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# The Role of Prepayment Penalties in Mortgage Loans<sup>☆</sup>

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## Abstract

We study the effect of mortgage prepayment penalties on borrowers' prepayments and delinquencies by exploiting a 2007 reform in Italy that reduced penalties on outstanding mortgages and banned penalties on newly-issued mortgages. Using a unique dataset of mortgages issued by a large Italian lender, we provide evidence that: 1) before the reform, mortgages issued to riskier borrowers included larger penalties; 2) higher prepayment penalties decreased borrowers' prepayments; and 3) higher prepayment penalties did not affect borrowers' delinquencies. Moreover, we find suggestive evidence that prepayment penalties affected mortgage pricing, as well as prepayments and delinquencies through borrowers' mortgage selection at origination, most notably for riskier borrowers.

*Keywords:* Mortgages, Prepayment penalties, Refinancing, Default

*JEL classification:* G20, G21, G28

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## 1. Introduction

For most households, housing represents their major asset and a mortgage represents their largest liability. Hence, the choice of a mortgage contract is

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one of households' most important financial decisions, and its management has  
5 important aggregate implications (Mian et al., 2013). Mortgages vary in sev-  
eral important characteristics (interest rate, maturity, etc.), and in this paper,  
we focus on the role of one key contractual feature: the prepayment penalty.  
More specifically, we exploit a 2007 reform in Italy that reduced prepayment  
penalties on outstanding mortgages and eliminated them on newly-issued ones.  
10 Our analysis shows that prepayment penalties have a direct effect on borrowers'  
prepayment behavior, but no direct effect on borrowers' delinquencies. Fur-  
thermore, we find suggestive evidence that prepayment penalties affect the cost  
of mortgage credit, and that they have an indirect effect on prepayments and  
delinquencies through borrowers' selection of mortgage type at the time of con-  
15 tracting, particularly for borrowers who face greater uncertainty.

Different incentives spur borrowers to prepay their mortgages: some depend  
on borrowers' characteristics, such as positive income shocks, while some de-  
pend on mortgage market characteristics, such as changes in interest rates. In  
particular, when interest rates fall, borrowers may choose to refinance their  
20 higher-interest-rate mortgages with lower-interest-rate ones. Hence, when in-  
terest rates fall, mortgages' cash flows may be lower than expected for lenders,  
thereby generating a risk for them. Overall, prepayment penalties allow lenders  
to reduce this interest rate risk because they reduce borrowers' incentives to  
prepay their mortgages. Therefore, prior to the recent financial crisis, many  
25 mortgages included these penalties, most notably those offered to riskier bor-  
rowers (Mayer et al., 2013; Rose, 2012).

The crisis spurred a heated debate over the usefulness and fairness of pre-  
payment penalties. One argument against them is that they raise the cost of  
repaying a loan through a refinancing or sale. Thus, borrowers unable to pay  
30 their mortgages may find prepayment expensive, potentially increasing delin-  
quencies if these borrowers receive negative shocks in the future.<sup>1</sup> For example,

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<sup>1</sup>We use the terms default and delinquency interchangeably, as our data do not allow us

Goldstein and Son (2003) argue: “Prepayment penalties can be abusive because they trap subprime borrowers in high-interest rate loans, forcing families to continue to pay more each month than available alternatives, and frequently leading to foreclosure.” Moreover, because a prepayment penalty raises the cost of refinancing with other lenders, it may reduce competition at the refinancing stage, potentially increasing “predatory” practices: the initial lender could offer refinancing on terms that ultimately harm borrowers (Bond et al., 2009). As a result of this debate, legislators in several countries imposed new rules restricting the use of these penalties; Title XIV of the Dodd-Frank Act in the United States is one example.<sup>2</sup> Nonetheless, they are still prevalent in many countries: for example, 98 percent of mortgages originated in the United Kingdom in 2015 include penalties, which generally vary between two and five percent of the prepaid balance.

This paper exploits a 2007 reform in Italy that reduced penalties on outstanding mortgages and banned them on newly-issued ones. Borrowers and lenders who signed a contract before the reform did not anticipate this reduction of penalties. Therefore, the reform provides a quasi-natural experiment to investigate how penalties affect households’ decisions to prepay or to default. More generally, the reform is well-suited to investigating how prepayment penalties affect mortgage pricing and borrowers’ selection in mortgage markets. Toward this goal, we collect a unique dataset that reports all mortgages issued by a large Italian lender in 2005 and 2009, along with their performance (i.e., prepayment and default) until 2012.

The reform triggered variations that allow us to understand the effects of

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to distinguish between them.

<sup>2</sup>Title XIV of the Dodd-Frank Act (Mortgage Reform and Anti-Predatory Lending Act) prohibits prepayment penalties on all adjustable-rate mortgages and certain high-priced fixed-rate mortgages. On all other mortgages, the amount of the penalty in the first, second, and third year after origination is limited to three, two, and one percent, respectively, of the outstanding loan balance, and the penalty is prohibited three years after origination. The Appendix describes the current regulation of penalties in selected countries.

penalties on households' prepayment and default behavior, as well as on households' mortgage choice. Our empirical analysis proceeds in three steps, establishing several results. In the first step, we consider only mortgages issued before the reform. We show that fixed-rate mortgages (FRMs) always include  
60 penalties, whereas most adjustable-rate mortgages (ARMs) do not, with the exception of the riskiest ARMs. Moreover, penalties on more-risky loans are larger than those on less-risky ones.

These initial findings motivate our subsequent analyses. In the second step of our study, we seek to understand the direct effect of penalties on borrowers' behavior (i.e., prepayments and delinquencies) using mortgages issued in 2005 only.  
65 We document that prepayments and delinquencies are higher for mortgages with lower penalties. However, these correlations lump together two effects: 1) penalties directly affect borrowers' cost-benefit analysis when deciding to prepay or to default; and 2) at the time of contracting, borrowers who expect that they are  
70 less likely to prepay or to default on their mortgage can select higher-penalty mortgages with, perhaps, other, more-favorable terms. Thus, to identify the causal effect of penalties, we isolate the exogenous variation in penalties due exclusively to the reform. Using a Cox model with two competing risks—i.e., prepayment and delinquency—we find that a one-percentage-point increase in  
75 penalties decreases prepayment by 27 percent—a sizable effect. This estimate implies that a household borrowing €100,000 increases its annual prepayment to approximately €2,500 from the pre-reform annual average of €2,000 as the prepayment penalty decreases from one percentage point to zero. Moreover, the point-estimates indicate that a one-percentage-point increase in penalties  
80 decreases default by 19 percent; however, these estimates are imprecise and, thus, we cannot rule out that penalties have no direct effect on delinquencies.

In the third step of our empirical study, we compare mortgages issued in 2005 and 2009. We show that the difference in the spreads on FRMs and on ARMs increased by approximately 80 basis points after the reform, thus suggesting  
85 that penalties (and, hence, their abolition) have non-trivial effects on mortgage pricing. Moreover, we further seek to understand whether the abolition of

penalties affected borrowers' mortgage selection between FRMs and ARMs. Aggregate shocks may confound the interpretation of these comparisons over time: our lender merged with another bank in 2007, and the financial crisis affected housing and credit markets.<sup>3</sup> With these important caveats in mind, we deal with these concerns by comparing the performances of FRMs and ARMs within three groups of mortgages: 1) mortgages issued in 2005, comparing their performances from issuance until the reform; 2) mortgages issued in 2005, comparing their performances from the reform until 2012; and 3) mortgages issued in 2009, comparing their performances from issuance until 2012. We argue that, by reducing penalties, the reform made mortgages in the last two groups relatively similar in terms of their incentives to prepay and to default; thus, comparing their performance within the same time period may reduce the concerns that aggregate shocks between 2005 and 2009 account for all observed differences and could be suggestive, instead, of borrowers' selection at the time of contracting. We document that the differences in prepayment and delinquency rates between FRMs and ARMs have increased by 59 and 97 percent, respectively, when we compare mortgages issued in 2009 with mortgages issued in 2005 but after the reform reduced penalties on them. Overall, this last step of our analysis suggests that borrowers' selection of FRMs versus ARMs is substantially different after the reform, most notably for riskier borrowers—i.e., borrowers who faced greater overall uncertainty and who were more likely to be subject to penalties before the reform.

The paper proceeds as follows. Section 2 reviews the literature, highlighting our contributions. Section 3 provides some background information on mortgage

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<sup>3</sup>We should point out that the main crisis in Europe was the sovereign-debt crisis, which started in late 2009 in Greece and spread to other European countries in 2010 and 2011. The Italian sovereign bond market did not receive major shocks until the summer of 2011: the ten-year bond spread over German bonds was quite stable at a value below 100 basis points until May 2010, when it rose to around 150 basis points; in July 2011, it started to rise and reached over 500 basis points at the end of 2011.

markets in Italy and explains the provisions of the 2007 Reform in detail. Section 4 presents the data. Section 5 presents our empirical analysis, and Section 6 concludes. The Appendix describes the current regulation of penalties in selected countries.

## 115 2. Related Literature

Our paper contributes to several strands of the literature. First, a few papers investigate how penalties affect borrowers' behavior, sometimes obtaining different results: for example, Rose (2013) finds a negative correlation between penalties and both prepayments and delinquencies, whereas Steinbuks (2015) finds that subprime mortgages issued in U.S. states that have introduced laws limiting prepayment penalties exhibit higher prepayment rates but no significantly different default rates from those issued in states with no such laws. However, the interpretation of some these correlations may not be straightforward; for example, borrowers who know that they are less likely to prepay may prefer mortgages with penalties since they are less likely to pay them. Hence, our main contribution to this strand of the literature is our use of a novel (and, in our view, more compelling) identification strategy that exploits a policy change (within a country) in the level of prepayment penalties to infer their causal effect on borrowers' behavior. A more precise identification seems quite valuable, as the option to prepay makes mortgages different from other loans and, as our data confirm, this option is quantitatively more relevant than the default option (Beckett, 1988; Deng et al., 2000). Hence, our work has implications for financial market investors and intermediaries, as prepayment plays a key role in the valuation of mortgage-backed securities (Beckett, 1988; Campbell, 2013). For example, Gabaix et al. (2007) show that prepayment risk is not fully diversified in equilibrium and that it affects the pricing of mortgage-backed securities. In many countries, including Italy, securitization has not been an important source of funding for lenders, but prepayment could magnify interest rate risk, as it



introduces a potential mismatch between the maturities of banks' assets and li-  
140 abilities. Thus, banks may want to hedge their interest rate exposure and fully  
match assets with liabilities, but they cannot entirely do so to the extent that  
they cannot perfectly predict mortgages' future cash flows.

Second, our analysis complements those that investigate whether prepay-  
ment penalties affect mortgage terms and may benefit borrowers (Dunn and  
145 Spatt, 1985; Rose, 2012; Mayer et al., 2013). Specifically, Mayer et al. (2013)  
show that, when the improvement in borrowers' creditworthiness is an important  
reason for refinancing, prepayment penalties can improve welfare—most notably  
of riskier borrowers—in the form of lower mortgage rates, reduced defaults, and  
increased availability of credit. However, the empirical analysis in Sections 5.2  
150 and 5.3.3 suggests that changes in the overall level of market interest rates are  
stronger determinants of borrowers' prepayments than increases in house prices  
or improvements in borrowers' creditworthiness. Hence, prepayment penalties  
may limit the pass-through of lower rates to households, although our findings  
on mortgage pricing in Section 5.3.2 seem to imply that households are partially  
155 compensated by receiving lower rates on loans with prepayment penalties.

Third, several papers study households' choice between FRMs and ARMs,  
with a focus on the role of the interest rate differential (Brueckner and Follain,  
1988; Campbell and Cocco, 2003; Kojen et al., 2009). Our paper contributes  
to this academic debate by analyzing the effects of one contractual feature at  
160 the center of the policy debate: the prepayment penalty. We show how penal-  
ties affect mortgage pricing, as well as the credit risk of different contracts'  
pools of borrowers, thus complementing several recent contributions that ana-  
lyze households' defaults on their mortgages (Deng et al., 2000; Mayer et al.,  
2009; Demyanyk and Van Hemert, 2011), car loans (Adams et al., 2009; Einav  
165 et al., 2012; Assunção et al., 2014) and credit cards (Gross and Souleles, 2002).  
Moreover, by affecting households' choice between FRMs and ARMs, as well  
as mortgage refinancing, penalties also affect the transmission of interest rate

shocks and monetary policy into consumption and the real economy (Calza et al., 2013; Keys et al., 2014a; Agarwal et al., 2015a).

170 Finally, using data from Italy, our paper contributes to the current debate on the design of mortgage markets by establishing novel micro-evidence on the effects of an important reform. Mortgage markets vary greatly across countries, and international comparisons can help policy makers to devise optimal regulation (Campbell, 2013; Jaffee, 2015). For example, Campbell et al. (2015) 175 analyze how changes in regulation impacted mortgage lending and risk in India; and Allen et al. (2014) study the effect of bank mergers on the pricing of mortgages in Canada. More broadly, many countries have recently enacted reforms and introduced new regulations in markets for consumer financial products (Campbell et al., 2011a,b). Thus, our paper complements a few recent 180 contributions that analyze the effects of these reforms: for example, Assunção et al. (2014) study the effects of a 2004 Brazilian reform that simplified the sale of repossessed cars on car loans; and Agarwal et al. (2015b) analyze how regulatory limits on credit card fees affect borrowing costs in the U.S.

### 3. Institutional Background

185 Among developed countries, Italy has one of the highest homeownership rates, as well as one of the lowest mortgage debt-to-GDP ratios (Campbell, 2013). However, mortgage markets have developed rapidly since 2000, as the gap between house prices and available income has increased, and foreign lenders have entered the Italian market. For example, between 2004 and 2007, Italian 190 banks issued mortgages for an annual total value of 60 billion euros, which is unprecedented for the Italian market (Bonaccorsi di Patti and Felici, 2008). We now illustrate some key characteristics of the Italian mortgage market and describe the provisions of the 2007 Reform.

### 3.1. Mortgage Markets in Italy

195 Like several other countries, between 1998 and 2007, Italy experienced a prolonged increase in house prices, as well as an increase in banks' exposure to the housing market. By June 2012, housing-related loans accounted for 50 percent of private-sector lending, with mortgages to households accounting for more than 20 percent (Gobbi and Zollino, 2012).

200 Historically low interest rates, along with a favorable housing cycle and increasing competition between lenders, expanded the availability of mortgages to households after 2000. Specifically, the expanding supply of mortgages with maturity above 30 years, high loan-to-value and alternative mortgages (i.e., high ratio between first payments and income) made mortgages accessible to house-  
205 holds that were previously excluded from the market (e.g., young families and immigrants). The financial crisis halted the ongoing expansion of the mortgage market, reducing both households' demand and lenders' supply, as stricter balance sheet requirements and worse quality of applicants tightened most banks' lending policies. From 2004 to 2007, banks and other lenders issued 266,000  
210 mortgages annually, whereas between 2008 and 2011, they issued 208,000 contracts, a 22-percent decline (Felici et al., 2012).<sup>4</sup>

Traditionally, ARMs represented the most common mortgages on the Italian market, accounting for approximately 80 percent of new mortgages issued from 1999 to 2003 (Bonaccorsi di Patti and Felici, 2008). Figure 1 replicates Figure

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<sup>4</sup>Bank regulation and supervision through the Basel Accords may have changed banks' incentives to supply mortgages after 2008. Specifically, the Basel II Accords, implemented in 2008 in several countries, including Italy, specified banks' minimum capital requirement based on risk-weighted assets, thereby including mortgages, whereas the Basel I Accords (i.e., banks' regulatory framework before 2008) did not include such provisions. The Basel II Accords allowed the credit risk to be calculated in different ways, with varying degrees of sophistication; most notably, it allowed the use of banks' internal empirical models to quantify the required capital for credit risk, subject to the approval of local regulators (i.e., the Central Banks of different countries, or other bank regulators). The Bank of Italy approved the internal model of our lender in the fourth quarter of 2009. However, the approved model did not specify differential capital provisions for the credit risk of FRMs and ARMs.

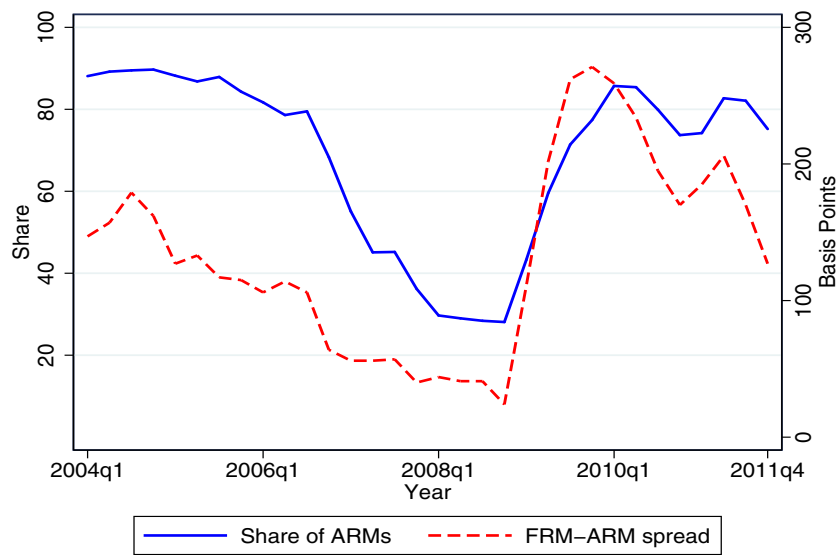


Figure 1: The solid line displays the quarterly share of ARMs (left axis) and the dashed line displays the spread between FRM and ARM rates (right axis) during 2004-2011.

215 12 of Felici et al. (2012): it displays the quarterly market share of ARMs (solid  
line) and the spread between the average rate on FRMs and on ARMs during  
the period 2004-2011.<sup>5</sup> This figure shows interesting patterns. Specifically, the  
share of new ARMs declined to about 30 percent during 2007-2009, as short-  
term interest rates increased in the Euro area, thereby narrowing the difference  
220 between fixed and variable rates to approximately 50 basis points. However,  
by 2010, the ARM share reverted to about 80 percent, as the sharp decline in  
short-term interest rates widened the gap between the initial rates on FRMs and  
on ARMs to more than 200 basis points. Notably, the average level of the FRM-  
ARM spread was substantially higher in 2010-2011 than in 2005-2006, while the  
225 share of ARMs was quite similar in those two periods, thereby suggesting that  
FRMs became more attractive to borrowers between 2006 and 2010.

The average mortgage size increased from 134,000 euros in 2004-2007 to  
145,000 euros in 2008-2011, broadly in line with the increase in the consumer  
price index over the same period, with larger increases in provinces with higher  
230 house-price growth. This increase in size is attributable to the higher incidence  
of mortgages above 150,000 euros, issued mainly to high-income borrowers (Fe-  
lici et al., 2012). Loan-to-values declined from 68.7 percent in 2006 to 61.1  
percent in 2011.

Our empirical analysis focuses on the role of prepayment penalties. The  
235 main Italian economic newspaper, *Il Sole 24 Ore*, reported that, in 2006, the  
average prepayment penalty was higher on FRMs than on ARMs: between one  
and two percent of the mortgage amount for ARMs, and between two and three  
percent for FRMs, but some penalties were as high as eight percent (*Il Sole 24*

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<sup>5</sup>ARMs are defined as mortgages with a fully variable rate or a fixed rate up to one year,  
whereas FRMs are mortgages with a rate fixed for more than ten years. The interest rates  
on most ARMs adjust every month (or at the alternative frequency that parties determine at  
origination) according to the following explicit formula: the sum of the spread, determined at  
origination and fixed for the entire duration of the mortgage, and the three-month Euribor  
rate (or any other rate determined at origination); in most cases, the date at which this rate  
is determined is the penultimate working day prior to the payment due date.

*Ore*, February 2, 2007). Hence, for a mortgage of the average size of 134,000  
240 euros, average penalties were between 1,340 and 2,680 euros for ARMs and  
between 2,680 and 4,020 euros for FRMs, with an extra cost of almost 10,000  
euros for the mortgages with the highest penalties. Most penalties were fixed  
for the entire duration of the mortgages and displayed only small differences  
across banks (*Il Sole 24 Ore*, October 21, 2006).

### 245 3.2. The 2007 Reform

The 2007 reform was part of liberalization measures involving different sec-  
tors of the Italian economy. The goal of the reform was to favor mortgage  
refinancing—*Il Sole 24 Ore* reported on March 6, 2007 that only six percent of  
outstanding mortgages were refinanced—and to promote competition in mort-  
250 gage markets, thereby benefitting consumers. Our main focus is Article 7 of the  
law, as it regulates prepayment penalties for residential mortgages.

Our empirical analysis exploits two provisions of Article 7. First, Italian  
banks and consumers' associations had to agree on limits to prepayment pen-  
alties applicable to all 3.5 million outstanding residential mortgage contracts is-  
255 sued before 2007. For existing ARMs, maximum penalties were set to 0.5 per-  
cent, 0.2 percent in the third-from-last year, and zero in the last two years of  
amortization. For existing FRMs, maximum penalties were set to 1.90 percent  
in the first half of the amortization period, 1.50 percent in the second half, 0.2  
percent in the third-from-last year, and zero in the last two years of amorti-  
260 zation. These reductions were exogenous and unexpected for borrowers who  
took their mortgages before the reform. Thus, in Section 5.2, we exploit this  
provision, along with data on mortgages issued before the reform, to analyze  
the effect of prepayment penalties on both prepayments and delinquencies. Sec-  
ond, the reform abolished prepayment penalties on all new mortgages issued for  
265 purchasing households' main residence. Thus, in Section 5.3, we exploit this  
provision, along with data on mortgages issued before and after the reform, to  
analyze the effect of prepayment penalties on households' choice between FRMs

and ARMs.<sup>6</sup>

While our empirical analysis shows that the 2007 reform increased mortgage  
270 prepayments and refinancing, we should point out that the post-reform aggregate level of refinancing and, more generally, of mortgage debt are still substantially lower than those observed in many other advanced countries—e.g., the European Mortgage Federation (2011) reports that the ratio of residential debt to GDP was 22.9 in Italy, 51.7 in the European Union, and 76.1 in the United  
275 States in 2011. Information technology has been rapidly changing the lending practices of financial institutions around the world, but Italian lenders introduced credit scoring systems later and more gradually than those in many other countries (Albareto et al., 2011). Hence, Italian consumer credit markets still lag those of other countries in terms of the sophistication and the diffusion of a  
280 credit scoring system that is regularly updated and widely adopted by lenders, such as the FICO score in the U.S. Similarly, house price indexes are much coarser than those available in many other countries—e.g., there is no website that reports the transaction history of individual properties, as [www.zillow.com](http://www.zillow.com) does in the U.S. Hence, these features suggest that improvements in borrowers' credit scores and increases in house prices should account for a smaller share of  
285 prepayments in Italy than in the U.S.

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<sup>6</sup>Article 8 of the law also included two ancillary provisions related to the fact that real estate transactions and mortgage deeds are recorded in public registries: 1) Introduction of the subrogation. Before the reform, a borrower could refinance his mortgage only by redeeming the original mortgage and registering a new one. This registration was costly for the borrower. Since the reform, a borrower can refinance his mortgages by switching from the original bank to a new bank without redeeming the original mortgage and registering a new one. The borrower needs to notify the original lender, but the original lender cannot apply any repayment penalties and cannot oppose the subrogation (Bajo and Barbi, 2015). 2) Automatic cancellation of the mortgage lien at no cost to the borrower when he repays his mortgage in full. Before the reform, a public notary had to register the cancellation of the lien, and this was costly to borrowers.

#### 4. Data

We obtain proprietary data on all mortgages issued by a large Italian bank in 2005 and 2009. The bank merged with another bank in 2007, and the 2005  
 290 sample is from one of the (then separate) lenders, whereas the 2009 sample is from the merged entity.

We study mortgages issued with the purpose of buying households' primary residence, which represent more than 90 percent of the mortgages in our sample. The literature identifies two main categories of mortgages: FRMs and ARMs  
 295 (Campbell, 2006; Koijen et al., 2009; Badarinza et al., Forthcoming). Therefore, we focus on these two types and drop mortgages with interest rates classified as *mixed*—i.e., mortgages that allow borrowers to choose at predefined frequencies (usually every three or five years) whether the interest rate will be fixed or adjustable in the future.<sup>7</sup> We further exclude mortgages issued to bank employees,  
 300 which account for four percent of the sample composed of ARMs and FRMs. Finally, we drop mortgages for which the address of the property financed is missing (an additional 7.4 percent of the remaining sample). Our final sample has 37,094 mortgages, 17,519 issued in 2005 and 19,575 issued in 2009.

Our database contains detailed information on mortgage contract terms and  
 305 mortgage performance until December 2012, whereas detailed information on borrowers' characteristics is available only for mortgages issued in 2009. We observe the interest rate applicable over the life of the loan (fixed for FRMs; spread plus three-month Euribor for ARMs); the mortgage spread, which equals the interest rate minus the Euro Interest Rate Swap (Eurirs) reported by the  
 310 European Banking Federation for the corresponding maturity (e.g., 20 years) on

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<sup>7</sup>Mixed mortgages represent approximately nine percent of the mortgages in our original sample, 13 percent of the 2005 sample and four percent of the 2009 sample. Hence, the decline in their market share between 2005 to 2009 is consistent with the idea that the 2007 reform affected mortgage selection since the value of the option to adjust the interest rate type embedded in mixed mortgages declined, as the 2007 reform made it easier to refinance mortgages when interest rates vary.



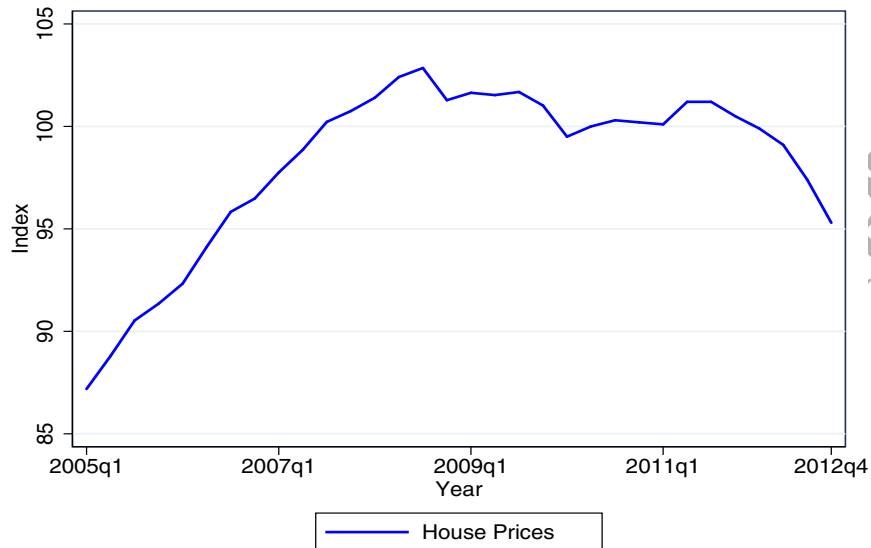


Figure 2: The figure displays Italy's aggregate quarterly house price index between the first quarter of 2005 and the fourth quarter of 2012, with baseline value of 100 in the first quarter of 2012.

FRMs, and the initial interest rate minus the three-month Euribor on ARMs; the amount of the loan; the loan-to-value ratio; the date of issuance; the maturity; and the amount of the prepayment penalties. The database further includes information on the performance of the mortgage, such as any amount prepaid and all delinquencies throughout the life of the mortgage until 2012. For mortgages issued in 2009, we observe some borrowers' characteristics at origination, such as age, gender, personal and family income, occupation, and number of people in the household.

We complement our original dataset with additional aggregate time-varying variables that seek to capture incentives to prepay or to default during the contract period. We use the ARM refinancing rate in month  $t$ —equal to the three-month Euribor plus the average posted spread that the lender charges on a 20-year ARM—to proxy for the incentives to refinance the current mortgage

with an ARM; and the 20-year FRM refinancing rate in month  $t$ —equal to 20-  
325 year Eurirs plus the average posted spread that the lender charges on a 20-year  
FRM—to capture the incentives to refinance with an FRM. While the entire  
yield curve should matter for refinancing incentives across different maturities,  
these short-term and long-term rates are those of the most popular mortgages  
in the Italian market, and the evidence reported in Badarinza et al. (Forthcom-  
330 ing) indicates that these rates on ARMs and FRMs are adequate to capture  
refinancing incentives.<sup>8</sup> Figure 1 displayed the difference between the FRM and  
ARM rates, showing that it varied greatly during the period 2005-2011, as it  
decreased from 2005 to 2009 and then increased dramatically during 2009.

Moreover, our data report the postcode of the financed property. We match  
335 it to the annual local house price index published by Nomisma, an Italian re-  
search firm, for the corresponding province (Italy is divided into 110 provinces,  
which have an area comparable to U.S. counties), thereby allowing us to measure  
the effect of house prices on borrowers' prepayments and delinquencies. Figure  
2 displayed the quarterly aggregate index for Italy, which increased rapidly from  
340 2005 to mid-2008, stayed approximately constant from mid-2008 to mid-2011,  
and declined beginning in mid-2011. Finally, we match each property to the  
annual local unemployment rate published by Istat, Italy's National Institute of  
Statistics, for the corresponding province to capture local economic conditions.

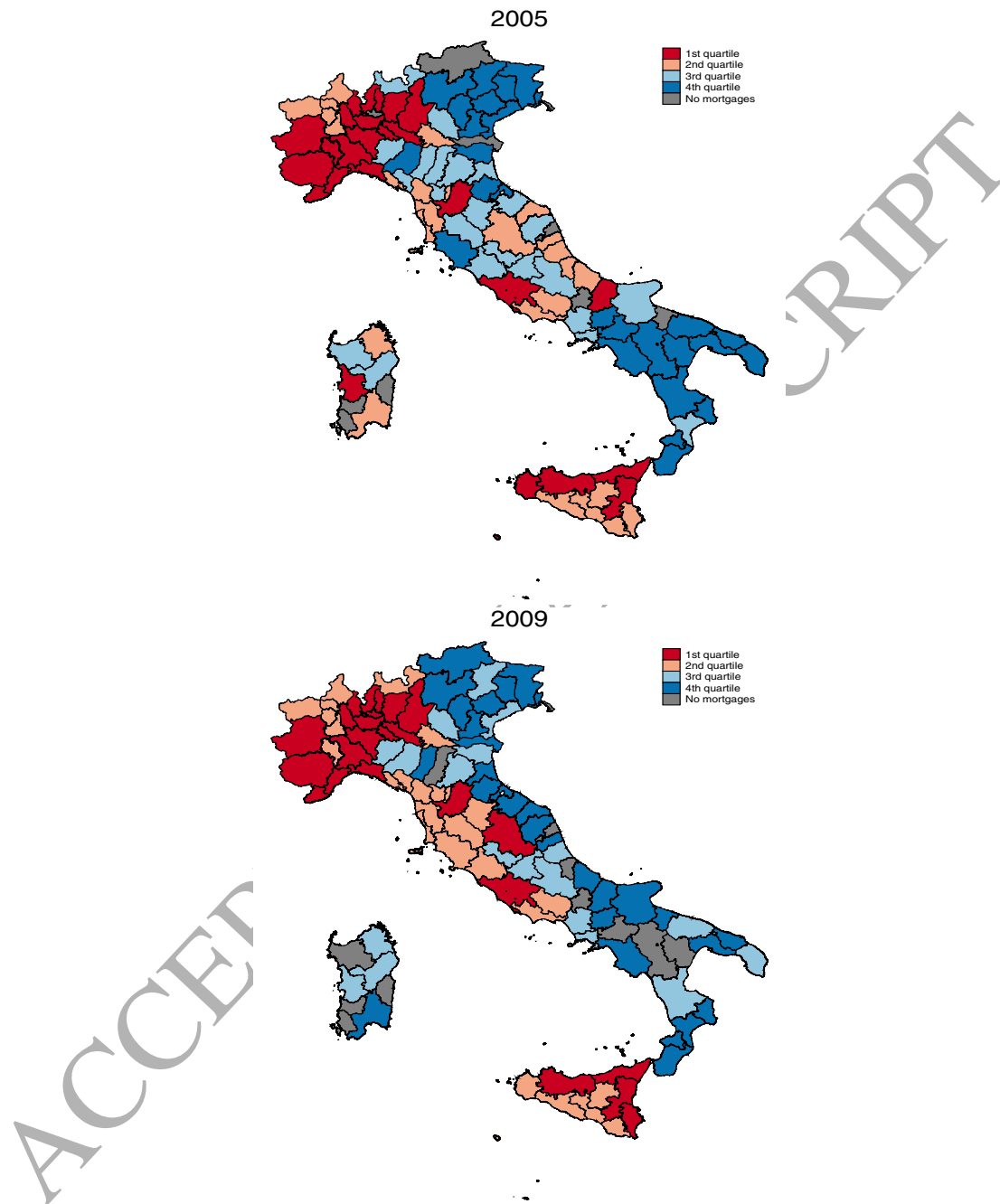


Figure 3: The left panel displays the number of mortgages originated in 2005 in each province, and the right panel displays the number of mortgages originated in 2009 in each province.

#### 4.1. Data Overview

345 Figure 3 displays maps that show the geographic distribution of originations for each cohort: the left map refers to mortgages originated in 2005 and the right map to those originated in 2009. While, as we recounted above, the bank merged with another bank in 2007, the provinces with most originations are almost identical across the two cohorts—i.e., provinces in the Northwest, the  
 350 central province of Rome, and the provinces on the island of Sicily—indicating that the geographic distribution of borrower pools is not substantially different across cohorts.

In Table 1, we compare mortgage characteristics at origination, as well as mortgage performances by year of issuance and interest-rate type. Panel A  
 355 compares mortgages by year of issuance and shows that mortgages issued in 2005 have lower interest rates and loan-to-values, but lower sizes and shorter maturities, than those issued in 2009. Prepayment penalties apply only to the 2005 cohort, and the average penalty is about one percent. With respect to  
 360 ex-post performances, we observe more prepayments and delinquencies for 2005 than for 2009 mortgages. These differences are due partly to the fact that we observe 2005 mortgages over a longer period, but in the case of prepayment, they persist if we consider them only until four years after the issuance. Table 1 also shows that 18 percent of mortgages are prepaid, whereas only three percent are delinquent, confirming that prepayments are quantitatively more relevant

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<sup>8</sup>Koijen et al. (2009) suggest that the long-term bond risk premium is the main determinant of mortgage choice, and they find support for this hypothesis using U.S. data. Campbell and Cocco (2003) and Campbell (2013) argue, instead, that the spread between the FRM rate and the current ARM rate may be the most relevant variable for determining mortgage choice since borrowing-constrained households care about current interest costs and are likely to choose ARMs in order to reduce those costs. Badarizna et al. (Forthcoming) use international data outside the U.S. to study the main determinant of mortgage choices: their results generally support the hypothesis that the spread between the FRM rate and the current ARM rate is the proximate driver of household mortgage choice, whereas they find little support for the hypothesis that the long-term bond risk premium helps determine the ARM share.

365 than delinquencies. The difference between the FRM and ARM refinancing rates suggests that refinancing FRMs with ARMs could substantially lower at least the initial monthly payments after refinancing.

Panel B of Table 1 compares fixed-rate and adjustable-rate mortgages at origination and their performances. FRMs have significantly higher interest 370 rates and spreads, as well as lower amounts and collaterals. The average interest rate difference between FRMs and ARMs is 1.79 percent. At origination, ARMs appear more risky than FRMs: ARMs have, on average, higher loan-to-values and longer maturities than FRMs. FRMs and ARMs are also significantly different when we focus on prepayment penalties. Almost all FRMs issued in 375 2005 feature a prepayment penalty, with an average penalty of 2.6 percent; only 22 percent of ARMs issued in 2005 feature such a penalty, and the average penalty is 0.4 percent. The comparison of *ex-post* performances confirms the differences that we documented at origination. ARMs are more risky: they are more likely to be delinquent than FRMs—four percent of ARMs versus one 380 percent of FRMs are delinquent—and they are more likely to be prepaid than FRMs—20 percent of ARMs versus 14 percent of FRMs are prepaid.<sup>9</sup>

Overall, our dataset is ideally suited to investigating how prepayment penalties affect borrowers' behavior on their outstanding mortgages and to providing insights on how penalties affect borrowers' mortgage selection. Moreover, we 385 have good information on the market value of each property over time, which allows us to compute borrowers' equity. Even with all these advantages, however, the data pose some challenges. First, they do not report detailed borrowers' characteristics. In particular, they do not report information on borrowers' assets/liabilities and their evolution over time. Similarly, they report income at 390 origination only for mortgages issued in 2009, and there is no information on its evolution. Second, the data do not report any information on the reasons for

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<sup>9</sup>The 20-year and the three-month interest rates differ between FRMs and ARMs because of their different share over time.

Table 1: Summary Statistics

PANEL A: MORTGAGES BY YEAR OF ISSUANCE					
	2005		2009		$\Delta$
	MEAN	S.D.	MEAN	S.D.	
FRM SHARE (%)	31.17	46.32	59.85	49.02	-28.68***
INTEREST RATE (%)	3.98	0.70	4.08	1.26	-0.10***
SPREAD (%)	1.32	0.58	1.76	0.63	-0.45***
AMOUNT (€1,000)	102.34	77.10	116.44	83.99	-14.09***
COLLATERAL (€1,000)	219.18	675.11	246.79	1554.34	-27.61*
LOAN-TO-VALUE (%)	55.81	21.96	55.17	22.55	0.64**
MATURITY (YEARS)	18.96	6.26	20.24	7.39	-1.27***
PENALTY (%)	45.89	49.83	0.00	0.00	45.89***
PENALTY AMOUNT (%)	1.12	1.36	0.00	0.00	1.12***
DELINQUENCY (%)	5.36	22.52	0.85	9.17	4.51***
DELINQUENCY - 4 YEARS (%)	1.17	10.75	0.85	9.17	0.32**
PREPAYMENT (%)	25.34	43.50	10.21	30.27	15.14***
PREPAYMENT - 4 YEARS (%)	11.58	31.99	10.21	30.27	1.37***
ARM REFI RATE (%)	4.04	1.33	3.01	0.54	1.03***
FRM REFI RATE (%)	5.55	0.53	5.29	0.54	0.26***
HOUSE PRICE (INDEX)	99.98	5.53	101.44	1.79	-1.46***
UNEMPLOYMENT RATE (%)	6.76	3.30	7.93	3.12	-1.17***
OBSERVATIONS	17,519		19,575		37,094

PANEL B: MORTGAGES BY INTEREST RATE TYPE					
	FRM		ARM		$\Delta$
	MEAN	S.D.	MEAN	S.D.	
INTEREST RATE (%)	4.99	0.44	3.20	0.59	-1.79***
SPREAD (%)	1.71	0.86	1.41	0.30	-0.30***
AMOUNT (€1,000)	94.54	59.03	122.92	94.21	28.38***
COLLATERAL (€1,000)	208.15	304.32	255.83	1641.59	47.68***
LOAN-TO-VALUE (%)	52.16	22.28	58.32	21.88	6.16***
MATURITY (YEARS)	18.56	7.03	20.56	6.67	1.99***
PENALTY (%)	31.41	46.42	13.27	33.93	-18.14***
PENALTY AMOUNT (%)	0.84	1.30	0.25	0.76	-0.59***
DELINQUENCY (%)	1.40	11.74	4.34	20.38	2.95***
DELINQUENCY - 4 YEARS (%)	0.69	8.29	1.27	11.18	0.57***
PREPAYMENT (%)	14.27	34.98	20.02	40.01	5.75***
PREPAYMENT - 4 YEARS (%)	9.54	29.37	11.99	32.48	2.45***
ARM REFI RATE (%)	3.35	1.00	3.62	1.20	0.28***
FRM REFI RATE (%)	5.38	0.55	5.45	0.55	0.06***
HOUSE PRICE (INDEX)	101.05	3.61	100.50	4.43	-0.55***
UNEMPLOYMENT RATE (%)	8.18	3.44	6.69	2.91	-1.49***
OBSERVATIONS	17,177		19,917		37,094

Notes: PENALTY is an indicator variable taking value one when the mortgage has a positive prepayment penalty and zero otherwise. PENALTY AMOUNT is the actual amount of the penalty. DELINQUENCY is an indicator variable taking value one if the mortgage has a missed payment in any year in the sample and zero otherwise. PREPAYMENT is an indicator variable equal to one if the mortgage is repaid in full before maturity and zero otherwise. DELINQUENCY - 4 YEARS and PREPAYMENT - 4 YEARS are indicator variables that take value of one if the respective event is realized within four years from issuance, and zero otherwise. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. <sup>a</sup>Calculated only on mortgages issued in 2005.

prepayments and delinquencies. For example, they do not report whether the prepayment is due to refinancing with a newly-issued mortgage, the sale of the house, or a bequest that allows borrowers to fully repay the mortgage. Finally,  
 395 as we mention in footnote 1, the data do not allow us to distinguish between delinquencies (i.e., missed and late payments) and defaults.

## 5. Empirical Analysis

Our empirical analysis proceeds in three main steps. First, we use only mortgages issued in 2005 to show that riskier mortgages were more likely to include  
 400 prepayment penalties. Second, and central to our analysis, we use mortgages issued in 2005 and exploit the exogenous variation in penalties due to the 2007 reform to study the causal effect of penalties on households' prepayment and default behavior. Third, we compare mortgages issued in 2005 and 2009 and provide suggestive evidence that the abolition of penalties affected households'  
 405 mortgage choice between ARMs and FRMs, most notably inducing riskier borrowers to disproportionately choose FRMs.

### 5.1. Which Mortgages Include Prepayment Penalties?

We compare mortgages with and without penalties in panel A of Table 2, looking at contract characteristics and ex-post performances. Mortgages  
 410 with penalties have, on average, higher interest rates, higher spreads, smaller amounts, lower loan-to-value and shorter maturities. A comparison of ex-post performances indicates that mortgages with penalties are less likely to be pre-paid and less likely to default. These aggregate comparisons, however, mask stark differences that emerge once we condition on how the interest rate is set.

415 Specifically, almost all (99 percent) FRMs include prepayment penalties, whereas only 22 percent of ARMs include them. Hence, panel B of Table 2 explores whether the previous differences between mortgages with and without penalties persist once we control for how the interest rate is set. Panel B indicates that ARMs with penalties have higher interest rates, higher spreads, higher

Table 2: Prepayment Penalties

PANEL A: ALL MORTGAGES					
	WITH PENALTY		WITHOUT PENALTY		$\Delta$
	MEAN	ST. DEV.	MEAN	ST. DEV.	
INTEREST RATE (%)	4.56	0.60	3.49	0.28	1.07***
SPREAD (%)	1.33	0.81	1.30	0.26	-0.03***
AMOUNT (€1,000)	87.66	56.76	114.80	88.97	-27.14***
COLLATERAL (€1,000)	223.48	981.22	215.50	160.78	7.97
LOAN-TO-VALUE (%)	53.77	22.43	57.53	21.40	-3.75***
MATURITY (YEARS)	17.89	6.12	19.87	6.23	-1.98***
DELINQUENCY (%)	4.37	20.44	6.20	24.12	-1.84***
PREPAYMENT (%)	20.34	40.25	29.59	45.65	-9.25***
OBSERVATIONS	8,039		9,480		17,519

PANEL B: MORTGAGES BY INTEREST RATE TYPE

	FRM			ARM		
	HIGH	LOW	$\Delta$	WITH	WITHOUT	$\Delta$
	PENALTY	PENALTY		PENALTY	PENALTY	
INTEREST RATE (%)	4.88	4.84	0.04**	3.93	3.48	0.45***
SPREAD (%)	1.15	1.07	0.08***	1.75	1.30	0.45***
AMOUNT (€1,000)	75.22	98.65	-23.42***	102.90	114.73	-11.85***
COLLATERAL (€1,000)	178.87	268.96	-95.48***	281.54	215.21	66.31***
LOAN-TO-VALUE (%)	49.43	48.74	0.69	63.08	57.55	5.52***
MATURITY (YEARS)	16.89	16.31	0.58***	20.92	19.87	1.05***
DELINQUENCY (%)	2.99	1.41	1.58***	7.91	6.23	1.67**
PREPAYMENT (%)	17.83	25.94	-8.11***	22.10	29.52	-7.42***
OBSERVATIONS	1,276	4,185	5,461	2,643	9,415	12,058

Notes: DELINQUENCY is an indicator variable taking value one if the mortgage has a missed payment in any year in the sample and zero otherwise. PREPAYMENT is an indicator variable equal to one if the mortgage is repaid in full before maturity and zero otherwise. In panel B, FRMs with a high (low) penalty are those whose penalty is above (below) three percent; approximately 70 percent of FRMs have a high penalty. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.



420 loan-to-value and longer maturities than ARMs without penalties. Hence,  
 ARMs with penalties appear more risky than ARMs without penalties at orig-  
 ination. Indeed, ARMs with penalties are more likely to default than ARMs  
 without penalties. Moreover, ARMs with penalties are less likely to be prepaid  
 than those without penalties, perhaps suggesting that penalties affect borrowers'  
 425 prepayment behavior.

Since almost all FRMs include penalties, we compare FRMs with higher  
 penalties to those with relatively lower penalties. Overall, for most characteris-  
 tics, the differences between FRMs with larger penalties and those with smaller  
 penalties are similar to the differences between ARMs with and without penal-  
 430 ties. The collateral value (i.e., the price of the financed property) represents the  
 most noticeable discrepancy in this comparison.

Overall, the empirical patterns that emerge from Table 2 motivate the anal-  
 yses of the next two sections. Specifically, the table suggests a thorough analysis  
 of the direct effect of penalties on prepayment behavior; thus, to identify this  
 435 effect, Section 5.2 exploits the 2007 revision of penalties on mortgages issued  
 in 2005. The table further suggests that penalties were more likely to apply to  
 higher-risk borrowers and to FRMs. Thus, section 5.3 compares the difference  
 between FRMs issued in 2005 and in 2009 to the difference between ARMs is-  
 sued in 2005 and in 2009 to seek to understand whether the abolition of penalties  
 440 affected mortgage pricing and borrowers' choice among mortgage contracts.

### 5.2. *Prepayment Penalties and Mortgage Performance*

In this section, we exploit the exogenous variation in penalties due to the  
 2007 reform to identify the causal effect of prepayment penalties on mortgage  
 performance using mortgages issued in 2005.

445 While prepayment penalties should, perhaps, have a larger effect on prepay-  
 ments than on delinquencies, the arguments that we recounted in the Introduc-  
 tion assert that these penalties may lock borrowers into expensive mortgages,  
 thereby prompting default. Hence, following Deng et al. (2000), we specify

an empirical model of borrowers' repayment behavior that includes two dif-  
 450 ferent outcomes: anticipated repayment (i.e., prepayment) and no repayment  
 (i.e., delinquency). For this purpose, we employ stratified hazard models with  
 competing risks, which allow us to capture borrowers' repayment behavior in a  
 flexible way and to account for the censoring of the data after December 2012.

We start with a non-parametric graphical analysis. We have two separate  
 events of interest (i.e.,  $K = 2$ ): prepayment ( $k = 1$ ) and delinquency ( $k = 2$ ).  
 We calculate the instantaneous hazard  $h_k(s)$  of an event  $k$  at  $s$ , given that the  
 borrower has not fully repaid the mortgage and has not defaulted.<sup>10</sup> Hence,  
 $h(s) = \sum_{k=1}^K h_k(s)$  gives the overall hazard rate, given the  $K$  possible "failure"  
 events, and  $\frac{h_k(s)}{h(s)}$  gives the probability of event  $k$  once a failure occurs. From  
 the event-specific hazard  $h_k(s)$ , we obtain the cumulative incidence function  
 $CIF_k(s)$ , the probability of event  $k$  happening before (or up to)  $s$ , as

$$CIF_k(s) = \int_0^s h_k(x)S(x)dx,$$

where  $S(x)$  is the overall survival function.<sup>11</sup> We can obtain a non-parametric  
 455 estimate of the cumulative incidence function as:

$$\widehat{CIF}_k(s) = \sum_{j:s_j \leq s} \frac{d_{kj}}{n_j} \widehat{S}(s_{j-1}),$$

where  $\widehat{S}(\cdot)$  is the Kaplan-Meier estimate of surviving for all failures;  $d_{kj}$  is the  
 number of failures from cause  $k$  at  $s_j$ ; and  $n_j$  is the number at risk of failing from  
 any cause at  $s_j$ . In our case, we specify  $s$  as the fraction of the mortgage repaid,  
 rather than as time, to take into account mortgages of different maturities.

460 Hence,  $s$  ranges from 0 at origination to 1 when the borrower fully repays it.

<sup>10</sup>When we compute the cause-specific hazard for prepayment  $h_1(t)$ , failure due to default  
 is treated as right-censored.

<sup>11</sup>Let  $H_k(x)$  be the cause-specific cumulative hazard for cause  $k$ . Then,  $H(x) = \sum_{k=1}^K H_k(x)$   
 is the overall cumulative hazard, and  $S(x) = \exp(-H(x))$  gives the relationship between the  
 overall survival and the overall cumulative hazard.

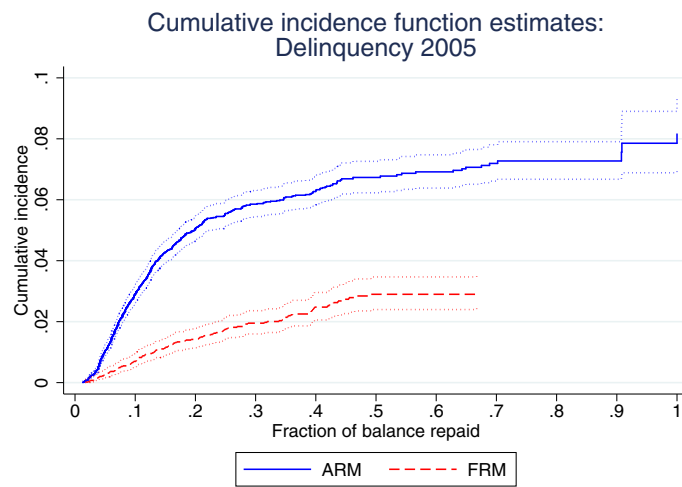
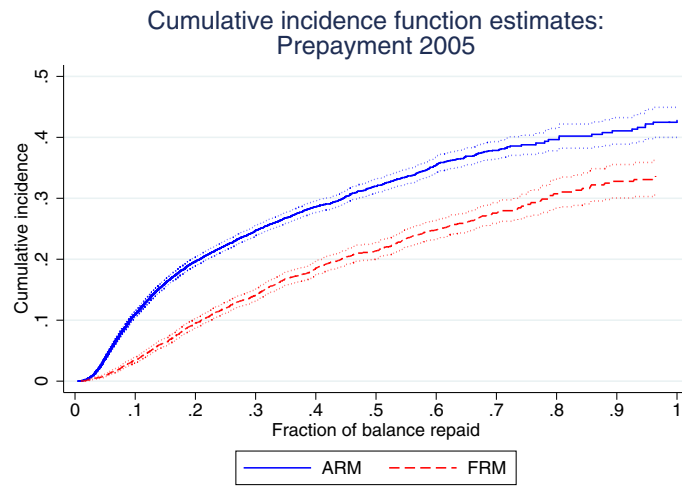


Figure 4: The top panel displays the cumulative incidence of prepayments, and the bottom panel the cumulative incidence of delinquencies of mortgages issued in 2005.

Figure 4 plots these non-parametric estimates of the cumulative incidence functions of prepayments (top panel) and delinquencies (bottom panel), distinguishing between ARMs (solid line) and FRMs (dashed line). The panels display interesting patterns. First, the cumulative incidence of prepayments and delinquencies are higher for ARMs than for FRMs, confirming that ARMs are riskier than FRMs. Second, the plot of prepayments' cumulative incidence shows that ARMs' incidence starts substantially higher than that of FRMs, but the latter seem to catch up over time. This second pattern suggests that the 2007 reform accelerated borrowers' prepayments by reducing prepayment penalties on outstanding mortgages: since penalties were concentrated on FRMs, the reform had a larger effect on the prepayments of FRMs than on those of ARMs. Third, the reform did not seem to affect delinquencies and, indeed, the bottom panel shows that we do not observe any effect on the difference between FRMs' and ARMs' cumulative delinquencies. Finally, the slopes of the cumulative incidence functions indicate that the instantaneous hazards of prepayment and delinquency are highest at the beginning of the repayment period, when the loan balance is highest. Then, they gradually decline as borrowers repay part of the loan, and, thus, the balance is lower.

We further investigate these issues using a semi-parametric Cox model with competing risks, which allows us to analyze how mortgage characteristics are correlated with borrowers' behavior. The Cox model implies that the instantaneous probability of an event  $k$  at  $s$ , given that borrower  $i$  has not fully repaid the mortgage and has not defaulted before  $s$ , equals:

$$h_k(s|X_{it}) = h_{0k}(s) \exp(\beta_k X_{it}), \quad (1)$$

where  $X_{it}$  are characteristics of the mortgage of borrower  $i$  at time  $t$ ;  $\beta_k$  are coefficients specific to event  $k$ ; and  $h_{0k}(s)$  is the baseline hazard of event  $k$ . Thus,  $h(s|X_{it}) = \sum_{k=1}^K h_k(s|X_{it})$  gives the overall hazard rate, given the  $K$  possible events. We include in  $X_{it}$  time-invariant mortgage characteristics determined at origination, such as the amount, the loan-to-value, the maturity, and the

interest-rate type (i.e., ARM versus FRM); and time-varying mortgage charac-  
485 teristics, such as the interest rate and, most notably, the prepayment penalty,  
which changed over time due to the 2007 reform.

Table 3 reports hazard rate estimates of different specifications—i.e., a coef-  
ficient greater (smaller) than one indicates that an increase in the value of the  
corresponding variable increases (decreases) prepayment and/or delinquency.  
490 Specification (1) compares the differences between the hazards of FRMs and  
ARMs before and after the reform. The estimates of this specification imply  
that borrowers are significantly less likely to prepay and to default on FRMs  
than on ARMs before the reform. The magnitudes of both differences are large:  
FRMs' prepayment hazard is approximately 60-percent lower than ARMs', and  
495 FRMs' delinquency hazard is approximately 80-percent lower than ARMs'. The  
reform coincides with a large increase in prepayments on both types of mort-  
gages. Delinquencies also increased after the reform, perhaps as aggregate eco-  
nomic conditions worsened (in addition to what the contemporaneous local un-  
employment rate already captures). The point estimates suggest that FRMs  
500 experienced a larger increase in prepayments and delinquencies than ARMs did  
after the reform; however, these estimates are not precise and, thus, the hazard  
rates are statistically indistinguishable from one.

While we focus primarily on penalties and their revision due to the reform,  
the effects of mortgage terms are also of interest. Borrowers are significantly  
505 more likely to prepay mortgages if the interest rates are higher and if, at orig-  
ination, the mortgage amounts are larger and the maturities longer.<sup>12</sup> These  
results are, perhaps, to be expected, as the benefits to prepaying mortgages are  
greater when they have higher interest rates, larger amounts and longer matu-  
rities. Moreover, borrowers are more likely to default on mortgages with higher  
510 interest rates, with higher LTVs, and with longer maturities. Again, these re-  
sults are largely expected: for example, distressed borrowers may find it more

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<sup>12</sup>LOG(AMOUNT), LOAN-TO-VALUE and MATURITY are time-invariant variables with values set at origination.

Table 3: The Effect of Penalties on Mortgage Performance, 2005

	PREPAYMENT			DELINQUENCY		
	(1)	(2)	(3)	(1)	(2)	(3)
FRM	0.380*** (0.048)	0.911 (0.072)	0.662*** (0.089)	0.183*** (0.109)	0.314*** (0.072)	0.324*** (0.132)
POST-REFORM	2.023*** (0.154)			2.302*** (0.470)		
FRM × POST-REFORM	1.141 (0.151)			1.432 (0.888)		
ACTUAL PENALTY		0.593*** (0.026)	0.731*** (0.060)		0.830** (0.075)	0.815 (0.156)
RESIDUAL PENALTY			0.855*** (0.043)			1.012 (0.118)
INTEREST RATE	1.534*** (0.030)	1.625*** (0.033)	1.610*** (0.033)	1.625*** (0.114)	1.724*** (0.126)	1.724*** (0.126)
LOG(AMOUNT)	1.081** (0.036)	1.031 (0.034)	1.051 (0.035)	0.936 (0.085)	0.911 (0.082)	0.909 (0.083)
LOAN-TO-VALUE	0.999 (0.001)	1.000 (0.001)	0.999 (0.001)	1.015*** (0.002)	1.016*** (0.002)	1.016*** (0.002)
MATURITY	1.071*** (0.005)	1.093*** (0.004)	1.094*** (0.004)	1.219*** (0.012)	1.238*** (0.011)	1.238*** (0.011)
ARM REFI RATE	0.869*** (0.023)	0.838*** (0.022)	0.841*** (0.023)	0.604*** (0.051)	0.573*** (0.051)	0.573*** (0.051)
FRM REFI RATE	0.834*** (0.038)	0.890** (0.040)	0.896** (0.041)	1.573*** (0.156)	1.676*** (0.164)	1.675*** (0.165)
HOUSE PRICES	1.016*** (0.004)	1.022*** (0.004)	1.024*** (0.004)	1.004 (0.010)	1.015* (0.009)	1.015* (0.009)
UNEMPLOYMENT RATE	0.983*** (0.006)	0.991 (0.006)	0.988** (0.006)	1.018 (0.013)	1.021 (0.013)	1.021 (0.013)
OBSERVATIONS	1,373,909	1,373,909	1,373,909	1,345,660	1,345,660	1,345,660
MORTGAGES	17,519	17,519	17,519	17,519	17,519	17,519

Notes: The table reports hazard rate estimates using all mortgages issued in 2005. FRM is an indicator variable taking value one when the mortgage has a fixed rate, and zero otherwise. POST-REFORM is an indicator variable taking the value one after April 2007, and zero otherwise. ACTUAL PENALTY is the penalty that the borrower pays if he prepays the mortgage. Robust standard error in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.

difficult to make payments on more expensive mortgages, and/or a higher interest rate reflects risk-based pricing. Similarly, less-creditworthy borrowers are more likely to select mortgages with higher LTVs and longer maturities. Overall, these correlations suggest that borrowers who were paying higher interest rates were more likely to prepay and to default on their mortgages, hinting that these individuals perhaps may have had higher income volatility—i.e., a higher probability of a negative shock leading to default, as well as a higher probability of a positive shock leading to prepayment.<sup>13</sup> Furthermore, the ARM and FRM refinancing rates suggest that borrowers are more likely to prepay when current interest rates are lower. The correlations between the refinancing rates and the default hazard rates are, perhaps, more difficult to interpret, but they suggest that delinquencies increased when refinancing rates on ARMs and FRMs diverged after 2011. Finally, prepayments rise when local house prices increase and the local unemployment rate decreases, whereas these local economic conditions do not seem to significantly affect delinquencies. The magnitudes of the prepayment hazard rate estimates suggest that the overall level of market interest rates has stronger effects on refinancing than the increase in house prices has. Moreover, the (no) effect of house prices on defaults seem to rule out that the main reason for defaults is borrowers having negative equity (remember that LTVs are not high in our sample).<sup>14</sup>

Specification (2) seeks to understand the relationships between penalties and the prepayment and the delinquency hazard rates by including the time-varying actual penalties among the covariates. Thus, for each mortgage in the sample with a positive penalty at origination, the penalty takes on two different values:

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<sup>13</sup>Unfortunately, as we argued in Section 4 when we introduced our data, they do not allow us to provide direct evidence on borrowers' income volatility, but our analyses uncover several patterns consistent with this interpretation.

<sup>14</sup>These effects on delinquencies are also consistent with the evidence reported by Foote et al. (2008) on U.S. data from 1991 to 1994: they document that less than ten percent of borrowers likely to have had negative equity experienced a foreclosure during the following three years.

the contractual penalty before April 2007 and the revised lower penalty after April 2007; for mortgages with no penalties at origination, the penalty always equals zero. The estimates indicate that the prepayment hazard is 41-percent lower for mortgages that feature a one-percentage-point larger penalty—i.e., a large magnitude. Moreover, the delinquency hazard rate is approximately 17-percent lower for mortgages that feature a one-percentage-point larger penalty. The effects of other mortgage terms are quite similar to those of specification (1).

While most of the variation that specification (2) exploits is by comparing penalties before and after the 2007 reform, the estimated relationship between penalties and the hazard rates in specification (2) lumps together two effects: 1) penalties directly affect borrowers' cost-benefit analysis when deciding to prepay or default; and 2) at the time of contracting, borrowers who expect that they are less likely to prepay or to default on their mortgage could select higher-penalty mortgages, with perhaps other more-favorable terms.

Specification (3) of Table 3 seeks to decompose these two different effects using a two-step control function (Blundell and Powell, 2003), following an approach similar to that of Adams et al.'s (2009) analysis of delinquencies on subprime car loans. More specifically, in the first step, we follow the procedure described in Bertrand et al. (2004) for a difference-in-difference analysis: for each mortgage, we retain two observations, one pre-reform and one post-reform, calculating the average of the mortgage characteristics in each respective period.<sup>15</sup> The first step proceeds by regressing the time-varying penalty on an indicator variable that equals one after April 2007, and zero otherwise, and its interaction with an indicator variable that equals one for FRMs and zero for ARMs, as well as on mortgage characteristics and on macro controls. Table 4 reports the first-stage estimates of different specifications: (A) does not include mortgage characteristics and macro controls; (B) includes them; (C) uses data on FRMs

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<sup>15</sup>Nine ARMs were fully prepaid before the reform, so we do not have post-reform observations for them.



only; and (D) uses data on ARMs only. Overall, the estimates are similar across  
565 specifications and indicate that the reform reduced penalties on FRMs and on  
ARMs by approximately 110 and 50/70 basis points, respectively. Based on  
specification (B) with richer controls, we then construct the residuals of this  
first-stage regression. By construction, the residuals capture the variation in  
penalties at the time of contracting, thus containing borrowers' preference as  
570 pertains to their choice of penalties. In the second step, we include both the  
time-varying penalties and the residuals in the estimation of the hazard rates.  
By including the residual penalty, as well as the other observed covariates, when  
estimating the prepayment and delinquency hazards, the remaining variation  
in actual penalties is due entirely to the reform. Hence, the two-step control  
575 function applies the insights and the identification of an instrumental variable  
approach to a non-linear hazard model, using the indicator variable that equals  
one after April 2007, along with its interaction with the indicator variable that  
equals one for FRMs, as the excluded first-stage instruments.

The estimates of specification (3) of Table 3 indicate that an exogenous  
580 one-percentage-point increase in the penalty decreases the prepayment hazard  
by approximately 27 percent, thus providing evidence of a large direct effect  
of penalties on prepayment. Since the annual average prepayment before the  
reform was approximately two percent of the total amount borrowed, the hazard  
estimates imply that a household borrowing €100,000 prepays approximately  
585 €500 extra per year—i.e., from the pre-reform average of €2,000 to the post-  
reform average of €2,500—when the prepayment penalty decreases from one  
percentage point to zero. Moreover, the estimates of the hazard rates associated  
with the residuals suggest that borrowers who selected mortgages with one-  
percentage-point larger penalties have a 15-percent-lower prepayment hazard,  
590 thus providing evidence of the selection of borrowers at the time of contracting.

Furthermore, an exogenous one-percentage-point increase in the penalty de-  
creases the delinquency hazard rate by approximately 19 percent, although the  
estimate is not statistically different from zero. This estimate indicates that the  
delinquency rate observed after the reform in specification (1) is not due to the

Table 4: The Effect of the Reform on Penalties, 2005

	FRMs AND ARMs		FRMs	ARMs
	(A)	(B)	(C)	(D)
FRM	3.091*** (0.017)	0.483*** (0.048)		
POST-REFORM	-0.523*** (0.023)	-0.635*** (0.024)	-1.088*** (0.019)	-0.725*** (0.040)
FRM × POST-REFORM	-0.516*** (0.026)	-0.457*** (0.025)		
INTEREST RATE		1.812*** (0.031)	0.285*** (0.033)	4.596*** (0.067)
LOG(AMOUNT)		-0.084*** (0.015)	-0.210*** (0.014)	0.175*** (0.033)
LOAN-TO-VALUE		0.002*** (0.000)	0.001*** (0.000)	0.000 (0.001)
MATURITY		-0.052*** (0.002)	0.007*** (0.002)	-0.086*** (0.004)
HOUSE PRICES		-0.001 (0.002)	0.005*** (0.002)	-0.010*** (0.003)
UNEMPLOYMENT		0.033*** (0.002)	0.009*** (0.002)	0.052*** (0.004)
CONSTANT	-0.444*** (0.016)	-5.678*** (0.198)	1.411*** (0.219)	-15.969*** (0.403)
HOUSE PRICES		-0.001 (0.002)	0.005*** (0.002)	-0.010*** (0.003)
UNEMPLOYMENT		0.033*** (0.002)	0.009*** (0.002)	0.052*** (0.004)
OBSERVATIONS	35,029	35,029	10,922	24,107
MORTGAGES	17,519	17,519	5,461	12,056

Notes: The table reports coefficient estimates of a Tobit model in which the dependent variable is the prepayment penalty. The sample consists of all mortgages issued in 2005; we use two observations for each mortgage, one pre-reform and one post-reform, calculating the average of the mortgage characteristics in each respective period (nine ARMs were fully prepaid before the reform, so we do not have post-reform observations for them). FRM is an indicator variable taking value one when the mortgage has a fixed rate, and zero otherwise. POST-REFORM is an indicator variable taking the value one after April 2007, and zero otherwise. Robust standard error in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.

595 reduction in penalties. Similarly, the hazard rate associated with the residual  
of the first step indicates that mortgages with larger penalties are more likely  
to default, although, again, the standard errors do not rule out that this hazard  
rate is indistinguishable from one. Overall, the delinquency hazard estimates are  
imprecise, and, thus, we have no statistically significant evidence that prepay-  
600 ment penalties have a direct effect on default behavior, in contrast to the U.S.  
evidence reported in Rose (2013); perhaps the lower LTVs—as well as the fact  
that mortgages are recourse loans under Italian law, while they are non-recourse  
loans in several U.S. states—could explain these different patterns of defaults.  
Moreover, there is only weak evidence in this sample that borrowers with higher  
605 default risk at the time of contracting select higher-penalty mortgages.

Specification (3) is also useful for comparing the magnitudes of borrowers'  
responses to different mortgage terms. Specifically, the estimates imply that  
a one-percentage-point change in prepayment penalties has the same effect on  
prepayments as a 1.7-percentage-point change in the ARM REFI RATE or a 2.4-  
610 percentage-point change in the FRM REFI RATE. This is, perhaps, puzzling, as  
a one-percentage-point decrease in interest rates guarantees greater savings than  
a one-percentage-point decrease in prepayment penalties, as the former affects  
interest payments over multiple years, whereas the latter affects a one-time (pre-  
)payment. However, it seems to confirm that many borrowers fail to refinance  
615 optimally (Andersen et al., 2015; Keys et al., 2014b), as well as to highlight the  
salience of penalties for prepayments. Moreover, changes in interest rates seem  
to trigger larger effects on delinquencies than on prepayments, whereas changes  
in house prices have larger effects on prepayments than on delinquencies.<sup>16</sup>

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<sup>16</sup>We should mention that we have also estimated different Cox regression models separately  
on FRMs and ARMs. The results, available from the authors upon request, are similar to  
those reported in Tables 3 and 7.

### 5.3. Comparisons Between Mortgages Issued in 2005 and in 2009

620 In this section, we compare mortgages issued in 2005 with mortgages issued  
in 2009. Specifically, we seek to understand whether the 2007 reform affected the  
cost of mortgage credit by examining whether the difference in the spreads on  
FRMs and on ARMs changed after the reform. We further seek to understand  
the effect of prepayment penalties on borrowers' choice between FRMs and  
625 ARMs. We do so by leveraging one key advantage of our data and performing  
a within-period comparison of the ex-post performance of mortgages issued in  
2009 with those issued in 2005. We acknowledge at the outset that the results  
on the direct effect of penalties on prepayments and delinquencies of mortgages  
issued in 2005, reported in Section 5.2, rely on a cleaner identification than  
630 those that we report in this section. Most notably, the financial crisis affected  
credit and housing markets beginning in 2008; in addition, our lender merged  
with another bank in 2007. With these important caveats in mind, the patterns  
that we document in this section seem to suggest that lenders' mortgage pricing  
and borrowers' mortgage selection changed after the 2007 reform.

#### 635 5.3.1. Univariate Comparisons

Simple univariate comparisons between FRMs and ARMs issued in 2005  
and 2009 display some interesting patterns. First, Panel A of Table 1 already  
reported that the share of FRMs doubled, as Figure 1 and Felici et al. (2012)  
also show for the aggregate Italian market. Second, this increase is particularly  
640 striking because Table 5 shows that, simultaneously, interest rates on FRMs  
increased and interest rates on ARMs decreased. The two patterns together  
suggest that a change in other mortgage characteristics—the change in penal-  
ties could be one of them—made FRMs more attractive over time and to riskier  
borrowers, in particular. Third, Table 5 further reports that LTVs of FRMs in-  
645 creased, whereas LTVs of ARMs decreased. Finally, maturity of FRMs increased  
relatively more than that of ARMs. These observable mortgage characteristics  
further reinforce the idea that the ex-ante riskiness of FRMs increased relative  
to that of ARMs between 2005 and 2009. Indeed, ex-post performances seem

Table 5: Differences between FRMs and ARMs by year of issuance

	FRM		$\Delta$	ARM		$\Delta$
	2005	2009		2005	2009	
INTEREST RATE (%)	4.87	5.05	-0.18***	3.58	2.63	0.95***
SPREAD (%)	1.13	1.98	-0.85***	1.40	1.43	-0.03***
AMOUNT (€1,000)	80.70	101.00	-20.30***	112.15	139.46	-27.31***
COLLATERAL (€1,000)	195.79	213.90	-18.11**	229.77	295.81	-66.04*
LOAN-TO-VALUE (%)	49.27	53.51	-4.24***	58.76	57.64	1.13***
MATURITY (YEARS)	16.44	19.55	- 3.11***	20.10	21.26	-1.15***
PENALTY AMOUNT (%)	2.65	0.00	2.65***	0.42	0.00	0.42***
DELINQUENCY (%)	2.62	0.83	1.79***	6.60	0.88	5.72***
DELINQUENCY - 4 YEARS (%)	0.40	0.83	-0.43***	1.52	0.88	0.64***
PREPAYMENT (%)	19.72	11.73	7.99***	27.89	7.94	19.95***
PREPAYMENT - 4 YEARS (%)	4.83	11.73	-6.89***	14.63	7.94	6.69***
OBSERVATIONS	5,461	11,716	17,177	12,058	7,859	19,917

Notes: DELINQUENCY is an indicator variable taking value one if the mortgage has a missed payment in any year in the sample and zero otherwise. PREPAYMENT is an indicator variable equal to one if the mortgage is repaid in full before maturity and zero otherwise. DELINQUENCY - 4 YEARS and PREPAYMENT - 4 YEARS are indicator variables that take value of one if the respective event is realized within four years from issuance, and zero otherwise. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.

to confirm this increase in riskiness: delinquencies on FRMs increased relatively  
 650 more than on ARMs; and prepayments of FRMs increased, whereas prepayment  
 of ARMs declined over time. These patterns seem consistent with our earlier  
 interpretation that riskier borrowers face greater overall uncertainty and, thus,  
 are more likely to suffer both shocks leading to prepayments and shocks leading  
 to delinquencies.

### 655 5.3.2. Cost of Mortgage Credit

We further seek to determine whether the abolition of prepayment penalties  
 affected mortgage rates. More specifically, lenders may have adjusted their  
 spreads on FRMs and ARMs after the reform to account for the increase in  
 the value of the prepayment option and for the loss of prepayment fees. Since  
 660 the evidence that we reported in Sections 5.1 and 5.2 indicates that the reform  
 should have differentially affected FRMs and ARMs, we can estimate difference-  
 in-difference regressions of the spreads on the FRMs and on the ARMs that our  
 lender originated in 2005 and in 2009.

Table 6 reports the coefficients of two specifications: specification (1) is the  
 665 simplest difference-in-difference regression with no additional controls, whereas  
 specification (2) includes other mortgage characteristics. The estimate of the  
 coefficient of  $\text{FRM} \times \text{ISSUED IN 2009}$  in specification (1) indicates that the  
 spread on FRMs increased by 78 basis points relative to the spread on ARMs  
 after the reform. The estimate of the coefficient of  $\text{FRM} \times \text{ISSUED IN 2009}$   
 670 is almost identical in specification (2)—i.e., it equals 75 basis points—after we  
 include other mortgage characteristics in the regression equation.

Overall, Table 6 is consistent with the idea that prepayment penalties and,  
 thus, their abolition have a non-trivial effect on the cost of mortgage credit.

### 5.3.3. Mortgage Performance

675 Figure 5 plots the non-parametric cumulative incidence functions for mort-  
 gages issued in 2009, displaying a stark contrast with those of Figure 4: cumu-  
 lative prepayments of FRMs are statistically significantly higher than ARMs'

Table 6: The Effect of the Reform on Mortgage Spreads

	SPREAD	
	(1)	(2)
FRM	-0.246*** (0.086)	-0.213** (0.085)
ISSUED IN 2009	0.032*** (0.003)	-0.208*** (0.032)
FRM × ISSUED IN 2009	0.782*** (0.088)	0.753*** (0.088)
EURIBOR (3 MONTHS)		0.050*** (0.006)
EURIRS (20 YEARS)		-0.468*** (0.009)
HOUSE PRICES		-0.002** (0.001)
UNEMPLOYMENT		0.012*** (0.001)
LOG(AMOUNT)		-0.127*** (0.005)
LOAN-TO-VALUE		0.001*** (0.000)
MATURITY		0.022*** (0.001)
CONSTANT	1.400*** (0.003)	3.239*** (0.079)
OBSERVATIONS	37,094	37,094

Notes: The table reports coefficient estimates of an OLS regression in which the dependent variable is the mortgage spread. The sample consists of all mortgages issued in 2005 and in 2009. FRM is an indicator variable taking value one when the mortgage has a fixed rate, and zero otherwise. ISSUED IN 2009 is an indicator variable taking the value one if the mortgage is issued in 2009, and zero otherwise. Robust standard error in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.

for mortgages issued in 2009, whereas they are lower for those issued in 2005; cumulative delinquencies of FRMs start statistically significantly higher than  
 680 ARMs' for mortgages issued in 2009 (although they then become statistically indistinguishable), whereas they start lower for those issued in 2005.

Table 7 reports hazard rate estimates of different specifications of the semi-parametric Cox model with competing risks, using mortgages issued in 2005 and in 2009. Specification (1) compares the differences between the hazards of FRMs  
 685 and ARMs before and after the reform. This is similar to the comparison that we reported in specification (1) of Table 3, with the difference that the after-reform comparison group now also includes all mortgages issued in 2009. The point estimate of POST-REFORM on the prepayment hazard rate is similar in magnitude to that of specification (1) in Table 3, whereas the point estimate  
 690 of  $FRM \times POST-REFORM$  is slightly larger, perhaps suggesting that the 2009 cohort repaid FRMs at a higher rate than the 2005 cohort after the reform. The comparison of the estimates of the delinquency hazard between specifications (1) of Tables 3 and 7 indicate that the 2005 cohort defaulted at a higher rate than the 2009 cohort.

695 Specification (2) performs a different comparison: the difference between the hazards of FRMs and ARMs issued before and after the reform. Hence, specification (2) compares the performance of mortgages issued in 2005 with that of mortgages issued in 2009 from their respective origination, whereas specification (1) compares the performance of mortgages issued in 2005, from their  
 700 origination until the 2007 reform, with the performance of mortgages issued in 2005, from the 2007 reform until December 2012, and mortgages issued in 2009, from their origination until December 2012. The estimates of the prepayment hazard rates confirm that borrowers are significantly less likely to prepay FRMs than ARMs issued before the reform. The magnitude of this effect is also  
 705 almost identical to the one that we reported in specification (1) of Table 3, using only mortgages issued in 2005 and comparing them before and after the reform reduced the penalties. The estimate of the hazard rate associated with FRM



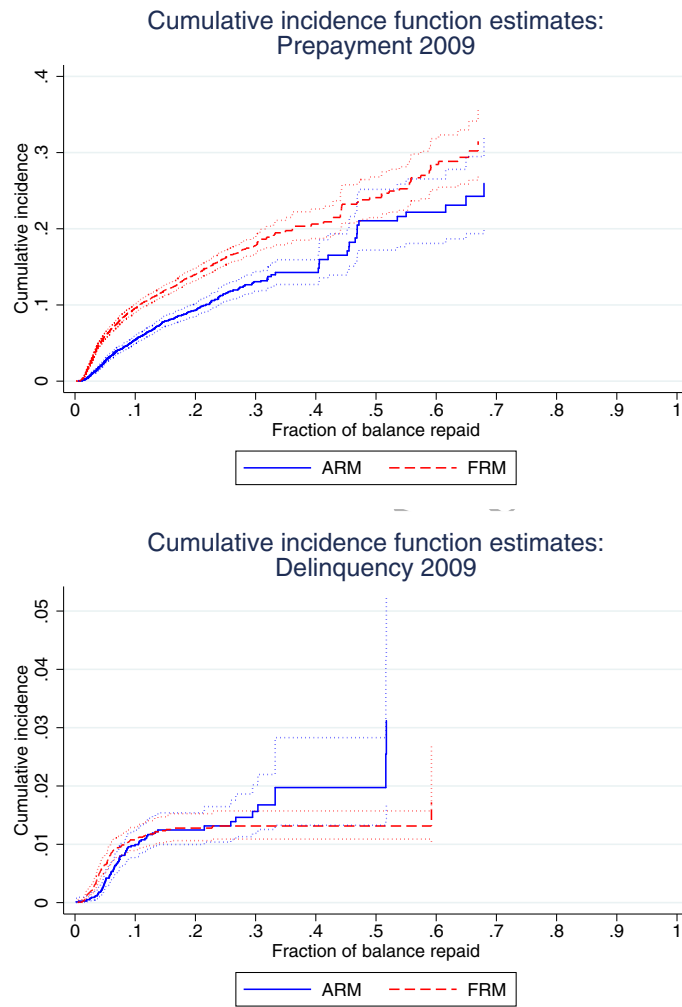


Figure 5: The top panel displays the cumulative incidence of prepayments, and the bottom panel displays the cumulative incidence of delinquencies, both for mortgages issued in 2009.

Table 7: The Effect of Penalties on Mortgage Performance, 2005 and 2009

	PREPAYMENT			DELINQUENCY		
	(1)	(2)	(3)	(1)	(2)	(3)
FRM	0.398*** (0.050)	0.406*** (0.020)	0.407*** (0.051)	0.153*** (0.091)	0.194*** (0.039)	0.156*** (0.093)
POST-REFORM	2.002*** (0.122)		1.928*** (0.129)	1.600*** (0.272)		2.114*** (0.388)
FRM × POST-REFORM	1.212 (0.157)		1.033 (0.137)	1.174 (0.717)		1.357 (0.842)
ISSUED IN 2009		1.072 (0.058)	0.875** (0.051)		0.515*** (0.071)	0.429*** (0.064)
FRM × ISSUED IN 2009		1.578*** (0.101)	1.592*** (0.103)		2.037*** (0.351)	1.974*** (0.341)
INTEREST RATE	1.633*** (0.028)	1.639*** (0.032)	1.589*** (0.031)	2.022*** (0.124)	1.824*** (0.121)	1.749*** (0.119)
LOG(AMOUNT)	1.100*** (0.031)	1.074** (0.031)	1.088*** (0.031)	0.955 (0.077)	0.976 (0.078)	0.988 (0.079)
LOAN-TO-VALUE	0.998*** (0.001)	0.999 (0.001)	0.998** (0.001)	1.013*** (0.002)	1.013*** (0.002)	1.012*** (0.002)
MATURITY	1.087*** (0.003)	1.103*** (0.004)	1.092*** (0.004)	1.221*** (0.009)	1.222*** (0.009)	1.207*** (0.010)
ARM REFI RATE	0.900*** (0.021)	0.895*** (0.022)	0.928*** (0.023)	0.542*** (0.046)	0.565*** (0.046)	0.589*** (0.047)
FRM REFI RATE	0.692*** (0.024)	0.699*** (0.024)	0.679*** (0.023)	1.531*** (0.130)	1.499*** (0.126)	1.470*** (0.124)
HOUSE PRICES	1.018*** (0.004)	1.034*** (0.004)	1.019*** (0.004)	0.995 (0.010)	1.010 (0.008)	0.993 (0.009)
UNEMPLOYMENT RATE	0.976*** (0.004)	0.976*** (0.005)	0.976*** (0.005)	1.028** (0.011)	1.035*** (0.011)	1.036*** (0.011)
OBSERVATIONS	2,128,365	2,128,365	2,128,365	2,097,007	2,097,007	2,097,007
MORTGAGES	37,094	37,094	37,094	37,094	37,094	37,094

Notes: The table reports hazard rate estimates using all mortgages issued in 2005 and in 2009.

FRM is an indicator variable taking value one when the mortgage has a fixed rate, and zero otherwise. POST-REFORM is an indicator variable taking the value one after April 2007, and zero otherwise. ISSUED IN 2009 is an indicator variable taking the value one if the mortgage is issued in 2009, and zero otherwise. Robust standard error in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively.

× ISSUED IN 2009 indicates that prepayments on FRMs have increased more over time than those on ARMs have. The magnitude of this effect is sizable: 710 the estimate implies that the difference in the prepayment hazard on FRMs and ARMs has increased by 58 percent between mortgages issued in 2005 and in 2009.

The estimates of the delinquency hazard rates show that borrowers are less likely to default on ARMs issued in 2009 than on ARMs issued in 2005, and on 715 FRMs issued in 2009 than on FRMs issued in 2005. The magnitudes of these differences are large: borrowers are 49-percent less likely to default on an ARM issued in 2009 than on an ARM with the same observable characteristics issued in 2005. The sum of the estimates of the hazard rates associated with ISSUED IN 2009 and FRM × ISSUED IN 2009 indicates that borrowers are 48-percent more 720 likely to default on FRMs issued in 2009 than on those issued in 2005. Therefore, the differences in delinquencies between FRMs and ARMs have increased over time by almost 100 percent—a large amount. These patterns seem to suggest that borrowers' mortgage choice between FRMs and ARMs at the time of contracting, along with their prepayment and delinquency behavior throughout 725 the amortization period, changed between 2005 and 2009, and, perhaps, relatively more so for riskier borrowers. Since Table 2 documents that mortgages offered to these riskier borrowers were more likely to include penalties, these patterns of delinquencies are consistent with the idea that reform—and, thus, penalties—had a larger effect on the mortgage selection of riskier borrowers than 730 on that of less-risky ones.

The effects of other mortgage terms are identical in signs and very similar in magnitudes to those reported in Table 3. The similarity of these coefficients could reduce the concerns that aggregate shocks have dramatically affected the economic environment over time. Thus, the differences between the perfor- 735 mances of FRMs and ARMs stand out, suggesting that the reform had quite an important effect on borrowers' choices.

Specification (3) combines the comparisons of specifications (1) and (2), thereby providing a finer comparison. More precisely, specification (3) compares

mortgages issued in 2009, starting from their origination, to those issued in  
740 2005, starting as of the 2007 reform that reduced penalties on them. While we  
acknowledge that, had the reform completely abolished penalties on outstanding  
mortgages, it would have allowed an even cleaner comparison, we believe that  
specification (3) is as close as we can get to the best comparison.

This finer comparison delivers several results. First, the estimate of the pre-  
745 payment hazard rate for the variable POST-REFORM confirms that borrowers be-  
came more likely to prepay their mortgages after the reform reduced/abolished  
penalties. Second, the point estimate of the prepayment hazard rate for the vari-  
able ISSUED IN 2009 means that, once we account for the reduction in penalties,  
borrowers are prepaying mortgages issued in 2009 at a lower rate than they are  
750 repaying those issued in 2005. Third, the point estimate for  $FRM \times POST$   
REFORM suggests that, since the reform, FRMs' prepayment hazard is higher  
than that of ARMs; however, this estimate is imprecise and not statistically  
different from one. Finally, the point estimate for  $FRM \times ISSUED IN 2009$   
indicates that the difference in prepayment hazard rates between FRMs and  
755 ARMs has increased by almost 60 percent when we compare mortgages issued  
in 2009 with those issued in 2005, but after the reform reduced penalties on  
them. Overall, the estimates of these two interactions suggest that the selection  
by borrowers at the time of contracting may account for the differential increase  
in prepayments between the cohorts of FRMs and ARMs, as the difference in  
760 prepayments between FRMs and ARMs after the 2007 reform arises exclusively  
for mortgages issued in 2009.

The estimates of the delinquency hazards of specification (3) show that bor-  
rowers are more likely to default on their mortgages after 2007. Moreover, the  
estimate for the variable ISSUED IN 2009 means that borrowers' delinquencies on  
765 mortgages issued in 2009 is 50-percent lower than on mortgages issued in 2005.  
The point estimate for  $FRM \times POST REFORM$  suggests that, after the reform,  
the FRMs' delinquency hazard is higher than ARMs', although the standard  
errors are large and, thus, we have no statistically significant evidence that the  
hazard rates differ. The point estimate for  $FRM \times ISSUED IN 2009$  indicates

770 that the difference in delinquency hazard rates between FRMs and ARMs has  
increased by approximately 97 percent when we compare mortgages issued in  
2009 with those issued in 2005, but after the reform. Overall, these delinquency  
rates seem to describe a consistent pattern that prepayment penalties have no  
direct effect on borrowers' delinquencies, as we documented in Table 3. Instead,  
775 they seem to buttress the argument that borrowers' selection of FRMs versus  
ARMs is substantially different after the reform, most notably for riskier bor-  
rowers, who are more likely to be affected by the reform because their pre-reform  
mortgages were more likely to include higher penalties (see Table 2).

## 6. Conclusions

780 We provide evidence from a 2007 reform in Italy that reduced prepayment  
penalties on outstanding mortgages and eliminated them on newly-issued ones.  
We show that prepayment penalties have a direct effect on borrowers' prepay-  
ment behavior, whereas they do not directly affect borrowers' delinquencies.  
We also find suggestive evidence that prepayment penalties affect the cost of  
785 mortgage credit, as well as borrowers' selection of mortgage type at the time of  
contracting, thus indirectly affecting prepayments and delinquencies, particu-  
larly for borrowers who face greater uncertainty. Overall, the magnitudes of all  
these effects are sizable, implying that prepayment penalties have quite a large  
effect on borrowers' behaviors and choices.

790 Our empirical results contribute to the debate on the design and regulation  
of mortgage markets. Households' mortgage choice and repayment behavior are  
among their most important financial decisions, with aggregate consequences.  
Although we exploit a reform in one country (Italy) and use data from one  
lender, our results have potential micro and macro policy implications. On the  
795 one hand, lower prepayment costs imply that households can more easily adapt  
to changes in interest rates. On the other hand, lenders and mortgage investors  
face bigger prepayment and interest rate risks, and their credit risk is affected,  
as borrowers select into different mortgage types. Lenders' management of these

risks has potential implications for the level and volatility of interest rates, as  
800 well as for risk premia. These additional financial burdens on lenders imply  
that households may pay higher costs for the increased flexibility that lower  
prepayment penalties allow them, consistent with the evidence in Section 5.3.2.  
A complete evaluation of all these effects requires a general equilibrium model  
that is outside of the scope of this paper, as it is not a priori clear whether the  
805 welfare gains for consumers compensate for lenders' increased costs.

## Appendix: International Comparisons

Table 8 presents a comparison of the current regulations of prepayment penalties in selected countries. Italy outlawed penalties on all mortgages, and the U.S. outlawed them on ARMs and high-priced FRMs. Most other countries  
 810 impose a cap on penalties that usually differs between FRMs and ARMs.

Table 8: Regulation of Prepayment Penalties, Selected Countries

COUNTRY	PREPAYMENT COSTS
Italy	No penalties
Germany	Interest margin damage and reinvestment loss on fixed rate
France	Maximum 6 months interest or 3% of outstanding balance
Spain	Penalties up to 2.5% on fixed rate; 0.5% on variable rate
Denmark	Yield maintenance on short-term fixed with non-callable bond
U.K.	Penalties equal to 2-5% of amount repaid
U.S.	No penalties on ARMs, high-priced FRMs and three years after origination.

Sources: Authors' elaboration from Campbell (2013) and International Monetary Fund (2011).

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