.M. and Van Order, R. 2000. "Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options," *Econometrica* (68), pp. 275-307.

Diamond, D. W. (1989). Reputation acquisition in debt markets. J*ournal of Political Economy*, pp. 828-862.

Diamond, D. W. (1991). Monitoring and reputation: The choice between bank loans and directly placed debt. *Journal of Political Economy*, pp. 689-721.

Edelberg, W. (2004). "Testing for Adverse Selection and Moral Hazard in Consumer Loan Markets," Finance and Economics Discussion Series No. 09, Board of Governors of the Federal Reserve System.

Elul, R., N. Souleles, S. Chomsisengphet, D. Glennon, and R. Hunt (2010). "What Triggers Mortgage Default," *American Economic Review*, Papers & Proceedings, 100, pp. 490-494.

Fay, S., Hurst, E., and White, M. J. (2002). "The Household Bankruptcy Decision," *American Economic Review*, pp. 706-718.

Giroud, X., Mueller, H. M., Stomper, A., & Westerkamp, A. (2012). Snow and leverage. *Review of Financial Studies*, 25(3), pp. 680-710.

Gross, D. B. and Souleles, N. S. (2002). "An Empirical Analysis of Personal Bankruptcy and Delinquency," *Review of Financial Studies*, (15:1), pp. 319-347.

Guiso, L., Sapienza, P. and Zingales, L. (2013). "The Determinants of Attitudes Toward Strategic Default on Mortgages," *Journal of Finance* (68:4), pp. 1473-1515.

Hölmstrom, B. (1979). "Moral Hazard and Observability," *Bell Journal of Economics* (10:1), pp. 74-91.

Hyytinen, A. and Väänänen, L. (2006). Where do financial constraints originate from? An empirical analysis of adverse selection and moral hazard in capital markets. *Small Business Economics*, 27(4-5), pp. 323-348.

Jagtiani, J. and W. W. Lang (2010). "Strategic Default on First and Second Lien Mortgages During the Financial Crisis," Working paper, Federal Reserve of Philadelphia.

Jensen, Michael C. and William H. Meckling (1976). "Theory of the Firm: Managerial Behavior Agency Costs and Ownership Structure." *Journal of Financial Economics* 3, pp. 305 – 360.

Jensen, Michael C. and Clifford W. Smith (1985). "Stockholder, Manager, and Creditor Interests: Applications of Agency Theory" in E. Altman and M. Subrahmanyam (editors): Recent Advances in Corporate Finance by , Irwin: Homewood, IL, pp. 93 – 131.

Kalay, Avner (1982). "Stockholder – Bondholder conflict and Dividend Constraint." *Journal of Financial Economics,* 10, pp. 211 – 33.

Karlan, D. and J. Zinman (2009). "Observing Unobservables: Identifying Information Asymmetries With a Consumer Credit Field Experiment," *Econometrica* (77:6), pp. 1993-2008.

Mayer, C., E. Morrison, T. Piskorski and A. Gupta (2014). Mortgage Modification and Strategic Behavior: Evidence from a Legal Settlement with Countrywide. *American Economic Review*, 104, Issue 9, pp. 2830-57.

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *Journal of Finance*, 29(2), pp. 449-470.

Morse, A., & Tsoutsoura, M. (2013). Life without Foreclosures. Working Paper, University of California Berkeley, NBER

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics,* 5(2), pp. 147-175.

Petersen, M. A. and Rajan, R. G. (1994). The benefits of lending relationships: Evidence from small business data. *Journal of Finance*, 49(1), pp. 3-37.

Sharp, S. (1990). Asymmetric information, bank lending and implicit contracts: A stylized model of bank relationships. *Journal of Finance*, 45(4), pp. 1069-1087.

Table 1: Annual aggregate descriptive statistics of loan, financial and commercial data.					
Variable	**Observations**	**Mean**	**Std.Dev.**	**Min**	**Max**
Total Assets ('000 Euro)	49,408	30,300	292,000	3.218	16,200,000
Total Liabilities ('000 Euro)	49,354	19,400	183,000	0.289	11,800,000
Sales ('000 Euro)	47,988	17,600	169,000	0	9,900,000
EBITDA ('000 Euro)	49,345	1,177	20,000	-1,250,000	1,670,000
Outstanding debt (% total assets)	49,408	0.477	4.404	0	850.49
Interest Coverage	45,733	-11.74	1,143.42	-229,775.00	100.80
Liquidity	49,312	1.922	3.186	0	25.320
ROA (%)	49,327	-0.010	0.776	-164.645	28.093
Age	50,584	20	15	0	186
Total Loans ('000 Euro)	70,390	7,444	42,059	1	3,398,540
Total NPL ('000 Euro)	70,390	1,243	7,672	0	568,494
Total Collateral ('000 Euro)	70,390	2,406	19,741	0	2,611,972

Sources: Data collected from Bank of Greece.

Table 2: Annual aggregated statistics of loan sample data.			
	(1)	**(2)**	**(3)=(2)/(1)**
year	**Total Loans ('000)**	**Total NPL ('000)**	**NPL ratio**
2008	70,800,000	1,682,000	2.37%
2009	68,300,000	3,369,000	4.93%
2010	71,600,000	4,179,000	5.84%
2011	70,300,000	7,939,000	11.29%
2012	65,200,000	14,800,000	22.64%
2013	63,000,000	18,500,000	29.34%
2014	57,900,000	18,400,000	31.78%
2015	56,800,000	18,700,000	32.88%

Sources: Data collected from Bank of Greece.

Table 3: Summary statistics of aggregated loan data by exposure size (2008-2015).		
Loan amount	**%-Frequency***	**NPL Ratio**
≤1m	26.52%	10.52%
1m< ≤5m	49.30%	23.16%
5m< ≤20m	17.69%	20.92%
20m< ≤50m	4.37%	17.77%
50m<	2.12%	11.92%
Total	70,390	16.72%

Sources: Data collected from Bank of Greece.

*Measures the % share in total loans in each bucket.

Table 4: Annual summary statistics of default and strategic default rate.			
	(1)	**(2)**	**(3)=(2)/(1)**
year	**All defaults (% of all borrowers)**	**Strategic defaults (% of all borrowers)**	**Strategic defaults (% of all defaults)**
2008	4.19%	0. 98%	23%
2009	7.89%	1.66%	21%
2010	10.48%	1.78%	17%
2011	19.90%	2.68%	13%
2012	31.05%	5.49%	18%
2013	35.11%	6.10%	17%
2014	39.42%	5.39%	14%
2015	38.63%	6.06%	16%

Sources: Data collected from Bank of Greece.

Table 5: Summary statistics of default and strategic default rate per Sector (NACE rev2 classification).			
	(1)	**(2)**	**(3)=(2)/(1)**
Sector	**All defaults (% of all borrowers)**	**Strategic defaults (% of all borrowers)**	**Strategic defaults (% of all defaults)**
AGRICULTURE, FORESTRY AND FISHING	24.51%	3.11%	12.68%
MINING AND QUARRYING	24.53%	2.83%	11.54%
MANUFACTURING	25.26%	4.30%	17.01%
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	3.91%	0.34%	8.62%
WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	16.43%	2.14%	13.04%
CONSTRUCTION	28.09%	5.06%	18.02%
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	21.96%	3.44%	15.67%
TRANSPORTATION AND STORAGE	16.60%	2.58%	15.53%
ACCOMMODATION AND FOOD SERVICE ACTIVITIES	19.54%	2.93%	15.01%
INFORMATION AND COMMUNICATION	21.91%	4.10%	18.72%
FINANCIAL AND INSURANCE ACTIVITIES	13.47%	1.39%	10.29%
REAL ESTATE ACTIVITIES	13.57%	2.44%	17.98%
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	20.81%	2.00%	9.62%
ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	18.32%	3.87%	21.11%
PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	16.67%	2.22%	13.33%
EDUCATION	20.60%	3.27%	15.85%
HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	18.70%	3.16%	16.91%
ARTS, ENTERTAINMENT AND RECREATION	17.08%	2.92%	17.07%
OTHER SERVICE ACTIVITIES	18.99%	1.68%	8.86%
ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES	7.23%	0.00%	0.00%
ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES	100.00%	1.39%	1.39%

Sources: Data collected from Bank of Greece.

Table 6: Probit regression model: Maximum-likelihood estimates of probability of (1) strategic defaulters vs non-defaulters, (2) strategic defaulters vs non-strategic defaulters.

VARIABLES	(1) Strategic default vs non-defaults	(2) Strategic default vs default
Size	1.167***	0.242
	(0.311)	(0.483)
Size*Size	-0.0285***	0.00306
	(0.00933)	(0.0147)
Age	0.0192***	0.00293
	(0.00369)	(0.00546)
Age*Age	-0.0003***	-3.83e-05
	(5.55e-05)	(7.89e-05)
Outstanding debt	0.935***	-0.00467
	(0.0673)	(0.0972)
Collateral to debt	-0.0534***	-0.0677***
	(0.0117)	(0.0221)
Int. Coverage	-0.00756***	-0.00109
	(0.00268)	(0.00140)
Liquidity	-0.0295***	0.0144
	(0.00814)	(0.00988)
Profitability(ROA)	-1.910***	1.918***
	(0.266)	(0.400)
Listed	0.0829	-0.159
	(0.0971)	(0.148)
2009	0.281***	0.0348
	(0.103)	(0.210)
2010	0.240**	-0.348*
	(0.101)	(0.192)
2011	0.501***	-0.458**
	(0.0952)	(0.179)
2012	0.985***	-0.162
	(0.0912)	(0.174)
2013	1.012***	-0.271
	(0.0908)	(0.173)
2014	0.988***	-0.353**
	(0.0921)	(0.174)
Constant	-14.50***	-5.242
	(2.601)	(3.968)
Sector effects	yes	yes
Region effects	yes	yes
Observations	21,802	3,359

The Table reports estimates of Probit regression equation (1). Definitions of strategic defaulter and independent variables are presented in section 3.1. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Average Marginal Effects for strategic defaulters:

Panel A – Average marginal effects estimates for strategic defaulters to non-defaulters

	dy/dx	Std.Err.	p-value	[95% Conf.	Interval]
Size	0.0602	0.0156	0.000	0.0295	0.0908
Size^2	-0.0015	0.0005	0.002	-0.0024	-0.0005
Age	0.0010	0.0002	0.000	0.0006	0.0014
Age^2	0.00001	0.000002	0.000	0.0000	0.0000
Collateral	-0.0028	0.0006	0.000	-0.0040	-0.0015
Outstanding debt	0.0482	0.0035	0.000	0.0414	0.0551
ROA	-0.0985	0.0140	0.000	-0.1259	-0.0712
2009	0.0056	0.0020	0.006	0.0016	0.0095
2010	0.0045	0.0018	0.013	0.0009	0.0080
2011	0.0133	0.0023	0.000	0.0087	0.0179
2012	0.0487	0.0041	0.000	0.0406	0.0568
2013	0.0518	0.0042	0.000	0.0436	0.0600
2014	0.0490	0.0044	0.000	0.0404	0.0577

Panel B – Average marginal effects estimates for strategic defaulters to non-strategic defaulters

	dy/dx	Std.Err.	p-value	[95% Conf.	Interval]
Collateral	-0.0221	0.0072	0.002	-0.0363	-0.0080
ROA	0.6262	0.1303	0.000	0.3707	0.8816
2009	0.0131	0.0790	0.868	-0.1417	0.1680
2010	-0.1204	0.0692	0.082	-0.2560	0.0152
2011	-0.1536	0.0653	0.019	-0.2816	-0.0257
2012	-0.0590	0.0650	0.364	-0.1863	0.0684
2013	-0.0959	0.0643	0.136	-0.2220	0.0302
2014	-0.1222	0.0643	0.057	-0.2482	0.0038

Derivatives of responses are average changes in the dependent variable for a change in the specified covariate, reported as elasticity. Standard errors are obtained by the delta method.

Figure 1: Real GDP, unemployment rate and NPL ratios

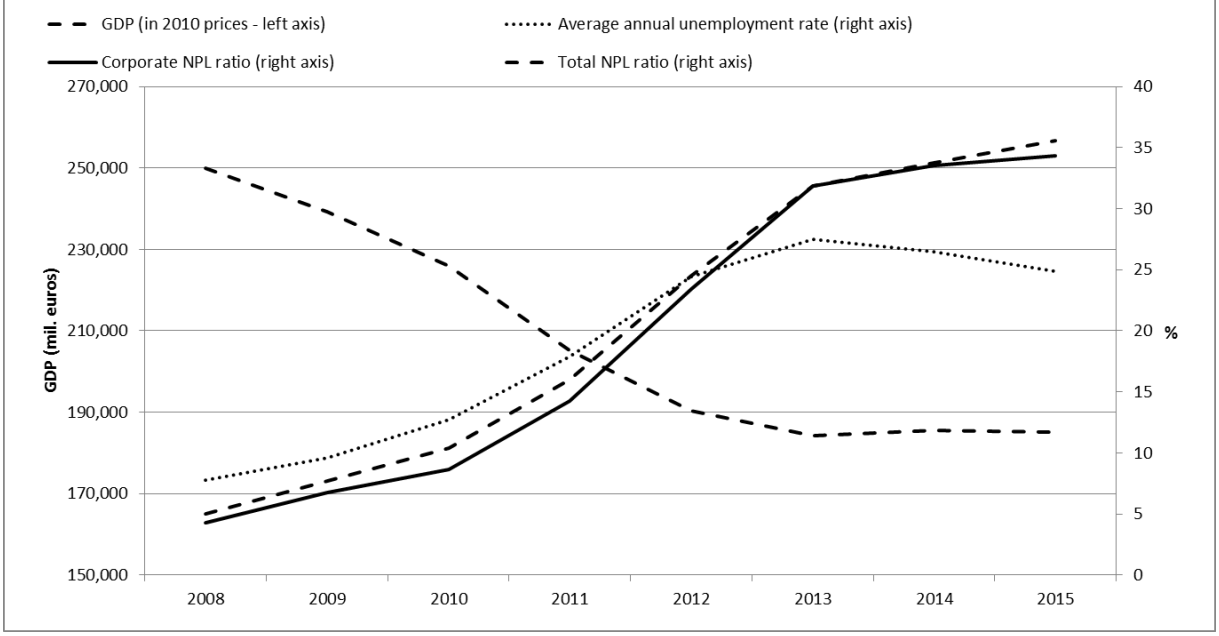


Figure 2: Marginal effect of firm size on probability of strategic default

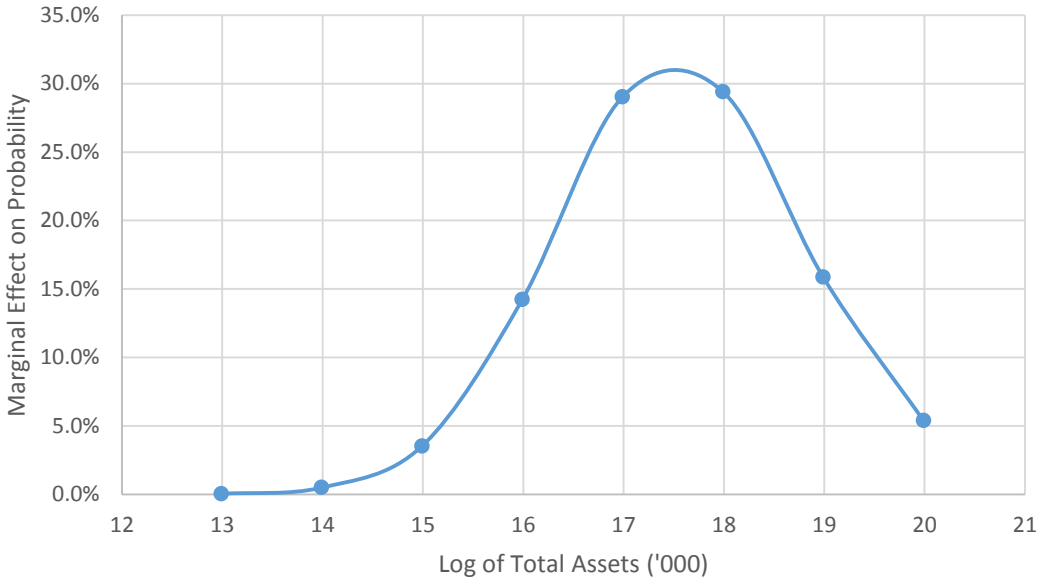
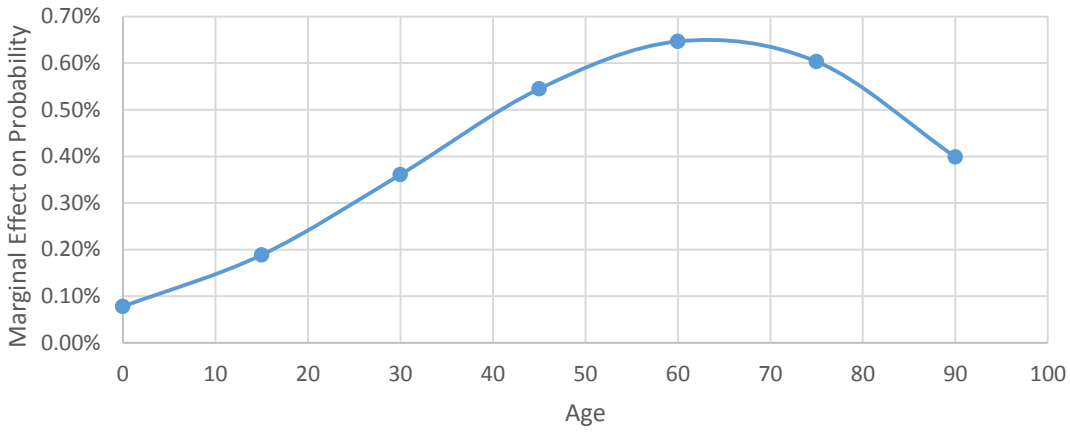


Figure 3: Marginal effect of firm age on probability of strategic default



BANK OF GREECE WORKING PAPERS

185. Adam, A., and T., Moutos, "Industry-Level Labour Demand Elasticities Across the Eurozone: Will There Be Any Gain After the Pain of Internal Devaluation?" July, 2014.

186. Tagkalakis, O.A., "Fiscal Policy, Net Exports, and the Sectoral Composition of Output in Greece", September 2014.

187. Hondroyiannis, G. and D., Papaoikonomou, "When Does it Pay To Tax? Evidence from State-Dependent Fiscal Multipliers in the Euro Area", October 2014.

188. Charalambakis, C. E., "On Corporate Financial Distress Prediction: What Can we Learn From Private Firms in a Small Open Economy?, November 2014.

189. Pagratis, S., E., Karakatsani and E. Louri, "Bank Leverage and Return on Equity Targeting: Intrinsic Procyclicality of Short-Term Choices", November 2014.

190. Evgenidis, A. and C., Siriopoulos, "What are the International Channels Through Which a US Policy Shock is Transmitted to the World Economies? Evidence from a Time Varying Favar", January 2015.

191. Louzis, D. P., and A.T., Vouldis, "Profitability in the Greek Banking System: a Dual Investigation of Net Interest and Non-Interest Income", February 2015.

192. Papaspyrou, S.T, "EMU 2.0 - Drawing Lessons From the Crisis - a New Framework For Stability and Growth", March 2014.

193. Litina, A and T, Palivos, "Corruption and Tax Evasion: Reflections on Greek Tragedy", June 2015.

194. Balfoussia, H. and H.D. Gibson, "Financial Conditions and Economic Activity: The Potential Impact of the Targeted Longer-Term Refinancing Operations (TLTROS)", July 2015.

195. Louzis, P. D., "Steady-State Priors and Bayesian Variable Selection in VAR Forecasting", July 2015.

196. Zografakis, S. and A., Sarris, "The Distributional Consequences of the Stabilization and Adjustment Policies in Greece During the Crisis, with the Use of A Multisectoral Computable General Equilibrium Model", August 2015.

197. Papageorgiou, D. and E. Vourvachaki, "The Macroeconomic Impact of Structural Reforms in Product and Labour Markets: Trade-Offs and Complementarities", October 2015.

198. Louri, H., and P. M. Migiakis, "Determinants of Euro-Area Bank Lending Margins: Financial Fragmentation and ECB Policies", October 2015.

199. Gibson, D. H, S.G. Hall, and G. S. Tavlas, "The effectiveness of the ECB's asset purchase programs of 2009 to 2012", November 2015.

200. Balfoussia, H and D. Malliaropulos, "Credit-less recoveries: the role of investment-savings imbalances", November 2015.

201. Kalyvitis, S., "Who Exports High-Quality Products? Some Empirical Regularities From Greek Exporting Firms", December 2015.

202. Papadopoulos, S., P. Stavroulias and T. Sager, "Systemic Early Warning Systems for EU15 Based on the 2008 Crisis", January 2016.

203. Papadopoulos, G., S. Papadopoulos and T. Sager, "Credit Risk Stress Testing for EU15 Banks: a Model Combination Approach", January 2016.

204. Louzis, P. D., "Macroeconomic Forecasting and Structural Changes in Steady States", March 2016.

205. Christodoulakis, N. and C. Axioglou, "Underinvestment and Unemployment: the Double Hazard in the Euro Area", April 2016.

206. Bardaka, C. I., "Structural and Cyclical Factors of Greece's Current Account Balances: A Note", May 2016.

207. Lothian, J. R., and G. S. Tavlas, "How Friedman and Schwartz Became Monetarists", May 2016.

208. Balfoussia, H. and H. D. Gibson, "Firm Investment and Financial Conditions in the Euro Area: Evidence from Firm-Level Data", June 2016.

209. Samantas, G.I., On the Optimality of Bank Competition Policy, July 2016.

210. Malliaropulos, D., and P.M. Migiakis, "The Re-Pricing of Sovereign Risks Following the Global Financial Crisis", July 2016.