Does a Larger Menu Increase Appetite? Collateral Eligibility and Bank Risk-Taking*

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Abstract

We examine a change in the European Central Bank's collateral framework, which significantly lowered the rating requirement for eligible residential mortgage-backed securities (RMBS), and its impact on bank lending and risk-taking in the Netherlands. Banks most affected by the policy increase loan supply and lower interest rates on new mortgage originations. These lower interest rate loans serve as collateral for newly issued RMBS with lower-rated tranches and subsequently experience worse repayment performance. The performance deterioration is pronounced among loans with state guarantees, which suggests looser collateral requirements may lead to undesired credit risk transfer to the sovereign.

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"Favoring illiquid collateral in the collateral framework may then lead to an overproduction of illiquid real assets" Nyborg (2015a)

In recent financial crises, central banks around the world took dramatic steps to provide liquidity to financial intermediaries with the goal of stabilizing the financial sector and stimulating the economy. Liquidity provision took place against collateral of lower quality as requirements loosened in response to deteriorating market conditions.[1] Conceptually, when high quality collateral is scarce and constraints on collateralized borrowing in private funding markets bind, looser collateral requirements in central bank credit facilities can alleviate banks' funding constraints (e.g., Heider and Hoerova, 2009; Koulischer and Struyven, 2014). However, when central bank collateral frameworks favor illiquid collateral this may reduce discipline in money and asset markets, which could spill over to the real economy through an overproduction of illiquid real assets (Nyborg, 2015a,b). Consequently, changes in central bank collateral policy and their effects on financial markets and the real economy have become a controversial aspect of monetary policy.

In this paper, we show how this loosening of collateral policy can produce significant real effects in terms of expanding bank lending and increasing risk-taking. We focus on the ECB's relaxation of collateral eligibility criteria, which, in 2012, allowed residential mortgage-backed securities (RMBS) rated as low as BBB- to be eligible as collateral for the first time.[2] Until that time, only AAA-rated RMBS were eligible as collateral. Our main hypothesis is that by lowering the eligibility requirements of RMBS, the ECB stimulated the production of lower-rated RMBS—particularly among banks actively issuing such securities—leading to

[1] Asset-backed securities and non-marketable assets made up the lion's share of collateral pledged in the Federal Reserve's lending facilities in 2008 and 2009. The Federal Reserve began to accept illiquid asset-backed securities (ABS) in their credit operations once liquidity in private markets evaporated. In contrast, before 2007 the Fed's open market operations centered on buying and selling of liquid government securities. Similarly, the European Central Bank (ECB) removed credit rating thresholds for distressed government debt securities once private lenders refused to accept them as collateral (Drechsler et al., 2014).

[2] The ECB collateral framework determines the implementation of monetary policy. All monetary interventions (medium- and long-term refinancing operations, and, to a large extent, asset purchase programs) take place within the collateral framework. See Section 1 for details.

an increase in the supply and reduction in the cost of mortgage debt for households.

Our empirical tests are based on proprietary loan-level data for a large fraction of the mortgage market in the Netherlands. This unique data set allows us to observe the terms of originations and subsequently track whether a given loan is securitized or retained on the balance sheet, as well as loan repayment performance. We conduct a difference-in-differences analysis around the ECB's decision to lower collateral requirements on RMBS. We compare changes in the behavior of banks actively issuing lower-rated, newly-eligible RMBS relative to a control group banks that are historically less active in this segment of the market. We analyze mortgage origination, securitization activity, and risk-taking (i.e., ex post performance, as measured by payment arrears) within a postal code and origination month controlling for a host of loan, borrower, and bank characteristics.

Our main findings are as follows. First, we find banks more likely to be affected by the relaxed collateral requirement moderately increase the share of newly-acceptable A- to BBB-rated tranches in RMBS issuances by about 3.83 percentage points (approximately €937 million per deal) following the policy change, as compared to the period before and also to other banks. These results are consistent with Nyborg (2015a,b) who argues that the collateral is endogenously produced and give us confidence that the effect of the policy change operates through incentives to securitize.

Second, affected banks increase loan supply and reduce interest rates on mortgage originations, controlling for observable determinants of loan risk. The magnitude of this reduction is again moderate, yet meaningful: on average, affected banks reduce rates by about 2.5 percent of the mean (4.39 percent) and 16.9 percent of the standard deviation (0.65 percent) in the period following the rule relative to other banks. Affected banks expand mortgage origination volumes by approximately 15 percent in the wake of the rule change, consistent with an increase in the supply of credit. In falsification tests, we show this effect on interest rates disappears for undercapitalized banks that may risk-shift in bad times (when the

central bank is likely to loosen collateral policy). Nor is the effect present after monetary interventions in the previous recession that did not alter collateral eligibility, and thus it seems unlikely to reflect cyclical differences in lending between banks.

To better understand the mechanism underlying the results we examine the direct impact of collateral eligibility on securitization. We compare securitization patterns of mortgage loans originated in the period following the rule change and, in line with our main hypothesis, we find that affected banks are more likely to securitize loans with lower interest rates.[3]

We also analyze the repayment performance of these loans to discern whether the change in collateral requirements on RMBS led to a deterioration of underwriting standards or whether it alleviated funding and liquidity constraints, allowing banks to pursue new investment opportunities without any increase in risk. Using our difference-in-differences framework with payment arrears as the dependent variable, we find that interest rate cutting by affected banks translates into a significant deterioration in repayment performance.

In a final step, we exploit within-bank heterogeneity among loan types to further understand how securitization incentives may interact with the policy change.[4] First, we rerun our analysis for two sets of non-standard loans that are ex ante unlikely to be securitized. For each non-standard loan type, we find no difference in behavior between affected banks and other banks in terms of interest rates on originations as well as subsequent repayment performance. This suggests that banks do not take additional risk in loans likely to remain on-balance sheet, reinforcing the empirical evidence in support of the securitization channel. Second, we examine loans originated with state guarantees and find the worse repayment performance is concentrated among these loans. Loans originated without guarantees by affected banks, on the other hand, tend to perform just as well as similar loans originated

[3]All else equal, banks are more likely to securitize loans with higher interest rates, since these loans generate surplus income that acts as a form of credit enhancement or can be paid out to RMBS investors.

[4]Exploiting within-bank variation gives us confidence that our results are not driven by unobservable confounding changes (for example, bank-specific interventions by regulators) that may affect interest rate setting for some banks more than others.

by other banks. This latter finding suggests that additional bank risk-taking induced by the collateral policy change could impose a negative externality on the state through loan guarantees.

Overall, our results highlight an important channel for transmission of central bank collateral policy to the real economy. We interpret our findings as an expansion of loan supply coupled with a decline in lending standards in response to the greater incentives to securitize to capture the liquidity benefits of lower-rated RMBS. This additional credit risk is not compensated for, at least not in terms of direct interest payments from borrowers, and often ends up transferred to the state through loan guarantees. This latter effect suggests a potential undesirable consequence of this non-traditional monetary policy tool.

Our findings contribute to the literature on collateralized borrowing and financial institutions. The classic literature on firm-level credit constraints which connects collateral values and real activity (e.g., Bernanke and Gertler, 1989) may also apply to repurchase transactions by financial institutions, where the form of collateral is a financial, as opposed to physical, asset (Nyborg, 2015a,b). A small literature examines collateralized borrowing from central banks and the effects of collateral frameworks. Notably, Nyborg et al. (2002) find that collateral eligibility affects the willingness of financial institutions to pay for liquidity.[5] More generally, by distorting prices in money and assets markets, changes in collateral eligibility may influence the investment and lending decisions of financial institutions. As argued by Nyborg (2015a,b), when collateral frameworks accept illiquid collateral this may lead to its overproduction, which, ultimately, may result in a misallocation of resources towards illiquid underlying real assets, including residential real estate. In this spirit, our paper shows that financial institutions respond to changes in RMBS eligibility criteria by

[5]Indeed, Buiter and Sibert (2005) show theoretically that lower haircuts in repurchase agreements with the central bank increase the secondary market prices of the underlying collateral. Ashcraft et al. (2011) provide evidence consistent with this claim in the context of collateral haircuts in Eurosystem operations and secondary market values and required returns.

expanding lower-rated tranches in securitizations and expanding mortgage loan supply.[6]

More broadly, we contribute to the literature on the outcomes of policy interventions during financial crises, particularly the outcomes of non-traditional central bank activities. Duchin and Sosyura (2014) show banks receiving equity capital injections as part of the Troubled Asset Relief Program increased risk-taking by banks in the U.S. mortgage market. Acharya et al. (2015b) examine the bank deposit rates and corporate loan spreads, as well as subsequent real effects for firms, following the ECB's decision to switch to unlimited lender-of-last-resort lending on October 8, 2008 (see also Acharya et al., 2015a). Several related papers examine if and how central bank asset purchase programs stimulate bank mortgage and commercial loan supply (Acharya et al., 2016; Carpinelli and Crosignani, 2015; Chakraborty et al., 2016; Di Maggio et al., 2016; Foley-Fisher et al., 2015; Fuster and Willen, 2010). Our paper departs from the existing literature by instead assessing the importance of changes in central bank collateral frameworks during times of stress and its impact on bank risk-taking behavior in the mortgage market. Our results suggest that non-traditional monetary policy tools may expand lending, possibly having positive real effects. However, our results also suggest potential negative effects to the extent that bank risk-taking could spill over to the sovereign via guarantees.[7]

The remainder of this paper is organized as follows. Section 1 describes the ECB's collateral framework and our setting. Section 2 summarizes the data and the empirical approach. Section 3 presents the results. Section 4 concludes.

[6]In doing so, we also contribute to a growing literature on the determinants of RMBS structure. Begley and Purnanandam (2016) document empirically the role of asymmetric information for the size of the equity tranche and deal performance (see also, Ashcraft et al., 2010). We show that regulatory requirements are an important determinant of RMBS structure, as motivated theoretically by, among others, Hebert (2015), Hartman-Glaser (2013), and Chemla and Hennessy (2014).

[7]Our paper is silent on whether relaxed collateral requirements are socially optimal. On the one hand, by mitigating counterparty risk concerns collateral may have a positive effect on money markets during times of stress (e.g., repo markets, see, Ewerhart and Tapking, 2008; Heider and Hoerova, 2009), thus promoting interbank lending and financial stability. On the other, greater use of collateral could be destabilizing in the presence of margin requirements and fluctuations in collateral values (Brunnermeier and Pedersen, 2009).

1 Institutional Setting

The ECB allocates liquidity to financial institutions through repurchase agreements, i.e., exchanging collateral for loans. As part of this process, the ECB uses a collateral framework consisting of a list of eligible securities that banks can post as collateral and corresponding "haircuts"—margins imposed on the collateral seller—that determine the amount that can be borrowed per unit of collateral. The ECB is authorized to change the list of eligible securities and haircuts. Both eligibility and haircuts have always been in part based on credit ratings provided externally by a recognized credit rating agency, which are mapped into a common internal ("harmonized") rating scale.[8]

When the European interbank lending market came under stress in 2008, the ECB started allocating liquidity to fully meet banks' demands (Eberl and Weber, 2014).[9] As the eurozone sovereign debt crisis unfolded and conditions in financial markets worsened, collateral eligibility requirements on RMBS relaxed. As of December 19, 2011, the ECB made A-rated (Class 2) RMBS at issuance temporarily eligible as collateral (ECB, 2011/25). Shortly thereafter, in June 2012, the ECB made BBB-rated (Class 3) RMBS temporarily acceptable at a higher haircut (26 percent for BBB compared to 16 percent for AAA/A, see ECB, 2012/11). These decisions were repealed and replaced on August 2, 2012, making Class 2 RMBS permanently eligible and keeping Class 3 RMBS temporarily eligible (ECB, 2012/17). Importantly, not only did the ECB begin accepting lower quality RMBS, but they did so at lower haircuts relative to the private market, thus providing implicit subsidies to banks (Drechsler et al., 2014).[10]

[8]Under the ECB's harmonized rating scale, every external rating is mapped into a credit "Class". Class 1, 2, 3 assets correspond to AAA/AA+/AA/AA-, A+/A/A-, BBB+/BBB/BBB- rated securities, respectively, under the Standard and Poor's long-term credit rating schedule (see Appendix B). For expositional purposes, we sometimes refer to Class 1, 2, and 3 as AAA, A, and BBB, respectively.

[9]Before 2008, the ECB followed a "liquidity neutral policy," whereby the total quantity of liquidity provided is determined by its assessment of the liquidity needs of the entire banking system (Acharya et al., 2015b; Bindseil et al., 2002, 2009).

[10]The difference between the central bank and private market haircuts on the same collateral is called

The proportion of ABS (particularly, RMBS) that is used as ECB collateral has increased from 5 to almost 30 percent moving from 2004 to 2008, and remained at 15 percent in 2013 (Nyborg, 2015a). When RMBS can be used in collateralized borrowing with the ECB, this reduces banks' need to carry traditional liquid assets thus allowing for an increase in the supply of bank lending (Loutskina, 2011). Since 2008, the process of securitizing mortgage loans and keeping the newly-created RMBS *with no intent to sell to outside investors*—commonly referred to as "self-securitization" or "retained securitization"—has gained prominence as a liquidity management technique. Currently, about two thirds of all issued RMBS are retained within the banking sector via self-securitization or secondary market purchases for pledging to the ECB or national banks (AFME, 2014). Thus, RMBS holdings in the eurozone represent a meaningful source of liquidity and the relaxation of collateral eligibility criteria studied in this paper may be particularly important for at least some European banks.

We examine how domestic banks that are active in the mortgage market in the Netherlands respond in terms of their lending activities. This is an attractive setting for our empirical analysis for at least three reasons. First, the ECB's decisions regarding collateral policy during this period were made at the Eurosystem level and directed towards the struggling economies of Greece, Ireland, Italy, Portugal, and Spain. It is therefore unlikely that the fundamentals or risk-taking opportunities of Dutch banks were central to the policy change and therefore it represents a plausibly exogenous shock. Second, banks play an important role in credit intermediation in the Netherlands: domestic credit provided by Dutch banks (excluding credit to the government) amounts to more than 200 percent of GDP, and bank deposits are over 300 percent of GDP. Third, the extent of securitization activity is the highest in Europe, with the ratio of securitized assets to GDP equal to 16.15 and 7.47 percent in 2007 and 2012, respectively (AFME, 2014).

the "haircut subsidy". Drechsler et al. (2014) argue that the haircut subsidy on collateral is increasing with its risk and therefore is likely to be significant for Class 2 and 3 RMBS.

Finally, the mortgage market in the Netherlands has some additional features worth noting at this point. Mortgage originators are typically banks and insurance companies. Mortgages are usually fixed rate with a maturity of 30 years and interest rates reset every 10 years. Lenders can repossess and sell properties by public auction without a court order. They also have full recourse to the borrower, whereby any leftover debt (after foreclosure) remains enforceable until fully discharged. In part because of this, mortgage foreclosures amount to a mere 0.046 percent in 2013. Finally, high loan-to-value (LTV) ratios, often exceeding 100 percent, are the result of favorable interest deductibility from taxable income on the mortgage loan on a borrower's primary residence.

2 Data and Empirical Methodology

2.1 Data Sources and Sample Selection

Our data on mortgage originations comes from a software engineering company based in the Netherlands. This company provides software that helps banks manage their loan portfolios. The software enables banks to identify pools of loans that they would like to remove from their balance sheet. When this takes place through a securitization program, the company also generates periodic investor reports on performance and investor payouts associated with the newly-created securities. These reports are generally issued at the monthly frequency. More recently, the software has begun facilitating compliance with the ECB's Loan-level Initiative to ensure that banks' securities are eligible as collateral in Eurosystem credit operations.[11] This requires transmitting detailed loan-level information on a regular basis in a standardized format provided by the ECB. When a bank first begins working with the company, all mortgage loans are read into the software program. These consist of two

[11] Loan level information has been required for RMBSs since January 2013; see `https://www.ecb.europa.eu/paym/coll/loanlevel/html/index.en.html`.

types of loans. First, loans retained on the balance sheet. Second, the set of securitized loans that have been removed from the balance sheet but remain in the system so that RMBS investor reports can be generated.

We download this data directly from the company, collecting loan data from banks' loan portfolios and RMBSs as of January 2014. The data contain loan-, property-, and borrower-level identifiers, as well as related characteristics. The loan characteristics include the origination date, mortgage size, LTV ratio, interest rate, payment type, purpose, and whether the loan has a state guarantee or not. The data also indicate whether the loan is currently in default, payment arrears, or performing.[12] The main property characteristics are the location (two-digit postal code) and valuation, but no further information about property features are given.[13] The borrower characteristics include, for example, the primary income and employment status. The identifier of the originating bank is also provided, which we use to merge the mortgage data onto bank and RMBS deal characteristics.

We focus on fixed-rate mortgage originations. The typical mortgage in the Netherlands is a 30-year fixed rate mortgage, comprising 81.33 percent of the sample. These fixed interest rate mortgages usually reset the interest rate every 10 years. No loan originated in our event window has been reset. Thus, the current interest rate as of January 2014 is a close approximation of interest rate at origination. In contrast, variable rate and hybrid rate mortgages (9.31 and 9.33 percent of the sample, respectively) have interest rates that depend on the reference rate, the reset periods, and other factors. Thus, our choice ensures the initial interest rate on the mortgage contract is correct and avoids potential ambiguities arising from resetting rates over the tenure of the loan.

[12] Arrears are measured at the end of the sample in January 2014. Loans in arrears (and eventual default) do not drop out of our sample. This occurs for two reasons. First, reporting requirements of the Dutch Central Bank and the ECB's Loan-level Initiative require that defaulted loans remain in the asset pool underlying RMBS. Second, the length of time to conduct a repossession in the Netherlands is long relative to our event window. Indeed, the national mortgage default rate during our window is the same as our in-sample default rate (less than 0.05 percent) confirming sample selection is unlikely to be an issue.

[13] Postal codes in the Netherlands are longer, but for anonymity the data only show the first two digits.

Our second source of mortgage data comes from the European Datawarehouse (ED), the repository of all loan level information under the ECB's Loan Level Initiative.[14] The ED provides data under the same format as the software company for loans used as collateral for eligible RMBS. While the ED does not contain data on balance sheet loans, the ED provides snapshots of the data over a period that is longer for some banks than the time series obtained from the software company—for instance, if a bank begins using the software at a later stage. We combine the ED and our proprietary data to reconstruct the loan portfolio back to January 2013, the beginning of the Loan-level Initiative. Thus, our second source contains data on securitization status for the stock of loans as reported in 2013.

We obtain data on banks' accounting variables and securitization activity from Bureau van Dijk's Orbis database and Concept ABS, respectively. Orbis provides balance sheet and income statement information collected from annual reports on Dutch banks, where balance sheet information is broken down to the bank (rather than the bank holding company) level. In terms of coverage, the market for Dutch mortgage suppliers is concentrated: in 2012, the five largest banks held 85 percent of the market. Our sample contains three of the four largest banks and other smaller players.[15] Concept ABS provides data on RMBSs drawn from deal prospectuses. This includes public information on the size and rating of each tranche (security), and whether an issue is retained by the issuing bank or sold.

Based on this data, we construct two samples for our loan-level analysis. First, a sample of mortgage originations, which we shall refer to as the "Originations" sample. This sample consists of a list of matched mortgage loan, property, borrower, and bank characteristics at the time of origination. This sample contains new originations for the period from January 2010 until January 2014. In terms of coverage, the 426,866 originations cover approximately €85 billions of assets and represent 49 percent of total originations in the Netherlands during

[14]These data can be acquired upon request from `https://eurodw.eu`.

[15]We do not disclose the names or accounting information of any individual bank in our sample. Also, to ensure anonymity we were given permission to download complete loan data for a subset of banks.

this period.[16] Figure 1 shows the geographical distribution of mortgage originations across two-digit postal codes across the Netherlands. The majority of originations occur in the densely populated center and west of the country, which we will account for in our regressions through inclusion of postal code fixed effects. We call our second sample the "Loan Portfolio" sample. This data set classifies the stock of loans (578,099 loans) previously originated into two groups depending on whether the loan is securitized or not, as of January 2014. In terms of coverage, the €25 billion of securitized loans in our sample constitute 65 percent of RMBS collateral over the same period (AFME, 2014).

2.2 Variable Construction and Summary Statistics

To understand the impact of the change in collateral eligibility on bank lending and risk-taking behavior, we will use a difference-in-differences methodology. This requires a suitable definition of an event window and a classification of banks.

The event window is defined as follows. In December 2011, the ECB declared that RMBS rated Class 2 (A-rated) at issuance were temporarily eligible as collateral for Eurosystem credit operations, in addition to AAA-rated RMBS (ECB, 2011/25). In June 2012, the ECB ruled that Class 3 (BBB-rated) RMBS will temporarily be accepted (ECB, 2012/11). Therefore, we define the "Before" period as the period from January 2010 until December 2011, when only AAA-rated RMBS are eligible. The "After" period starts in January 2012. At this point RMBS rated below Class 1 are eligible. The After period ends in December 2013, which is the last month we obtain loan information from the software company.[17]

We classify banks into "affected" and "unaffected" groups by the rule change as follows. The rule change relaxes eligibility criteria for RMBS with credit quality Class 2 or 3, which

[16] There were 874,802 originations in the Netherlands during this period; see `http://www.kadaster.nl/web/zakelijk/vastgoedcijfers/hypotheken.htm`.

[17] Due to data restrictions associated with the ED data, our analysis of securitization focuses on a shorter post-event window from January 2013 until December 2013.

were previously not accepted as collateral in Eurosystem credit operations. These lower-rated securities were explicitly targeted by the rule change, as opposed to AAA-rated securities that were eligible since 2008. We assume changes in eligibility matter more for banks that actively issue lower-rated RMBS. We identify such banks based on RMBS issuance data gathered from Concept ABS. We cumulate RMBS issuance by rating Class 1, 2, and 3 in the period prior to the rule change. We examine a three year window as this is the standard callable period for RMBS issued by Dutch banks, which guarantees that issuances before the rule change have not been canceled. We then sort banks according to share of RMBS rated Class 2 or 3 out of total issuance and classify banks as "Class 2/3 Issuer" (affected) banks if they have an above-median share and "Other Banks" (unaffected) otherwise.

In robustness checks, we use two additional classification schemes. First, we scale RMBS issuance by bank total assets rather than total issuance. We classify banks as affected if they have an above-median share of Class 2 or 3 rated RMBS to total assets. This measure captures the importance of lower-rated RMBS in overall bank activity, as opposed to mortgage securitization activity. Second, we exploit RMBS distribution information from Concept ABS to identify banks engaged in self-securitization. These banks meet the following criteria: they have fully retained at least one RMBS deal in the three years prior to the rule change; and, at least one of these fully retained deals contains a security of Class 2 or 3 rating. Since the rule change most directly affects the liquidity of retained RMBS, these banks are more likely to be affected by the change in collateral eligibility.

Our main dependent variable is the interest rate in new mortgage originations, which is provided directly in our mortgage data at the loan-level. This variable captures an important dimension of the pricing of new loan originations, since most loans have a 30 year tenure and are fixed rate. We consider other dependent variables in our analysis. First, the volume of mortgage originations as a measure of loan supply. Second, an indicator variable equal to one if a loan is securitized and zero otherwise. This variable is used to investigate whether

affected banks are more likely to securitize originations after the rule change. Third, an indicator variable equal to one if a loan is in payment arrears and zero otherwise. We use arrears to measure loan repayment performance (e.g., Keys et al., 2010), as foreclosures and repossessions occur infrequently on the loan originations in our short event window (less than 0.05 percent).

To account for observable differences among loans in our regressions, we control for standard loan-, property-, and borrower-level characteristics commonly used in the mortgage lending literature. These variables are described here and precisely defined in Appendix A. We consider the following continuously-measured characteristics: LTV, debt-to-income (DTI), and mortgage size. These variables are winsorized at the 1 and 99 percent level to eliminate the influence of outliers. We consider the origination month of the mortgage and the location (postal code) of the property. We also consider categorical variables for the borrower's employment status, payment type, and mortgage purpose. The employment status categories include whether a borrower is employed or the loan is fully guaranteed, unemployed, self-employed, and so on. The payment type categories indicate whether a part of that loan repayment is made during the life of the loan (annuity or linear) and/or at maturity (bullet). The mortgage purpose categories include whether the loan was made for purchase, remortgage, renovation, or less common purposes including equity release or debt consolidation. We also control for bank fixed effects and the following time-varying bank fundamentals: bank size, leverage, and return-on-equity.

The unit of observation in our analysis is a mortgage loan. In the Netherlands, a property is often financed with multiple smaller mortgage loan parts. We do not observe loan parts straddling different property-date-borrower combinations, so we aggregate these smaller loans and define a "loan" as the set of loans on a single borrower and property, originated at the same date (to avoid bundling together subsequent refinancing or second-lien mortgages by the same borrower). We aggregate loans in two ways. For mortgage size, DTI, and LTV,

we take the sum across loan parts at origination. Other loan variables, for example, the interest rate, are all mortgage balance-weighted averages.

In Table I, we present summary statistics of the variables used in the analysis. We find significant variation in all the key variables. Panel B shows the average interest rate on mortgage originations of all banks in the before period is 4.39 percent, with a standard deviation of 0.65 percent. The fraction of mortgages in payment arrears in the after period is 3 percent. Panel D shows that around one third of loans are securitized and these loans tend to have more state guarantees (52 percent versus 29 percent) and better repayment performance (2 percent versus 4 percent of loans in arrears). Panels F and G indicate that mortgages for purchase with a single final payment ("bullet") structure are most common. Finally, panel H indicates that affected banks (Class 2/3 Issuer) are comparable with the other banks in terms of size and leverage, with the exception of better performance (return-on-equity) in the before period. These banks appear to grant new loans at similar interest rates and these loans have roughly the same repayment performance (panel A).

2.3 Empirical Strategy

We assess the impact of the collateral eligibility rule change on bank lending and risk-taking using a difference-in-differences methodology.

The change in collateral eligibility affects all Eurosystem member banks, so we do not have a natural partition of banks in our analysis. Nevertheless, since the reform does not impact all banks in the same way, it is possible to construct affected and control groups. Under the assumption that banks actively issuing lower-rated RMBS are more likely to be affected, we can classify banks into affected and control groups. Specifically, banks with above-median share of RMBS rated Class 2 or 3 out of total issuance are affected group ("Class 2/3 Issuer") and others form the control group ("Other Banks").

To examine the effect of the collateral eligibility rule change, we estimate the following

cross-sectional regression using OLS on loan originations data:

$$y_{ijklt} = \alpha_l \times \alpha_t + \alpha_k + \beta \text{ After}_t \times \text{Class 2/3 Issuer}_k + \theta' \mathbf{X}_{ijkt} + \epsilon_{ijklt}, \quad (1)$$

where i indexes loans, j indexes borrowers, k indexes banks, l indexes locations (postal codes), and t indexes time (months). The dependent variable is y_{ijklt}, which will mostly be interest rates on new originations and subsequent payment arrears. After_t is an indicator variable equal to one in the months in our sample following the rule change (January 2012 until December 2013), and zero otherwise (January 2010 until December 2011). Class 2/3 Issuer_k is an indicator variable equal to one if the bank belongs to the affected group and zero if it belongs to the control group. The α_k, α_l and α_t denote bank, location, and time fixed effects, respectively. The postal code by month fixed effects control for mortgage demand in a given location in a given month. The bank fixed effects control for time-invariant differences between banks individually and across the affected and the control groups, the location fixed effects control for regional differences, and the time (origination month) fixed effects control for aggregate economic shocks. $\mathbf{X}_{ijkt}$ is a vector of control variables (e.g., mortgage size, bank return-on-equity, etc.) and ϵ_{ijklt} is the error term. Since individual loans only appear in the sample once in a cross-sectional regression (i.e., at the time of origination), we cluster all our standard errors at the origination month level (Petersen, 2009).

The main coefficient of interest, β, measures how affected banks respond to the change in central bank collateral requirements relative to control banks. If Class 2/3 Issuers have incentives to expand lending and price mortgages more competitively in the after period, the coefficient β will be strictly negative. The null hypothesis that collateral policy is irrelevant for bank lending behavior (say, because banks can easily restructure RMBSs without changing lending) corresponds to expecting that β will be zero.

This specification adequately controls for unobservables that might influence loan pricing

of affected and control groups in a similar fashion. However, identification of β requires controlling for any variation in the characteristics of the affected group that systematically correlate with the rule change. Put differently, we need to control for other shocks that might be correlated with the choice to issue lower-rated RMBS and the changes in central bank collateral policy. To illustrate, it might be the case that risk-taking opportunities of different banks changed around the time of the rule change. This is potentially a concern if these banks are also more likely to be among the set of affected banks.

We tackle such concerns in several ways. First, to control for changes in risk-taking opportunities, we account for a large number of loan, borrower, and property characteristics in $\mathbf{X}_{ijkt}$. These include standard controls such as LTV, DTI, and mortgage size, but also categorical variables for borrower employment status, payment type, and mortgage purpose. In our preferred specification, we additionally include the interaction term $\alpha_l \times \alpha_t$ to control for local market conditions at the postal code-month level. We therefore compare the lending behavior of affected and other banks in very similar geographical and product markets. Second, we include bank-level control variables for size, profitability, and leverage to account for additional heterogeneity. Third, we conduct two falsification tests on risk-shifting and cyclical behavior. Fourth, while our main approach partitions the set of banks, in some tests we partition the set of loans within-bank on the basis of ease of securitization into those likely to be affected and other loans. In particular, we restrict the analysis to the set of non-standard loan types that are ineligible for securitization and thus unlikely to be impacted by the collateral rule change. We discuss the falsification tests and non-standard loan types tests in detail later.

One remaining question is what kind of frictions must exist that prevent banks in the control group from taking advantage of the loosening of the collateral requirement? Indeed, we do not observe any control banks "switching" to the affected group after the rule change by ramping up lower-rated RMBS issuance. This suggests that there are nontrivial costs of

lower-rated RMBS issuance such that the liquidity benefits are not large enough to induce non-issuers to issue these securities for the first time.

We lean on three main frictions that could explain inertia among control banks and justify our empirical approach. First of all, regulatory capital constraints. Since Dutch mortgage originators face capital regulation and lower-rated RMBS have severe capital charges, some banks may prefer to issue only AAA-rated securities which have minimal capital requirements.[18,19] Thus, for these banks, the incremental capital charges may outweigh the liquidity benefits of holding lower-rated securities after the rule change. Second, there may be fixed costs associated with issuing these securities. It may be costly to setup a securitization program if a bank does not already have one, or switch to marketing lower-rated RMBS to a different clientele after the rule change. The latter will be especially true if bond market investor demand is segmented across risk classes (e.g., Becker and Ivashina, 2015; Chernenko and Sunderam, 2012). Third, originators may be reluctant to issue low-rated RMBS for the first time after the rule change to take advantage of the ECB's assistance either out of concerns that regulators, depositors, creditors, or analysts could interpret it as a signal of financial weakness (Armantier et al., 2015) or due to persistent differences in business models or risk cultures (Fahlenbrach et al., 2012).

In summary, our empirical approach is designed to alleviate concerns regarding unobservables that might jointly impact selection into the affected group and lending behavior after the rule change. However, to the extent that banks are not randomly assigned into treated and control groups, the coefficient β may be interpreted as the average effect of the rule change among banks that choose to issue lower-rated RMBS. While our control variables

[18]Under Basel III, the risk weights applied to five year maturity, senior RMBS exposures are 20 (AAA), 40 (AA), 65 (A), and 105 (BBB) percent (BCBS, 2014).

[19]For reputation or signaling purposes, banks almost always retain some of the RMBS as skin-in-the-game, so it is unlikely that banks simply take advantage by originating, securitizing, and distributing mortgages in their entirety without incurring any capital charge. Indeed, more recently, Dutch regulators require issuers to retain an economic interest in each RMBS, including the equity tranche (CEBS, 2010).

and falsification tests help reduce concerns regarding unobservables, however, in the absence of a true experiment, we cannot rule out this alternative interpretation.

3 Empirical Results

This section provides estimates of the collateral eligibility rule change on bank securitization, lending, and risk-taking behavior. We begin by estimating the change in securitization activity at the bank-level resulting from the change in collateral eligibility (Section 3.1). In Section 3.2, we conduct an analysis of interest rates on mortgage originations as well as loan volumes. Section 3.3 examines the repayment performance mortgage loans issued before and after the rule change. Section 3.4 provides additional within-bank analysis focusing on non-standard loans as well as loans with state guarantees.

3.1 Effect of Collateral Eligibility on Bank Securitization Activity

We first estimate the effect of the change in collateral eligibility on the securitization activity of banks. Our empirical analysis is based on the premise that the change in collateral eligibility policy increased the liquidity of lower-rated RMBS. Banks active in this segment of the market should increase the share of Class 2 and 3 rated RMBS, relative to other periods and relative to other banks, as these securities were the focus of the rule change.

We test for a change in incentives to securitize among banks by separately examining RMBS issuances from affected and control banks. We collect data from Concept ABS on the universe of RMBS deals associated with banks headquartered in the Netherlands for the years 2010 until 2013. This data consists of 74 deals with a total value of €249.44 billion, of which €179.87 billion was issued prior to the rule change and the remainder after.[20] Each deal corresponds to an off-balance sheet vehicle that holds mortgage loans and is funded by

[20]We exclude three RMBS deals collateralized solely by state-guaranteed mortgages. Such deals are riskless and always AAA-rated, and the ECB rule is therefore irrelevant.

multiple RMBS issues. On average, each deal has 5.39 RMBS issues ranging from AAA-rated to unrated. For a given deal, we aggregate issues by credit rating according to the ECB's harmonized rating scale. Over the event window, the bulk of these securities are highly rated: €226.65 billion Class 1 versus €10.59 billion Class 2 or 3.

We next show a substantial variation over time and by bank affected status in issuance behavior. In Figure 2 we first provide graphical evidence on changes in securitization activity before and after the rule change by affected bank status. The figure shows the distribution of RMBS across the Class 1, 2, and 3 ratings categories aggregated across banks in each group. For the affected banks, two notable facts emerge. First, banks in the affected group have a non-trivial allocation of assets to Class 2 and 3 rated securities, about 5 and 6 percent of assets, respectively. Second, following the rule change these banks exhibit an increase in the issuance of both Class 2 and 3 rated tranches, notably, the allocation to these securities increases to about 18 percent of issuance. In contrast, the total issuance of Class 2 and 3 rated securities by the other banks is small and remains constant through the rule change.

We next provide corresponding regression evidence. We simply estimate:

$$y_{skt} = \alpha_k + \beta \text{ After}_t \times \text{Class 2/3 Issuer}_k + \epsilon_{skt}, \tag{2}$$

where s indexes deals, k indexes banks, and t indexes time (i.e., before or after the rule change). The dependent variable, y_{skt}, is either the value (in billions of €) or the percentage of Class 2 or 3 rated securities in the current deal. The α_k correspond to bank fixed effects. The estimation is performed using weighted-least squares, weighted by issue size, which addresses concerns that any estimated effect is driven by a large number of small deals. Standard errors are clustered at the level of the bank to account for correlations across deals. The coefficient of interest, β, measures how affected banks respond to the change in collateral eligibility in terms of issuance of Class 2 or 3 rated securities.

Table II presents the results. Column [1] shows deals originated by affected banks following the rule change contained a greater value of Class 2 or 3 rated securities. Column [2] controls for bank fixed effects. Columns [3] and [4] consider the percentage of Class 2 or 3 rated securities in deals originated by affected banks. These last two columns indicate that the affected banks structure deals to include a larger fraction of Class 2 or 3 rated securities after the rule change, corroborating the graphical evidence in Figure 2. With the inclusion of bank fixed effects, these results remain statistically significant and the economic magnitudes are moderate, yet meaningful. Indeed, affected banks increase issuance of newly-eligible securities by €937 million or 3.83 percentage points of the issuance per deal relative to the unaffected banks' deals.

Taken together, these results indicate a response to the rule change among the set of affected banks. These banks increased securitization activity, particularly through issuance of Class 2 and 3 rated securities.

3.2 Effect of Collateral Eligibility on Mortgage Originations

3.2.1 Interest Rates

We first provide a graphical summary of our main results. In Figure 3 we plot the kernel density estimates of interest rates on mortgage originations for both the affected and control groups before and after the change in collateral policy. The figure depicts a leftward shift of the kernel density for the affected group after the rule and thus the distribution of interest rates shifts downwards. The kernel density of the control group exhibits no such shift. Second, in Figure 4 we separately plot the time series (monthly) average of interest rates for both groups, along with the 10-year government bond rate.[21] It can be seen that before the rule change, interest rates are higher for affected banks at times and higher for control

[21]The typical Dutch mortgage is a 10-year fixed rate, 30-year maturity loan and the relevant benchmark rate is therefore the 10-year government bond.

banks at other times. In contrast, after the rule change, affected banks offer consistently lower interest rates.

We now formally describe the relation between the rule change and interest rates on mortgage originations based on the estimation of Equation (1). We show that the findings in the figures are statistically robust to an analysis that accounts for heterogeneity across loans, borrowers, and banks in a multivariate regression framework.

Table III shows the results. Column [1] shows the basic result without including any control variables. It can be seen that the average interest rates decreased by 0.179 percent for affected banks relative to the control group after the rule change. The point estimate is statistically significant at the 1 percent confidence level.

In column [2], we include employment status, payment type, and mortgage purpose fixed effects along with lender and postal code fixed effects to account for loan, borrower, bank, and location heterogeneity. Of particular importance are the lender fixed effects. These control for time-invariant bank factors that may be correlated with affected bank status and ensure our estimates are identified from within-bank changes in behavior around the rule change. The point estimate changes to -0.110 and remains significant at the 1 percent level.

We further control for aggregate economic shocks through the inclusion of origination month fixed effects in column [3]. In column [4], we control non-parametrically for any observed or unobserved location-time-specific shocks that may be correlated with affected bank status by augmenting the model with the interaction between postal code and origination month fixed effects. Columns [3] and [4] shows the estimated impact of the rule change drops to between -0.076 and -0.079, in line with the previous estimates.

Column [5] controls linearly for the LTV and DTI ratios, and the (log) mortgage size. The former two ratios are important measures of lending standards. Other things equal, an increase in either ratio would signal a greater risk of default for the borrower. When we include these additional controls we find the point estimate remains essentially unchanged

at -0.079 and still significant at the 1 percent confidence level. The similarity of the point estimate is unsurprising as the affected and control banks are roughly similar along these observable dimensions, at least on average (see panel A of Table I).

Column [6] further adds a control variable for whether the loan receives a state guarantee or not. This is an indicator variable equal to one if any part of the loan is documented to have a state guarantee and zero otherwise. This corresponds to roughly 50 percent of the loans in the sample. The estimated impact of the rule change on interest rates is essentially unchanged in terms of size and statistical significance. The coefficient on State Guarantee is negative and significant, indicating that guaranteed loans have lower interest rates. This is reassuring since the state guarantee by itself implies higher recovery rates in case of default.

Finally, we rerun the analysis with controls for beginning-of-year bank size, profitability (return-on-equity), and leverage (one minus the equity ratio) to account for differences among affected banks and between the affected and control groups. We see in column [7] that the estimate increases to -0.133 and remains significant at the 1 percent confidence level.

Overall, the results indicate that there is a reduction in interest rates on mortgage originations following the collateral eligibility rule change and that the size of this reduction is roughly 11 basis points in absolute terms. Importantly, in terms of economic magnitudes, this represents a moderate, yet meaningful reduction in rates in the period after the rule change, about 2.5 percent of the unconditional mean (4.39 percent) and 16.9 percent of the standard deviation (0.65 percent) from the period before.

3.2.2 Robustness Checks

In the baseline estimation, we split 2010 to 2013 into before and after periods. The coefficients in Table III capture time-averaged estimates across each event window. To verify that these estimates are significant because of changes in lending after the rule change, we now examine the relation between the policy change and mortgage interest rates on a year-

by-year basis by estimating our model separately for each year. Here, we drop the time and bank fixed effects due to collinearity. Table IV provides the results.

Examining the coefficients on Class 2/3 Issuer across columns [1] to [4], we can see the reduction in interest rates on new originations occurs only after the policy change. For 2010 and 2011, the years before the policy change, the point estimates are statistically insignificant. From the end of 2011 to the end of 2012, a clear pattern emerges: the point estimate is -0.047 and significant at the 5 percent confidence level, a pattern that continues into 2013. These dynamics support our assertion that affected banks responded to the collateral policy change. Crucially for our empirical strategy to be valid, and in line with the graphical evidence presented in Figure 4, there is no evidence of pre-existing trends in rate cutting behavior by these banks in the run up to the policy change.

Next, we conduct two falsification tests that are designed to rule out two alternative hypotheses. First, we wish to rule out the possibility that affected banks behave differently during recessions, irrespective of collateral policy. Second, the possibility exists that our assignment of banks into affected and control groups is merely picking up a weak-bank effect. The results of these tests are shown in Table V.

In the first test, we examine the behavior of the Class 2/3 Issuer (affected) and the other (control) banks in a prior economic recession in the early 2000s. Since all of the banks in our sample are present, we maintain the same classification as in our baseline analysis. We then falsely assume that the rule change occurred during a prior recession, when the ECB implemented traditional monetary policy measures (i.e., policy rate cuts) but did not alter RMBS collateral eligibility. We redefine the After_t dummy variable to take value one for the period from September 4, 2000 until March 12, 2003. During this period the Dutch stock market index dropped from 703 to 218 points. As a before period (After_t equal to zero), we take the period from the launch of the Euro (January 4, 1999) up to the beginning of the after period (August 31, 2000).

Columns [1] and [2] show the results of re-estimating Equation (1) with this alternative timing. Column [1] includes no controls in the estimation and find the point estimate of interest on After $\times$ Class 2/3 Issuer is now negative and small (-0.011) and statistically insignificant at conventional levels. In column [2] we add the full battery of fixed effects from our baseline analysis—employment status, payment type, mortgage purpose, lender, and postal code times origination month fixed effects—and control parametrically for LTV, DTI, and mortgage size to test the robustness of this initial finding. The coefficient of interest now becomes positive (0.013) but still statistically insignificant at conventional levels. Thus, we find evidence that the affected banks had similar interest rates as control banks had during the prior recession, casting doubt on the simple alternative that affected banks always cut rates during bad times (i.e., our results reflect a selection effect).

In our second test, we examine the behavior of undercapitalized banks around the rule change. The policy to relax collateral eligibility may have been in response to weak economic conditions and, during such times, undercapitalized banks may have incentives to gamble-for-resurrection (i.e., have risk-shifting incentives). We formally test this alternative by classifying affected banks to be those with book value of equity scaled by assets (the leverage ratio) less than three percent, following the methodology of Acharya and Steffen (2014).

We rerun our baseline estimation on the full sample of loans under this alternative capital-based classification. Columns [3] and [4] present the results. As described above, the columns include a progressively larger set of control variables to account for heterogeneity among loans and allow for tighter identification of β. Looking across the columns we see that the coefficient is mixed in sign, ranging from -0.027 to 0.103, and statistically insignificant at conventional levels. This finding reassures us that we are not simply picking up a risk-shifting effect, whereby weak banks cut rates following the rule change in order to gamble-for-resurrection.

Finally, we consider two alternative definitions of measures of banks' exposure to the change in collateral policy. First, we calculate banks' exposure based on their total issuance

of RMBS of Class 2 and 3 scaled by bank assets to eliminate concerns regarding bank size effects. Then, we label a bank as affected if they are ranked above-median. Second, we sort banks into groups based on whether they have issued and fully retained an RMBS with a Class 2 or 3 rated security ("Self-Securitization"). This classification scheme captures net exposure to newly-eligible collateral. For each exposure measure, we label a bank as affected by the rule change if they are ranked above-median. Based on these classification schemes, we repeat our baseline estimation. The results are shown in Table VI. In both cases, the estimate of β is similar to the baseline estimate in terms of size and statistical significance. This indicates that the rate setting behavior is driven by banks' exposure to Class 2 and 3 rated RMBS in general and is not an artifact of particular modeling choices.

3.2.3 Loan Volumes

This section examines the hypothesis that the change in collateral eligibility to include lower-rated RMBS led to an expansion of mortgage credit supply for banks actively issuing these RMBS. We test this hypothesis by estimating the following difference-differences model on monthly data at the bank-postal code-month level of observation:

$$y_{klt} = \alpha_l \times \alpha_t + \alpha_k + \beta \text{ After}_t \times \text{Class 2/3 Issuer}_k + \theta' \mathbf{X}_{klt} + \epsilon_{klt}, \tag{3}$$

where k indexes banks, l indexes locations (postal codes), and t indexes time (months). The dependent variable y_{klt} is the volume of mortgage originations in millions of euros. $\mathbf{X}_{klt}$ includes control variables that are either the bank accounting variables or loan characteristics, averaged (unweighted) across loans within a given bank-postal code-month. We continue to cluster the error term, ϵ_{klt}, at the origination month level. Here, our estimate of β captures the response of affected banks in terms of mortgage credit growth to the collateral requirements relative to control banks.

Table VII presents the results of the estimation. Columns [1] to [7] show the estimate of β including progressively more control variables. It can be seen that, in a given postal code and month, the average loan volume increased between €740,000 and €1.4 million for affected banks relative to the control group after the rule change. The point estimate is relatively stable and always statistically significant at the 1 percent confidence level. The average bank during the event window from 2010 to 2011 issues roughly €6.7 million in loan volume per postal code in a given month. Based on the last point estimate in column [7], we find about a 15 percent increase in loan supply for the affected banks relative to the control group per postal code over a given month in the wake of the policy change.

3.2.4 Loan-Level Evidence on Securitization Activity

We now formally investigate the securitization activity of banks around the rule change at the loan level. We ask whether affected banks were more likely to securitize mortgages with low interest rates originated after the rule change. This analysis complements the bank-level evidence in Section 3.1 and corroborates our hypothesis that the additional origination activity by affected banks is funded through low-rated security issuance.

To study the securitization decision of the banks in our sample we now focus on the "Loan Portfolio" sample. This sample contains the stock of loans and indicates whether they have been securitized into an RMBS issued after the rule change or retained on the balance sheet, as of the end of 2013 (the end point of our analysis).[22] We estimate the following cross-sectional linear probability model using OLS:

$$\mathrm{y}_{ijklt} = \alpha_l \times \alpha_t + \alpha_k + \gamma \text{ Class 2/3 Issuer}_k \times \text{Interest Rate}_i + \theta' \mathbf{X}_{ijkt} + \epsilon_{ijklt}, \qquad (4)$$

where, as before, i indexes loans, j indexes borrowers, k indexes banks, l indexes locations

[22] As discussed in Section 2.1, the ED data identify securitized loans for 2013 only.

(postal codes), and t indexes time (months). The dependent variable, y_{ijklt}, is an indicator variable equal to one if the loan is securitized into an RMBS issued after the rule change and zero otherwise, and all other variables are as before.

The main coefficient of interest, γ, measures how the securitization rate of a typical loan originated by affected banks depends on the interest rate, all else equal, as compared to other banks. If the rule change induces affected banks to increase securitization of relatively low interest rate loans then the coefficient γ will be strictly negative. The null hypothesis is that collateral policy is irrelevant for securitization activity, which corresponds to expecting that γ will be zero.

Table VIII presents the results. Column [1] shows the basic result without including any control variables. Two important results emerge. First, the relation between interest rates and securitization is in general positive: loans with higher interest tend to have higher securitization rates, on average. This finding is consistent with the view that higher interest rate loans—by generating surplus income that tends to enhance the credit or can be paid out to investors of the RMBS—are more appealing to securitize. Second, it can be seen that this relation is flipped for affected banks. The point estimate of γ is negative (-0.054) and statistically significant at the 1 percent confidence level. This indicates that in the period after the rule change, affected banks were more likely to securitize loans with relatively low interest rates, as compared to other banks.

In column [2], we include employment status, payment type, mortgage purpose and lender fixed effects along with postal code by origination month fixed effects to account for loan, borrower, bank, and location heterogeneity. On inclusion of these controls, the coefficient increases in absolute terms to -0.068 and remains significant at the 1 percent level.

Columns [3] and [4] further control for mortgage size, and LTV and DTI ratios and the presence of a state guarantee, respectively. While the DTI ratio and the presence of a state guarantee have a strong association with the likelihood of securitization, we find the

coefficient of interest remains essentially the same in size (-0.068 and -0.057, respectively) and is still significant at the 1 percent confidence level.

In column [5], we rerun the analysis controlling for the interaction of banks' affected status with mortgage size, and LTV and DTI ratios. This test examines whether the interaction of affected status with interest rate is merely proxying for other borrower- or loan-characteristics. The point estimate shows that this is not the case, remaining significant at the 1 percent confidence level and very similar to previous estimates (-0.063).

Taken together with the results in Section 3.1, we find evidence on the securitization activity of affected banks (relative to a benchmark group of control banks) that corroborates our central hypothesis. Namely, following the collateral eligibility rule change affected banks tend to increase issuance of Class 2 and 3 rated tranches. Moreover, mortgage loans with lower interest rates are more likely to enter the collateral pools for these securities in the period following the rule change.

3.3 Mortgage Originations and Repayment Performance

The results so far suggest that some banks respond to the change in collateral eligibility by increasing securitization activity and originating a greater number of mortgages with lower interest rates. In this section, we analyze repayment performance of these loans to assess whether the policy led to a deterioration of underwriting standards.

It is unclear ex ante whether the lower interest rates on mortgage originations at some banks reflect additional risk-taking. On the one hand, banks may face a homogenous set of borrowers at the margin, providing profitable opportunities with relatively low risk. In this case, the collateral eligibility rule change may have increased loanable funds for affected banks to exploit these opportunities without increasing risk. In this case, we may observe an increase in loan volume and lower interest rates. On the other hand, if the marginal borrowers that were rationed out of the credit market in the previous equilibrium were of

lower credit quality (Stiglitz and Weiss, 1981), then the increase in loanable funds may flow to riskier borrowers resulting in worse repayment performance further down the line.

We examine the impact of the rule change on loan repayment performance by estimating Equation (1) as a linear probability model on the sample of loan originations. As before, the unit of analysis is a loan. The dependent variable in the regression is a measure of repayment performance, Payment Arrears$_{ijklt}$, set equal to one if the loan is in payment arrears at the end of the event window.

In columns [1] to [4] of panel A of Table IX, we report the results from this regression analysis. We find strong evidence that the loans originated by affected banks after the rule change are more likely to enter payment arrears. The point estimate is between 0.004 and 0.008 and statistically significant at the 1 percent level. This effect is robust to the inclusion of our large array of control variables, including continuously-measured loan characteristics and numerous fixed effects. This indicates that worse repayment performance is unlikely to be explained by observable differences among loans.

Columns [5] to [8] conduct robustness tests of this analysis, in line with tests conducted in Section 3.2.2. In each column, we include the full set of control variables and fixed effects. The tests in columns [5] and [6] rule out the alternative explanations that our affected banks behave differently in bad times or that we capture an undercapitalized-bank (risk-shifting) effect, rather than the observed risk-taking behavior being induced by the change in collateral policy. In both cases, the point estimate indicates that the proposed alternative is an unlikely explanation. The final two columns of the table consider the two alternative classification schemes of affected banks—based on a different scaling of gross issuance and an approximation of self-securitization activity—and similar results to the baseline case emerge.

Note also, the economic magnitudes of the effects estimated in this section are non-trivial: the approximate 0.005 increase in the probability of arrears constitutes about 20 percent of the unconditional mean (0.03) in the period after the rule change. Thus, we find evidence

that the more aggressive loan pricing by the affected banks translates into a meaningful deterioration in repayment performance. We interpret this finding as a decline in lending standards in response to the increased incentives to securitize.

In Panel B of Table IX we examine the dynamics of the estimated effect of the collateral policy change on arrears. Our approach mimics the prior dynamic analysis of interest rates, where we re-estimate the arrears equation on a year-by-year basis while dropping time and bank fixed effects. The result of this estimation are consistent with our findings thus far. They show that the repayment performance of new originations of affected banks deteriorate relative to other banks after the policy change. These effects do not show up in the data in 2012, suggesting borrowers do not become delinquent on their loans within the first year. The effect is significant in 2013 (at the 5 percent level with point estimate of 0.008). We observe no such differential effects in the pre-event window from 2010 until 2011, which gives us confidence that the default behavior we document is not part of some pre-existing trend.

3.4 Exploring Loan Heterogeneity

We explore the heterogeneity within-bank of loan types to further understand how banks affected by the rule change alter lending behavior. This helps to address the residual concern that our assignment of banks into affected or control groups may conflate with time-varying unobservable shocks at the bank level around the ECB rule change.[23] In Section 3.4.1, we examine interest rates and repayment performance on sets of loans that are ex ante unlikely to be securitized. In Section 3.4.2, we analyze loans with and without state guarantees and show the relatively worse repayment is concentrated among loans with state guarantees.

[23]For example, some Dutch banks were subject to "price leadership bans" at some points during the event window (Overvest and Tezel, 2014).

3.4.1 Further Evidence on the Securitization Channel: Non-Standard Loans

Our evidence thus far suggests that affected banks respond to the change in collateral policy by relaxing underwriting standards and expanding lending. We also provide evidence that these banks place these additional loans in newly-created securities, which are now more liquid. In this section, we provide further evidence on this behavior by examining bank lending and risk-taking on loans that are ex ante unlikely to be securitized. The idea behind this test is that if the rule change operates through incentives to securitize, it should have no impact on loans that are ineligible for securitization.

We identify two sets of loans that are unlikely to be securitized. First, we focus on non-standard repayment structures of the mortgage (the payment type categorical variable). Specifically, we repeat our analysis including "Bullet plus Life Insurance" and "Bullet plus Investment Portfolio" only mortgages. These mortgage products re-invest the savings into risky assets until maturity and, hence, at maturity, savings may be lower (or higher) than the principal and interest to be repaid.[24] Due to this uncertainty, these mortgages are not popular among RMBS investors and therefore less likely to be securitized.

Second, we consider mortgages with a non-standard purpose. As detailed in panel G of Table I, about 90 percent of originations have the stated purpose of a purchase, remortgage, or renovation. Furthermore, based on the "Loan Portfolio" sample, columns [2] to [4] indicate that the loans with a non-standard loan purpose have a very low probability of securitization.

We implement our test by re-estimating Equation (1) separately on the sets of loans with non-standard repayment schedules and purposes. The results are shown in Table X. Columns [1] and [2] show the results for interest rates on originations with non-standard payment types. Several important results emerge. First, notice that despite the considerable decrease in sample size (from 426,866 to 5,286) the coefficients on the important loan

[24]The difference between these two payment types relates to the legal status of the account used to accumulate capital: a life insurance product and an investment account, respectively.

characteristics—LTV, DTI, mortgage size, and the state guarantee indicator—very similar identical to estimates based on the full sample. This reassures us that differences in bank behavior are not driven by different rate-setting relations among loans with standard and non-standard payment types, at least along these dimensions. Second, the coefficient of interest, on the After $\times$ Class 2/3 Issuer interaction term, is statistically indistinguishable from zero once we include controls, indicating that there is no difference in interest rate setting behavior between affected and other banks in the period following the rule change. Thus, for mortgage products with non-standard payment types the affected banks do not appear to charge lower interest rates based on observables, in contrast to the previous results presented on the full sample (of predominantly standard loan types).

We next apply the same analysis to the subsequent repayment performance of these loans. The dependent variable in this analysis is an indicator variable for whether the loan goes into payment arrears or not. It can be seen from columns [5] and [6] that the repayment performance of non-standard loans originated by affected banks is roughly the same as the other set of banks. This contrasts the result on regressions that include standard loan types, for which we found a consistently positive and statistically significant increase in arrears.

We repeat this analysis for non-standard mortgage purposes. Columns [3] and [4] indicate that interest rates increase for loans with non-standard mortgage purpose granted by the affected banks after the rule change. In addition, columns [7] and [8] show a negative coefficient indicating the payment arrears associated with these loans is lower for affected banks in the after period. Thus, for the second set of non-standard loan types we find no evidence that affected banks relax lending standards. If anything, affected banks' lending appears to be more conservative with respect to this set of loans.

Our interpretation of these results is that the increased benefits of securitization after the rule change did not apply to loans that are unlikely to be securitized. For these loans, affected banks were less willing to price loans aggressively and lower lending standards.

3.4.2 State Guarantees and Repayment Performance

In this section, we examine the impact of the collateral eligibility rule change on bank behavior across loans with and without state guarantees. If guaranteed loans experience worse repayment performance, then additional credit risk might be transferred to the government in response to the policy change, which may be an important unintended consequence.

In the Netherlands, state guarantees for mortgages (Nationale Hypotheek Garantie, NHG) are provided by the Homeownership Guarantee Fund. During the mortgage application, a mortgage underwriter can apply for NHG. If the NHG is granted, the borrower has to pay a one-off, tax deductible fee equal to 0.55 percent of the mortgage amount at the beginning of our sample. In return, in case of default, the NHG guarantee covers the outstanding principal, accrued unpaid interest and foreclosure costs. Borrowers are subject to certain acceptance conditions including a conforming loan size limit of €290,000 at the end of our sample. In 2013, about 90 percent of all mortgages within the conforming loan size limit were NHG-financed. This insurance implies that mortgage interest rates are lower for mortgages with an NHG guarantee, with discounts as large as 0.6 percent.[25]

How might the presence of government guarantees interact with the incentives to securitize following changes in ECB collateral eligibility rules? We have already documented that affected banks have incentives to originate mortgages that end up in arrears when the ECB begins to accept lower-rated RMBS. This issue is likely to be more acute for state-guaranteed mortgages, for the following reasons. First, government guarantees on risky loans are likely to be *underpriced* because the fee for a Dutch government guarantee is fixed (and thus independent of mortgage default risk). Second, an originating bank may prefer to immediately realize the gain by packaging (default-free) loans with a state guarantee into an RMBS that is sold in the secondary market at the correct price. Hence, all else equal, guaranteed loans have a higher probability of being securitized (as we observe in Table VIII). In sum, at least

[25]Further details are available at `https://www.nhg.nl/`.

part of the additional risk associated with greater incentives to securitize arising from the changes in ECB collateral eligibility rules may be transferred to the government.

To implement our tests, we partition the set of loans into two groups: those with state guarantees and those without. We then simply re-estimate our baseline difference-in-differences model for loan originations separately on each sample. The results of this estimation are presented in Table XI.

In columns [1] to [4] we show results of the estimation where the interest rate is the dependent variable, for both guaranteed and non-guaranteed loans. Looking across the columns, we see the coefficient of interest is negative for both loans with and without state guarantees and of a similar order of magnitude (-0.107 versus -0.084, respectively). In each case, the point estimate is statistically significant at the 1 percent level. Importantly, note that the average interest rate on state guaranteed loans is much smaller and therefore for these loans this is a substantially larger effect in relative terms.

Turning to repayment performance, in columns [5] to [8], a clear contrast emerges between the sets of loans. While the estimate for the loans without a guarantee is indistinguishable from zero, it is positive (roughly, 0.007) and highly significant for the state guaranteed loans. The estimated effect on payment arrears for the state guaranteed loans is about 50 percent larger than the baseline effect (0.005, see Table IX).

Our interpretation of the evidence present in this section is that affected banks increased their risk-taking mostly within the set of guaranteed loans. This may have increased the credit risk implicitly transferred to the state and highlights a potentially negative externality of the change in the ECB's collateral eligibility policy.

4 Conclusion

This paper provides evidence on how changes in central bank collateral policy may stimulate bank lending and highlights the underlying mechanism through which the policy works. We focus on a change in collateral eligibility by the ECB that, for the first time, allowed lower-rated (e.g., BBB-) RMBS to be accepted as collateral in central bank credit operations. We study the impact on the mortgage market in the Netherlands. Consistent with the policy change increasing the liquidity of RMBS and therefore banks' funding ability, we document an expansion in mortgage credit both in terms of lower interest rates and greater loan volumes among banks that actively issue RMBS with lower-rated tranches.

In addition, and consistent with the change in collateral policy operating through incentives to securitize, we find these banks issue more low-rated securities that are more likely to contain these new lower interest rate originations. We also find that these cheaper loans subsequently experience worse repayment performance—as compared to very similar loans originated by other banks and loans ineligible for securitization originated across all banks—suggesting that banks might be willing to lower underwriting standards to capture these liquidity benefits. Finally, the deterioration of repayment performance is only present for loans with state guarantees, which suggests some credit risk may be transferred to the state.

Overall, our results suggest that looser central bank collateral requirements may affect resource allocation in the real economy by stimulating bank lending. However, our results also suggest potential negative effects to the extent that bank risk-taking may be excessive and could spill over to the sovereign via guarantees.

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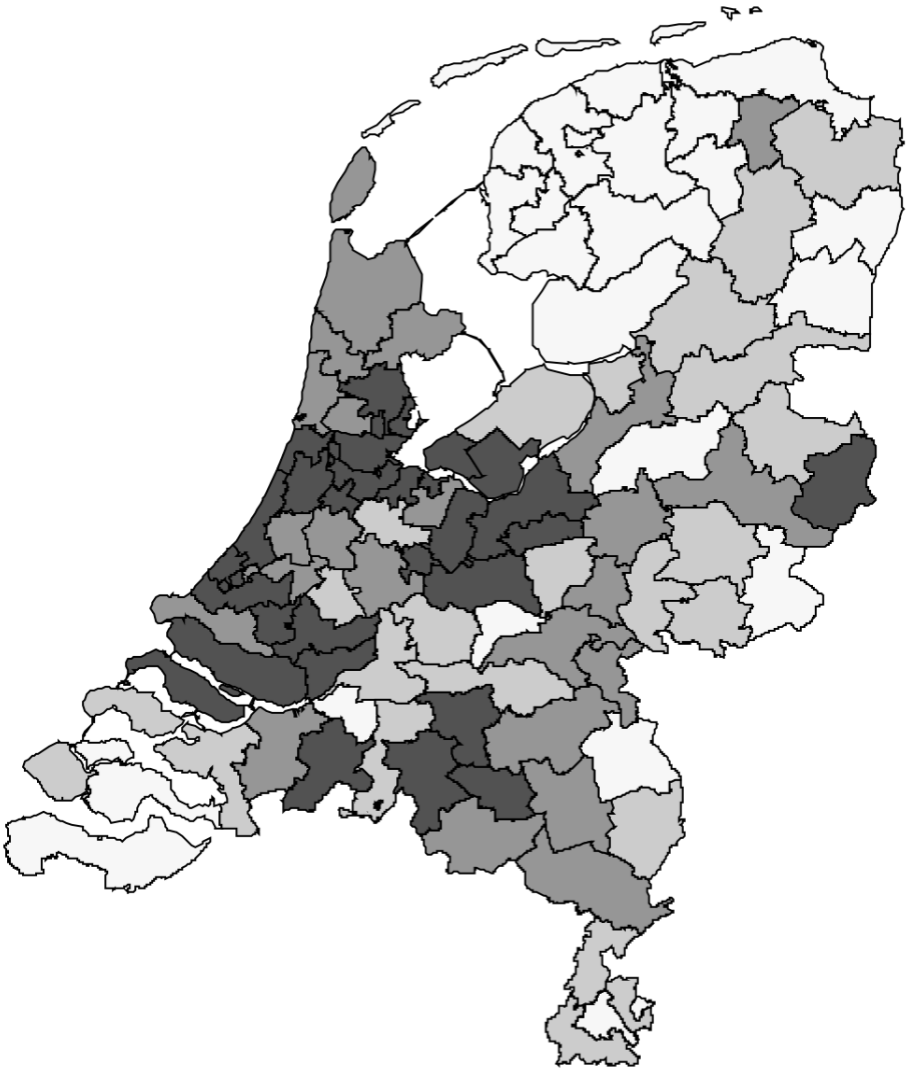


Figure 1: Geography of Mortgage Originations. Number of mortgage originations in our sample overlaid on two-digit postal codes in the Netherlands. Darker shading indicates a greater number of originations. White areas are bodies of water.

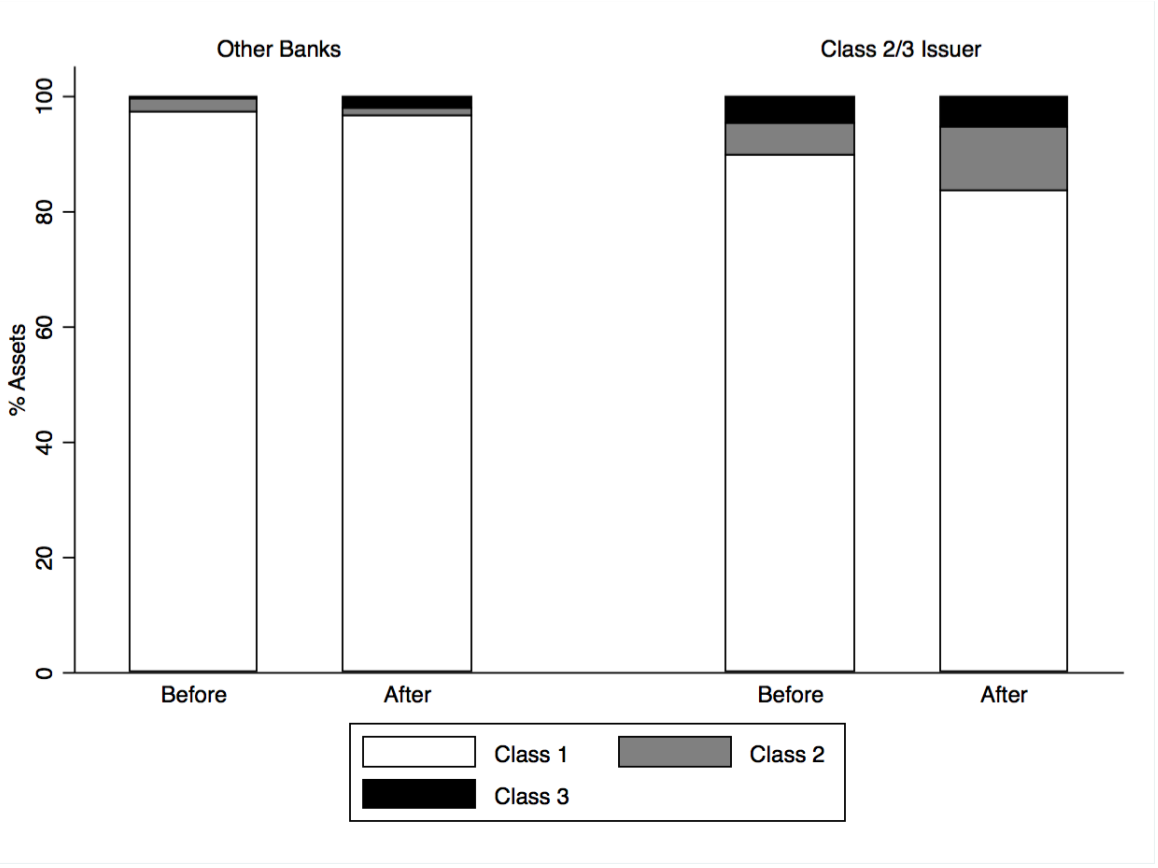
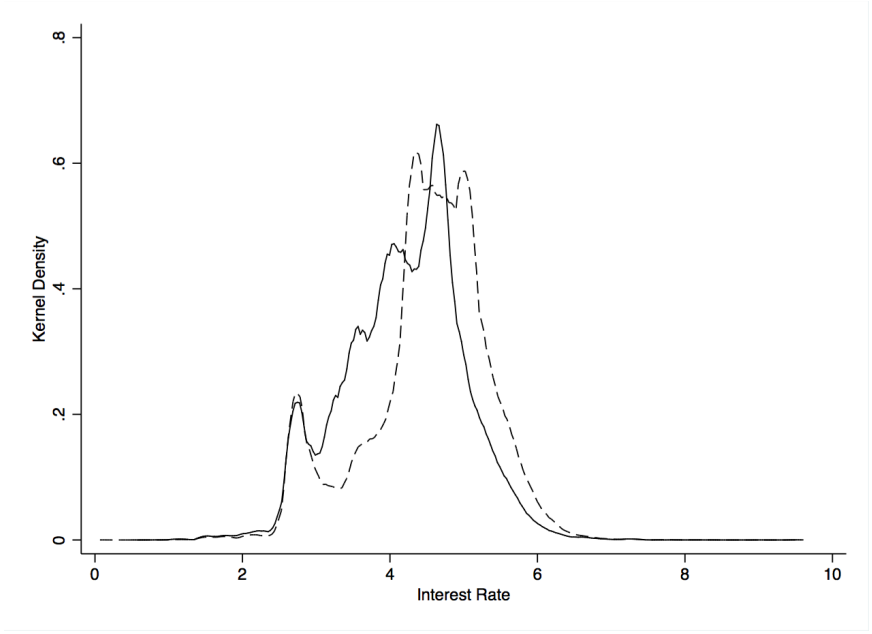
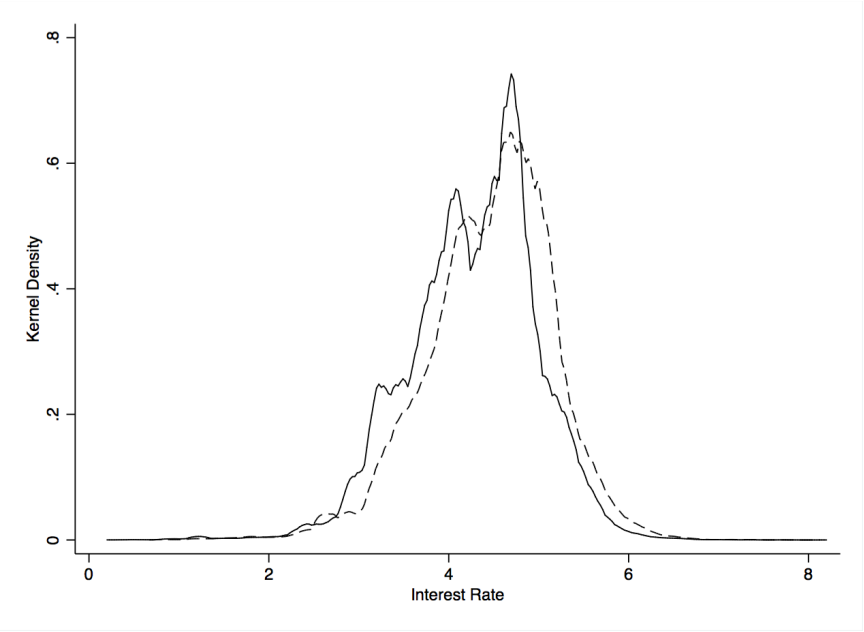


Figure 2: Collateral Eligibility and Bank Securitization Activity. Share of assets in Class 1, 2, 3 ratings tranches of residential mortgage-back securities (RMBS) issued by banks from the Netherlands before (from 01/2010 until 12/2011) and after (from 01/2012 until 12/2013) the December 2011 change in ECB collateral eligibility. Class 1, 2, 3 assets correspond to AAA/AA+/AA/AA-, A+/A/A-, BBB+/BBB/BBB- rated securities, respectively, under the Standard and Poor's long-term credit rating schedule (see Appendix B). Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period.



(a) Class 2/3 Issuer Banks



(b) Other Banks

Figure 3: Collateral Eligibility and the Distribution of Mortgage Interest Rates. This figure shows the Epanechnikov kernel density of interest rate on new mortgage originations for both the Class 2/3 Issuer and Other Banks groups for the period before (from 01/2010 until 12/2011, dashed line) and after (from 01/2012 until 12/2013, solid line) the December 2011 change in ECB collateral eligibility. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period.

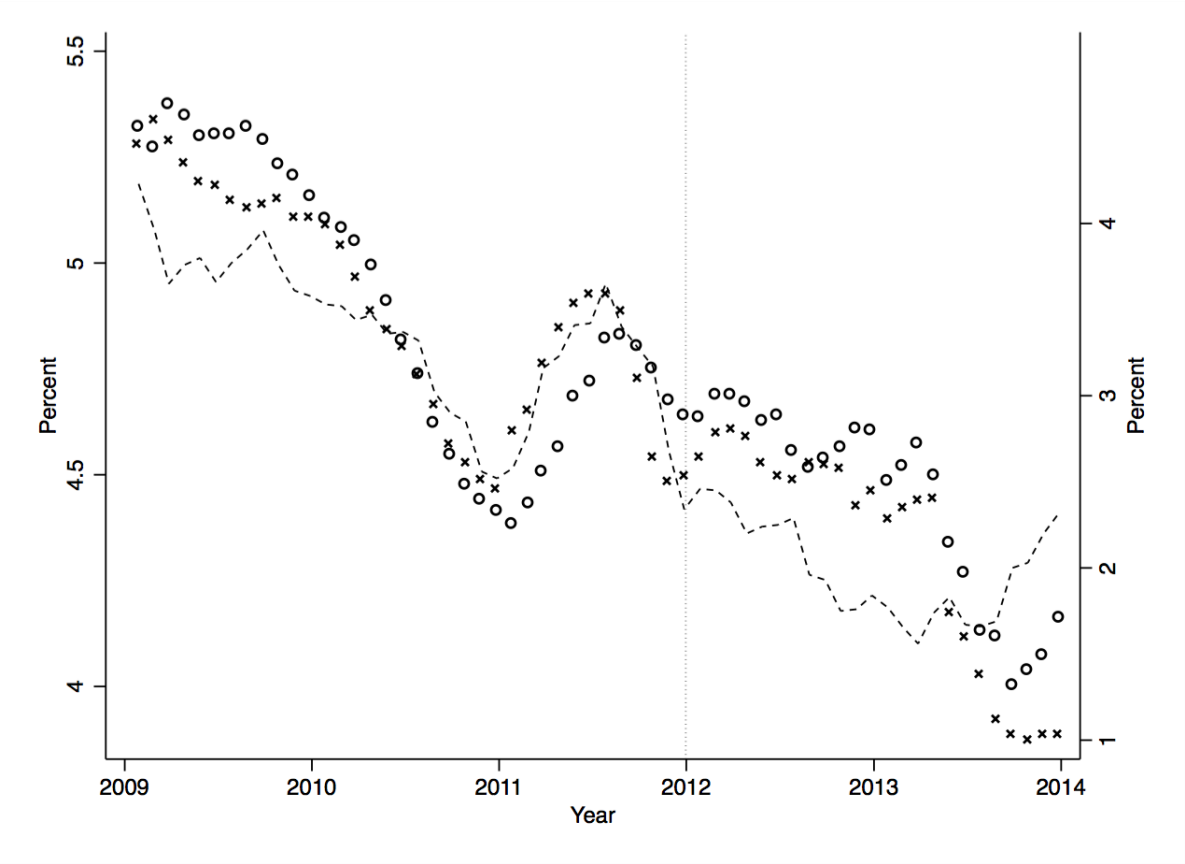


Figure 4: Time Trend of Mortgage Interest Rates. This figure shows the time series trend of interest rate on new mortgage originations for both the Class 2/3 Issuer (crosses, left axis) and Other Banks (circles, left axis) groups from 2009 until 2013, including the period before (from 01/2010 until 12/2011) and after (from 01/2012 until 12/2013) the December 2011 (vertical dotted line) change in ECB collateral eligibility. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The yield on the ten year Dutch government bond is also shown (dashed line, right axis).

Table I
Summary Statistics

This table provides sample summary statistics for the mortgage and bank data. Panels A and B provide statistics on mortgage originations. This sample contains loan originations from the before (from 01/2010 until 12/2011) and after (from 01/2012 until 12/2013) periods. Panel C and D provide statistics on the loan portfolio. This sample contains both the stock of loans as of 01/2012 and the flow of loans originated in the after period. The unit of observation in panels A to D is a loan. Panels E to G provide a breakdown of the equally-weighted fraction of mortgage loans in the Originations (column [1]) and Loan Portfolio (columns [2] to [4]) samples across employment status (panel E), payment type (panel F), and mortgage purpose (Panel G). Panel H provides statistics on banks in the before and after periods. The unit of observation in panel H is a bank. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. All variables are measured at time of origination. All variables are defined in Appendix A.

	N	Mean	Std.	p25	Med.	p75	N	Mean	Std.	p25	Med.	p75
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
Panel A: Originations by Affected Status												
	Class 2/3 Issuer						Other Banks					
Interest Rate	201,945	4.51	0.69	4.10	4.59	4.95	224,921	4.57	0.59	4.20	4.60	4.95
Payment Arrears	201,945	0.03	0.17	0	0	0	224,921	0.03	0.16	0	0	0
Loan-to-Value	200,767	80.12	26.19	62.41	86.66	101.9	221,627	88.51	24.03	76.19	95.88	105.00
Debt-to-Income	134,880	1.39	0.65	1.25	1.53	1.78	186,600	1.35	0.58	1.22	1.48	1.63
Log(Mortgage Size)	198,473	11.93	0.72	11.62	12.05	12.39	222,471	12.04	0.61	11.81	12.12	12.42
State Guarantee	201,945	0.44	0.50	0	0	1	224,921	0.55	0.50	0	1	1
Panel B: Originations of All Banks by Time Period												
	Before Period						After Period					
Interest Rate	213,657	4.39	0.65	3.95	4.45	4.80	213,209	4.70	0.58	4.35	4.72	5.06
Payment Arrears	213,657	0.02	0.15	0	0	0	213,209	0.03	0.17	0	0	0
Loan-to-Value	212,127	84.96	25.35	69.60	94.16	104 .00	210,267	84.07	25.50	69.42	90.11	102.70
Debt-to-Income	149,362	1.35	0.58	1.18	1.46	1.67	172,118	1.37	0.64	1.28	1.52	1.71
Log(Mortgage Size)	211,207	11.98	0.64	11.70	12.06	12.39	209,737	12.00	0.69	11.78	12.11	12.43
State Guarantee	213,657	0.49	0.50	0	0	1	213,209	0.51	0.50	0	1	1
Panel C: Loan Portfolio by Affected Status												
	Class 2/3 Issuer						Other Banks					
Interest Rate	315,635	4.71	0.79	4.25	4.70	5.17	262,464	4.78	0.81	4.30	4.76	5.26
Payment Arrears	315,635	0.04	0.19	0	0	0	262,464	0.04	0.20	0	0	0
Loan-to-Value	311,591	74.19	30.71	49.02	80.47	101.80	249,438	80.28	30.24	59.70	84.05	103.90
Debt-to-Income	171,101	1.47	0.52	1.30	1.54	1.81	145,547	1.27	0.57	1.02	1.42	1.62
Log(Mortgage Size)	308,035	11.85	0.68	11.48	11.96	12.31	257,465	12.00	0.68	11.65	12.09	12.44
State Guarantee	315,635	0.40	0.49	0	0	1	262,464	0.27	0.44	0	0	1
Panel D: Loan Portfolio of All Banks by Securitization Status												
	Loan Securitized						Loan Not Securitized					
Interest Rate	113,827	4.72	0.70	4.30	4.70	5.10	464,272	4.75	0.82	4.25	4.75	5.25
Payment Arrears	113,827	0.02	0.13	0	0	0	464,272	0.04	0.21	0	0	0
Loan-to-Value	113,533	84.65	24.86	68.77	91.50	103.20	447,496	74.93	31.66	49.73	79.97	102.10
Debt-to-Income	82,810	1.54	0.46	1.35	1.56	1.84	233,838	1.32	0.57	1.10	1.46	1.68
Log(Mortgage Size)	112,913	12.06	0.55	11.79	12.11	12.40	452,587	11.88	0.71	11.48	11.99	12.36
State Guarantee	113,827	0.52	0.50	0	1	1	464,272	0.29	0.46	0	0	1

	Originations	Loan Portfolio		
		All	Securitized	Not Securitized
	[1]	[2]	[3]	[4]
Panel E: Employment Status				
Employed or Full Loan Guaranteed	0.67	0.45	0.71	0.38
Unemployment	0.00	0.00	0.00	0.00
Self-Employed	0.06	0.03	0.05	0.03
Student	0.00	0.00	0.00	0.00
Pensioner	0.02	0.01	0.02	0.01
Other	0.09	0.16	0.03	0.19
Unreported	0.16	0.34	0.18	0.38
Panel F: Payment Type				
Annuity	0.18	0.12	0.09	0.13
Linear	0.02	0.02	0.01	0.02
Bullet	0.78	0.75	0.76	0.75
Bullet plus Saving Deposit	0.56	0.42	0.63	0.37
Bullet plus Life Insurance	0.06	0.15	0.13	0.16
Bullet plus Investment Portfolio	0.02	0.08	0.06	0.08
Other	0.03	0.03	0.02	0.04
Panel G: Mortgage Purpose				
Purchase	0.74	0.76	0.81	0.74
Remortgage	0.07	0.07	0.07	0.07
Renovation	0.10	0.10	0.07	0.10
Equity Release	0.03	0.02	0.01	0.02
Construction	0.02	0.02	0.01	0.02
Debt Consolidation	0.00	0.00	0.00	0.00
Remortgage with Equity	0.01	0.00	0.00	0.00
Remortgage with Different Terms	0.00	0.00	0.00	0.00
Investment Mortgage	0.00	0.00	0.00	0.00
Other	0.04	0.03	0.03	0.04

Panel H: Bank Summary Statistics

	Class 2/3 Issuer				Other Banks			
	Before Period		After Period		Before Period		After Period	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Log(Assets)	11.69	1.65	11.03	1.83	11.36	1.79	11.78	1.51
Return-on-Equity	0.10	0.09	0.08	0.06	0.04	0.03	0.08	0.02
Leverage	0.04	0.02	0.05	0.02	0.03	0.01	0.03	0.00

Table II
Collateral Eligibility and Bank Securitization Activity

This table presents estimates of the impact of the change in European Central Bank (ECB) collateral eligibility policy on securitization activity at the bank level. The unit of observation in each regression is a securitization (i.e., a special finance vehicle). Columns [1] and [2] define the dependent variable as the value of securities issued of Class 2 or 3 credit rating in billions of euros (see Appendix B for the ECB's harmonized rating scale). Columns [3] and [4] define the dependent variable as the ratio of the value of securities of rating Class 2 or 3 to total issuance size. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Where indicated, regressions control for special finance vehicle originating bank fixed effects. All regressions are estimated using weighted-least squares (weighted by total issuance size). All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the bank level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable:	Class 2/3 Amount		Class 2/3 Share	
	[1]	[2]	[3]	[4]
After × Class 2/3 Issuer	1.037*	0.937*	4.721***	3.829*
	(0.511)	(0.462)	(1.280)	(1.815)
After	-0.695	-0.431	-0.306	0.536
	(0.433)	(0.437)	(0.283)	(0.415)
Class 2/3 Issuer	-0.193		3.966***	
	(0.452)		(1.096)	
Bank FE	N	Y	N	Y
N	74	74	74	74
R^2	0.141	0.548	0.481	0.592

Table III
Collateral Eligibility and Mortgage Originations: Main Result

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rates of new mortgage originations. The unit of observation in each regression is a loan. The dependent variable is the interest rate. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable: Interest Rate							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
After × Class 2/3 Issuer	-0.179***	-0.110***	-0.076***	-0.079***	-0.077***	-0.097***	-0.133***
	(0.034)	(0.025)	(0.023)	(0.023)	(0.022)	(0.023)	(0.029)
Loan-to-Value					0.001***	0.002***	0.002***
					(0.000)	(0.000)	(0.000)
Debt-to-Income					-0.067***	-0.009	-0.005
					(0.006)	(0.006)	(0.006)
Log(Mortgage Size)					-0.064***	-0.106***	-0.109***
					(0.005)	(0.005)	(0.005)
State Guarantee						-0.281***	-0.295***
						(0.008)	(0.008)
Log(Assets)							0.269***
							(0.048)
Equity Ratio							0.169**
							(0.064)
Return-on-Equity							-1.684***
							(0.234)
After	-0.221***	-0.234***					
	(0.061)	(0.046)					
Class 2/3 Issuer	0.046						
	(0.031)						
Employment status FE	N	Y	Y	Y	Y	Y	Y
Payment type FE	N	Y	Y	Y	Y	Y	Y
Mortgage purpose FE	N	Y	Y	Y	Y	Y	Y
Bank FE	N	Y	Y	Y	Y	Y	Y
Postal code FE	N	Y	Y	N	N	N	N
Origination month FE	N	N	Y	N	N	N	N
Postal code × Origination month FE	N	N	N	Y	Y	Y	Y
N	426,866	426,864	426,864	426,864	426,864	426,864	401,663
R^2	0.065	0.161	0.250	0.259	0.267	0.294	0.312

Table IV
Collateral Eligibility and Mortgage Originations: Dynamics of Estimated Effect

This table examines the dynamics of the estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rates of new mortgage originations. The unit of observation in each regression is a loan. The dependent variable is the interest rate. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The specification from column [6] of Table III is repeated separately for each year. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable: Interest Rate				
Year:	2010	2011	2012	2013
	[1]	[2]	[3]	[4]
Class 2/3 Issuer	-0.008	0.068	-0.047**	-0.044*
	(0.018)	(0.053)	(0.020)	(0.022)
Loan-to-Value	0.002***	0.002***	0.002***	0.006***
	(0.000)	(0.000)	(0.000)	(0.000)
Debt-to-Income	-0.012	0.010*	0.071***	0.062***
	(0.008)	(0.005)	(0.007)	(0.010)
Log(Mortgage Size)	-0.111***	-0.142***	-0.137***	-0.169***
	(0.012)	(0.009)	(0.005)	(0.014)
State Guarantee	-0.276***	-0.323***	-0.246***	-0.288***
	(0.014)	(0.017)	(0.012)	(0.012)
Employment status FE	Y	Y	Y	Y
Payment type FE	Y	Y	Y	Y
Mortgage purpose FE	Y	Y	Y	Y
Postal code FE	Y	Y	Y	Y
N	102,824	110,384	111,431	102,225
R^2	0.103	0.126	0.105	0.194

Table V
Collateral Eligibility and Mortgage Originations: Falsification of Main Result

This table presents falsification tests for the estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rates of new mortgage originations. The unit of observation in each regression is a loan. The dependent variable is the interest rate. Columns [1] and [2] consider the previous recession as an alternative timing, where the before and after periods are defined from 1/1999 until 8/2000 and from 9/2000 until 3/2003, respectively. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. Columns [3] and [4] redefines affected banks as those with book value of equity divided by assets less than three percent (Undercapitalized Banks) with the standard before period from 01/2010 until 12/2011 and after period is from 01/2012 until 12/2013. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Falsification Test:	Prior Recession		Undercapitalized Banks	
	[1]	[2]	[3]	[4]
After × Class 2/3 Issuer	-0.011	0.013	0.103	-0.027
	(0.024)	(0.020)	(0.058)	(0.025)
Loan-to-Value		0.001***		0.002***
		(0.000)		(0.000)
Debt-to-Income		-0.035***		-0.009
		(0.010)		(0.006)
Log(Mortgage Size)		-0.115***		-0.105***
		(0.011)		(0.005)
State Guarantee		-0.170***		-0.278***
		(0.011)		(0.008)
After	-0.285***		-0.329***	
	(0.033)		(0.075)	
Class 2/3 Issuer	0.072***		0.130***	
	(0.016)		(0.038)	
Employment status FE	N	Y	N	Y
Payment type FE	N	Y	N	Y
Mortgage purpose FE	N	Y	N	Y
Bank FE	N	Y	N	Y
Postal code × Origination month FE	N	Y	N	Y
N	168,119	168,119	426,866	426,864
R^2	0.026	0.191	0.080	0.293

Table VI
Collateral Eligibility and Mortgage Originations: Alternative Measurement

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rates of new mortgage originations based on alternative classifications of affected banks. The unit of observation in each regression is a loan. The dependent variable is the interest rate. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Columns [1] and [2] redefine banks as affected if they have an above-median share of RMBS rated Class 2 or 3 out of total assets in the before period. Columns [3] and [4] redefine banks as affected if they have issued and fully retained deals with RMBS of Class 2 or 3 (Self-Securitization) in the before period. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denotes 1, 5, and 10 percent statistical significance.

Affected Definition:	Issuance/Assets		Self-Securitization	
	[1]	[2]	[3]	[4]
After × Affected	-0.165***	-0.111***	-0.179***	-0.096***
	(0.041)	(0.029)	(0.034)	(0.023)
Loan-to-Value		0.002***		0.002***
		(0.000)		(0.000)
Debt-to-Income		-0.008		-0.009
		(0.006)		(0.006)
Log(Mortgage Size)		-0.105***		-0.106***
		(0.005)		(0.005)
State Guarantee		-0.280***		-0.281***
		(0.008)		(0.008)
After	-0.211***		-0.221***	
	(0.067)		(0.061)	
Affected	0.046		0.132***	
	(0.031)		(0.038)	
Employment status FE	N	Y	N	Y
Payment type FE	N	Y	N	Y
Mortgage purpose FE	N	Y	N	Y
Bank FE	N	Y	N	Y
Postal code × Origination month FE	N	Y	N	Y
N	426,866	426,864	426,866	426,864
R^2	0.064	0.295	0.064	0.294

Table VII
Collateral Eligibility and Mortgage Originations: Loan Volume

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on banks' volume of mortgage originations. The unit of observation in each regression is a bank-postal code-month. The dependent variable is the total value (in millions of euros) of new mortgage originations. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Where indicated, regressions control for loan characteristics at origination and various fixed effects averaged across loans within a given bank-postal code-month cell. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable: Loan Volume							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
After × Class 2/3 Issuer	0.740***	0.787***	0.795***	0.847***	1.214***	1.400***	1.078***
	(0.161)	(0.174)	(0.176)	(0.192)	(0.233)	(0.240)	(0.321)
Loan-to-Value					0.007***	-0.000	0.000
					(0.001)	(0.001)	(0.001)
Debt-to-Income					0.093**	-0.151***	-0.159***
					(0.046)	(0.037)	(0.036)
Log(Mortgage Size)					0.000***	0.000***	0.000***
					(0.000)	(0.000)	(0.000)
State Guarantee						1.666***	1.626***
						(0.126)	(0.146)
Log(Assets)							1.041
							(0.640)
Equity Ratio							1.635***
							(0.560)
Return-on-Equity							-7.084**
							(3.010)
After	-0.615***	-0.725***					
	(0.139)	(0.152)					
Class 2/3 Issuer	-1.851***						
	(0.126)						
Employment status FE	N	Y	Y	Y	Y	Y	Y
Payment type FE	N	Y	Y	Y	Y	Y	Y
Mortgage purpose FE	N	Y	Y	Y	Y	Y	Y
Bank FE	N	Y	Y	Y	Y	Y	Y
Postal code FE	N	Y	Y	N	N	N	N
Origination month FE	N	N	Y	N	N	N	N
Postal code × Origination month FE	N	N	N	Y	Y	Y	Y
N	41,597	41,595	41,595	41,595	33,129	33,129	33,129
R^2	0.035	0.499	0.506	0.518	0.538	0.544	0.546

Table VIII
Collateral Eligibility, Mortgage Originations, and Securitization

This table presents estimates of the relation between interest rates of new mortgage originations and the securitization rate after the change in European Central Bank collateral eligibility policy. The unit of observation in each regression is a loan. The dependent variable is an indicator variable equal to one if the loan is securitized and zero otherwise. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. A cross-sectional regression is conducted as of 12/2013. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable: Loan Securitized					
	[1]	[2]	[3]	[4]	[5]
Class 2/3 Issuer × Interest Rate	-0.054***	-0.068***	-0.068***	-0.057***	-0.063***
	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Interest Rate	0.024***	0.056***	0.057***	0.052***	0.055***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Loan-to-Value			-0.000	-0.000	-0.002***
			(0.000)	(0.000)	(0.000)
Debt-to-Income			0.085***	0.063***	0.115***
			(0.010)	(0.009)	(0.007)
Log(Mortgage Size)			-0.012***	-0.006	0.006*
			(0.005)	(0.005)	(0.004)
State Guarantee				0.086***	
				(0.012)	
Class 2/3 Issuer × Loan-to-Value					0.004***
					(0.000)
Class 2/3 Issuer × Debt-to-Income					-0.063**
					(0.022)
Class 2/3 Issuer × Log(Mortgage Size)					-0.046***
					(0.006)
Class 2/3 Issuer	0.375***				
	(0.040)				
Employment status FE	N	Y	Y	Y	Y
Payment type FE	N	Y	Y	Y	Y
Mortgage purpose FE	N	Y	Y	Y	Y
Bank FE	N	Y	Y	Y	Y
Postal code × Origination month FE	N	Y	Y	Y	Y
N	578,099	578,097	578,097	542,792	578,097
R^2	0.026	0.244	0.251	0.261	0.264

Table IX
Collateral Eligibility, Mortgage Originations, and Repayment Performance

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on the repayment performance of new mortgage originations. The unit of observation in each regression is a loan. The dependent variable is an indicator variable equal to one if a loan enters payment arrears and zero otherwise. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before (after) period is from 01/2010 until 12/2011 (01/2012 until 12/2013). Panel A shows the main results. Falsification and Measurement tests in columns [5] to [8] are defined in Table V and Table VI, respectively. Panel B provides the dynamics of the interest rate effect by repeating the baseline estimation in column [4] of panel A for each year separately. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Panel A: Main Results					Falsification		Measurement	
Dependent Variable: Payment Arrears					Prior Recession	Undercap. Banks	Issuance/ Assets	Self-Sec-uritization
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
After × Class 2/3 Issuer	0.008***	0.004***	0.005***	0.005***	-0.002	0.001	0.005***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Loan-to-Value			0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Debt-to-Income			0.008***	0.008***	0.003***	0.008***	0.008***	0.008***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log(Mortgage Size)			-0.011***	-0.011***	0.002***	-0.011***	-0.011***	-0.011***
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
State Guarantee				-0.002*	-0.015***	-0.002*	-0.002*	-0.002*
				(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
After	-0.011***							
	(0.001)							
Class 2/3 Issuer	-0.002*							
	(0.001)							
Employment status FE	N	Y	Y	Y	Y	Y	Y	Y
Payment type FE	N	Y	Y	Y	Y	Y	Y	Y
Mortgage purpose FE	N	Y	Y	Y	Y	Y	Y	Y
Bank FE	N	Y	Y	Y	Y	Y	Y	Y
Postal code × Origination month FE	N	Y	Y	Y	Y	Y	Y	Y
N	426,866	426,864	426,864	426,864	168,119	426,864	426,864	426,864
R^2	0.001	0.019	0.026	0.026	0.049	0.026	0.026	0.026

Panel B: Dynamics of Estimated Effect

Dependent Variable: Payment Arrears

Year:	2010	2011	2012	2013
	[1]	[2]	[3]	[4]
Class 2/3 Issuer	0.000	-0.002	0.002	0.008**
	(0.001)	(0.002)	(0.002)	(0.003)
Loan-to-Value	0.001***	0.001***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Debt-to-Income	0.012***	0.011***	0.009***	0.003**
	(0.002)	(0.001)	(0.001)	(0.001)
Log(Mortgage Size)	-0.012***	-0.014***	-0.013***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
State Guarantee	-0.005**	-0.000	-0.006***	-0.003**
	(0.002)	(0.001)	(0.001)	(0.001)
Employment status FE	Y	Y	Y	Y
Payment type FE	Y	Y	Y	Y
Mortgage purpose FE	Y	Y	Y	Y
Postal code FE	Y	Y	Y	Y
N	102,824	110,384	111,431	102,225
R^2	0.019	0.017	0.016	0.009

Table X
Collateral Eligibility and Mortgage Originations: Unlikely to be Securitized

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rate and repayment performance of new mortgage originations that are ex ante unlikely to be securitized. Mortgages with a non-standard payment type include those with "Bullet plus Life Insurance" and "Bullet plus Investment Portfolio" repayment schedules. Mortgages with a non-standard purpose include all mortgage loans except those for purchase, remortgage, and renovation. The unit of observation in each regression is a loan. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Columns [1] to [4] define the dependent variable as the interest rate. Columns [5] to [8] define the dependent variable as an indicator variable equal to one if a loan enters into payment arrears and zero otherwise. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable:	Interest Rate				Payment Arrears			
Non-Standard:	Payment Type		Mortgage Purpose		Payment Type		Mortgage Purpose	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
After × Class 2/3 Issuer	-0.353***	-0.184	0.370***	0.538***	-0.038***	-0.001	-0.046***	-0.033*
	(0.060)	(0.118)	(0.109)	(0.112)	(0.013)	(0.029)	(0.014)	(0.018)
Loan-to-Value		0.004***		0.002***		0.001***		0.000***
		(0.001)		(0.001)		(0.000)		(0.000)
Debt-to-Income		0.026		0.003		0.003		0.008***
		(0.044)		(0.014)		(0.012)		(0.003)
Log(Mortgage Size)		-0.147***		-0.161***		-0.022**		-0.001
		(0.039)		(0.014)		(0.010)		(0.003)
State Guarantee		-0.307***		-0.262***		-0.006		-0.001
		(0.043)		(0.045)		(0.017)		(0.006)
After	-0.036		-0.390***		-0.003		-0.003	
	(0.066)		(0.095)		(0.009)		(0.003)	
Class 2/3 Issuer	-0.018		0.207***		0.037***		0.062***	
	(0.034)		(0.066)		(0.007)		(0.014)	
Employment status FE	N	Y	N	Y	N	Y	N	Y
Payment type FE	N	Y	N	Y	N	Y	N	Y
Mortgage purpose FE	N	Y	N	Y	N	Y	N	Y
Bank FE	N	Y	N	Y	N	Y	N	Y
Postal code FE	N	N	N	N	N	N	N	N
Origination month FE	N	N	N	N	N	N	N	N
Postal code × Origination month FE	N	Y	N	Y	N	Y	N	Y
N	5,286	5,286	22,674	22,674	5,286	5,286	22,674	22,674
R^2	0.066	0.625	0.095	0.449	0.007	0.496	0.005	0.197

Table XI
Collateral Eligibility and Mortgage Originations: State Guaranteed Loans

This table presents estimates of the impact of the change in European Central Bank collateral eligibility policy on the interest rate and repayment performance of new mortgage originations with and without a state guarantee. The unit of observation in each regression is a loan. Class 2/3 Issuer banks have an above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period. The before period is from 01/2010 until 12/2011 and the after period is from 01/2012 until 12/2013. Columns [1] to [4] define the dependent variable as the interest rate. Columns [5] to [8] define the dependent variable as an indicator variable equal to one if a loan enters payment arrears and zero otherwise. Where indicated, regressions control for loan characteristics at origination and various fixed effects. Regressions containing loan characteristics also include corresponding indicator variables equal to one whenever the characteristic is missing. All variables are defined in Appendix A. Heteroskedasticity-robust standard errors are clustered at the origination month level and shown in parentheses. ***, **, * denote 1, 5, and 10 percent statistical significance, respectively.

Dependent Variable:	Interest Rate				Payment Arrears			
Guarantee Status:	No Guarantee		State Guarantee		No Guarantee		State Guarantee	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
After × Class 2/3 Issuer	-0.204***	-0.107***	-0.137***	-0.084***	0.005**	0.002	0.011***	0.007***
	(0.032)	(0.027)	(0.039)	(0.021)	(0.002)	(0.002)	(0.002)	(0.002)
Loan-to-Value		0.003***		0.000***		0.001***		0.001***
		(0.000)		(0.000)		(0.000)		(0.000)
Debt-to-Income		-0.018***		0.065***		0.005***		0.018***
		(0.005)		(0.011)		(0.001)		(0.001)
Log(Mortgage Size)		-0.096***		-0.132***		-0.005***		-0.035***
		(0.004)		(0.011)		(0.001)		(0.002)
After	-0.280***		-0.163**		-0.007***		-0.014***	
	(0.060)		(0.067)		(0.002)		(0.002)	
Class 2/3 Issuer	0.015		0.059		0.003**		-0.007***	
	(0.026)		(0.035)		(0.002)		(0.001)	
Employment status FE	N	Y	N	Y	N	Y	N	Y
Payment type FE	N	Y	N	Y	N	Y	N	Y
Mortgage purpose FE	N	Y	N	Y	N	Y	N	Y
Bank FE	N	Y	N	Y	N	Y	N	Y
Postal code FE	N	N	N	N	N	N	N	N
Origination month FE	N	N	N	N	N	N	N	N
Postal code × Origination month FE	N	Y	N	Y	N	Y	N	Y
N	215,060	215,058	211,806	211,806	215,060	215,058	211,806	211,806
R^2	0.083	0.293	0.048	0.351	0.001	0.038	0.001	0.038

Appendix A: Variable Definitions

This appendix presents the definitions for the variables used throughout the paper. In the source column, "SC" and "ED" stand for software engineering company and the European Datawarehouse, respectively.

Variable	Definition	Source
Panel A: Loan-Level Variables		
Interest Rate	Value-weighted average interest rate across loan parts at origination	SC, ED
Payment Arrears	Indicator variable equal to one if any part of the loan is in payment arrears	SC, ED
Loan-to-Value	Total loan amount divided by total value of the property across loan parts at origination	SC, ED
Debt-to-Income	Natural logarithm of loan balance divided by primary income of the borrower at origination	SC, ED
Log(Mortgage Size)	Natural logarithm of total loan amount summed across all loan parts at origination	SC, ED
State Guarantee	Equal to one if any part of the loan is documented to have a state guarantee	SC, ED
Loan Securitized	Indicator variable equal to one if all loan parts are securitized and zero otherwise	SC, ED
Panel B: Bank-Level Variables		
Class 2/3 Issuer	Indicator equal to one if above-median share of RMBS rated Class 2 or 3 out of total issuance in the before period	Concept ABS
Log(Assets)	Natural logarithm of book value of assets	Orbis
Return-on-Equity	Net income divided by book value of equity	Orbis
Leverage	One minus the ratio of book value of equity divided by book value of assets (logit transformed)	Orbis
Loan Volume	Total value (in millions of euros) of mortgage originations	SC, ED

Appendix B: European Central Bank's Harmonized Rating Scale

This appendix shows how different external long-term credit rating assessments map into Eurosystem rating grades. In order to be considered a particular Class, at least two of these credit rating agencies must provide the listed rating (or better) at origination. The mapping for short-term credit ratings are shown in brackets. "DBRS" stands for Dominion Bond Rating Services.

	Credit Quality Steps		
Rating Agency	Class 1	Class 2	Class 3
DBRS	AAA/AAH/AA/AAL	AH/A/AL (R-1H/R-1M)	BBBH/BBB/BBBL (R-1L/R-2H/R-2M/R2-L)
Fitch Ratings	AAA/AA+/AA/AA-	A+/A/A- (P1+/P1)	BBB+/BBB/BBB- (P2)
Moody's	Aaa/Aa1/Aa2/Aa3	A1/A2/A3 (P1)	Baa1/Baa2/Baa3 (P-2)
Standard & Poor's	AAA/AA+/AA/AA-	A+/A/A- (A-1+/A-1)	BBB+/BBB/BBB- (A-2)