

Internet Appendix for “Qualified Residential Mortgages and Default Risk”

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Discussion of default risk literature

Dodd-Frank identifies several loan characteristics for regulators to consider in determining the Qualified Residential Mortgage (QRM) definition. Dodd-Frank instructs regulators to analyze historical loan data in examining these characteristics. In this Internet Appendix, we provide a synthesis of extant literature on the relationship between default risk in non-agency securitizations and the characteristics of borrowers and loans.

IA.1. Borrower characteristics

Credit score: Credit scores, such as FICO, are widely used measures of credit risk at loan origination. FICO scores range from 300 to 850, with higher scores reflecting a lower probability of a default based on a borrower's past payment timeliness, credit utilization, and length of credit history. Demyanyk and Van Hemert (2011) find credit scores are one of the most significant variables explaining cross-sectional differences in subprime default rates. Although credit scores are generally expected to result in lower rates of default, higher credit scores may also facilitate access to non-traditional products such as loans with low or no documentation of income (Gorton, 2009). Mayer et al. (2009) cite stability in credit scores over 2003–2007 in arguing that other factors are more important in explaining the rise in mortgage defaults during the financial crisis. We expect credit scores to be negatively related to serious delinquency in general.

Debt-to-income: The debt-to-income ratio reflects the borrower's ability to repay a mortgage, with higher values representing a greater default risk. The front-end debt-to-income ratio reflects the mortgage debt ratio, or the house payment including principal, interest, taxes and insurance, while the back-end debt-to-income ratio includes non-mortgage debt in the numerator (e.g., auto loans). Mian and Sufi (2009) examine debt-to-income ratios and attribute part of the recent increase in mortgage delinquency rates to increases in debt-to-income ratios stemming from negative income growth despite expansions in credit growth

and debt. Many other recent studies do not include a debt-to-income ratio in models of default, likely due to missing information (e.g., Elul, 2015).

Loan-to-value: The initial equity a borrower has in their home is reflected in the loan-to-value ratio. An equity buffer may reduce the probability of default by protecting the borrower against adverse income and housing price shocks. In order to avoid underestimating this amount, many studies examine the combined loan-to-value, which includes secondary liens. Finance literature has long identified the initial loan-to-value ratio as one of the most important predictors of mortgage default (von Furstenberg, 1969). Recent studies of subprime mortgage default also find the combined loan-to-value ratio is one of the most important factors explaining default (e.g., Demyanyk and Van Hemert, 2011). Campbell and Cocco (2015) present a model where high combined loan-to-value levels are positively associated with negative equity, which Elul et al. (2010) find is a key “trigger” of default when housing prices decline. Although higher loan-to-value ratios are typically viewed as being positively associated with default, Elul et al. (2010) find low combined loan-to-value ratios may also be at a high risk of default when considering other borrower and loan characteristics.

IA.2. Loan characteristics

Affiliation: In some securitizations, the servicer may not be an entity affiliated with the loan originator or sponsor. For unaffiliated originators, securitization separates compensation incentives from factors associated with the performance of underlying asset. This separation gives rise to moral hazard by reducing the incentives to ensure the quality of loans based on both hard and soft information. Keys et al. (2010) note that while residential mortgage-backed securities investors must rely on reported hard information (e.g., credit scores), loan originators are privy to non-reported soft information (e.g., future income stability or recent illness) when processing the credit applications of potential borrowers. The moral hazard resulting from differing incentives may be exacerbated during periods of high securitization. For example, Keys et al. (2012) find evidence that as the ease of securitization increases,

originators focus more on hard information because it is easier to convey to investors than soft information, even if the soft information indicates a higher risk of default. Demiroglu and James (2012) find unaffiliated non-agency securitizations are more likely to include loan products such as negative amortization, low documentation, and adjustable interest rates. They provide evidence that default rates are significantly higher when the loan originator is unaffiliated with the servicer, but this relationship not significant for full documentation loans.¹ We expect loans in our sample where the loan originator and servicer are the same or can be identified as part of the same entity (i.e., are affiliated) will have a lower rate of serious delinquency.

Balloon payments: Loans that do not fully amortize over the life of the loan require a large final payment. These balloon payment loans reduce the short-term borrowing cost and make initial homeownership more affordable, but introduce the risk that borrower may not be able to make the balloon payment if their financial condition worsens when the large payment is due. Borrowers unable to afford the large final payment are forced to default or refinance, often with higher loan-to-value ratios and increased borrowing costs through higher interest rates and fees. Demyanyk and Van Hemert (2011) find a positive association between balloon payments and serious delinquency. In the model by Campbell and Cocco (2015), the default risk of loans with a balloon payment are less sensitive to housing price changes shortly after origination, but increase in sensitivity to housing prices as the balloon payment approaches and the loan matures. *Ceteris paribus*, we expect balloon payments to be positively associated with serious delinquency.

Documentation level: Agency loans require the borrower to submit full documentation of income, assets, and debts with the mortgage application. Non-agency loans that do not require proof of income or assets are referred to as low documentation (“low-doc”) or no documentation (“no-doc”) loans. Although borrowers with a low or no documentation

¹Demiroglu and James (2012) also have a “mixed” category, where some but not all of the loans in a securitization pool are serviced by an affiliated agent. Because our data are loan-level and not tranche-level, we do not have a mixed category.

loan may have a credit profile that is considered prime, the lack of full documentation means these loans are considered non-prime. Mayer et al. (2009) find about 70% (35%) of Alternative-A (subprime) loans lack full documentation. Borrower's with less than full documentation are often self-employed or have highly variable income, thus we would expect low and no documentation loans to be associated with greater delinquency. Low and no documentation loans may also facilitate the obfuscation of a borrower's true ability to repay a loan and exacerbate the moral hazard present in securitized loans (Mayer et al., 2009). Several recent studies find low and no documentation loans increase the risk of default (Elul et al., 2010; Demyanyk and Van Hemert, 2011). Keys et al. (2012) find the increased default risk for subprime securitizations is focused in loans without full documentation where soft information is vital. Elul (2015) finds similar results for prime securitizations.

Interest-only loans: Loans where a borrower defers principal repayments are known as interest-only loans. Borrowers choosing an interest-only product are more likely to expect a higher future income (Cocco, 2013). Keys et al. (2013) find interest-only loans are common in Alternative-A and jumbo segments of the prime market, but not in the subprime market. Campbell and Cocco (2015) present a model where interest-only loans increase the probability that borrowers will have negative equity and thus increase default sensitivity to falling house prices. Consistent with several recent studies, we expect interest-only mortgages to be positively associated with serious delinquency (e.g., Mayer et al., 2009; Elul et al., 2010; Elul, 2015).

Interest rate: The interest rate of a securitized residential mortgage reflects three types of risk: default risk, prepayment risk, and interest rate risk. We employ two measures of interest rates to determine the association with serious delinquency. The initial interest rate is the observed interest rate at the loan origination. The initial interest rate spread, or the difference between the initial interest rate and average prime offer rate, might better isolate the pricing of default risk. Maddaloni and Peydró (2011) find extended periods of low short-term interest rates reduce underwriting standards for mortgages. This effect

is intensified during periods of high securitization. Other studies find interest rates are positively associated with serious delinquency (e.g., Elul et al., 2010; Elul, 2015; Demyanyk and Van Hemert, 2011).

Interest rate type: Prior to the savings and loan crisis of the 1980s, most mortgages in the US featured a fixed interest rate. More recently, lenders offer an adjustable rate mortgage (ARM), which features interest rates that float based on some common index and transfer the interest rate and prepayment risk from the lender to the borrower. Demiroglu and James (2012) find a positive association between ARMs and serious delinquency. Fuster and Vickery (2015) find lenders are more likely to offer a fixed rate mortgage during periods of high securitization. Another interest rate type is the teaser rate (also known as a hybrid) where the initial rate is fixed for a short period before floating for the remainder of the loan. Gorton (2009) notes that most subprime mortgages are 2/28 or 3/27 adjustable rate mortgages with a hybrid feature where the initial rate is fixed for a period of 2 or 3 years, then floats for the remaining 28 or 27 years. Mayer et al. (2009) find significantly higher delinquency rates among hybrid adjustable rate mortgages. We expect both adjustable rate mortgages and teaser rates to result in greater serious delinquency rates than fixed rate mortgages or loans without teaser rates.

Lien status: The order of lender reimbursement in the event of foreclosure is reflected by the lien status. The first lien indicates that the creditor has seniority if the property is foreclosed. Second or junior liens often indicate the borrower has extracted some of the equity in the home to use for expenditures. While Goodman et al. (2010) find a negative relationship between lien seniority and serious delinquency, a study by Lee et al. (2013) finds second loans typically default at the same rate as a first loan, and that borrowers sometimes strategically delay the default on the second loan despite being past due on the first loan. Eriksen et al. (2013) find borrowers with a piggyback second lien are more likely to default on the primary loan than the characteristics of the primary loan would predict. We do not predict the expected relationship between lien status and default rates.

Loan purpose: Borrowers may obtain a residential mortgage to purchase a new home or refinance an existing debt. The 2011 proposed definition of a QRM discerns between two types of refinancing based on changes in the principal balance. In a rate and term refinance, the principal balance does not change. Borrowers may seek a rate and term refinance to restructure a mortgage to take advantage of improvements in interest rates or to lower monthly debt obligations. Conversely, when a borrower refinances a mortgage resulting in an increase in the principal balance, the loan is termed a cash-out refinance. In this case, the borrower may extract equity to capture housing price appreciation and use this cash for other discretionary spending. Because the cash-out refinance increases the loan-to-value ratio of the property and reduces the equity buffer from potential housing price declines, we expect cash-out refinancing to be associated with higher levels of default than purchase or rate and term refinance. However, Chomsisengphet and Pennington-Cross (2007) examine subprime refinancing and find cash-out refinance loans are less likely to default than rate and term refinance loans, but are more sensitive to declining house prices.

Loan size: By law, agency loans must have origination balances below the conforming loan limit published annually by the Federal Housing and Finance Agency. A non-agency loan is considered to be a jumbo loan if the origination balance is above this limit. Because jumbo loans are non-conforming, the loan rate is usually higher. The higher rate may reflect reduced liquidity because agencies do not fund these loans (Loutskina and Strahan, 2009) and increased housing price volatility for higher-priced homes (Ambrose et al., 2001). Keys et al. (2013) find non-agency jumbo securitization increased faster than agency securitization during 2002–2007, and often featured an additional layer of risk through interest-only payments. Elul (2015) finds securitized jumbo loans are riskier than jumbo loans held in a portfolio, which may reflect moral hazard. Fuster and Vickery (2015) find banks are more likely to offer fixed rate jumbo loans during periods when non-agency securitizations are more liquid. We anticipate a positive relationship between jumbo loans and serious delinquency.

Loan term: While most mortgages were traditionally originated with 15 or 30 year maturities, some non-agency securitized loans have amortization periods longer than 30 years. Since these loans take more time to fully amortize, the risk of not building enough equity to buffer a default triggering event (e.g., income loss or housing price declines) increases. Elul et al. (2010) find non-agency securitized loans with terms of 40 years are more likely to experience a 60 day delinquency than those with 15 or 30 year maturities. All else equal, we expect long-term loans (i.e., loans with terms exceeding 30 years) to experience greater instances of serious delinquency, especially during the earliest stages of the loan where the borrower has the least amount of equity.

Negative amortization: Loans where the periodic payment is less than the accrued interest are referred to as negative amortization loans since the principal amount owed increases over time. Because the borrower does not build an equity buffer over time, these loans may be more default sensitive to a decline in housing prices or an income shock. However, such features may provide optimal flexibility for borrowers with risky income (Piskorski and Tchisty, 2010) or in locations with greater expected growth in income or housing prices (Piskorski and Tchisty, 2011), but this requires borrowers to be more financially sophisticated to manage these products (Keys et al., 2013). Consistent with financial sophistication, recent papers (e.g., Mayer et al., 2009; Keys et al., 2013) find negative amortization is common in Alternative-A mortgages but rare in subprime mortgages where literature shows borrowers are less informed in general about the mortgage process (Courchane et al., 2004). Surprisingly, Demiroglu and James (2012) find a negative association between negative amortization loans and serious delinquency in a multivariate setting even though most of these loans are made by originators with no affiliation to the servicer. We do not predict a multivariate relationship between negative amortization and serious delinquency since the ability to obtain a negative amortization loan is multifaceted.

Occupancy status: Loans for properties where the primary resident is the owner are considered to be owner occupied. Conversely, non-owner occupied loans (e.g., investment

properties), may be riskier if owners are more willing to default on the loan during periods of large housing price declines. One might also expect non-owner occupied loans to be more prevalent in areas that have experienced recent housing price appreciation (e.g., “spec” houses). Appraisals used to determine loan-to-value ratios for properties experiencing rapid price appreciation may be increasingly difficult and less accurate. Lee et al. (2013) find owner-occupants are more likely to use piggyback second liens than non-owner occupants, which may increase default risk. While some studies of non-agency securitized loans exclude non-owner occupied loans from their sample (e.g., Elul, 2015; Keys et al., 2013), others find non-owner occupied homes are more common among Alternative-A mortgages than subprime mortgages and are more likely to default than owner occupied loans (Mayer et al., 2009). Demyanyk and Van Hemert (2011) also find non-owner occupied subprime loans are more likely to be seriously delinquent. Piskorski et al. (2015) find non-agency securitized loans misreported as owner occupied are more likely to default than those correctly reported as owner occupied.

Prepayment penalty: Borrowers may prepay a loan because they receive better terms or products, or when the house is sold. Loans where the borrower pays a fee if the mortgage is paid in full within a certain period of time include a prepayment penalty to attenuate the effects of prepayment risk. Around 70 to 80% of subprime mortgages include a prepayment penalty, compared to less than 5% of prime mortgages (Mayer et al., 2009; Gorton, 2009; Demyanyk and Van Hemert, 2011). On the one hand, several papers find prepayment penalties are associated with higher serious delinquency (e.g., Elul et al., 2010; Elul, 2015; Demyanyk and Van Hemert, 2011). On the other hand, Mayer et al. (2009) note that higher delinquencies among products such as a short-term hybrid with a prepayment penalty may stem from matching of riskier borrowers with lower credit scores and higher combined loan-to-value ratios to complicated product types, including prepayment penalties. Agarwal et al. (2012) find evidence that lenders balance prepayment risk and default risk when choosing which loans to securitize, and that this tradeoff differs in prime and subprime markets and

throughout time. Thus, it is not clear if prepayment penalties will be associated with higher delinquencies when controlling for other risk factors.

Private mortgage insurance: Loans with higher combined loan-to-value levels often include private mortgage insurance to protect the lender in the instance of default. Intuitively, one might not expect an insurance policy that protects a lender to affect borrower behavior. However, given the separation of underwriting and default risk in non-agency securitized loans, the role of the private mortgage insurer may be enhanced as the insurer shares the default risk with the residential mortgage-backed securities investor. Insurance companies have an economic incentive to monitor underwriting practices.² The additional layer of due diligence could result in lower rates of serious delinquency. Consistent with this notion, many previous studies find a negative association between private mortgage insurance and serious delinquency (e.g., Elul et al., 2010; Elul, 2015; Piskorski et al., 2010). However, once a loan becomes seriously delinquent, private mortgage insurance may expedite foreclosure versus loan modification. Non-agency securitized loans must follow pooling and servicing agreements that instruct servicers to maximize the interests of investors, typically by comparing the net present value of foreclosure versus loan modification. Since lenders are not indemnified until submitting a foreclosure bill to the insurance company, the inclusion of private mortgage insurance increases the net present value of the foreclosure option and may expedite the foreclosure process. Because our analysis centers on serious delinquency rather than foreclosure, this effect should not impact our results.

²See comment letters by the Mortgage Insurance Companies of America (<http://www.sec.gov/comments/s7-14-11/s71411-224.pdf>) and the Mortgage Guaranty Insurance Corporation (<http://www.sec.gov/comments/s7-14-11/s71411-308.pdf>) for a discussion of this due diligence.

Internet Appendix References

- Agarwal, S., Chang, Y., Yavas, A., 2012. Adverse selection in mortgage securitization. *Journal of Financial Economics* 105, 640–660.
- Ambrose, B., Buttimer, R., Thibodeau, T., 2001. A new spin on the jumbo/conforming loan rate differential. *Journal of Real Estate Finance and Economics* 23, 309–335.
- Campbell, J., Cocco, J., 2015. A model of mortgage default. *Journal of Finance* 70, 1495–1554.
- Chomsisengphet, S., Pennington-Cross, A., 2007. Subprime refinancing: Equity extraction and mortgage termination. *Real Estate Economics* 35, 233–263.
- Cocco, J., 2013. Evidence on the benefits of alternative mortgage products. *Journal of Finance* 68, 1663–1690.
- Courchane, M., Surette, B., Zorn, P., 2004. Subprime borrowers: Mortgage transitions and outcomes. *Journal of Real Estate Finance and Economics* 29, 365–392.
- Demiroglu, C., James, C., 2012. How important is having skin in the game? Originator-sponsor affiliation and losses on mortgage-backed securities. *Review of Financial Studies* 25, 3217–3258.
- Demyanyk, Y., Van Hemert, O., 2011. Understanding the subprime mortgage crisis. *Review of Financial Studies* 24, 1848–1880.
- Elul, R., 2015. Securitization and mortgage default. *Journal of Financial Services Research*, forthcoming.
- Elul, R., Souleles, N., Chomsisengphet, S., Glennon, D., Hunt, R., 2010. What ‘triggers’ mortgage default? *American Economic Review* 100, 490–494.
- Eriksen, M., Kau, J., Keenan, D., 2013. The impact of second loans on subprime mortgage defaults. *Real Estate Economics* 41, 858–886.
- Fuster, A., Vickery, J., 2015. Securitization and the fixed-rate mortgage. *Review of Financial Studies* 28, 176–211.
- Goodman, L., Ashworth, R., Landy, B., Yin, K., 2010. Second liens: How important? *Journal of Fixed Income* 20, 19–30.
- Gorton, G., 2009. The subprime panic. *European Financial Management* 15, 10–46.
- Keys, B., Mukherjee, T., Seru, A., Vig, V., 2010. Did securitization lead to lax screening? Evidence from subprime loans. *Quarterly Journal of Economics* 125, 307–362.

- Keys, B., Piskorski, T., Seru, A., Vig, V., 2013. Mortgage financing in the housing boom and bust. In: Glaeser, E. L., Sinai, T. (eds.), *Housing and the Financial Crisis*, University of Chicago Press, vol. 1, pp. 143–204.
- Keys, B., Seru, A., Vig, V., 2012. Lender screening and the role of securitization: Evidence from prime and subprime mortgage markets. *Review of Financial Studies* 25, 2071–2108.
- Lee, D., Mayer, C., Tracy, J., 2013. A new look at second liens. In: Glaeser, E. L., Sinai, T. (eds.), *Housing and the Financial Crisis*, University of Chicago Press, vol. 1, pp. 205–234.
- Loutskina, E., Strahan, P., 2009. Securitization and the declining impact of bank finance on loan supply: Evidence from mortgage originations. *Journal of Finance* 64, 861–889.
- Maddaloni, A., Peydró, J., 2011. Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the Euro-area and the US lending standards. *Review of Financial Studies* 24, 2121–2165.
- Mayer, C., Pence, K., Sherlund, S., 2009. The rise in mortgage defaults. *Journal of Economic Perspectives* 23, 27–50.
- Mian, A., Sufi, A., 2009. The consequences of mortgage credit expansion: Evidence from the US mortgage default crisis. *Quarterly Journal of Economics* 124, 1449–1496.
- Piskorski, T., Seru, A., Vig, V., 2010. Securitization and distressed loan renegotiation: Evidence from the subprime mortgage crisis. *Journal of Financial Economics* 97, 369–397.
- Piskorski, T., Seru, A., Witkin, J., 2015. Asset quality misrepresentation by financial intermediaries: Evidence from the RMBS market. *Journal of Finance*, 70, 2635–2678.
- Piskorski, T., Tchisty, A., 2010. Optimal mortgage design. *Review of Financial Studies* 23, 3098–3140.
- Piskorski, T., Tchisty, A., 2011. Stochastic house appreciation and optimal mortgage lending. *Review of Financial Studies* 24, 1407–1446.
- von Furstenberg, G., 1969. Default risk on FHA-insured home mortgages as a function of the terms of financing: A quantitative analysis. *Journal of Finance* 24, 459–477.