Behavioral Attributes of Strategic Default: Evidence From the Foreclosure Moratorium in Greece*

Nikolaos Artavanis[1] and Ioannis Spyridopoulos[2]

[1]University of Massachusetts Amherst & Virginia Tech
[2]American University

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Contact information: N.Artavanis (corresponding author); nartavanis@isenberg.umass.edu, I.Spyridopoulos; ispyrido@american.edu.

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Abstract

We exploit the introduction of a foreclosure moratorium and a new personal bankruptcy process in Greece that protect primary residences, to identify strategic defaulters. The regulation created distinct optimal strategies for strategic and non-strategic defaulters, allowing us to distinguish strategic defaults through mortgagors' revealed preference. We show that 28% of defaults are strategic, and document considerable heterogeneity in strategic delinquencies across mortgagors. Our findings indicate prior engagement in moral hazard in the form of tax evasion, the existence of adverse liquidity shocks, and the level of financial and legal sophistication significantly contribute to strategic behavior.

Keywords: Strategic default, Foreclosure moratorium, Mortgage default, Moral hazard.

JEL classification: G21, D10, K35.

Moral hazard and adverse selection problems permeate financial markets and create significant distortions (Akerlof (1970), Stiglitz and Weiss (1981)). These issues take a prominent form in the case of strategic default, whereby borrowers become delinquent despite their ability to service their debt. Strategic default has received increased attention following the recent financial crisis, particularly in mortgage markets (Foote and Willen (2018)), where it can create significant welfare and economic spillover effects (Mian and Sufi (2014), Bradley et al. (2015)), compromising the effectiveness of intervention policies (Mayer et al. (2014), Giné and Kanz (2017)).[1] Recent literature suggests not all households that can default strategically choose to do so (Guiso et al. (2013), Gerardi et al. (2017)), but due to the difficulty of identifying strategic behavior, we know very little about factors that can explain strategic decisions.

In this paper, we exploit a unique set of regulatory changes in Greece that allow us to identify mortgagors who default strategically, and examine whether homeowners' behavioral attributes are associated with this decision. In the face of the deepest economic contraction in its modern history, the Greek government introduced in 2010 an almost universal moratorium on the foreclosure of primary homes.[2] This provision fostered moral hazard behavior by allowing individuals who could afford their mortgage to stop paying without risk of losing their primary residence. However, assessing whether individuals exploit the moratorium to default strategically remains difficult, because debt moratoria and restructuring programs coincide with negative economic shocks that affect homeowners' ability to pay.

In our setting, we can identify strategic defaulters by exploiting the fact that legislators, concurrently with the foreclosure moratorium, introduced a personal bankruptcy process.[3] The new bankruptcy law allowed over-indebted households to file for bankruptcy and undergo a rigorous, multi-stage process to prove their inability to service their debt in exchange

[1] Even though the focus of this paper is on mortgages, strategic default has been documented in almost every credit market, including corporate debt (Giroud et al. (2012)), unsecured debt (Gross and Souleles (2002)), student loans (Yannelis (2016)), and sovereign debt (Yeyati and Panizza (2011)).

[2] Similar debt moratoria during periods of large economic or financial distress have been implemented in the U.S. (Alston (1984), Rucker and Alston (1987)).

[3] Prior to this legislative intervention, personal bankruptcy was only available to individuals with commercial activity.

for a generous debt discharge (up to 80%-90% of outstanding debt). Moreover, even though the process required liquidation of the borrower's assets, it also provided protection for primary residences by excluding primary homes from liquidation. This regulatory framework creates a dominant strategy for borrowers who truly cannot pay their mortgage: to default and apply for bankruptcy. This strategy allows borrowers with the inability to pay to protect their primary residence and become eligible for a generous, permanent debt haircut with minimal liquidation costs. By contrast, for mortgagors with sufficient wealth or income, the bankruptcy process entails significant liquidation costs, without providing a debt haircut. As a result, mortgagors with the ability to pay, should they choose to default, would prefer to protect their primary homes through the foreclosure moratorium rather than apply for the debt-discharge process.

This regulatory framework creates distinct optimal strategies for delinquent mortgagors that allows us to separate non-strategic defaulters—those who apply for debt-discharge—from strategic defaulters—those who do not apply for bankruptcy and use the foreclosure moratorium to protect their primary homes. We apply our identification criterion to a large representative sample of households in Greece to estimate the incidence of strategic default in the mortgage market. We conservatively estimate that, until the end of 2013, at least 28% of delinquencies were strategic (12% of mortgagors in our sample). This rate aggregates to over 5 billion euros (3% of Greek GDP) in non-performing loans (NPLs) across the Greek banking system. The respective cost was largely moved to the public through recapitalizations that increased government debt and depleted state holdings in Greek banks.

A unique feature of our empirical strategy is that we identify strategic defaulters using mortgagors' revealed preference with respect to the bankruptcy process, instead of attempting to estimate their ability to pay. Therefore, we do not impose any restrictions on borrower (e.g., income, credit scores) or mortgage characteristics (e.g., loan amount, combined loan-to-value (CLTV) ratio) to identify strategic delinquencies. Consistent with prior work on mortgage defaults, we find that borrowers with lower credit scores, higher loan amounts, and higher combined CLTV ratios are more likely to become delinquent. Furthermore,

we show that defaults by mortgagors with higher credit scores, higher income, and lower CLTVs are more likely to be strategic. Taken together, these results are consistent with the idea that strategic defaulters have greater ability to pay than their non-strategic peers, and corroborate the validity of our identification strategy.

We find considerable heterogeneity in the incidence of strategic defaults across homeowners, and examine behavioral attributes associated with strategic default. In our tests, we use two specifications to capture different types of information regarding strategic behavior. First, we consider only delinquent mortgagors, and compare strategic with non-strategic defaulters; these tests focus on the probability of a delinquency being strategic. Second, we compare non-defaulters with strategic defaulters to examine factors that motivate strategic behavior among borrowers with the ability to pay.

First, we examine whether previous engagement in moral hazard is related to strategic behavior in the future. We find that self-employed mortgagors exhibit a high propensity to default strategically, and relate this finding to tax evasion—a prominent characteristic of self-employment (Kleven et al. (2011), Artavanis et al. (2016)). We look into the effect of tax evasion on strategic default at the extensive margin, by matching self-employed professionals and wage workers at the job-description level and across mortgage characteristics. Self-employed borrowers are 5.5% more likely to default strategically, whereas a default by a self-employed mortgagor is 7.4% more likely to be deliberate. We provide further evidence on the intensive margin of this relationship using tax-evasion multipliers estimated following the methodology of Artavanis et al. (2016). We find the magnitude of past tax-evading activity is significantly related to the propensity to exhibit strategic behavior; specifically, hiding half of the true income from tax authorities increases the probability of strategic default by 5%.

Second, we investigate the role of liquidity preference on strategic behavior. Specifically, we examine whether homeowners—in order to substitute for the loss of liquidity—choose to default even if they can afford to pay their mortgage. Cohen-Cole and Morse (2010) find that some individuals choose to remain solvent on credit card debt and default on their mortgage

in order to retain precautionary liquidity. Bajari et al. (2008) and Elul et al. (2010) argue mortgagors who face significant liquidity constraints may default even on positive equity mortgages. To test our hypothesis, we focus on borrowers who suffer a substantial adverse liquidity shock, and therefore, would be more likely to default strategically if they want to restore their prior levels of liquidity. To this end, we exploit the disproportionate effect of Greek austerity measures on retirees during our sample period; high-income pensioners experienced a 30% reduction in their pensions, whereas low-income pensioners were almost unaffected (Tinios (2016)). Our results indicate that even though high-earning retirees exhibit lower default rates, they are 3.7% more likely to default strategically than their low-income peers. Furthermore, a delinquency from a high-income pensioner is 13.8% more likely to be deliberate. These findings are consistent with the idea that individuals substitute the loss of liquidity by foregoing mortgage payments.

Finally, we examine the role of household sophistication on strategic default. Guiso et al. (2013) argue that college education is not related to strategic behavior. We extend their findings by examining the effect of professional specialization in conjunction with education. Even though college education does not affect the likelihood of strategic default in our tests, we find a clear dichotomy among high-profile professions that typically require a college degree. Professionals in medicine, engineering, and education exhibit strategic behavior close to the sample average. By contrast, borrowers working in law and finance are significantly more likely to default deliberately. For instance, finance and law professionals are 4% more likely to default strategically than professionals in other high-profile industries. Furthermore, delinquencies in finance and law are, respectively, 8% and 22.5% more likely to be deliberate. We attribute this finding to the fact that these professionals have a better understanding of the financial and legal ramifications of the foreclosure moratorium, and thus, are more likely to exploit the regulatory provisions to their benefit. Importantly, finance professionals, unlike their peers in law, react more aggressively to the presence of negative equity, which increases their strategic default rate by an additional 4.6%. This finding suggests the two groups process different types of information: financial and legal, respectively. On the

other hand, the military exhibits remarkably low strategic default rates, consistent with the view that military service may inculcate a stronger sense of ethics and social consciousness (Akerlof and Kranton (2005), Benmelech and Frydman (2015)).

Our paper contributes to the literature on the determinants of strategic default in mortgage markets. Guiso et al. (2013) highlight the importance of both pecuniary and non-pecuniary factors on the incidence of strategic default. Mayer et al. (2014) show that a favorable legal settlement of delinquent mortgages results in an increase in default rates, as solvent borrowers attempt to benefit from the provision. Gerardi et al. (2017) measure ability to pay from formal financial datasets, and find a high percentage of borrowers with no apparent liquidity continue to service their debt obligations. Finally, Bhutta et al. (2017) find that borrowers continue to service their mortgages until they are deep underwater, and suggest that behavioral factors may play an important role on mortgagors' decision to default. Our work extends these findings by providing evidence on specific behavioral attributes—namely, previous engagement in moral-hazard (tax-evasion), liquidity preference, and borrower sophistication—that contribute significantly to strategic default.

Additionally, our study uses a novel method to identify strategic defaulters based on the revealed preference of the agent with superior information regarding ability to pay, namely, *the borrower*. This approach is free of self-reporting biases that may hinder survey methods (Hurst et al. (2014)), or limitations of financial and banking data in estimating borrowers' true ability to pay (Guiso et al. (2013)). More importantly, our method does not condition on borrower or loan characteristics (i.e., credit scores, CLTV, employment type) to identify strategic default, which allows us to include these variables in our analysis.

Finally, our study contributes to the literature on the political economy of credit by examining the lengthiest moratorium in modern history.[4] Agarwal et al. (2018) find evidence of U.S. banks attempting to influence the political process by delaying foreclosures in districts of the House of Representatives Financial Services Committee members. Giné and Kanz (2017) show that a bailout program in India had a significant effect on strategic behavior,

[4]The foreclosure moratorium on primary residences remained intact at least until the end of 2014.

which was sensitive to the state electoral cycle. In this paper, we investigate the effects of credit market intervention on borrower repayment patterns, complementing the existing literature on foreclosure moratoria that is mainly focused on supply-side effects (Alston (1984), Pence (2006), Morse and Tsoutsoura (2013)).

The remainder of the study is as follows. The next section provides details for the legal framework and our identification criterion. Section II describes our data and our empirical methodology. Section III presents our empirical results regarding the incidence and the distribution of strategic default. In section IV, we examine the behavioral factors of strategic default. Section V concludes the study.

I. Legal Framework and Identification

A. Legal Framework for Personal Bankruptcy and Foreclosure Moratoria

Before 2010, Greece did not have a personal bankruptcy framework for individuals.[5] In June of 2010, the Greek Parliament introduced new legislation to provide relief to over-indebted households. Law N.3869/2010, also known as the "Katseli law," imposed a *primary residence moratorium* and introduced a *debt-discharge process*.

The new set of regulations provided *dual protection* for primary residences, a feature we exploit to identify strategic default. First, the law imposed a foreclosure moratorium on primary homes with objective value below 300,000 euros.[6] In practice, the imposed thresholds protected the vast majority of primary residences and made the effect of the provision almost universal. The median objective value in our sample is just 71,000 euros, and, as Figure 1 shows, 98.7% of dwellings fall below the inclusion threshold. The law originally deferred foreclosures for six months but was subsequently extended without any

[5] The ability to default was only available to commercials with N.3855/2007. See Vallender et al. (2013) for more details on personal debt charge provisions in Greece and other European countries.

[6] Objective values correspond to presumed values used by tax authorities to estimate tax liabilities, and at the time of the implementation they were significantly lower than market values. The 300,000-euros threshold applied to single individuals. A threshold of up to 450,000 euros applied for married couples with three or more children.

change until the end of 2013.[7] The electorate provided strong support for politicians to protect mortgagors, creating the expectation for the public that the government would maintain the status quo for the foreseeable future.[8]

Second, the same law (N.3869/2010) introduced a bankruptcy procedure for individuals that *excluded primary residences from liquidation*, using the same threshold as the foreclosure moratorium. The debt-discharge process included the following three stages:

- *Stage 1 (Application)*: The borrower applies for personal bankruptcy protection. From the time of the application, mortgages accrue interest at the non-delinquency rate.

- *Stage 2 (Out-of-Court Settlement)*: The borrower provides to creditors a list of eligible debt obligations to be settled, a comprehensive report of current financial state (financial/real assets and income), and a proposed repayment plan. The case is settled if the two parties agree on the repayment plan within three months.

- *Stage 3 (In-Court Settlement)*: If the out-of-court settlement is unsuccessful, the case is deferred to the court. The court orders the liquidation of the borrower's assets *excluding the primary residence*, sets a monthly payment for the next four years, and eliminates the residual debt (debt haircut).

In practice, this framework proved to be incomplete, dysfunctional, and prone to abuse due to the inefficiencies of the Greek judicial system (Paulus et al. (2015)). The bankruptcy provisions were relevant only for private debt, thus failing to provide relief for a wide range of other obligations, mainly toward the government, such as taxes or social security. Additionally, the vagueness of the law allowed for its subjective interpretation; for instance, during the in-court settlement stage, the law prescribes that monthly payments are set at

[7] The government extended protection of the primary residence prescribed in N.3869/2010 with N.3886/2011, N.4047/2012, and N.4128/2013. Starting from 1/1/2014, N.4224/2013 imposed additional criteria on the objective value of the primary residence and income. This is the main reason our sample period ends in December 2013.

[8] Bolton and Rosenthal (2002) describe a similar setting where an unanticipated foreclosure moratorium receives political support by improving efficiency and preventing negative spillover effects from a large number of foreclosures.

an amount that allows borrowers to maintain "decent living standards" without further clarification.

B. Identification of Strategic Default

Borrowers default strategically if they become delinquent despite having the financial means to service their debt obligations. Identifying strategic defaulters is a particularly challenging task because these individuals have a strong incentive to camouflage as borrowers with inability to pay (Guiso et al. (2013)). Therefore, detecting such behavior requires a comprehensive view of the borrower's financial state. However, in reality, this information is not attainable because individuals may hold hidden assets or have informal income.

Previous studies have used three approaches to determine borrowers' ability to pay, each having its own merits and limitations. One approach relies on survey data, whereby strategic behavior is assessed through a set of survey questions. By altering a set of hypothetical questions, surveys are helpful in examining counterfactual scenarios (Guiso et al. (2013)), but they can be subject to self-reporting biases (Hurst et al. (2014)), especially if they do not reflect agents' actions. Another method is to estimate the agent's ability to pay using formal financial data, such as measures of liquidity (Gerardi et al. (2017)), credit scores (Goodstein et al. (2017)), or repayment patterns (Cohen-Cole and Morse (2010)). Even though more direct, this approach may fail to determine mortgagors' ability to pay if they hide their assets or income.[9] Finally, a third approach is to examine borrowers' response to exogenous policy shocks (Mayer et al. (2014)). This method provides strong causal evidence about the overall incidence of strategic defaults, but it requires additional criteria to detect strategic defaulters (e.g., credit score, LTV).

In this study, we identify strategic defaulters based on their revealed preference with respect to the new bankruptcy process. We illustrate the set of possible actions in our setting in the form of a decision tree in Figure 2, which also lays out our identification

[9]For example, Gerardi et al. (2017) find that 80% of households without ability to pay continue to service their mortgages, which implies these borrowers have access to income streams that formal financial datasets do not reflect.

approach. Before the implementation of the law, two states were possible: default and non-default. Due to the existence of foreclosure costs and legal recourse, default is only preferable when mortgagors cannot pay *and* have negative equity.

The introduction of the foreclosure moratorium and the personal bankruptcy process create a new set of choices for borrowers (see Figure 2.b). Our identifying assumption relies on the fact that the new regulatory environment creates a dominant strategy for mortgagors with inability to pay. These borrowers strictly prefer to default and apply for bankruptcy, because they are subject to low liquidation costs and are eligible for a large debt haircut. In contrast, borrowers with ability to pay are subject to higher liquidation costs and are less likely to receive debt-relief. Therefore, these borrowers do not apply for debt discharge if they choose to default, and instead protect their primary residence through the foreclosure moratorium.

Table A.I summarizes the optimal strategies of borrowers with respect to their ability to pay (w) and the net benefits of strategic behavior ($B_i - C_i$). We show that for mortgagors inability to pay ($w < w^*$) "default and apply" is a dominant strategy. On the other hand, for mortgagors with ability to pay ($w > w^*$) the bankruptcy process is never optimal; the decision to "default without applying" or remaining current on their mortgage payments depends on the relevant costs and benefits of the former option. Following the intuition behind these outcomes, we separate defaults to strategic, if the borrower does not apply for personal bankruptcy, and non-strategic, if the borrower applies for debt discharge.

Our approach has two major advantages over alternative identification methods. First, we identify strategic defaulters based on the behavior of the entity with superior information regarding their ability to pay—the borrower. Second, our method does not condition on any borrower or loan characteristics to identify strategic defaults, which allows us to include these variables in our analysis. For example, if strategic behavior is assessed through borrowers' credit scores, it would not be possible to investigate how cross-mortgagor heterogeneity in credit scores (or any variable highly correlated with it, such as income) explains the variation in strategic default.

II. Data and Methodology

A. Data and Samples

Our dataset includes the universe of primary residence mortgages from a large Greek bank. We focus only on primary residence mortgages to exploit the overlap of protection from the foreclosure moratorium and the personal bankruptcy process. We also restrict our sample to mortgages originated after 2006, for which both application and performance files are available, and exclude any loans that were made post-legislation to mitigate potential selection issues.

Our study combines multiple proprietary datasets from the bank. From mortgage application files, we obtain information on loan terms (amount approved, monthly installment, interest rate, interest-rate type, maturity, and number of cosigners). We complement this information with mortgagor characteristics (credit score, reported personal and total income, age, occupation, marital status, number of children, and education). Our data also include borrowers' total outstanding debt with the bank and other financial institutions from the credit registry. For each mortgage, we observe initial loan-to-value (LTV) and combined loan-to-value (CLTV) ratios, and the initial market value of the property. We use a real-estate index (updated annually) to calculate current LTV and CLTV ratios. From mortgage performance files, we track monthly repayment patterns and delinquency rates. Finally, we also observe whether a borrower files for bankruptcy, and the exact time of the filing.

We define defaulters as borrowers whose loans are in delay for more than 180 days (t+6 rule), or if they become delinquent on a previously restructured loan.[10] Following our identification criterion, we define as non-strategic defaulters those mortgagors who default before the implementation of the new regulation or become delinquent after the passage of the regulation and apply for personal bankruptcy anytime until six months from the end of our sample period (June 2014).

[10] We impose this condition to account for possible "evergreening" effects (see Peek and Rosengren (2005)) in accordance to the European Central Bank definition of Non-Performing Exposures (EU 680/2014).

To ensure all mortgagors in our sample are eligible for both regulatory provisions, we apply the following filters. First, we exclude mortgages held by commercials, because the bankruptcy law applies only to non-commercial individuals.[11] Second, we exclude mortgages on primary residences with objective values above the threshold (300,000 euros) because the foreclosure moratorium does not protect these residences. Third, we exclude subsidized mortgages, or mortgages guaranteed by the state.

Note that our identification method is by design conservative for a number of reasons. For example, we cannot exclude the possibility that a mortgagor with "ability to pay" applies for personal bankruptcy, even if doing so constitutes a sub-optimal choice. Furthermore, we cannot rule out the possibility that a mortgagor attempts to hide her assets through transfers to family members or trusts, in order to camouflage as a borrower with inability to pay. However, during the court process, judges can monitor mortgagors' transaction history, and therefore, such fraudulent practices entail considerable risk and are less likely to affect our identification strategy.

Table I presents summary statistics for our sample. The average mortgage has an outstanding amount of 103,000 euros, an interest rate of around 4%, and maturity of 25 years. The commercial value of the houses are significantly higher than their objective values, and the mean initial CLTV is 62%. The median borrower is 51 years old, has personal (total) income of approximately 12,200 (25,700) euros, and the median mortgage has two cosigners.

B. Methodology

In sections III and IV, we investigate default and strategic default patterns across borrowers with different mortgage and demographic characteristics using multivariate regressions. Our baseline regression model is as follows:

$$\Pr(Y_i = 1) = \mathbb{B}_i + \mathbb{L}_i + \alpha_z + \varepsilon_i, \tag{1}$$

[11] According to Greek law, the definition of commercials includes individuals who profit from commercial activity. This definition excludes self-employed individuals, such as doctors, engineers, lawyers, and low-scale commercials who are mainly compensated for personal labor. We define commercials based on their detailed occupation description and require that they report more than 50,000 euros in annual income. We also use an alternative threshold of 30,000 euros, with no significant changes in our main results.

where indicator i refers to the borrower, z refers to the residence ZIP code, and $\mathbb{B}_i$ and $\mathbb{L}_i$ are vectors of variables for borrower and loan characteristics, respectively. We choose a linear probability model for our baseline regressions to partial out unobservable time-invariant local factors by including ZIP-code fixed effects (α_z).[12]

We use three different specifications of regression (1) to capture different types of information regarding borrower behavior. In the first set of tests, we focus on the determinants of default. Therefore, in regression (2) our dependent variable Y_i equals one if the mortgagor defaults, and zero otherwise. These tests allow us to identify borrower and mortgage characteristics that affect delinquencies, both strategic and non-strategic.

$$\Pr(\text{Default=1}) = \mathbb{B}_i + \mathbb{L}_i + \alpha_z + \varepsilon_i \tag{2}$$

In the next two regression models, we examine the determinants of strategic default. In regression (3), we focus on the probability of strategic default (*Str.Default=1*) conditional on the event of a delinquency (*Default=1*). In this specification, the dependent variable (Y_i) equals one if the mortgagor defaults strategically, and zero if the default is not deliberate. These tests allows us to examine how borrower and mortgage characteristics affect the probability of a default being strategic.

$$\Pr(\text{Str. Default=1} \mid \text{Default=1}) = \mathbb{B}_i + \mathbb{L}_i + \alpha_z + \varepsilon_i \tag{3}$$

Finally, our third set of tests focus on borrowers with ability to pay (i.e., we exclude delinquent mortgagors that are not strategic) and examine factors that may affect their decision to default deliberately or remain current on their debt obligations.

$$\Pr(\text{Str. Default=1} \mid \text{Non Str. Default=0}) = \mathbb{B}_i + \mathbb{L}_i + \alpha_z + \varepsilon_i \tag{4}$$

In regression (4), we examine the probability of strategic default (*Str.Default=1*) given that our borrower has ability to pay (i.e., is not a non-strategic defaulter, *Non-Str.Default=0*). We use this specification exclusively in section IV, where we look into the behavioral determinants of strategic default.

[12] We find economically larger estimates using Probit regressions (marginal effects are tabulated in the Appendix, Table A.II).

III. The Incidence and Distribution of Strategic Default

A. The Incidence of Strategic Default

During the financial crisis, Greek banks experienced an unprecedented period of high delinquency rates across all credit products (Haliassos et al. (2017)), including mortgages. The residential mortgage portfolio accounts for over 30% of Greek banks' assets (Bank of Greece, 2013). Therefore, the effects of the foreclosure moratorium on borrower behavior and repayment patterns may have far-reaching implications on the overall stability of the banking sector.

Figure 3 presents delinquency rates for primary and secondary residence mortgages. Default rates increase dramatically in the post-crisis period exceeding 40% for the primary and 20% for the secondary mortgage portfolio by the end of 2013. Default-rate slopes become steeper after the legislative intervention with a six-month lag reflecting the t+6 rule on payment delay that is required for mortgage delinquencies in Greece.

However, we cannot fully attribute the increase in mortgage defaults to the new regulations because the Greek economy is in deep recession during the sample period. In Figure 3, even though default rates for primary residence mortgages increase more sharply after the moratorium, we refrain from drawing causal inferences for two reasons. First, secondary residence mortgages also received (a more limited) protection by a general foreclosure moratorium based on mortgagors' total indebtedness. Because we do not have information on mortgagors' non-bank debt, we cannot implement a regression discontinuity approach around the inclusion threshold.[13] Second, there are wealth-effect considerations; borrowers who can afford a secondary residence may be wealthier, which in turn can affect the probability of default. We avoid these identification issues by focusing our analysis only on

[13] Law N.3858/2010, which was also enacted in June 2010, prevented any foreclosure for total debt—including non-bank debt—below 200,000 euros. However, the Greek credit registry does not provide information for non-bank debt, so we cannot assess whether total debt obligations are below or above this threshold.

primary residences, and detect strategic behavior through mortgagors' preference toward the bankruptcy process.

By the end of 2013, default rates for primary residences reach 41.5%. To put this number in perspective, the delinquency and foreclosure rates during the recent U.S. mortgage crisis were just 11.5% and 4.6%, respectively (Frame (2010)). Applying our identification criterion, we conservatively estimate that at least 28.4% of the defaults are deliberate. This percentage corresponds to 11.8% of the borrowers in our sample. These mortgagors become delinquent and do not apply for debt discharge, indicating the existence of additional assets or sufficient income.

The incidence of strategic default in this paper is comparable to previous studies. Using survey data, Guiso et al. (2013) estimate a strategic default rate between 26% and 35%. Gerardi et al. (2017) use liquidity measures to assess ability to pay, and find that 38% of the delinquencies in their sample are intentional. Even though default rates in the two settings are different, the share of strategic to total defaults is comparable.

Strategic behavior had a significant impact on the financial health of Greek banks, which held over 70 billion euros in outstanding mortgages by the end of 2013. Our estimates aggregate to over 5 billion euros in non-performing loans due to strategic default in primary residences, given that 60%-70% of the mortgage portfolio refers to primary homes.[14] The respective cost was primarily moved to the public through bank-recapitalizations that increased government debt and depleted state bank holdings.[15]

B. Distribution of Strategic Default

Most studies define strategic default by conditioning on borrower and mortgage characteristics. For instance, a defaulter might be identified as strategic if she has high income/credit score or negative equity (high LTV). However, this conditioning prevents the

[14] Bank of Greece does not provide information on mortgages by residence type (primary vs secondary). Instead, we surveyed bank managers of Greek systemic banks, and used their lower-bound estimates as benchmarks.

[15] Specifically, the recapitalization of Greek banks in 2014 amounted to 8.3 billion euros (Haliassos et al. (2017)).

inclusion of these variables in the analysis of strategic behavior. By contrast, our identification method is free of these limitations, therefore we can use our criterion to examine the role of borrower and loan characteristics on the decision to default, deliberately or not.

In Table II, we present mean values for characteristics of defaulters and non-defaulters, along with univariate differences (columns (1)-(3)). Defaulters have significantly higher loan amounts and CLTVs, but lower income and credit scores. Columns (4)-(5) report mean values for strategic and non-strategic defaulters. We find that strategic defaulters have, on average, higher initial credit scores, higher total income, and lower CLTVs than non-strategic defaulters.

In Table III, we examine the effect of borrower and loan characteristics on default and strategic default in a regression setting. Consistent with findings in the literature (Campbell and Dietrich (1983), Elul et al. (2010), Demyanyk and Van Hemert (2011)) borrowers with lower income, lower credit scores, and higher CLTV are more likely to default (columns (1)-(2)). Specifically, a 10% increase in CLTV increases the likelihood of default by 2.5%, while doubling mortgagors' income decreases the likelihood of default by 2.6%-4.4%.

In columns (3) and (4) we show that defaults by mortgagors with higher credit scores, higher reported income, and lower CLTVs are more probable to be strategic. A one-standard-deviation increase in a homeowner's credit score (100 points) increases the likelihood that a default is strategic by 3%, and a one-standard-deviation increase in CLTV (20%) reduces the probability of a strategic default by 4.4%-4.6%. These findings are consistent with the idea that strategic defaulters are less likely to be financially constrained than their non-strategic peers (Guiso et al. (2013) and Gerardi et al. (2017)).

Additionally, the interest rate is positively correlated with delinquency, consistent with adverse selection (Karlan and Zinman (2009)), but it does not have a significant effect on strategic default. Importantly, we find that the existence of cosigners, even though it has no impact on whether a mortgagor defaults, it has a large negative effect on the probability that a default is strategic. Specifically, adding an additional cosigner in the mortgage reduces the probably of strategic default by 2.8%-3.2%. This result is consistent with the idea

that strategic decisions require coordination, and coordination failure is more likely due to "strategic uncertainty"—the notion that some individuals involved in the transaction may perceive this strategy as too risky (Van Huyck et al. (1990)).

Next, we examine the impact of educational and occupational characteristics on strategic behavior. We find that college graduates are less likely to default on their mortgages, suggesting educated individuals weathered the economic crisis more successfully. Borrowers employed in the private sector exhibit a higher propensity to default than public employees, consistent with the existence of a public-sector wage premium (Christopoulou and Monastiriotis (2015)). Within the private sector, we find that self-employed professionals are not just more likely to default, but also more prone to strategic behavior. In contrast to Guiso et al. (2013), our results suggest that defaults by pensioners and older borrowers overall are less likely to be strategic.

Finally, we examine the effect of demographic variables on default patterns. Single borrowers are less likely to default, whereas parenthood increases the probability of becoming delinquent. However, neither variable seems to be significantly related to strategic default. One of the most striking results relates to single-parent families. Single parents exhibit both significantly high default rates and one of the lowest levels of strategic behavior in our sample (21.3%), indicating that even though this group defaults more frequently, failure to meet mortgage payments in most cases is not deliberate.

IV. Behavioral Attributes of Strategic Default

A. Tax Evasion and Strategic Default

Mortgagors who default strategically exploit the inefficiencies in regulatory interventions. But, similar opportunities may arise from any poorly-designed or weakly implemented policy. For instance, households can exploit weak tax enforcement to evade their taxes. In this section, we examine whether these two cases of moral hazard are related; more specifically,

we test whether individuals who evade taxes are also more prone to exhibiting strategic behavior.

It is important to note that the existence of tax evasion further complicates the identification of strategic defaulters. The reason is that tax evaders hide their income and assets from authorities. Therefore, assessing their ability to pay using financial data becomes even more challenging, because formal datasets tend to underestimate mortgagors' true wealth and income. Our approach is not subject to this limitation, because we rely on borrower's revealed preference to identify strategic behavior.

The literature provides strong evidence that self-employment status is related to tax evasion, mainly due to the lack of third-party reporting (Kleven et al. (2016)). Kleven et al. (2011) show that under-reporting in Denmark is concentrated among taxpayers who self-report their income. Artavanis et al. (2016) find that self-employed professionals in Greece hide almost half of their income from tax authorities, and identify medicine, law, engineering, and finance as the top-evading industries. We relate the high incidence of tax evasion among self-employed professionals in Greece to our results in Table III, that self-employed professionals are more prone to strategic default.

In Table IV, we examine default and strategic default patterns of self-employed professionals. We start our analysis by matching mortgagors who are self-employed (treated) with wage-workers (control) based on their exact job description, as well as on their credit score and CLTV. This procedure reduces our sample size because it requires the presence of individuals from both groups within the same job-description cell. For example, in the law industry, we keep lawyers but exclude judges, because judges can only be wage-workers (employed by the state).

In Table IV we find that self-employed professionals are 2.8% more likely to default on their mortgage (column (1)). The regression results in column (2) suggest that defaults by self-employed individuals are 7.4% more likely to be strategic compared to wage-workers, even after the matching process. In column (3), we exclude non-strategic defaulters and focus on a sample of self-employed and wage-workers with ability to pay. The regression

estimate on self-employment remains positive and statistically significant. Self-employed mortgagors are 5.5% more likely to default strategically than wage-workers with the same job and similar characteristics.

These results are suggestive of a relationship between tax evasion and strategic behavior at the extensive margin. We provide evidence for this relationship at the intensive margin as well, using estimates of income under-reporting. To this end, we follow the methodology of Artavanis et al. (2016) that estimate tax evasion multipliers from borrower's credit capacity. This method gauges tax-evaded income by comparing credit extended by commercial banks to self-employed individuals and wage workers (who cannot evade taxes) while controlling for a host of customer and loan characteristics. The multipliers provide an intensive-margin measure of tax evasion for self-employed by mapping reported to true income, using wage-workers with similar characteristics as benchmark.

Ideally, this methodology requires that we focus on borrowers who exhaust their credit capacity. Because we do not have information on whether the mortgage provided is close to this limit, we only keep mortgages with CLTV over 50%. Therefore, we focus on mortgagors who borrow substantially toward the purchase of their primary home. This control does not alleviate concerns that our borrower might choose a property below her full credit capacity. However, buying a house in Greece is usually a lifetime decision, in contrast to markets where entry houses, geographical migration, or frequent flipping of properties are more common. Therefore, our assumption that Greek mortgagors attempt to buy the "best house" they can afford and consequently exhaust their current credit capacity is plausible.

We use two models to estimate the extent of an individual's evading activity. The first measure relies on the sensitivity of reported income to credit capacity among self-employed professionals, controlling for customer and loan characteristics. Coefficient κ_i in equation (6) is the ratio of the mortgage amount the bank offers to the customer over the predicted credit capacity in regression (5). This coefficient therefore serves as a relative measure of

income under-reporting with respect to the average self-employed in our sample.

$$\widehat{Cc}_i = \alpha_i + \beta_1 \cdot \mathrm{Y}_i^R + \beta_2 \cdot \mathbb{B}_i + \beta_3 \cdot \mathbb{L}_i + \varepsilon_i \tag{5}$$

$$\kappa_i = \frac{Cc_i}{\widehat{Cc}_i} \tag{6}$$

In (5) and (6), i denotes the borrower, Cc denotes the credit capacity extended by the bank, Y^R denotes the reported income, $\mathbb{B}$ is a vector of customer characteristics (credit score, income, job description), and $\mathbb{L}$ is a vector of the mortgage characteristics (CLTV, loan amount, interest rate, maturity, number of cosigners, and housing collateral).

The second measure of tax evasion follows the methodology of Artavanis et al. (2016) at the job-description—instead of the industry—level. As in Pissarides and Weber (1989), we assume wage-workers do not evade taxes. First, we estimate the sensitivity of credit capacity to true income for wage-workers (β_1) and the sensitivity of credit capacity to reported income for self-employed professionals within a detailed job-specification level (β_{2j}). Then, we define the tax evasion multiplier λ_j as the ratio of β_{2j} over β_1 (equation (8)). Intuitively, this ratio maps reported-to-true income for self-employed professionals, using wage-workers—who cannot tax-evade—as benchmark.

$$\mathrm{Cc}_{ij} = \alpha_j + \beta_1 Y_i^T \cdot \mathbb{I}_{ww_i} + \beta_{2j} Y_i^R \cdot \mathbb{I}_{se_{ij}} + \gamma_1 \cdot \mathbb{B}_i + \gamma_3 \cdot \mathbb{L}_i + \varepsilon_{ij} \tag{7}$$

$$\lambda_j = \frac{\beta_{2j}}{\beta_1} \tag{8}$$

We include the indicators of evading activity κ_i and λ_j as independent variables in our baseline regression (4), which focuses only on borrowers with ability to pay. Table V presents the results. In column (1), we find that self-employed professionals who receive higher credit capacity than their peers with similar characteristics are significantly more likely to default strategically. In column (2) we find the tax evasion multiplier λ is also significantly and positively related to the propensity to exhibit strategic behavior. The regression in column (2) also provides an intuitive way to quantify the relationship between tax evasion and strategic default. Specifically, we find that mortgagors who report half of

their true income to tax authorities (λ_j=2) are approximately 5% more likely to default strategically, compared to individuals that do not tax-evade (λ_j=1).

Taken together, our results suggest individuals who engaged in moral hazard in the past (tax evasion) are more likely to exhibit similar behavior in the future (strategic default). Moreover, we find evidence that not only the incidence, but also the intensity of prior evading activity affects the propensity to default deliberately.

B. Liquidity Preference and Strategic Default

The past literature identifies two factors that can motivate strategic default in mortgages: the existence of negative equity and the preference for (precautionary) liquidity. The *negative-equity hypothesis* refers to deliberate defaults because the outstanding balance of the mortgage exceeds the market value of the house (Bajari et al. (2008)). The *liquidity-preference hypothesis*, on the other hand, attributes strategic behavior to mortgagors' choice of maintaining a certain level of liquidity (Cohen-Cole and Morse (2010)). These two channels are not mutually exclusive, and they can affect borrower behavior simultaneously.[16]

A common misconception is that negative equity is a necessary condition for strategic default. However, this condition is true only for a specific class of debt obligations; namely, secured loans that are contracted in non-recourse states. In recourse states, the borrower remains responsible for the residual debt (Ghent and Kudlyak (2011)), thus walking away from an underwater loan does not reduce the size of the debt obligation. Furthermore, for unsecured loans, the concept of equity cannot be defined due to the lack of collateral, although, strategic behavior also exists in these settings (see Gross and Souleles (2002), Yannelis (2016)).

On the other hand, liquidity preference can explain strategic behavior in the presence of recourse or the absence of collateral. Specifically for mortgages, the liquidity-preference channel can provide an explanation for strategic default, even when the loan is not un-

[16] Both factors contribute to mortgage defaults, in general, as shown in the context of double-trigger default models (Vandell (1995), Elul et al. (2010), Schelkle (2018)).

derwater. For example, Mayer et al. (2014) report increased delinquency rates following a loan-modification plan, even for positive equity mortgages.

The foreclosure moratorium has two important implications that allow us to examine the liquidity channel in a loan-class for which the negative-equity hypothesis is usually dominant. First, the inability to foreclose the collateral transforms previously secured loans to de facto unsecured debt, at least for the duration of the law. Thus, the negative-equity condition becomes less binding. Second, because banks cannot foreclose primary residences, defaulters do not have to acquire alternative housing services, and realize the entirety of the foregone mortgage payment as a positive liquidity shock. In short, the moratorium mutes the effect of negative equity to a certain degree, whereas it underpins the importance of the liquidity channel.

In support of the view that the negative-equity channel becomes less important after the moratorium, we first show that defaults (strategic or not) also occur in our sample for positive equity mortgages. The majority of mortgages in our sample have positive equity at the time of the moratorium implementation (Figure 4.a), and remain so at the end of our sample period (Figure 4.b). Furthermore, at the time of default most delinquencies, strategic or not, refer to positive equity mortgages (Figures 4.c, 4.d).

Directly testing the liquidity preference hypothesis is challenging, because it requires knowledge of current and desired (optimal) levels of liquidity, both of which are difficult to assess. Instead, we examine the effect of this channel on strategic behavior by focusing on borrowers who experience negative cash-flow shocks during the crisis. We hypothesize that individuals who realize significant adverse liquidity shocks may also exhibit a strong preference for liquidity to restore their prior state. Therefore, these borrowers may be more prone to strategic default and forego mortgage payments in order to substitute for the loss of liquidity.

To test this hypothesis, we focus on pensioners for two reasons. First, the Greek austerity measures significantly reduced pensions, but not uniformly, because the government attempted to protect lower-income retirees. Tinios (2016) identifies 13 distinct pension cuts

between 2010 and 2013 that resulted in reductions of over 30% for high-income pensioners. On the other hand, these measures had little effect on low-income retirees, who even received small increases in some cases. Second, identifying liquidity shocks can be challenging in an environment of pervasive tax evasion. Pensions in Greece are typically reported by the state, which mitigates concerns for under-reporting (Kleven et al. (2011)).

In Table VI, we examine the incidence of default and strategic default among pensioners for different income quartiles. In column (1), we show that the effect of income on the probability of default is monotonic—higher-income pensioners are 8.3% less likely to become delinquent on their mortgage obligations. Turning to strategic default, we find that high-income pensioners, who experienced the largest pension cuts, are more likely to exhibit strategic behavior. On average, high-income pensioner defaults are 13.8% more likely to be strategic than delinquencies by other groups of retirees (column (2)). The results are qualitatively similar when we exclude non-strategic defaulters and focus on borrowers with ability to pay; high-income pensioners are 3.7% more likely to default strategically (column (3)). Overall, our results are consistent with the hypothesis that individuals that experience a large liquidity shock are more likely to substitute mortgage payments to restore liquidity.

C. Borrower Sophistication and Strategic Default

Guiso et al. (2013) find that college education does not have a significant effect on strategic default, which is consistent with our findings in Table III. In this section, we focus on high-profile occupations that typically require a college degree, to further investigate the role of education in conjunction with professional specialization. Professionals in these high-profile industries exhibit relatively low default rates (30-33%) suggesting that they weathered the crisis more successfully.[17] Within this group, Table VII shows that individuals employed in medicine, education or in the military are less likely to default (6.5%-11.9%) compared to the average high-profile professional (column (1)).

[17] By contrast, low-profile groups, such as farmers and blue-collar workers, exhibit significantly higher default rates around 60%.

More importantly, we find significant heterogeneity in strategic defaults across mortgagors employed in different industries. Despite the insignificant effect of college education on strategic behavior, once we account for professional specialization we find a clear dichotomy. On the one hand, educators, doctors, and other scientists are less prone to strategic behavior than other high-profile professionals. On the other hand, approximately 48% and 41% of defaults in the law and finance industries, respectively, are strategic. Table VII shows that a default in finance or law industry is 7.9% and 22.5% more likely to be strategic, respectively (column (2)).

Military personnel exhibit distinct default patterns from other professionals. Not only they are less likely to default, but their delinquencies are also significantly less likely to be strategic. Delinquencies by military personnel are approximately 8.6% less likely to be strategic (column (2)). This finding is consistent with previous studies suggesting that military service may instill a stronger sense of ethics that prevents moral-hazard behavior (Akerlof and Kranton (2005)). For instance, Benmelech and Frydman (2015) show that military CEOs are less likely to engage in corporate fraudulent activity, and Law and Mills (2017) find that CEOs with military experience are less likely to pursue tax avoidance.

The stark contrast in strategic default patterns among high-profile professions is also evident when we focus on borrowers with ability to pay, in column (3). Mortgagors that work in finance and law are, respectively, 3.8% and 4.3% more likely to default strategically. On the other hand, the respective probability for doctors and educators is 4.2%-6.4% lower. Military personnel again exhibit a distinct stance toward moral hazard, and are 6.6% percent less likely to default strategically than other professionals.

The higher strategic default rates in finance and law, suggest that borrowers' sophistication—rather than education status—motivates strategic behavior. Mortgagors who understand the legal and financial ramifications of the foreclosure moratorium are more likely to act strategically by foregoing mortgage payments without declaring personal bankruptcy. This explanation is in line with the findings of Amromin et al. (2018), who argue that financially

sophisticated households tend to hold complex mortgage products in order to increase the option value of strategic default.

Finally, we examine whether highly sophisticated borrowers are not only better at processing information, but also whether they process different types of information. To this end, in Table VII, we test whether the propensity to default strategically is sensitive to the existence of negative equity for finance and law professionals (column (4)). Negative equity increases the likelihood of strategic default, on average, by 11.6%. The interaction terms in column (4) suggest a higher sensitivity to negative equity only for finance professionals. Specifically, having negative equity increases the likelihood of strategic default by an additional 4.6% in the finance industry. On the other hand, the sensitivity of law professionals to negative equity is not statistically significant. Taken together, these results suggest that finance and law professionals process different types of information. More specifically, law professionals focus more on the legal content of the moratorium, which protects delinquent borrowers regardless of whether they are underwater or not. By contrast, for finance professionals economic considerations, namely the existence of negative equity, also appears to play an important role in their decision making process.

V. Conclusion

In this study, we show that the introduction of a universal foreclosure moratorium on primary residences had a significant impact on strategic defaults and the deterioration of the Greek banking system. We conservatively estimate that 28% of defaults in our sample period are strategic, corresponding to over 5 billion euros (3% of Greek GDP) in non-performing loans, a cost that has mainly moved to the public through bank recapitalizations.

Our results provide new insights for separating strategic from non-strategic defaulters. We show that strategic defaulters tend to have higher income, higher credit scores and lower CLTVs on average. Past studies have used these variables as criteria for identifying strategic default. However, we show that these are outcomes rather than criteria. For example, low

formal income does not necessarily correspond to inability to pay (see Gerardi et al. (2017)). Our study shows that low reported-income, originating from tax evasion, is also consistent with strategic behavior. Therefore, defining strategic default only on the basis of borrower and loan characteristics across imperfect datasets may fail to capture strategic behavior.

Our main contribution lies on identifying behavioral factors that motivate strategic default. Our findings are important from a policy-making point of view for two reasons. First, they can facilitate the identification of strategic defaulters, which is the first step to address the problem. Second, it can assist policy-makers to design interventions that effectively target the desired groups by realizing the limitations of these policies. For example, our results suggest that policy interventions may be less effective in settings with pervasive moral hazard problems, like in industries or economies with high informality. We recognize that the list of behavioral attributes in this study is not exhaustive, and future research can shed more light on additional factors that motivate strategic behavior.

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Figures

Figure 1: Distribution of primary residence objective values
The histogram presents the distribution of objective values for the full sample of primary residence mortgages, excluding loans guaranteed by the state and loans with subsidized interest rates. A primary residence is protected from foreclosure if the objective value of the collateral is below €300,000 (vertical line) for single borrowers, and reaches up to €450,000 for married mortgagors with three children or more.

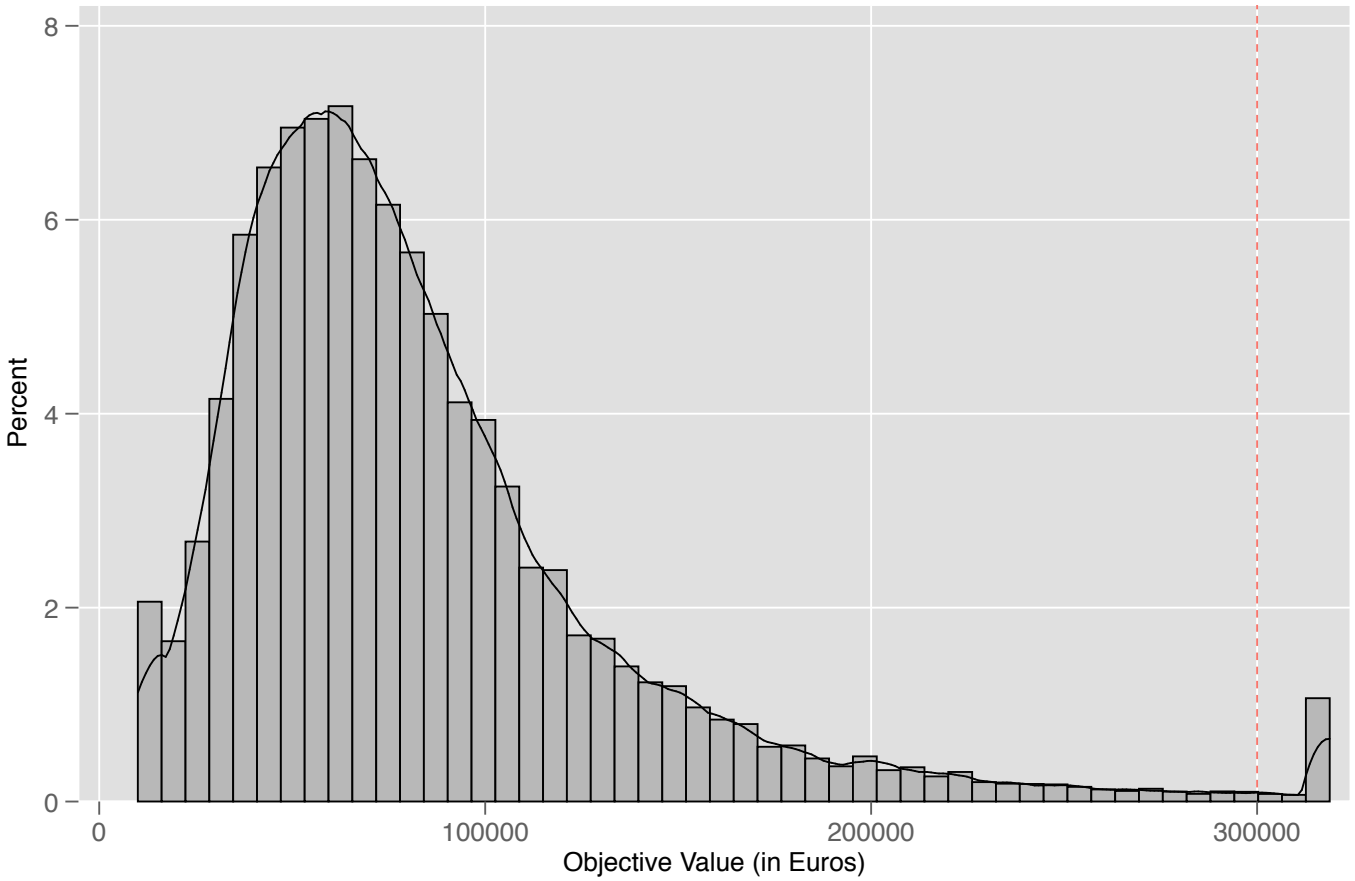


Figure 2: Identification of strategic default The figure presents available strategies for mortgagors before and after the implementation of Law N.3869/2010, and the respective costs and benefits. These are defined with respect to the ability to pay (w) and include the market value of the property (V), the loan amount outstanding (L), foreclosure costs (F), liquidation costs (Lq), an expected haircut from the bankruptcy process (h), benefits (B) and costs (P) from the use of the foreclosure moratorium.

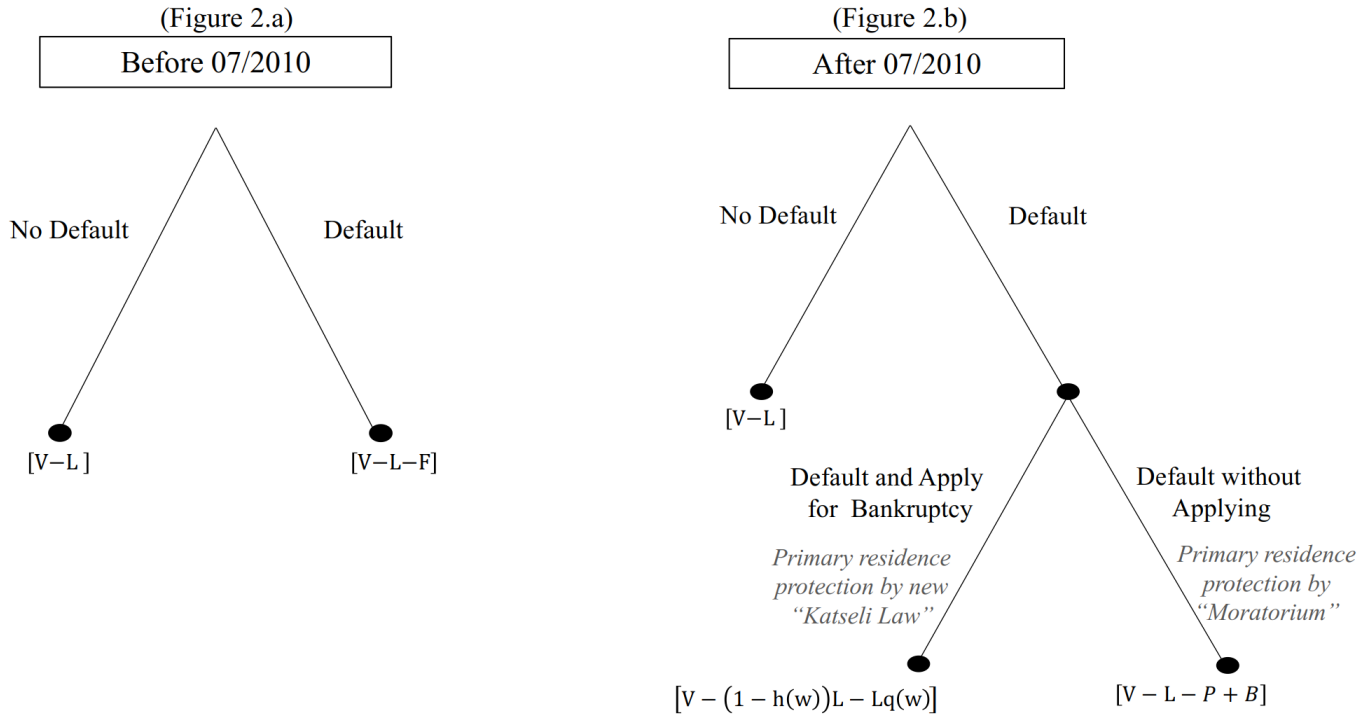


Figure 3: Default rates for primary and secondary mortgages
The graph presents cumulative default rates on a monthly frequency for our sample of mortgages on primary residences (straight line) and secondary residences (dashed line). The sample includes mortgages contracted after January of 2007. Default rates for secondary residence mortgages are at the lien level, and for primary residence mortgages are at the customer level. The dash-dot line depicts the difference in default rates between primary and secondary residences. We define mortgagors as defaulters if they are delinquent in more than 5% of their monthly installments (or more than 100 euros) for six consecutive months (t+6 rule). The horizontal line depicts the implementation time of regulation N.3869/2010 and N.3858/2010.

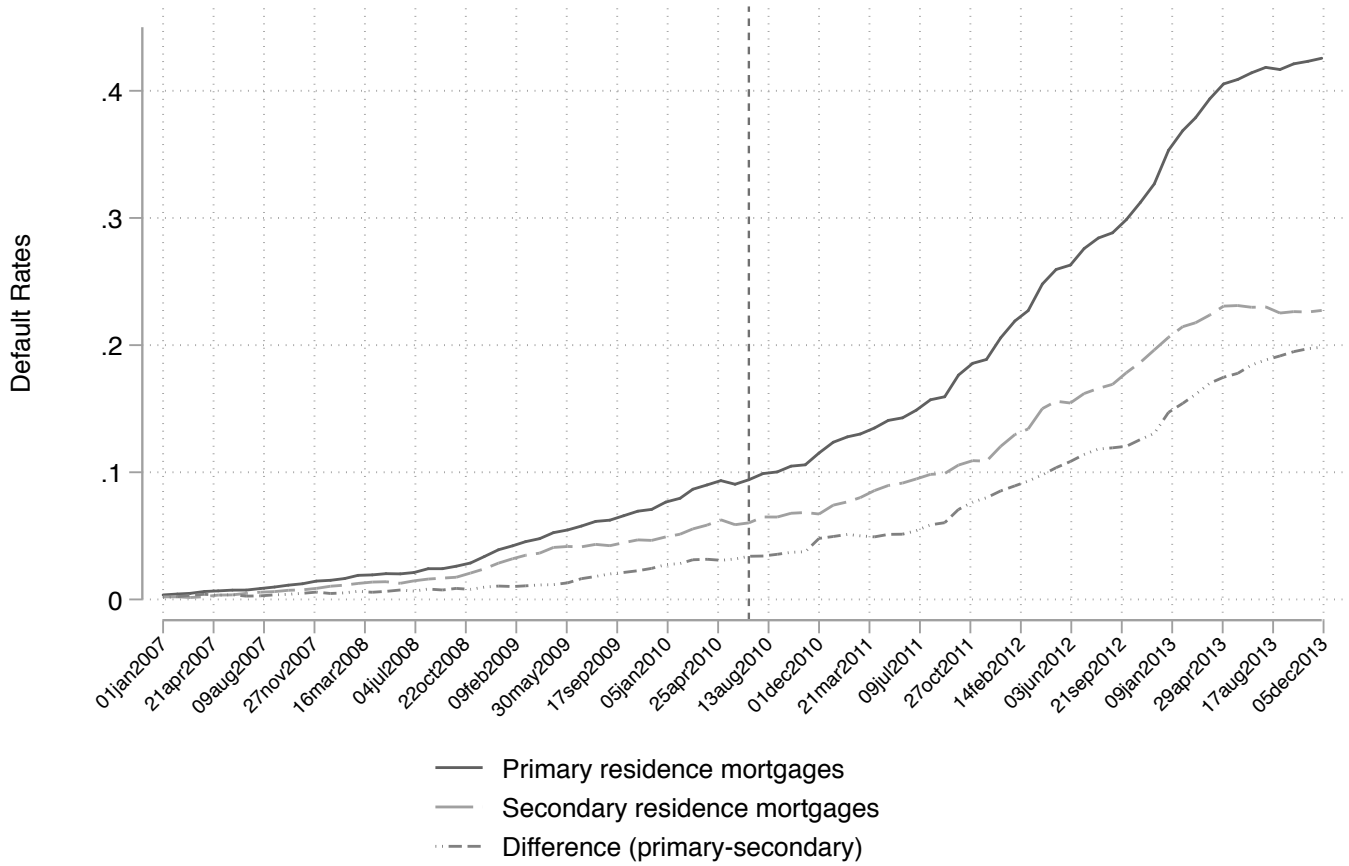
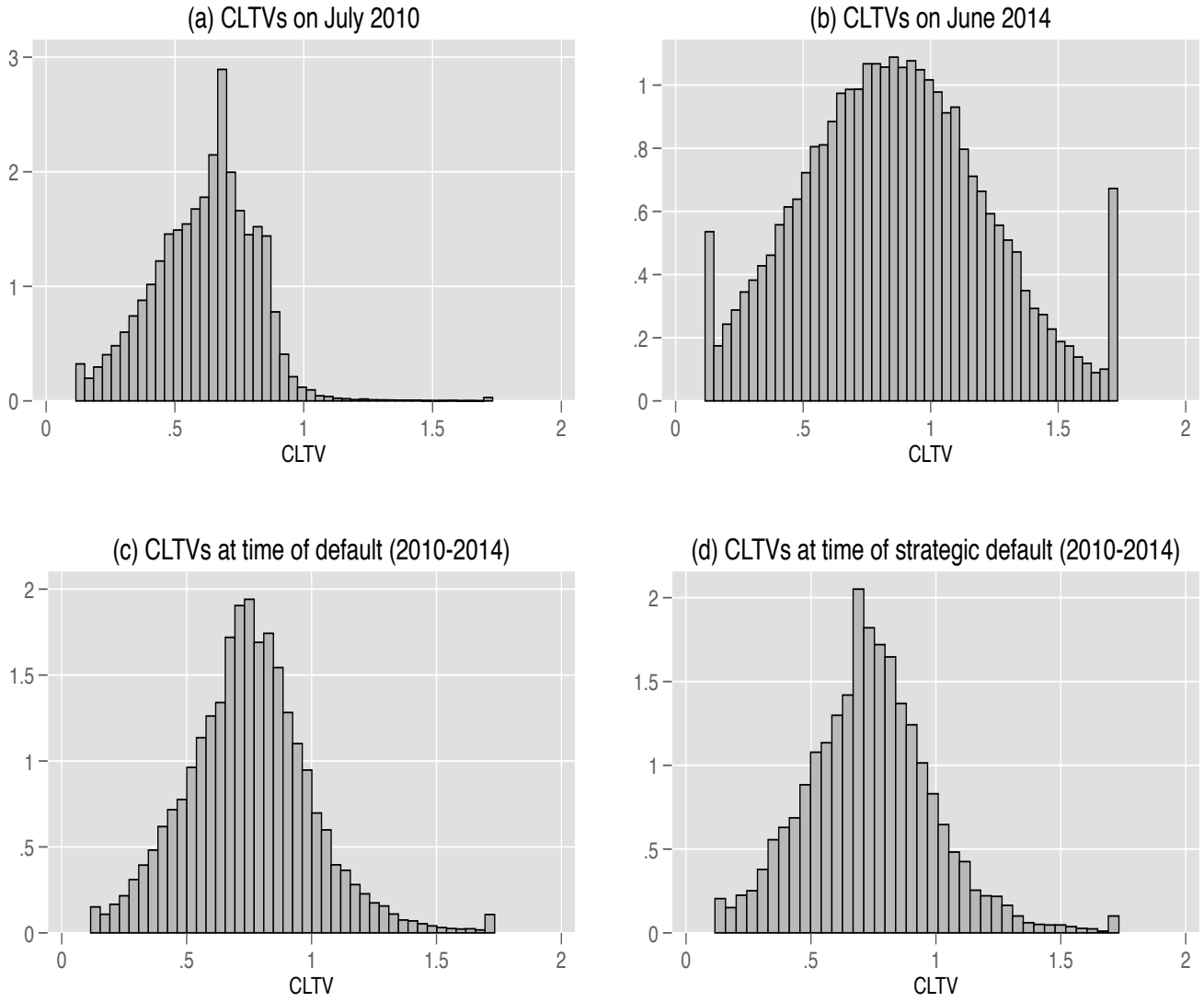


Figure 4: Distribution of CLTVs from 2010-2014
The histograms present the distribution of cumulative LTV (CLTV) values of primary residence mortgages in three different time periods. The first plot (top left) shows the distribution of CLTVs on July 2010, which is the date of the implementation of the foreclosure moratorium and the introduction of the new personal bankruptcy regulation (Katseli Law). The second plot (top right) shows the distribution of CLTVs of individuals at the time they default during the period July 2010 until June 2014. The third plot (bottom left) shows the distribution of CLTVs at the end of our sample period—June 2014. The fourth plot (bottom right) shows the distribution of CLTVs at the time of strategic default.



Tables

Table I: Summary Statistics of Mortgages on Primary Residences
The table presents summary statistics of primary residential mortgages from 2007 until 2013. We use mortgage, dwelling, and mortgagor characteristics from mortgage applications and performance information at the date of the foreclosure moratorium regulation (July 2010).

	N	Mean	sd	p10	p50	p90
Loan Characteristics						
Loan Amount (K)	57854	103.33	73.14	33.60	87.00	198.90
Monthly Installment	57854	518.95	362.80	153.55	449.86	964.07
Interest Rate	57854	4.08	1.09	2.62	4.07	5.42
Maturity (years)	51279	24.52	9.27	12.00	25.00	40.00
Num. of cosigners	51279	1.85	0.71	1.00	2.00	3.00
CLTV	50530	0.62	0.20	0.35	0.64	0.85
Dwelling Characteristics						
Commercial Value	55915	158.26	99.88	65.01	136.42	273.00
Objective Value	41708	78.90	49.78	30.41	67.50	141.18
Customer Characteristics						
Credit Score	51326	651.74	99.99	552.00	648.00	753.00
Reported Income	52346	14.54	13.70	0.00	12.23	30.00
Total Income	52833	31.13	21.04	12.16	25.72	55.23
College Education	45850	0.29	0.45	0.00	0.00	1.00
Age	50850	51.09	11.85	36.00	50.00	68.00
Default Statistics						
Defaulter	57854	0.42	0.49	0.00	0.00	1.00
Str. Defaulter	57854	0.12	0.32	0.00	0.00	1.00

Table II: Univariate Differences

This table presents average mortgage and mortgagor characteristics for the following type of mortgagors: non-defaulters (column 1), defaulters (column 2), non-strategic defaulters (column 4), and strategic defaulters (column 5) We define a mortgagor as a *defaulter* if he has been delinquent for six consecutive months, and as a *non-defaulter* otherwise. We define as *strategic defaulter* a mortgagor who defaults before December 2013 and does not apply for debt-discharge through the new bankruptcy law. We define borrowers who default and apply for debt discharge as *non-strategic defaulters*. The third column shows univariate differences in average characteristics between defaulting and non-defaulting customers, and the last column shows the differences in the characteristics between strategic and non-strategic defaulters. CLTV is based on July 2010, or at the time of default for defaulters.

	(1) Non-Defaulters	(2) Defaulters	(1)-(2)	(4) Non-strategic defaults	(5) Strategic defaults	(4)-(5)
Loan Amount (K)	99.61	108.55	-8.94***	107.96	110.08	-2.12
Monthly Installment	524.84	510.68	14.16***	494.70	551.63	-56.93***
Interest Rate	4.06	4.11	-0.05***	4.09	4.16	-0.07***
Maturity (years)	23.26	26.31	-3.05***	26.64	25.49	1.15***
Num. of cosigners	1.86	1.84	0.02**	1.84	1.82	0.02*
CLTV (at default)	0.59	0.75	-0.16***	0.76	0.74	0.02***
Commercial Value	155.78	161.75	-5.97***	158.82	169.22	-10.40***
Objective Value	80.19	77.23	2.96***	75.95	80.75	-4.80***
Credit Score	672.84	621.90	50.94***	614.33	640.49	-26.16***
Reported Income	15.75	12.85	2.90***	12.78	13.04	-0.27
Total Income	33.19	28.28	4.91***	27.36	30.55	-3.19***
College Education	0.35	0.20	0.15***	0.19	0.22	-0.03***
Age	51.11	51.06	0.05	51.28	50.53	0.75***

Table III: Mortgage and Borrower Determinants of Default and Strategic Default

This table presents OLS regressions of defaulting homeowners on mortgage and borrower characteristics. In columns (1)-(2) the dependent variable equals one if the mortgagor defaulted (delinquent for six consecutive months) and zero if the mortgagor did not default. In columns (3)-(4) the dependent variable equals one if the mortgagor defaulted strategically (delinquent for six consecutive months and did not apply for debt discharge) and zero if the mortgagor did not default strategically (defaulted and applied for debt discharge). All regressions include ZIP code fixed effects. We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
	Default=1 No default=0		Strategic Default=1 Non Strategic Default=0	
Ln(Total Income)	-0.0444***	-0.0258***	0.0519***	0.0504***
	(0.005)	(0.005)	(0.008)	(0.009)
Credit Score	-0.0009***	-0.0008***	0.0003***	0.0003***
	(0.000)	(0.000)	(0.000)	(0.000)
CLTV	0.0025***	0.0024***	-0.0023***	-0.0022***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Loan Amount)	0.0233***	0.0291***	0.0232***	0.0168**
	(0.004)	(0.004)	(0.007)	(0.008)
Interest Rate	0.0075***	0.0068***	0.0063*	0.0056
	(0.002)	(0.002)	(0.003)	(0.004)
Maturity (years)	0.0040***	0.0040***	-0.0005	-0.0006
	(0.000)	(0.000)	(0.000)	(0.001)
Num. of cosigners	0.0070*	-0.0061	-0.0322***	-0.0283***
	(0.004)	(0.004)	(0.005)	(0.006)
College Education		-0.1146***		0.0181
		(0.007)		(0.012)
Private Sector		0.0428***		0.0080
		(0.006)		(0.010)
Self-employed		0.0580***		0.0736***
		(0.007)		(0.012)
Pensioner		-0.0051		-0.0632***
		(0.008)		(0.014)
Single		-0.0309***		-0.0024
		(0.006)		(0.010)
Parent		0.0231***		0.0125
		(0.006)		(0.010)
Single-Parent		0.0759***		-0.0907***
		(0.017)		(0.020)
Zip Code FEs	Yes	Yes	Yes	Yes
Observations	44006	39626	18047	15917
Adjusted R^2	0.102	0.116	0.041	0.046

Table IV: Strategic Default and Self-Employment Status

This table presents coefficients from cross-sectional OLS regressions of strategic defaulters on mortgagors' ability to tax evade. In all regressions, we match self-employed professionals to wage-workers based on the same job description, credit score, and CLTV. In regression (1), the dependent variable equals one if the mortgagor defaulted (delinquent for six consecutive months) and zero if the mortgagor did not default. In regression (2), the dependent variable equals one if the mortgagor defaulted strategically (defaulted and did not apply for debt discharge) and zero if the mortgagor did not default strategically (defaulted and applied for debt discharge). Regression (3) excludes delinquent mortgagors that are not strategic, so the dependent variable equals one if the mortgagor defaulted strategically and zero if the mortgagor did not default. All regressions include ZIP code fixed effects. We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
	Default=1 No default=0	Strategic Default=1 Non-strategic Default=0	Strategic Default=1 No Default=0
Self-employed	0.0280***	0.0737***	0.0555***
	(0.008)	(0.011)	(0.008)
Controls			
Ln(Total Income)	-0.0321***	0.0611***	0.0095
	(0.007)	(0.011)	(0.007)
Credit Score	-0.0008***	0.0003***	-0.0004***
	(0.000)	(0.000)	(0.000)
CLTV	0.0026***	-0.0025***	0.0005**
	(0.000)	(0.000)	(0.000)
Ln(Loan Amount)	0.0144**	0.0155*	0.0238***
	(0.006)	(0.009)	(0.006)
Interest Rate	-0.0026	0.0143***	0.0051
	(0.003)	(0.005)	(0.004)
Maturity (years)	0.0051***	-0.0013*	0.0026***
	(0.001)	(0.001)	(0.000)
Num. of cosigners	0.0029	-0.0292***	-0.0117*
	(0.006)	(0.009)	(0.006)
Zipcode FEs	Yes	Yes	Yes
Observations	18634	8101	12972
Adjusted R^2	0.099	0.057	0.049

Table V: Strategic Defaults and Previous Moral Hazard Behavior—Intensive Margin
This table presents coefficients from cross-sectional OLS regressions of strategic defaulters on customers' ex-ante estimates of tax evasion. The dependent variable in regressions (1)-(2) is an indicator variable that equals one if the mortgagor defaults strategically (delinquent for six consecutive months and did not apply for debt discharge) and zero if the mortgagor did not default (i.e., we exclude delinquent mortgagors that are non-strategic). In regression (1), *tax evasion proxy-*κ is an estimate of tax evasion based on the excess credit capacity extended to a self-employed professional relative to a wage worker with similar personal and loan characteristics. In regression (2), *tax evasion proxy-*λ is the ratio of the sensitivity of credit capacity to income for self-employed professionals (who are able to tax evade) divided by the sensitivity of credit capacity to income for wage workers (who are not able to evade taxes). All regressions include ZIP code fixed effects, regression (1) also includes fixed effects at the job-description level. We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)
	Strategic Default=1 No Default=0	
Tax evasion proxy - κ	0.0706***	
	(0.025)	
Tax evasion proxy - λ		0.0499**
		(0.022)
Controls		
Ln(Total Income)	0.0313**	0.0366***
	(0.013)	(0.014)
Credit Score	-0.0004***	-0.0005***
	(0.000)	(0.000)
CLTV	0.0018***	0.0019***
	(0.000)	(0.001)
Ln(Loan Amount)	0.0870***	0.0375***
	(0.024)	(0.013)
Interest Rate	0.0006	0.0009
	(0.005)	(0.007)
Maturity (years)	0.0015	0.0032***
	(0.001)	(0.001)
Num. of cosigners	-0.0303**	-0.0316***
	(0.013)	(0.011)
Zipcode FEs	Yes	Yes
Job FEs	Yes	No
Observations	4499	4499
Adjusted R^2	0.062	0.047

Table VI: Cash-Flow Shocks and Strategic Default

This table presents coefficients from cross-sectional OLS regressions of defaulting mortgagors using only pensioners from our sample. We create income quartiles based on the distribution of pensioners' personal income and classify them as high income, medium income, and low income (lowest income-quartile is omitted). The dependent variable in regression (1) equals one if the mortgagor defaulted (delinquent for six consecutive months), and zero if the mortgagor did not default. In regression (2), the dependent variable equals one if the mortgagor defaulted strategically (defaulted and did not apply for debt discharge) and zero if the mortgagor did not default strategically (defaulted and applied for debt discharge). Regression (3) excludes delinquent mortgagors that are not strategic, so the dependent variable equals one if the mortgagor defaulted strategically and zero if the mortgagor did not default. All regressions include ZIP code fixed effects. We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
	Default=1	Strategic Default=1	Strategic Default=1
	No default=0	Non-Strategic Default=0	No Default=0
Pensioner income Q1 (Low)-omitted			
Pensioner income Q2	-0.0074	0.0165	0.0228
	(0.018)	(0.027)	(0.015)
Pensioner income Q3	-0.0616***	0.0682**	0.0226
	(0.019)	(0.031)	(0.016)
Pensioner income Q4 (high)	-0.0832***	0.1377***	0.0369**
	(0.021)	(0.032)	(0.019)
Credit Score	-0.0008***	0.0001	0.0001
	(0.000)	(0.000)	(0.000)
CLTV	0.0063***	0.0000	0.0027***
	(0.000)	(0.000)	(0.000)
Ln(Loan Amount)	0.0092	-0.0293	-0.0067
	(0.013)	(0.020)	(0.012)
Interest Rate	0.0100	0.0022	0.0073
	(0.006)	(0.010)	(0.006)
Maturity (years)	-0.0003	-0.0018	-0.0022***
	(0.001)	(0.002)	(0.001)
Num. of cosigners	0.0226**	-0.0300*	-0.0022
	(0.011)	(0.016)	(0.009)
Zipcode FEs	Yes	Yes	Yes
Observations	4771	1632	3522
Adjusted R^2	0.138	0.012	0.026

Table VII: Strategic Defaults and Borrower Sophistication

This table presents coefficients from cross-sectional OLS regressions of mortgagors who default strategically. The dependent variable in regression (1) equals one if the mortgagor defaulted (delinquent for six consecutive months), and zero if the mortgagor did not default. In regression (2), the dependent variable equals one if the mortgagor defaulted strategically (defaulted and did not apply for debt discharge) and zero if the mortgagor did not default strategically (defaulted and applied for debt discharge). In regressions (3) and (4) we exclude delinquent mortgagors that are not strategic (applied for debt-discharge), so the dependent variable equals one if the mortgagor defaulted strategically and zero if the mortgagor did not default. The independent variables of interest (Finance, Law, Medicine, Engin./Science, Military, Education) are indicator variables that equal one if the mortgagor is employed in the respective industry, and zero otherwise. *Negative Equity* is an indicator variable that takes the value of one if the CLTV of the customer at the time of default is above one, and equals zero otherwise. We control for mortgagor income, credit score, CLTV, loan amount, interest rate, and number of cosigners. All regressions include ZIP code fixed effects. We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
	Default=1	Strategic Default=1	Strategic Default=1	
	No default=0	Non-Strategic Default=0	No Default=0	
Finance	-0.0040	0.0793***	0.0379***	0.0212**
	(0.010)	(0.016)	(0.009)	(0.009)
Law	-0.0437*	0.2254***	0.0435**	0.0488**
	(0.024)	(0.048)	(0.020)	(0.022)
Medicine	-0.1189***	-0.0110	-0.0638***	
	(0.013)	(0.028)	(0.012)	
Engin./Science	-0.0112	0.0519*	0.0162	
	(0.015)	(0.030)	(0.014)	
Military	-0.0494***	-0.0861***	-0.0660***	
	(0.014)	(0.021)	(0.013)	
Education	-0.0651***	-0.0144	-0.0419***	
	(0.013)	(0.024)	(0.011)	
CLTV (at default)	0.0075***	0.0004	0.0054***	
	(0.000)	(0.000)	(0.000)	
Finance(x)Negative Equity				0.0459**
				(0.021)
Law(x)Negative Equity				-0.0246
				(0.047)
Negative equity				0.1164***
				(0.008)
Zipcode FEs	Yes	Yes	Yes	Yes
Observations	19802	8132	14050	16074
Adjusted R^2	0.170	0.044	0.114	0.043

Appendix

Definition Let V be the commercial value of the dwelling, L the outstanding value of the loan, and F the foreclosure costs.

In a recourse state, lenders who foreclose on a negative-equity mortgage ($V - L < 0$) have the right to claim deficiency judgments. Therefore, before the implementation of the law, the possible outcomes and their respective payoffs are as follows (see Figure 2.a):

$$\textit{No Default}\text{: } V - L \qquad \textit{Default}\text{: } V - L - F$$

Proposition V.1 *Before the implementation of the law, inability to pay and negative equity are both necessary conditions for default.*

Proof For a borrower with ability to pay, the payoff of non-default is always greater than the payoff of defaulting, in the presence of foreclosure costs.

$$V - L > V - L - F \Rightarrow F > 0 \tag{9}$$

For a borrower with inability to pay on a positive equity mortgage, the optimal strategy is to sell the dwelling, repay the loan, and realize the difference because of (9).
The borrower defaults if and only if the mortgage is negative equity and the borrower exhibits inability to pay. ∎

The new laws have two important implications in our setting: (i) They prevent foreclosures, and thus mortgagors do not face foreclosure costs (F) any more; and (ii) they provide two options for default, namely, "Default and Apply" and "Default and Not Apply" for bankruptcy (see Figure 2.b).

Definition Let $w \in [0, +\infty)$ be the borrower's ability to pay.

Definition Let $Lq(w)$ be a continuous function representing liquidation costs associated with the bankruptcy process, such that:

$$Lq(0) = 0, \quad \lim_{w \to \infty} Lq(w) \to \infty, \quad \frac{\partial Lq}{\partial w} \geq 0. \tag{10}$$

Define $h(w) \in (0, 1]$ as the haircut awarded from the bankruptcy process with

$$h(w_0) = 1, \quad \lim_{w \to \infty} h(w) \to 0. \tag{11}$$

Defaulting without applying for bankruptcy for mortgagor i entails an expected cost $C_i < L$ and expected benefits $B_i < L$.[18]

After the implementation of the law, the possible outcomes and their respective payoffs are as follows:

No Default:	Default and Apply:	Default and Not Apply:
$V - L$	$V - L + h(w) \cdot L - Lq(w)$	$V - L + B_i - C_i$

Proposition V.2 *For borrowers with low ability to pay, the strategy to "Default and Apply" is strictly preferable. For borrowers with high ability to pay the optimal strategy is to "Default without Applying" if* $B_i - C_i > 0$ *and "No Default" if* $B_i - C_i < 0$.

Proof Using backwards induction, we first evaluate the default node.

$$\text{"Default and Apply"} \succeq \text{"Default without Applying", if}$$
$$V - L + h(w) \cdot L - Lq(w) > V - L + B_i - C_i \Rightarrow f(w) = h(w) \cdot L - Lq(w) - B_i + C_i > 0$$

From (10),(11) $f(w)$ is continuous and decreasing in w, with $f(0) > 0$ and $f(\bar{w}) < 0$.
From the Bolzano theorem, $w^* \in (0, \bar{w})$ exists for which $f(w^*) = 0$ and $\exists\, \epsilon > 0$, such that $f(w^* - \epsilon) > 0$ and $f(w^* + \epsilon) < 0$.

Consider the following cases:

I. If $B_i - C_i > 0$ (expected benefits exceed expected penalties).

For $w < w^*$, "Default and Apply" $\succeq$ "Default without Applying" $\succeq$ "No Default", because

$$V - L + h(w) \cdot L - Lq(w) > V - L + B_i - C_i > V - L$$

For $w > w^*$, "Default without Applying" $\succeq$ "Default and Apply". Moving to the initial node, "Default without Applying" $\succeq$ "No Default", because $V - L + B_i - C_i > V - L$.

[18] The expected cost includes the effect of the delinquency rate, expected penalties and externalities of default (i.e. access to future credit). The expected benefits summarize benefits from delaying mortgage payments in a crisis state (i.e. high marginal utility of income) , expectations for a horizontal haircut of household debt (positively related to political uncertainty), expectations for Grexit, and subsequent devaluation of the domestic currency. This list is not exhaustive.

II. If $B_i - C_i < 0$, (expected penalties exceed expected benefits).

Define $g(w) = h(w) \cdot L - Lq(w)$. $g(w)$ is continuous and decreasing w, with $g(0) > 0$ and $g(w^*) < 0$.

From the Bolzano theorem, $w^{**} \in (0, w^*)$ exists for which $g(w^{**}) = 0$ and $\exists \delta > 0$, such that $g(w^{**} - \delta) > 0$ and $g(w^{**} + \delta) < 0$.

For $w < w^{**}$, "Default and Apply" $\succeq$ "No Default", because

$$h(w) \cdot L - Lq(w) > 0 \Rightarrow V - L + h(w) \cdot L - Lq(w) > V - L$$

For $w > w^{**}$, "No Default" $\succeq$ "Default and Apply", because

$$h(w) \cdot L - Lq(w) < 0 \Rightarrow V - L + h(w) \cdot L - Lq(w) < V - L$$

Appendix Tables

Table A.I: Optimal Strategies

	$w < w^*$	$w > w^*$
$B_i - C_i > 0$	Default & Apply	Default w/o Applying
$B_i - C_i < 0$	Default & Apply[19]	No Default

[19] Includes an area $w^{**} < w < w^*$ where $f(w) > 0$ and $g(w) < 0$, for which "No Default" $\succeq$ "Default and Apply".

Table A.II: Determinants of Defaults and Strategic Defaults—Probit Model

This table presents Probit regressions of defaulting mortgagors on mortgage and borrower characteristics. In columns (1)-(2) the dependent variable equals one if the mortgagor defaulted (delinquent for six consecutive months) and zero if the mortgagor did not default. In columns (3)-(4) the dependent variable equals one if the mortgagor defaulted strategically (delinquent for six consecutive months and did not apply for debt discharge) and zero if the mortgagor did not default strategically (defaulted and applied for debt discharge). We cluster at the ZIP code level and report standard errors in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
	Default=1 No default=0		Strategic Default=1 Non Strategic Default=0	
Ln(Total Income)	-0.0568***	-0.0333***	0.0452***	0.0425***
	(0.005)	(0.005)	(0.008)	(0.008)
Credit Score	-0.0010***	-0.0008***	0.0004***	0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)
CLTV	0.0025***	0.0025***	-0.0023***	-0.0021***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Loan Amount)	0.0229***	0.0301***	0.0173***	0.0090
	(0.004)	(0.004)	(0.006)	(0.007)
Interest Rate	0.0077***	0.0064**	0.0080**	0.0076**
	(0.002)	(0.003)	(0.003)	(0.003)
Maturity (years)	0.0041***	0.0040***	-0.0006	-0.0007
	(0.000)	(0.000)	(0.000)	(0.000)
Num. of cosigners	0.0145***	-0.0023	-0.0322***	-0.0289***
	(0.004)	(0.004)	(0.005)	(0.006)
College Education		-0.1297***		0.0174*
		(0.007)		(0.010)
Private Sector		0.0433***		0.0035
		(0.007)		(0.009)
Self-employed		0.0630***		0.0771***
		(0.007)		(0.010)
Pensioner		-0.0080		-0.0672***
		(0.008)		(0.014)
Single		-0.0332***		0.0016
		(0.006)		(0.010)
Parent		0.0259***		0.0140
		(0.006)		(0.009)
Single-Parent		0.0709***		-0.0993***
		(0.016)		(0.022)
Pseudo R^2	0.079	0.096	0.038	0.042
Observations	44006	39626	18047	15917

Table A.III: Determinants of Strategic Default (Multinomial Probit)
This table presents multivariate Probit regressions of defaulting mortgagors on mortgage and borrower characteristics. The dependent variable equals zero if the mortgagor is not delinquent, one if the mortgagor defaulted but non-strategically, and two if the mortgagor defaulted strategically (defaulted and did not apply for debt discharge). The coefficients represent the marginal effect of a unit change in the independent variable (keeping all else constant) on the probability of default relative to non-default (regressions (1)-(2)), and the probability of strategic default relative to non-default (regressions (3)-(4)). Standard errors are robust to heteroskedasticity and are reported in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
	Default=1 (base outcome: no default)		Strategic Default=1 (base outcome: no default)	
Ln(Total Income)	-0.0564***	-0.0398***	-0.0014	0.0058*
	(0.004)	(0.004)	(0.003)	(0.003)
Credit Score	-0.0008***	-0.0007***	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)
CLTV	0.0027***	0.0026***	-0.0002**	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Loan Amount)	0.0072*	0.0164***	0.0152***	0.0132***
	(0.004)	(0.004)	(0.003)	(0.003)
Interest Rate	0.0023	0.0013	0.0056***	0.0048***
	(0.002)	(0.002)	(0.001)	(0.002)
Maturity (years)	0.0030***	0.0030***	0.0010***	0.0010***
	(0.000)	(0.000)	(0.000)	(0.000)
Num. of cosigners	0.0223***	0.0098***	-0.0086***	-0.0127***
	(0.003)	(0.003)	(0.002)	(0.003)
College Education		-0.0969***		-0.0332***
		(0.006)		(0.004)
Private Sector		0.0290***		0.0141***
		(0.005)		(0.004)
Self-employed		0.0099		0.0511***
		(0.006)		(0.004)
Pensioner		0.0192**		-0.0294***
		(0.008)		(0.006)
Single		-0.0239***		-0.0095**
		(0.006)		(0.004)
Parent		0.0122**		0.0129***
		(0.005)		(0.004)
Single-Parent		0.0883***		-0.0195*
		(0.015)		(0.011)
Pseudo R-squared	0.079	0.096	0.038	0.042
Observations	44556	39787	44556	39787