

Reputation and Exaggeration: Adverse Selection and Moral Hazard in the Mortgage Market*

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November 20, 2014

PRELIMINARY: PLEASE DO NOT QUOTE

*We thank the Penn State Institute for Real Estate Studies for providing access to the New Century Mortgage database.

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Abstract

Using a national dataset of subprime mortgages originated by a major financial institution during the house price boom period, we document the role of borrower reputation in the run-up to the mortgage foreclosure crisis of 2007 to 2010. Our empirical analysis is consistent with the hypothesis that borrowers who are unable to originate full documentation loans place greater value on reputation acquisition than borrowers who have lower cost access to the full information documentation credit market. We show that the majority of additional risk associated with low-doc, or stated income mortgages is due to adverse selection on the part of borrowers with verifiable income. We also provide evidence that these borrowers are more likely to engage in a form of moral hazard by inflating or exaggerating their income on the mortgage application.

Key Words: *Subprime Mortgages, Default, Adverse Selection, Moral Hazard, Reputation*

JEL Classification: G2, G01, G10, G18, D1, R2

1 Introduction

Adverse selection occurs when a particular group that actively selects a product or service performs worse than expected. The ability to engage in adverse selection usually arises when one side to a contract has an information advantage over the other party. For example, health insurers face adverse selection in that the individuals most likely to purchase health insurance are those that are most apt to need and use the insurance. Economists have long studied the impact of adverse selection and how markets respond by either pricing the risk or designing contracts to reduce its risk. For example, in the health care industry insurers design contracts with features, such as deductibles, that attempt to identify groups that have similar risk characteristics. Other examples where adverse selection is prevalent include markets where buyers have less information than sellers such as the used car market, the labor market, and the market for financial products.

With respect to banking and financial institutions, the problems associated with adverse selection in the mortgage market are also well documented. For example, lenders face adverse selection issues when offering a menu of mortgage products (Garmaise, 2013; Das, 2012; LaCour-Little and Yang, 2013a). Recognizing this possibility, Harrison et al. (2004) develop a model linking borrower choice concerning loan terms and ex post loan performance to demonstrate the impact of adverse selection. Although lenders attempt to control adverse selection risk during the underwriting process, Burke et al. (2012) illustrate how lender screening to reject higher risk applicants results in greater adverse selection.¹ Obviously, market participants are aware of the potential for adverse selection. For example, Kau et al. (2012) show how originator reputation in securitizing mortgages may offset investor concerns about adverse selection. Reinforcing this insight, Loutskina and Strahan (2011) and Ambrose et al. (2005) demonstrate how adverse selection risk alters lender decisions about retaining loans in portfolio versus securitizing them. In addition, Passmore and Sparks (2000) derive a model to show

¹However, the presence of adverse selection at mortgage origination is not universally accepted. For example, Agarwal et al. (2012) rely on differences in loan performance between prime and subprime markets to claim that adverse selection was less severe in the subprime market.

how the introduction of lower cost screening technology can alter the adverse selection problem present in mortgage securitization.

In addition to the risks associated with adverse selection, lenders may also face the related risk of moral hazard. Moral hazard refers to the risk that one side to a contract has incentives to engage in activities that might cause harm or loss to the other party. Although moral hazard most often concerns actions by one party *after* entering into a contract while adverse selection occurs *prior* to the contract, the mortgage market often exhibits both risks during the loan origination process. For instance, moral hazard on the part of the borrower may arise from efforts to circumvent common rules-of-thumb used by lenders that dictate the amount of credit borrowers can obtain. A common underwriting metric is the debt-to-income ratio that effectively limits the loan amount based on the borrower's income. This metric, in combination with the loan-to-value (LTV) ratio, serves to limit the borrower's housing consumption. As a result, borrowers have an incentive to exaggerate their income in order to reduce the debt-to-income ratio in order to qualify for a higher loan amount. This income exaggeration is a form of moral hazard since the lender is exposed to risk from the borrower's action.

Counter balancing the role of moral hazard, Diamond (1991) discusses how borrowers concerned over reputation can mitigate the negative incentives associated with moral hazard. In the Diamond (1991) model, borrowers rely on building positive reputations for repayment of debts in order to secure access to future credit. Thus, the underwriting process by which lenders verify the borrower's capacity and willingness (reputation) to repay their debts is the natural response to the inherent moral hazard present in debt contracts. In this framework, borrowers with limited reputation (either through failure to repay past debts or from lack of experience) face higher credit costs than borrowers with positive reputations. As a result, reputation is a valuable asset for borrowers who expect to need future credit and thus will work to maintain their reputations.

Of course lenders do not rely solely on borrower reputation to control the adverse selection and moral hazard inherent to mortgage lending. For example, mortgage lenders normally engage in borrower screening by requiring that borrowers provide proof of reported assets and

incomes in order to verify that the borrower is capable of repaying the debt. Over time the mortgage industry came to refer to these types of mortgages as “full documentation” (or full-doc) loans. In addition to the full-doc requirement that the lender verify information contained on the mortgage application, the growth in computerized credit reporting bureaus created the ability for lenders to engage in a form of risk-based pricing. The central idea behind the credit rating is that it provides a numeric score that quantifies a borrower’s reputation.

Unfortunately, many potential borrowers are unable to comply with the full documentation mortgage underwriting requirements. For example, self-employed borrowers may have difficulty in verifying incomes and others may find the documentation requirements too burdensome. However, recognizing that these borrowers are effectively credit rationed in the traditional full-doc loan market, the mortgage industry developed an alternative low-documentation (low-doc), or stated-income stated-asset loan.² Under this type of product, the lender does not verify the borrower’s claims of income or assets recored on the mortgage application.³ Unfortunately, the low-doc product provides an avenue for some borrowers to inflate or exaggerate their incomes in order to qualify for larger mortgages, in effect exposing lenders to moral hazard. While borrowers are still subject to civil or criminal legal actions for providing inaccurate information, the costs associated with pursuing borrowers who fraudulently overstate income or assets often exceed the possible claims, particularly if the loan is still performing. Herein lies the tension in the low-doc product: as long as the borrower is making payments, the lender does not have an incentive to take actions against the borrower for falsely representing their income or assets.

The intersection of the full-doc and low-doc loan market along with the boom in subprime lending prior to the financial crisis in 2007 and 2008 provides an opportunity to study the interaction of borrower reputation, adverse selection, and moral hazard. Consider that prior to the introduction of low-doc loans, self-employed borrowers were often excluded from the credit market due to the difficulty in verifying income. As a result, self-employed borrowers who obtained loans viewed this credit as a valuable asset and worked to enhance their reputations

²See Paley and Tzioumis (2011) and LaCour-Little and Yang (2013b).

³Obviously, lenders recognized the higher risk associated with loc-doc mortgages and accordingly charged higher contract interest rates.

and lender relationships in order to maintain access to future credit. In contrast, borrowers with verifiable income relied less on reputation or lending relationships for future credit access.⁴ By explicitly recognizing the differences in reputation importance between self-employed and W2 borrowers, we demonstrate the role of reputation acquisition in ameliorating adverse selection in the residential mortgage market.

Our analysis builds on the theoretical insights regarding borrower reputation derived in Diamond (1989), and is consistent with the theory that borrowers who are unable to access credit channels that depend on observable risk measures (i.e. the full-documentation mortgage market) place greater value on reputation acquisition than borrowers that have access to the full credit market. Although we find that stated-doc loans experience higher *ex post* default rates than full-doc loans, the relationship is strongest for low-doc W2 loans – the borrowers with the ability to access the full documentation origination channel. In other words, we find that the majority of the additional risk associated with low-doc loans is due to adverse selection on the part of borrowers with verifiable income. We also present evidence that moral hazard, in the form of extreme income inflation on low-doc loans, is more likely for borrowers that rely less on reputation to access credit (W2 borrowers). Furthermore, income inflation is directly related to *ex post* mortgage default for W2 borrowers, but the connection is less clear for the self-employed, which suggests that income falsification is most problematic on low-doc loans originated by borrowers with less need to maintain a positive reputation (W2 borrowers). We also investigate how other forms of reputation impact adverse selection and moral hazard in mortgage contracts. Specifically, we show that the low-doc effect on mortgage performance is reduced for borrowers with established positive credit reputation (e.g. borrowers with a high FICO score or a history of mortgage repayment). Taken together, these results suggest that reputation can mitigate adverse selection and moral hazard in debt contracts with limited information collection (low-doc loans).

Figure 1 demonstrates why understanding the role of reputation in limited information contracts is particularly important for self-employed borrowers. Using data from one of the

⁴This does not imply that borrowers with verifiable income do not value their reputation since poor performance on existing debts would have an impact on the price of future credit.

largest subprime lenders in the runup to the crisis, Figure 1 shows the proportion of low-doc loans to self-employed and W2 borrowers by origination year. Roughly 80% of self-employed borrowers obtain low-doc loans, compared with only 30% for W2 borrowers. Clearly, low-doc loans are favored by the type of borrowers that they were originally intended for: the self-employed. Stated differently, limited information debt contracts are an important source of credit for borrowers that are likely to be credit rationed under full information (full-doc) mortgage contracts.

Figure 2 plots the average loan amount, by documentation type, for W2 borrowers from 1999 - 2005. As the figure shows, for W2 borrowers the average loan amounts are significantly larger when the loan is low-doc. Furthermore, the difference between average loan amounts grew steadily over time. By 2005, the average low-doc loan to a W2 borrower is \$50,000 larger than a full-doc loan to a W2 borrower. However, Figure 3 tells a different story. For self-employed borrowers, the average loan amount is nearly identical across documentation types. In fact, up until 2003, low-doc self-employed borrowers have smaller loans on average than their full-doc counterparts, and after 2003 average loan amounts are virtually identical across documentation types for self-employed borrowers. In other words, Figure 3 provides support for idea that *something* prevents self-employed borrowers from adversely selecting and engaging in moral hazard behavior. Our multiple regression analysis suggests that the *something* is valuable reputation and the need to access credit markets in the future.

Our findings are particularly important in light of the Consumer Financial Protections Bureau's (CFPB) "Ability to Repay Rule," which went into effect in January of 2014. The "Ability to Repay Rule" implements sections 1411 and 1412 of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act), requiring that lenders verify and document a potential borrower's ability to repay the loan.⁵ Loans that do not meet the rule leave the lender exposed to significant litigation risks, effectively eliminating the low-doc loan market. However, our results demonstrate that low-doc loans may facilitate access to credit for self-employed borrowers, without a large increase in default risk, as reputation acquisition for

⁵The Dodd-Frank Act is available online at <https://www.sec.gov/about/laws/wallstreetreform-cpa.pdf>. Information of the "Ability to Repay Rule" is available at <http://www.consumerfinance.gov/regulations/ability-to-repay-and-qualified-mortgage-standards-under-the-truth-in-lending-act-regulation-z/#rule>.

self-employed borrowers significantly reduces the adverse selection risks associated with low-doc loans. As a result, our analyses confirm the intuition embedded in models of reputation in financial contracting (e.g., Diamond (1989).)

Our paper adds to the growing literature on adverse selection and moral hazard in mortgage markets. Much of the recent research focuses on these issues in the context of securitization. For example, Keys et al. (2010) argue that lender incentives to screen potential borrowers varies across exogenously determined FICO score securitization boundaries, and Piskorski et al. (2010) demonstrate the moral hazard inherent in securitization as it inhibits mortgage modifications. However, Bubb and Kaufman (2014) show that the use of borrower credit score cutoff rules for securitization does not provide insights into the role of moral hazard in securitization and Agarwal et al. (2012) find no clear pattern of adverse selection in securitization for the subprime mortgage market. Evidence from earlier research on adverse selection and securitization is also mixed. For example, Downing et al. (2009) provide evidence that informed market participants retain higher quality securitizations in portfolio and sell lower quality securitizations to bankruptcy-remote special purpose vehicles. In contrast, Ambrose et al. (2005) use a sample of mortgages from one lender to show that the lender securitizes lower risk loans and retains higher risk loans its balance sheet, consistent with the hypothesis that lender reputation may mitigate adverse selection.⁶ Similarly, our results suggest that valuable reputation ameliorates adverse selection and moral hazard behavior on low-doc loans to the self-employed.

We also contribute to the literature examining the role low-doc mortgages played leading up to the 2007-2008 financial crisis. Several recent papers focus on low-doc loans and the role of income falsification and adverse selection. For example, Jiang et al. (2014) show that income falsification occurred on low-doc loans resulting in elevated defaults, particularly for loans originated through the wholesale channel while LaCour-Little and Yang (2013b) present a theoretical model where the existence of low-documentation creates adverse selection, both in borrower quality and choice of loan size, and confirm the model's predictions empirically. In

⁶As Ambrose et al. (2005) point out, they are unable to determine whether reputation or regulatory arbitrage incentivizes the lender to retain higher risk loans on its portfolio.

contrast, Paley and Tzioumis (2011) show that low-doc loans are not necessarily riskier than their full-doc counterparts, depending on borrower creditworthiness and whether the lender or the borrower initiates the low-doc loan. However, none of the previous studies have examined the impact of heterogeneity in the pool of low-doc applicants. By focusing on differences within the group of low-doc borrowers, we show that adverse selection and moral hazard is confined to a specific borrower group that was never intended to utilize the low-doc product.

Our paper proceeds as follows. In section 2, we discuss the interaction of borrower type based on income verification costs and mortgage product selection. Section 3 discusses the data and summary statistics. Section 4 presents the empirical results and section 5 concludes.

2 Hypotheses

To formulate testable hypotheses concerning the presence of adverse selection and borrower reputation, consider the following segmentation of borrowers and contracts:

Mortgage Contract Type	Borrower Information Verification	
	Low Cost ($W2 = 1$)	High Cost ($W2 = 0$)
Low Information (<i>Stated</i>)	Low Reputation	High Reputation
High Information (<i>Full-Doc</i>)	High Reputation	High Reputation

We categorize mortgage contracts into high and low information loans based on the amount and extent of borrower information collected by the lender during the underwriting process. High information contracts represent full documentation mortgages where the loan originator collects and verifies the financial information (income and assets) reported by the borrower on the loan application. In contrast, low information contracts are loans where the originator does not independently verify the borrower’s claims concerning assets or income. In offering the mortgage contracts, the lender faces borrowers with low or high information verification costs. For example, borrowers who are self-employed often face high information verification costs since they are unable to provide lenders a W2 tax document from an employer. In contrast, borrowers who are employed by a third party have low information verification costs since

they can easily produce an employer generated W2 statement that documents their income. Obviously, the lender understands that the low information contracts are *ex ante* riskier since the borrower's assets and income are not verified during underwriting and prices the contracts accordingly. Furthermore, since the level of borrower income is often a critical component in determining the maximum loan amount, the lender faces adverse selection risk in that some borrowers may inflate their reported income using the low information contract in order to secure a higher loan amount than would be available under a high information contract. Obviously, borrowers also understand the lender's risks associated with low information contracts and thus a natural response is for low risk borrowers who face high information verification costs (i.e., the self-employed) to build a reputation with lenders for repayment of debts. Thus, as in Diamond (1989), borrowers recognize that their reputation for repaying debt enhances their ability to obtain future credit. In contrast, borrowers with low information verification costs (i.e., the W2 borrowers) recognize that future credit is available through the high information contracts (the full-doc loans) where reputation is less important. As noted in the table, the intersection of low information verification cost borrowers and low information content mortgages results in the potential for adverse selection from borrowers who have low reputation values. In contrast, borrowers who select high information contracts or face high information verification costs value their reputation for debt repayments.

To clarify the role of reputation in the context of costly information verification, consider the mortgage rate sheet for New Century Mortgage Corporation (Figure 4). The rate sheet lists the interest rates charged on mortgages (as of March 30, 2007) originated by New Century based on whether the borrower was willing to verify income and assets ("Full Doc") or did not provide tax returns and bank accounts to verify income and assets ("Stated Doc"). Each block in the rate sheet represents a borrower risk class ("AAA through C") that is based on the number of late payments, prior default records, or bankruptcy filings. Shaded areas without interest rates indicate that the loan product is not offered to borrowers that have credit scores in those risk categories. To see the impact of reputation, consider a high information cost borrower rated "A+" with a credit score of 660 who seeks a 85% loan-to-value (LTV) ratio mortgage. The "A+" risk category indicates that this borrower was 30-days late on a previous

mortgage only once in the last twelve months. Since this borrower finds it costly to verify income, he applies under the “Stated Doc” product type and is quoted a contract interest rate of 7.925%. The impact of reputation becomes apparent if the borrower then misses two mortgage payments (i.e., has one 60-day late experience) and seeks to refinance into a new mortgage. As a result of having the 60-days late experience, the borrower moves from the “A+” to the “B” risk category. However, under the “B” risk category, New Century does not offer a stated doc loan at an 85% LTV.⁷ In contrast, a borrower with a low value on reputation that originated the same stated doc loan could easily switch to a full doc product with the same LTV (albeit with a slightly higher contract rate assuming that her credit score declines due to the 60-day late experience.)^{8,9}

Based on our classification of the mortgage market and the New Century rate sheet example, we formulate the following testable hypotheses concerning borrower reputation and adverse selection. First, we examine whether borrowers that have low information verification costs and select low information loan contracts exhibit behavior consistent with a low regard for reputation. Second, we test for the presence of moral hazard during mortgage origination by investigating the probability of income falsification. Third, we examine whether the relationship between income exaggeration and *ex post* mortgage default differs according to whether the borrower is likely to have a low regard for reputation. Finally, we test if the increased default risk for low-doc loans is reduced by previously established positive credit reputations.

⁷The borrower is effectively credit constrained unless he is willing to move to a lower LTV mortgage at a higher contract rate.

⁸In addition, borrowers who first originate a full doc loan and then experience a 60-day late episode are still able to originate a new mortgage but with a higher contract rate.

⁹Since income falsification is possible on low-doc loans, the borrower with a low value for reputation may not be able to easily refinance into a full-doc loan at the same LTV because his “true” income is insufficient to qualify for the full-doc loan. To see why this does not alter the intuition above, consider a different situation. Suppose two otherwise identical borrowers differ only in their cost (or ability) to verify income. Assume that both borrowers recently lost a property in foreclosure and are attempting to re-enter the mortgage market. Since the high verification cost borrower will still need to select a low-doc loan, she will qualify for a maximum LTV lower than the low verification cost borrower who can now select a full-doc loan. Since both borrowers are aware of this *ex ante*, reputation is relatively more valuable to the high verification cost borrower.

3 Data and Summary Statistics

3.1 Data

The main dataset used in the analysis contains loans originated by New Century Financial Corporation (New Century). New Century was one of the largest subprime lenders in the runup to the recent mortgage crisis, with a large portion of its business originated through independent mortgage brokers. Along with originations, New Century also serviced mortgage loans and held a portfolio of loans as investments. New Century collected detailed borrower and collateral information at the time of origination, as well as contractual features of the loans. Also, for the loans that New Century serviced, monthly mortgage performance data is available.

From the loan origination records, we identify the borrower’s employment type (e.g. W2 versus self-employed), as well as the level of income documentation (e.g. full-doc vs stated income.) We focus only on first-lien loans with complete servicing data that were originated through the mortgage broker channel between 1998 and 2005.¹⁰ Following Conklin (2014), to limit the effect of outliers and data entry errors we exclude loans where (1) total fees are negative or greater than 15% of the loan amount; (2) the yield spread premium paid from the bank to the broker is negative or greater than 5% of the loan amount; (3) the combined loan to value at origination is negative or greater than 125%; (4) the borrower’s FICO score is less than 450 or greater than 850; (5) the debt-to-income ratio is negative or greater than 60%; (6) the borrower’s monthly income is negative or greater than \$26,900 and (7) borrower age is less than 18 or greater than 99. The final sample includes 460,301 funded mortgage loans.

We also obtain data from several supplemental sources. First, market interest rate data come from the Federal Reserve Bank of St. Louis’s Federal Reserve Economic Data and Freddie Mac’s Primary Mortgage Market Survey. Second, monthly MSA level unemployment rates are obtained from the Bureau of Labor and Statistics. Finally, the Pahl Index for mortgage broker

¹⁰We focus on brokered loans since the majority of New Century’s originations were through brokers. Most of the results remain qualitatively unchanged when we focus on loans originated directly through New Century’s retail operations.

regulations at the state level is collected from Pahl (2007) where higher values of the Pahl index indicate stricter regulation of brokers at the state level.

3.2 Summary Statistics

Table 1 presents the summary statistics for the entire sample. We note that 21% of the borrowers have high information verification costs (self-employed), with the remainder having low information verification costs (received a W2 at year's end). Consistent with New Century's concentration in the subprime market niche, nearly 40% of the mortgages are stated income (low-doc) documentation loans. In comparison, Paley and Tzioumis (2011) state that roughly one third of all loans originated between 2000 and 2007 were low/no doc loans. We also note that 5% of the loans fall at least 60 days behind on their mortgage within the first 24 months after origination. Since New Century sold the majority of its loans within six months of origination, the observed default is a lower bound on the actual default rate.¹¹

Turning to loan characteristics, the average interest rate spread is 4.72%, and an overwhelming majority are adjustable rate mortgages (ARMs).¹² The mean loan amount is \$193,000 with a combined loan to value ratio (CLTV) at origination of 83%. Furthermore, 34% of the loans are originated to purchase a home, while 56% are refinance loans with the borrower extracting equity (CASH).¹³ The average FICO score is 613. Taken together, the summary statistics clearly reflect the fact that New Century was primarily a subprime lender with mortgages originated to higher risk borrowers.

In terms of observable borrower characteristics, Table 1 shows that the average borrower is 43 years old with an income of \$6,200 per month.¹⁴ In addition, we note that 40% of the borrowers are minorities, and a large share (44%) were originated in the West region of the

¹¹Some of the loans that exit the sample due to the transfer of servicing rights likely defaulted at a later period. Unfortunately, we cannot distinguish between loans that prepaid and loans where the servicing rights were transferred. Thus, standard techniques for handling competing risks with censored data cannot be employed.

¹²The average note rate on the mortgages is 7.68%, and the ARMs are actually "hybrid ARMs," with an initial fixed rate period (typically two years) with the interest rate adjusting every six months thereafter.

¹³The remaining 10% of loans are for rate/term refinances. These are cases where generally the borrower is refinancing to obtain an interest rate lower than the rate on the current mortgage.

¹⁴This number may overestimate true income since a large portion of the loans are stated income loans where borrowers (or brokers) likely inflated income on the application.

United States as classified by the U.S. Census Bureau. Since New Century began its operations in California, the strong focus in the West is not surprising. Furthermore, consistent with the entire subprime market, New Century experienced significant growth from 2000 through 2005 (Chomsisengphet and Pennington-Cross (2006)).

Table 2 presents the summary statistics across income documentation type for borrowers with low information verification costs. Although we cannot infer the value of reputation directly, we do know that W2 borrowers had a choice. Column 1 includes only full income documentation loans, while column 2 reports the descriptive statistics for stated income loans. Table 2 also includes the difference in means and the t-statistic for a mean difference test between the two groups.¹⁵ Several interesting facts emerge from this table. First, default rates are significantly higher for stated income loans.¹⁶ Stated income loans also carry a larger average rate premium. The average interest rate spread (over Treasury) on stated income loans for W2 borrowers is roughly 32 basis points higher than for full-documentation loans. Another notable difference across the two groups is the average loan amount. The average loan amount for low-doc mortgages is \$33,000 higher than for full-doc loans. Across borrower characteristics, the average age and proportion of minorities is similar across loan types.

Consistent with the theory that low-doc loans may attract borrowers with higher tendencies to engage in moral hazard, Table 2 shows that a large difference exists in borrower income between the mortgage types. The monthly income for the stated-income documentation loans is \$1,000 higher than that for the full-documentation loans. Although it is possible that higher-income individuals might prefer the low-doc mortgage type, in the subsequent analysis we utilize measures of possible income exaggeration to identify borrowers engaged in moral hazard increasing activities.

Table 3 reports summary statistics by loan type for self-employed borrowers. In contrast to the descriptive statistics for W2 borrowers in Table 2, the default rate for self-employed borrowers is not significantly higher on stated income loans. Also, although the interest rates are

¹⁵The mean difference test assumes unequal variance across the two groups. Since the sample sizes are large, nearly all of the mean differences are statistically significant.

¹⁶This is consistent with previous studies that show increased default risk for low-doc loans (Jiang et al. (2014) and LaCour-Little and Yang (2013b)).

significantly different across documentation type, the rate premium for stated documentation (0.21) for self-employed borrowers is only half that of W2 borrowers (0.32). Also, compared to the \$33,000 loan size difference in Table 2, the mean difference in loan size is only \$6,500. In addition, for self-employed borrowers, the average income on the full-doc sample is actually larger than the average income for the low-doc loans.

Comparing Tables 2 and 3, several key differences stand out. First, loans to high information verification cost borrowers are much more likely to be stated income documentation (80% of the self-employed subsample are low-doc loans, compared to 30% for the W2 subsample.) This is not surprising since the low-doc product was designed specifically for borrowers with difficult to verify financial situations. Also, the average loan amount in the W2 subsample is \$46,000 lower than the average for the self-employed group. Consistent with the difference in average loan sizes, the self-employed report a higher average income. Finally, the average FICO score is higher in the self employed subsample.

Since the summary tables suggest that differences exist among the four borrower and loan product groups (stated-income self-employed, stated-income W2, full-doc self-employed, and full-doc W2), we report the kernel density distributions for borrower and mortgage characteristics in Figures 5 and 6, respectively. First, in Figure 5, we see that the credit risk distribution for full-doc loans (W2 and self-employed) are wider and skewed lower than the stated-income borrower distributions. This is consistent with the lender imposing a higher underwriting screen on stated-income mortgages where borrowers have a greater opportunity to embellish their debt payment capacity. Second, the borrower income distribution for full-doc W2 loans is skewed lower than the other groups. In terms of borrower age, we see little difference in the kernel density distributions across the groups. Turning to loan characteristics, Figure 6 reveals a sizable difference in the distribution of loan amounts between the full-doc W2 borrowers and the other three groups. Figure 6 also reveals an interesting difference in loan pricing across the four groups. First, it appears that full-doc W2 borrowers have a higher proportion of high-fee mortgages. Second, the interest rate spread on full-doc loans (regardless of whether to a W2 borrower or self-employed borrower) are essentially the same. However, the interest rate spread distribution for the low-doc (stated-income) W2 borrowers is skewed higher. Thus,

it appears that from a pricing perspective, the lender did anticipate that borrowers with W2’s who selected low-doc loans were potentially higher risk and priced them accordingly. Yet, full-doc W2 borrowers tended to pay higher origination fees (as a percentage of their loan amount) than low-doc borrowers.

To summarize, Tables 2 and 3 point out several important differences between full-doc and low-doc loans according to borrower information verification cost type. First, borrowers with low information verification costs (W2 borrowers) that select the low-doc loan product have higher average incomes and loan amounts than similar borrowers who select the full documentation loans. Second, stated income loans for the W2 borrowers experience higher levels of *ex post* default. Third, we do not observe a similar pattern for borrowers with high information verification costs. For self-employed borrowers, the average income and loan amount are similar regardless of the loan type. Furthermore, stated income loans to self-employed borrowers do not have higher average default rates. As a result, tables 2 and 3 provide preliminary evidence that is consistent with the popular narrative that stated income loans were “liar’s loans,” but the role of borrower reputation may have ameliorated this tendency as low-doc loans to self-employed borrowers do not appear to have the same issues of income overstatement, loan amount distortion, or increased mortgage default risk.

4 Results

4.1 Reputation and Mortgage Performance

To test for adverse selection and borrower reputation, we estimate the following loan-level regression of mortgage default:

$$Pr(DEFAULT_{it} = 1) = \Phi(\alpha + \beta_1 W2_i + \beta_2 STATED_i + \beta_3 W2_i \times STATED_i + \delta X_i + \theta R_t + \vartheta W_{it} + \gamma T), \quad (1)$$

where $DEFAULT_{it}$ is an indicator for mortgage default for loan i originated at time t , and Φ is the standard normal cumulative distribution function.¹⁷ X_i represents information collected and recorded on the loan application. This information includes loan characteristics (fees charged on the loan, loan amount, combined loan-to-value ratio, whether the loan has a prepayment penalty, purchase or refinance, cash-out or rate/term refinance, and whether the payments are interest-only), property characteristics (two-unit, condominium, owner-occupied or investment property), and borrower characteristics (FICO score, borrower age, borrower income, debt-to-income ratio, whether the borrower met in person with the loan officer, and minority status). R_t captures market interest rates at the time of origination. The area characteristics, W_{it} , include the monthly MSA unemployment rate, the level of broker competition, the Pahl index capturing the level of broker regulation at the state level, and the census region (West, Midwest, South, Northeast, or Pacific).¹⁸ T is a set of variables denoting mortgage origination year to control for loan cohort effects. Throughout the analysis, unless otherwise stated, the reported standard errors are robust to heteroskedasticity and within cluster correlation of errors at the MSA level.

The parameters β_1 , β_2 , and β_3 are the primary coefficients of interest and capture the differential effect of borrower reputation on the probability of default. The reference category is full income documentation loans originated to high information verification cost (self-employed) borrowers. β_1 represents the difference in outcome for borrowers with low information verification costs (i.e., when the employment type is W2.) β_2 captures the change in outcome when the loan type is stated (low) doc. Finally, $\beta_1 + \beta_2 + \beta_3$ reflects the effect of borrowers with the least concern for reputation as it captures borrowers with low information verification costs ($W2 = 1$) who originate a low information content mortgage ($STATED = 1$). Since these borrowers have low information verification costs, they can easily switch to full-documentation loans in the future. In contrast, high information verification cost borrowers who originate low-doc mortgages have the most to lose in default as future access to credit may be curtailed.

¹⁷The default variable takes a value of one if the loan becomes 60 or more days delinquent within 24 months of origination.

¹⁸Broker competition is computed as the quarterly Herfindahl-Hirschman Index in each MSA as in Ambrose and Conklin (2014).

Table 4 presents the estimated marginal effects from the maximum likelihood estimation of equation 1. Since Ai and Norton (2003), Williams (2012) and Buis (2010) note that reporting and interpreting a single marginal effect of an interaction term in a nonlinear model can be problematic and misleading, we follow Williams (2012) and report the marginal effects of stated income documentation at representative values for borrower employment type (e.g. at values of zero and one for $W2$).¹⁹

In column 1, the marginal effects indicate that stated income (low-doc) loans are associated with higher *ex post* default rates, regardless of employment type. This is consistent with the increased risk associated with low-doc loans and supports the pricing effect observed in Tables 2 and 3. However, the difference in magnitude between the effects for self-employed and W2 borrowers shows a more complex relationship and is consistent with borrower reputation mitigating default risk. First, for borrowers with the highest concern for reputation (self-employed borrowers), the marginal effect of *STATED* is modest (0.38%). To place this in perspective, dividing the marginal effect by the mean default rate ($0.0038/.0511$) indicates that self-employed borrowers originating stated income documentation loans have a 7.4% higher probability of default than the reference group (self-employed borrowers originating full-doc loan.) In contrast, the marginal effects indicate that borrowers with the least concern for reputation value (W2 borrowers selecting stated income documentation loans) have a much larger and statistically significant (at the 1% level) probability of default. The marginal effect for stated-income W2 borrowers is 1.13%. Thus, for a W2 borrower, moving from full-doc to low-doc mortgage is associated with a 24% increase about the mean in mortgage default, *ceteris paribus*.²⁰ In other words, stated income loans to self-employed borrowers pose modest additional default risk consistent with the theory that borrowers with high information verification costs value reputation, but stated income loans to W2 borrowers have substantially higher default rates consistent with the theory that they have less reputation value since they can easily switch to full-doc mortgages in the future where reputation is less important.

¹⁹We also report the single estimate for the marginal effect of the interaction term using marginal effects at the sample means in the appendix in order to provide continuity with previous studies. William's provides a detailed discussion of the differences between average marginal effects and marginal effects at the mean <http://www3.nd.edu/~rwilliam/stats/Margins01.pdf>.

²⁰This is calculated by taking the ratio of the marginal effect to the average W2 borrower default rate ($0.0113/0.0477$.)

Although we include time-varying controls at the MSA level to account for local economic conditions, the possibility remains that unobserved time-constant geographic effects are driving the observed effect. Thus, in column 2, we include MSA fixed effects to address this concern.²¹ The results in column 2 are virtually identical to those in column 1. Stated income documentation increases the likelihood of default, but the marginal effect is much larger for W2 borrowers.

To summarize, Table 4 provides several key insights. First, full-doc loans to self-employed borrowers are, *ex post*, marginally riskier than full-doc loans to W2 borrowers. This makes sense as income for self-employed borrowers is likely more volatile. Second, stated income loans, in general, are riskier than full-doc loans. Third, and most importantly, a distinction exists between low-doc loans originated to self-employed borrowers (those with the highest incentive to value reputation) and low-doc mortgages originated by W2 borrowers (those with the least incentive to value reputation). Consistent with the hypothesis that reputation is valuable for preserving access to future capital, the magnitude of the change in default risk is considerably larger for W2 borrowers originating stated income loans.

4.2 Income Exaggeration and Mortgage Performance

In this section we explore the interaction of adverse selection, moral hazard, and reputation. As noted above, adverse selection arises from the natural information asymmetry that exists between borrowers and lenders in the low-doc mortgage product where borrower supplied information is not verified. Furthermore, moral hazard also exists in that borrowers may have incentives to take advantage of the non-verification of information to engage in information falsification during the origination process.²² In general, borrowers who place high value on reputation are least likely to engage in activities that would increase moral hazard. For example, borrowers with high information verification costs who place high value on future access to

²¹Since several MSAs had no defaults, the number of observations included in the regression in column 2 is lower than in column 1.

²²This form of moral hazard differs from the classic economic definition since the borrower is engaging in an activity that may alter the loan's risk prior to the contract origination. Classical moral hazard refers to the inability of one side in a contract to monitor or control the actions by the other party that may alter the contract's payoff or profitability.

credit (and thus have high value on reputation) have an incentive to accurately report income on the mortgage application. In contrast, borrowers with low information verification costs that originate loans that do not require income verification may reveal a tendency to engage in moral hazard by inflating their income on the mortgage application since reputational concerns are less likely to prevent this behavior.

As a first step in identifying moral hazard, we measure income exaggeration following the method outlined in Jiang et al. (2014) and assume that a borrower’s income is a linear function of borrower characteristics, area characteristics, origination year dummies, and state dummies. Thus, for each employment type, we estimate the following linear regression for income using a randomly generated subsample of the full income documentation loans:²³

$$\begin{aligned} INCOME_{it} = & \gamma_0 + \gamma_1 FICO_i + \gamma_2 FEMALE_i + \gamma_3 AGE_i + \gamma_4 MINORITY_i \\ & + \gamma_5 MSA_INC_{it} + \gamma_6 UNEMP_{it} + \phi T + \eta PROP_STATE + \varepsilon_{it}, \quad (2) \end{aligned}$$

where $INCOME_{it}$ is the verified income on the full-doc loan for borrower i originated at time t , $FICO_i$ is the borrower’s credit score, $FEMALE_i$ is an indicator for whether the primary borrower is female, AGE_i is the borrower’s age, $MINORITY_i$ equals one if the borrower is a minority, MSA_INC_{it} is the median annual income of the borrower’s MSA, $UNEMP_{it}$ is the monthly MSA unemployment rate, and T and $PROP_STATE$ represent origination year and state dummies, respectively.

Table 5 reports the coefficient estimates for the income regressions. The signs and significance of the coefficients generally match across the two subsamples of full-doc loans. $FEMALE$ and $MINORITY$ are negatively related to income, while $FICO$ is positively related to income. An individual’s income is positively related to the median MSA income, and negatively related to the MSA unemployment level.

We use the coefficients in Table 5 to compute out-of-sample estimates of income for the stated and full-doc loan borrowers that were not used in the income regressions. To calculate an estimate of income exaggeration (INC_EXAG), we subtract the reported income from the

²³The randomly generated subsamples include half of all the full-doc loans for each employment type.

estimated income, and divide by the estimated income. *INC_EXAG* represents the percentage variation between the borrower’s reported income and estimated income.

Table 6 presents descriptive statistics for *INC_EXAG* across employment and documentation type. For low information verification cost borrowers (W2 borrowers) originating stated income loans, the average estimated income overstatement is 0.1093, compared with -0.0004 for full-doc W2 loans.²⁴ Thus, it appears that income exaggeration is greatest for the set of borrowers with the least concern for reputation (low information verification costs borrowers originating stated income loans.) In contrast, for borrowers with the most incentive to value reputation (self-employed borrowers with high information verification costs), *INC_EXAG* is actually lower for the stated income subsample than for full-doc borrowers.

To formally identify the extent of moral hazard, we estimate the following regression:

$$Pr(INC_EXTREME_{it} = 1) = \Phi(\alpha + \beta_1 W2_i + \beta_2 STATED_i + \beta_3 W2_i \times STATED_i + \delta X_i + \theta R_t + \vartheta W_{it} + \gamma T), \quad (3)$$

where *INC_EXTREME_{it}* is a dummy variable equal to one if *INC_EXAG_{it}* is in the top decile for the borrower’s employment type, and *X_i*, *R_t*, *W_{i,t}*, and *T* are defined in equation (1).²⁵ Equation (3) tests whether borrowers selecting low-doc loans are more likely to have extreme positive values of income exaggeration and whether this effect depends on the value of reputation.²⁶

Table 7 reports the marginal effects (MERs) of *STATED* for self-employed and W2 borrowers. For self-employed borrowers, selection of a low-doc loan is not significantly related to the probability of extreme income exaggeration. However, W2 borrowers originating stated

²⁴Positive residuals indicate income exaggeration.

²⁵*INC_EXAG* takes a value of one if *INC_EXAG* is greater than 0.68 or 0.61 for W2 and self-employed borrowers, respectively.

²⁶As a robustness check, we estimate the following OLS model of income exaggeration:

$$INC_EXAG_{it} = \alpha + \beta_1 W2_i + \beta_2 STATED_i + \beta_3 W2_i \times STATED_i + \delta X_i + \theta R_t + \vartheta W_{it} + \gamma T + \varepsilon_{it}, \quad (4)$$

and report the coefficient estimates in Table 10 of the Appendix. The results show that *STATED* is positively related to our measure of income exaggeration for both employment types, but that income exaggeration increases in low-doc loans when the borrower is likely to have less concern for reputation (i.e., W2 borrowers). This is consistent with our findings reported in Table 7 when we estimate equation (3).

income loans are significantly more likely to have extreme income overstatement. These results are consistent with the hypothesis that borrowers with the lowest *ex ante* value for reputation (W2 borrowers originating low-doc loans) are likely to engage in moral hazard behavior (income inflation), but reputation acts as a mechanism to reduce moral hazard on low-doc loans to self-employed borrowers.

To estimate the impact of moral hazard on *ex post* mortgage default, we estimate the following regression:

$$\begin{aligned} Pr(DEFAULT_{i,t} = 1) = & \Phi(\alpha + \beta_1 W2_i + \beta_2 STATED_i + \beta_3 W2_i \times STATED_i \\ & + \lambda_1 INC_EXAG_i + \lambda_2 W2_i \times INC_EXAG_i + \lambda_3 STATED_i \times INC_EXAG_i + \\ & \lambda_4 W2_i \times STATED_i \times INC_EXAG_i + \delta X_i + \theta R_t + \vartheta W_{i,t} + \gamma T), \end{aligned} \quad (5)$$

where X_i , R_t , $W_{i,t}$, and T are defined in equation (1). To provide more comprehensive insight into the observed effect, we compute the average marginal effects of *STATED* at different values of the income exaggeration measures and present the results graphically.

Figure 7 plots the marginal effect of stated income at different levels of *INC_EXAG* across employment types.²⁷ We note that the average marginal effect of stated is higher at each level of *INC_EXAG*. In addition, we see that higher levels of income exaggeration have a larger impact on default, and the slope is steeper for W2 borrowers. Interestingly, for self-employed borrowers, zero is contained in the confidence interval for the marginal effect of *STATED* at each level of *INC_EXAG*. Thus, to summarize, the marginal effects reported in Figure 7 suggest that income falsification is positively related to default for stated income loans. In addition, the relationship between income exaggeration and default is stronger for W2 (versus self-employed) loans. Thus, the results support the hypothesis that borrowers with low *ex ante* value for reputation that self select into low information mortgages are most likely to engage in moral hazard during loan origination and this risk manifests itself in higher *ex post* default rates.

²⁷The horizontal axis in Figure 7 runs from the 5th to the 95th percentile of *INC_EXAG*.

4.2.1 Stated Income and Credit Reputation

Next, we examine the interaction of stated income documentation, employment type, and credit history. We measure credit history that is observable at origination using the borrower’s FICO score, a standard risk metric used in mortgage underwriting in the United States. Over time an individual develops a reputation with creditors through credit usage and debt repayment patterns. The FICO score quantifies this reputation, with higher scores reflecting more credit-worthy borrowers, *ceteris paribus*. Since credit scores are widely used for lending, insurance, and employment decisions, a strong credit reputation, as indicated by a high FICO score, is a valuable asset for a borrower.

In this section we test whether observed credit reputation mitigates the default risk of borrowers that otherwise have signaled a low value for reputation (W2 borrowers selecting stated income documentation loans). Our regression now takes the form

$$\begin{aligned}
 Pr(DEFAULT_{it} = 1) = & \Phi(\alpha + \beta_1 W2_i + \beta_2 STATED_i + \beta_3 W2_i \times STATED_i \\
 & + \lambda_1 FICO_i + \lambda_2 W2_i \times FICO_i + \lambda_3 STATED_i \times FICO_i + \\
 & \lambda_4 W2_i \times STATED_i \times FICO_i + \delta X_i + \theta R_t + \vartheta W_{i,t} + \gamma T), \quad (6)
 \end{aligned}$$

where $FICO_i$ is the borrower’s credit score at origination. All other variables are as defined in equation (1). The three-way interaction of $W2$ with $STATED$ and $FICO$ allows us to test whether an established credit reputation ameliorates the additional default risk of low-doc loans.

Figure 8 graphs the average marginal effects of stated income documentation, by employment type, across FICO scores. For low-cost verification borrowers (W2), the downward sloping line provides evidence that credit reputation counteracts the moral hazard problem inherent in low-doc loans. That is, borrowers with higher FICO scores have lower default probabilities. However, the same result does not hold for self-employed borrowers. Interestingly, we note that the average marginal effect of $STATED$ increases over the lower range of FICO scores for self-employed borrowers. Given the wide confidence intervals, we are careful not to interpret

the results in this section too strongly. However, Figure 8 does suggest that the increased risk associated with stated income loans is most severe for borrowers that are least likely to value reputation: W2 borrowers with low FICO scores.

4.3 Reputation and Refinancing

In this section, we explore how reputation and moral hazard differ depending on the purpose of the debt. To achieve identification, we rely on the differences between borrowers who originate mortgages to purchase homes versus those that are refinancing an existing debt. First, borrowers who originate subprime loans for home purchases typically have severely impaired or limited credit history (Alexander et al. (2002)), indicating that they either have low value on reputation or have not yet established a valuable reputation. Second, borrowers seeking to refinance an existing mortgage are likely to have heterogeneous opinions regarding the value of credit reputation. However, the fact that the borrower is refinancing an existing mortgage suggests that credit reputation is probably highly valued. For example, borrowers who have already established a positive reputation through previous mortgage repayment patterns may place a high value on maintaining that reputation in order to facilitate future access to credit. In addition, borrowers who are refinancing a debt as part of a plan to repair damaged credit also recognize the value of positive reputation, and thus seek to re-establish reputation through the use of a “credit-repair” loan (Mayer et al. (2009)). As a result, relative to population of home purchase loan borrowers, the average refinancing borrower should place higher value on reputation and thus is less likely to engage in adverse selection and moral hazard in the application process.

To investigate whether loan purpose affects moral hazard, we split our sample into four categories according to employment type and loan purpose (W2/Purchase, W2/Refinance, Self-employed/Purchase, and Self-employed/Refinance). Panel A of Table 8 presents the average default rate for each subsample. Consistent with the role of reputation, we see that the average default rate for refinancing borrowers is lower than for purchase borrowers. We hypothesize that reputation is less of a deterrent to adverse selection and moral hazard in the

purchase subsamples, *ceteris paribus*. To test this hypothesis, we estimate equation (1) for each subsample and report the marginal effect of *STATED* in Panel B of Table 8.²⁸ As expected, the marginal effects show that borrowers selecting low-doc loans (*STATED*) have a higher probability of default in all subsamples except for the Self-employed/Refinance category where we expect borrowers to have the highest value on reputation. To put the marginal effects into perspective, Panel C divides the marginal effect by the mean probability of default for each subsample. Consistent with our findings in previous sections, moving from left to right in Panel C shows that stated income documentation has less of an effect on the probability of default for the borrowers that are likely to place a high value on reputation (self-employed). Comparing the top to the bottom row in panel C (Purchase versus Refinance), we see that stated income documentation has less of an effect on refinance loans and purchase mortgages. For the set of borrowers where reputation is expected to have the greatest impact (i.e. self-employed refinancing borrowers), the use of a low-doc loan increases the probability of default by 4 percent around the sample mean. In contrast, low-doc loans increase the probability of default by 29 percent and 23 percent, respectively, in the subsample of borrowers that originated the loan to purchase a home. Thus, the results lend support to the hypothesis that borrower reputation mitigates adverse selection and moral hazard.

5 Conclusion

Since Diamond (1991), economists have considered the role that reputation can play in mitigating the effects of adverse selection and moral hazard in lending markets. In this framework, reputation is a valuable asset that borrowers should seek to protect in order to preserve access to future credit. However, with the advent of modern mortgage underwriting practices that focuses on risk-based pricing using observable information regarding borrower credit quality during the housing market boom of the previous decade, lenders began offering alternative

²⁸Full tables are available from the authors upon request. Since the probit regressions are run separately for each subsample, $W2$, $STATED \times W2$, and the purchase indicator variable are not included in the regressions. We include all other control variables from equation (1) in the estimation.

mortgage products to borrowers with potentially little regard for the consequences of reputation.

Using a national dataset of subprime mortgages originated by a major financial institution during the house price boom period, we document the role of borrower reputation in the years leading up to the mortgage foreclosure crisis of 2007 to 2010. Our empirical analysis is consistent with the hypothesis that borrowers who are unable to originate full documentation loans place greater value of reputation acquisition than borrowers who have lower cost access to the full information documentation credit market. We show that the majority of additional risk associated with low-doc, or stated income mortgages is due to adverse selection on the part of borrowers with verifiable income. We also provide evidence that these borrowers are more likely to engage in a form of moral hazard by inflating or exaggerating their income on the mortgage application. As a result, when housing prices began to stabilize and decline from their peak in 2005 and 2006, the default rate exploded for alternative loans originated to borrowers who had, a priori, less concern about their reputation.

Taken together, our empirical analysis suggests that borrower reputation can mitigate the effects of adverse selection and moral hazard in limited information documentation mortgage contracts. From a policy perspective, our analysis indicates that a blanket regulation mandating “qualified” mortgages (i.e. loans that require full documentation) may be overly restrictive and lead to credit rationing for a subset of the population that faces high information verification costs. Rather, our analysis suggests that regulators seeking to limit the potential for future foreclosure crisis should rely on a more nuanced or targeted regulatory approach that limits the use of low information documentation loans by borrowers who have ex ante low information verification costs.

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Table 1: Summary Statistics for W2 Loans by Documentation Type

	Full Sample			
	Mean	Std. Dev.	Min	Max
Default	0.0494	0.2168	0	1
W2	0.7942	0.4043	0	1
Stated Income	0.3970	0.4893	0	1
The difference between the rate on the mortgage and the two year Treasury rate (RATE-SPREAD)	4.7197	1.4939	0.2500	11.8400
Combined loan to value ratio at origination (CLTV)	83.2556	14.3000	0	125
Loan amount at origination (LOAN_AMOUNT)	193,182	118,003	10,400	1,068,000
Fees as a percentage of loan amount (FEES)	0.0391	0.0191	0	0.1753
An indicator set to one if the loan was an adjustable rate mortgage (ARM)	0.7662	0.4233	0	1
An indicator set to one if the loan was a prepayment penalty on the loan (PREPAY)	0.7751	0.4175	0	1
An indicator variable set to one if the loan was for a home purchase (PURCH)	0.3395	0.4735	0	1
An indicator variable set to one if the loan was a cash-out refinance (CASH)	0.5583	0.4966	0	1
The FICO score of the primary borrower at origination (FICO)	612.7167	62.4208	450	850
An indicator set to one if the loan had interest only payments (IO)	0.1416	0.3486	0	1
Months since origination (MONTHS)	6.8210	6.9797	0	24
An indicator set to one if the property was an investment property (INVESTMENT)	0.0773	0.2670	0	1
An indicator set to one if the property was a two-unit property (TWO_UNIT)	0.0728	0.2599	0	1
An indicator set to one if the property was a condo (CONDO)	0.0651	0.2468	0	1
The age of the primary borrower (AGE)	42.5529	11.4111	18	99
An indicator set to one if the borrower was a minority (MINORITY)	0.3976	0.4894	0	1
The total monthly income of the borrowers (INCOME)	6,221	3,621	0	26,901
Face-to-face interview between broker and borrower (FACE)	0.4180	0.4932	0	1
The average monthly prime 30-year fixed rate at the time of origination (RATE_30)	6.0607	0.5432	5.2300	8.5200
Monthly unemployment rate at the MSA level (UNEMP)	5.3460	1.4932	1.1000	27.9000
MSA level Herfindahl-Hirschman index for broker competition (HHI)	0.0833	0.1248	0.0050	1
Pahl-Index for state level broker regulations (REG)	7.8814	3.5996	0	14.6
MIDWEST	0.1816	0.3855	0	1
SOUTH	0.2428	0.4287	0	1
NORTHEAST	0.1297	0.3359	0	1
PACIFIC	0.0082	0.0902	0	1
orig_year				
1999	0.0200	0.1400	0	1
2000	0.0242	0.1538	0	1
2001	0.0427	0.2021	0	1
2002	0.0893	0.2851	0	1
2003	0.2101	0.4074	0	1
2004	0.2944	0.4558	0	1
2005	0.3081	0.4617	0	1
N	460,598			

Note: This table presents summary statistics for the funded loans from the New Century database.

Table 2: Summary Statistics for W2 Loans by Documentation Type

	[1] W2 Full-Doc		[2] W2 Stated Income		[1] - [2]	t-stat
	Mean	Std. Dev.	Mean	Std. Dev.		
Default	0.0477	0.2132	0.0526	0.2232	-0.0049	-6.14
The difference between the rate on the mortgage and the two year Treasury rate (RATE_SPREAD)	4.6338	1.5284	4.9518	1.4064	-0.3180	-60.77
Combined loan to value ratio at origination (CLTV)	82.9677	14.2808	83.5866	14.0564	-0.6189	-12.09
Loan amount at origination (LOAN_AMOUNT)	173,804	107,593	207,111	115,933	-33,307	-80.92
Fees as a percentage of loan amount (FEES)	0.0410	0.0196	0.0375	0.0180	0.0035	52.11
An indicator set to one if the loan was an adjustable rate mortgage (ARM)	0.7234	0.4473	0.8313	0.3745	-0.1080	-74.95
An indicator set to one if the loan was a prepayment penalty on the loan (PREPAY)	0.7896	0.4076	0.7525	0.4316	0.0371	24.10
An indicator set to one if the loan was for a home purchase (PURCH)	0.2804	0.4492	0.4194	0.4935	-0.1390	-79.74
An indicator variable set to one if the loan was a cash-out refinance (CASH)	0.5970	0.4905	0.5054	0.5000	0.0916	50.83
The FICO score of the primary borrower at origination (FICO)	600.5317	59.7557	627.9891	61.7446	-27.4574	-123.83
An indicator set to one if the loan had interest only payments (IO)	0.1213	0.3265	0.1471	0.3542	-0.0258	-20.52
Months since origination (MONTHS)	6.7813	7.0582	6.7900	6.7833	-0.0088	-0.35
An indicator set to one if the property was an investment property (INVESTMENT)	0.0573	0.2324	0.0846	0.2783	-0.0273	-28.38
An indicator set to one if the property was a two-unit property (TWO_UNIT)	0.0584	0.2344	0.1017	0.3022	-0.0433	-42.09
An indicator set to one if the property was a condo (CONDO)	0.0614	0.2401	0.0721	0.2586	-0.0106	-11.59
The age of the primary borrower (AGE)	43.1475	11.6704	40.6346	10.8294	2.5129	62.54
An indicator set to one if the borrower was a minority (MINORITY)	0.4115	0.4921	0.4183	0.4933	-0.0068	-3.79
The total monthly income of the borrowers (INCOME)	5,389	3,013	6,392	3,200	-1,004	-88.00
Face-to-face interview between broker and borrower (FACE)	0.3947	0.4888	0.4542	0.4979	-0.0595	-33.14
The average monthly prime 30-year fixed rate at the time of origination (RATE_30)	6.0777	0.5616	6.0182	0.4894	0.0595	32.09
Monthly unemployment rate at the MSA level (UNEMP)	5.3581	1.4983	5.3722	1.4621	-0.0141	-2.63
MSA level Herfindahl-Hirschman index for broker competition (HHI)	0.0903	0.1295	0.0689	0.1096	0.0214	50.94
Pahl-Index for state level broker regulations (REG)	7.6672	3.5952	8.0695	3.6361	-0.4223	-32.14
MIDWEST	0.2096	0.4070	0.1591	0.3657	0.0505	36.84
SOUTH	0.2553	0.4360	0.2213	0.4151	0.0340	22.26
NORTHEAST	0.1207	0.3258	0.1659	0.3720	-0.0452	-34.74
PACIFIC	0.0078	0.0882	0.0072	0.0847	0.0006	1.96
orig_year	0.0212	0.1439	0.0135	0.1154	0.0077	16.97
1999	0.0270	0.1620	0.0173	0.1303	0.0097	19.09
2000	0.0460	0.2094	0.0364	0.1872	0.0096	13.62
2001	0.0966	0.2954	0.0832	0.2762	0.0133	13.06
2002	0.2238	0.4168	0.1921	0.3940	0.0317	21.82
2003	0.2809	0.4494	0.3542	0.4783	-0.0733	-43.00
2004	0.2936	0.4554	0.2932	0.4552	0.0004	0.21
2005						
N	257,862		107,954			

Note: This table presents summary statistics for the W2 funded loans from the New Century database.

Table 3: Summary Statistics for Self-Employed Loans by Documentation Type

	[1]		[2]		t-stat
	Self-employed Full-Doc	Std. Dev.	Self-employed Stated Income	Std. Dev.	
Default	0.0511	0.2202	0.0504	0.2187	0.0007
The difference between the rate on the mortgage and the two year Treasury rate (RATE_SPREAD)	4.5222	1.4986	4.7336	1.4562	-0.2114
Combined loan to value ratio at origination (CLTV)	83.6232	13.4391	83.6725	14.9007	-0.0493
Loan amount at origination (LOAN_AMOUNT)	224,859	138,884	231,408	134,105	-6,549
Fees as a percentage of loan amount (FEES)	0.0358	0.0186	0.0359	0.0182	-0.0001
An indicator set to one if the loan was an adjustable rate mortgage (ARM)	0.7324	0.4427	0.8287	0.3768	-0.0962
An indicator set to one if the loan was a prepayment penalty on the loan (PREPAY)	0.8131	0.3898	0.7477	0.4343	0.0654
An indicator variable set to one if the loan was for a home purchase (PURCH)	0.3196	0.4663	0.4330	0.4955	-0.1134
An indicator variable set to one if the loan was a cash-out refinance (CASH)	0.5681	0.4954	0.4983	0.5000	0.0698
The FICO score of the primary borrower at origination (FICO)	613.3761	59.2486	632.4792	63.2692	-19.1031
An indicator set to one if the loan had interest only payments (IO)	0.1432	0.3503	0.2033	0.4024	-0.0601
Months since origination (MONTHS)	7.1528	7.4183	6.9142	6.8631	0.2385
An indicator set to one if the property was an investment property (INVESTMENT)	0.1256	0.3314	0.1227	0.3281	0.0029
An indicator set to one if the property was a two-unit property (TWO_UNIT)	0.0700	0.2552	0.0819	0.2742	-0.0119
An indicator set to one if the property was a condo (CONDO)	0.0604	0.2382	0.0692	0.2537	-0.0088
The age of the primary borrower (AGE)	43.9335	11.1029	42.9044	11.0882	1.0291
An indicator set to one if the borrower was a minority (MINORITY)	0.3233	0.4678	0.3399	0.4737	-0.0166
The total monthly income of the borrowers (INCOME)	8,468	5,251	8,244	4,406	224
Face-to-face interview between broker and borrower (FACE)	0.4214	0.4938	0.4450	0.4970	-0.0236
The average monthly prime 30-year fixed rate at the time of origination (RATE_30)	6.1845	0.6597	6.0308	0.5096	0.1537
Monthly unemployment rate at the MSA level (UNEMP)	5.3069	1.5160	5.2771	1.5118	0.0298
MSA level Herfindahl-Hirschman index for broker competition (HHI)	0.0985	0.1432	0.0760	0.1212	0.0225
Pahl-Index for state level broker regulations (REG)	8.1106	3.4853	8.2586	3.5390	-0.1480
MIDWEST	0.1426	0.3497	0.1279	0.3340	0.0147
SOUTH	0.2280	0.4196	0.2343	0.4236	-0.0063
NORTHEAST	0.0922	0.2894	0.1182	0.3229	-0.0260
PACIFIC	0.0120	0.1088	0.0098	0.0986	0.0022
orig_year					
1999	0.0355	0.1851	0.0213	0.1442	0.0143
2000	0.0466	0.2107	0.0190	0.1364	0.0276
2001	0.0660	0.2483	0.0341	0.1816	0.0319
2002	0.1003	0.3005	0.0699	0.2550	0.0304
2003	0.1976	0.3982	0.1921	0.3939	0.0055
2004	0.2358	0.4245	0.2704	0.4442	-0.0345
2005	0.2969	0.4569	0.3826	0.4860	-0.0857
N	19,882		74,900		-23.18

Note: This table presents summary statistics for the self-employed funded loans from the New Century database.

Table 4: Relationship Between Stated Doc, Employment Type, and Mortgage Performance

	[1]	[2]
Dependent Variable: Default	Default	Default
	Coeff.	Std. Err.
	Coeff.	Std. Err.
Marginal Effects of Stated Income Documentation		
Self-Employed (STATED)	0.0038**	(0.0017)
		0.0042**
W2 (STATED)	0.0113***	(0.0011)
		0.0111***
0.0042**		0.0042
0.0111***		0.0111
Yes	Yes	Yes
Property Characteristics	Yes	Yes
Borrower Characteristics	Yes	Yes
Interest rate environment	Yes	Yes
Area Characteristics	Yes	Yes
Origination Year Fixed Effects	Yes	Yes
MSA Fixed Effects	No	Yes
N	460,301	459,685
Mean Default Rate (Full-doc Self-Employed)	0.0511	0.0511
Mean Default Rate (Full-doc W2)	0.0477	0.0477
Log Likelihood	-78,582	-77,819

Note: This table presents marginal effects of stated income documentation on default by employment type. The marginal effects are derived from a probit model of mortgage performance on income documentation, employment type, an interaction term between income documentation and employment type, loan characteristics, borrower characteristics, property characteristics, and area characteristics for the funded loans from the New Century database. Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 5: Model for Income Estimation

	[1]	[2]
Dependent Variable: Borrower Income	W2 Monthly Income Full Doc Coeff. Std. Err.	Self-Employed Monthly Income Full Doc Coeff. Std. Err.
The FICO score of the primary borrower at origination (FICO)	5.9461*** (0.1366)	8.9716*** (0.9053)
An indicator set to one if the borrower was a female (FEMALE)	-771.2522*** (16.4939)	-885.7854*** (115.2723)
The age of the primary borrower (AGE)	-13.3548*** (0.6756)	-3.3008 (4.6843)
An indicator set to one if the borrower was a minority (MINORITY)	-289.9620*** (16.7466)	-277.1744** (114.9837)
The Median MSA Income by Year (MSA_INC)	0.0470*** (0.0010)	0.0405*** (0.0059)
Monthly unemployment rate at the MSA level (UNEMP)	-73.1836*** (7.1336)	-61.3699 (43.9529)
Origination Year Dummies	Yes	Yes
State Dummies	Yes	Yes
Constant	22.0033 (296.5183)	-608.4447 (1606.8660)
N	124429	9601
Adj. R ²	0.164	0.099

Note: This table presents coefficient estimates from an OLS regression of borrower income for a random sample of the full-doc funded loans from the New Century database. The coefficients in columns 1 and 2 are used to estimate the income of the W2 and self-employed loans, respectively. Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 6: Descriptive Statistics for Income Exaggeration Measure by Employment and Documentation Type

Documentation Type	[1] W2			[2] Self-employed		
	N	Mean	Std. Dev.	N	Mean	Std. Dev
Full Income Documentation	124,478	-0.0004	(0.4856)	9,602	-0.0134	(0.5682)
Stated Income Documentation	105,063	0.1093	(0.5037)	72,606	-0.0668	(0.4823)

Note: This table presents descriptive statistics for the income exaggeration measure. Column 1 presents the mean and standard deviation of income exaggeration for W2 borrowers split according to income documentation. Column 2 presents the mean and standard deviation of income exaggeration for self-employed borrowers split according to income documentation.

Table 7: Probability of Extreme Income Residual

[1]	
INC_EXTREME	INC_EXTREME
Dependent Variable: INC_EXTREME	Coeff. Std. Err.
Marginal Effects of Stated Income Documentation	
Self-Employed (STATED)	-0.0005 (0.0009)
W2 (STATED)	0.0075*** (0.0017)
Loan Characteristics	Yes
Property Characteristics	Yes
Borrower Characteristics	Yes
Interest rate environment	Yes
Area Characteristics	Yes
Origination Year Fixed Effects	Yes
N	311,749
Log Likelihood	-30,398

Note: This table presents marginal effect estimates from a probit regression of *INC_EXTREME* on type of income documentation, loan characteristics, borrower characteristics, property characteristics, and area characteristics for the funded loans that were not used in the income estimation equation from ?? *INC_EXAG* takes a value of one if *INC_OVER* falls in the top decile of *INC_OVER* for the loan's employment type (e.g. W2 or self-employed). Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 8: Employment Type, Loan Purpose, and Default

	[1]	[2]
	W2	Self-employed
Panel A: Sample Mean Probability of Default		
Purchase	0.0615	.0507
Refinance	0.0433	.0504
Panel B: Marginal Effect for Low-Doc (stated income)		
Purchase	0.0178*** (0.0010)	0.0119*** (0.0030)
Refinance	0.0078*** (0.0010)	0.0022 (0.0021)
Panel C: Percentage Increase in Sample Mean Default Probability Due to Low-Doc (Panel B / Panel A)		
Purchase	29%	23%
Refinance	18%	4%

Note: Panel A presents the mean of default for each of the subsamples. Panel B reports the marginal effects of low-doc from four separate probit regressions of default on of mortgage performance on income documentation, employment type, an interaction term between income documentation and employment type, loan characteristics, borrower characteristics, property characteristics, and area characteristics for the funded loans from the New Century database. Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Panel C reports the increase in sample mean probability of default due to low-doc.

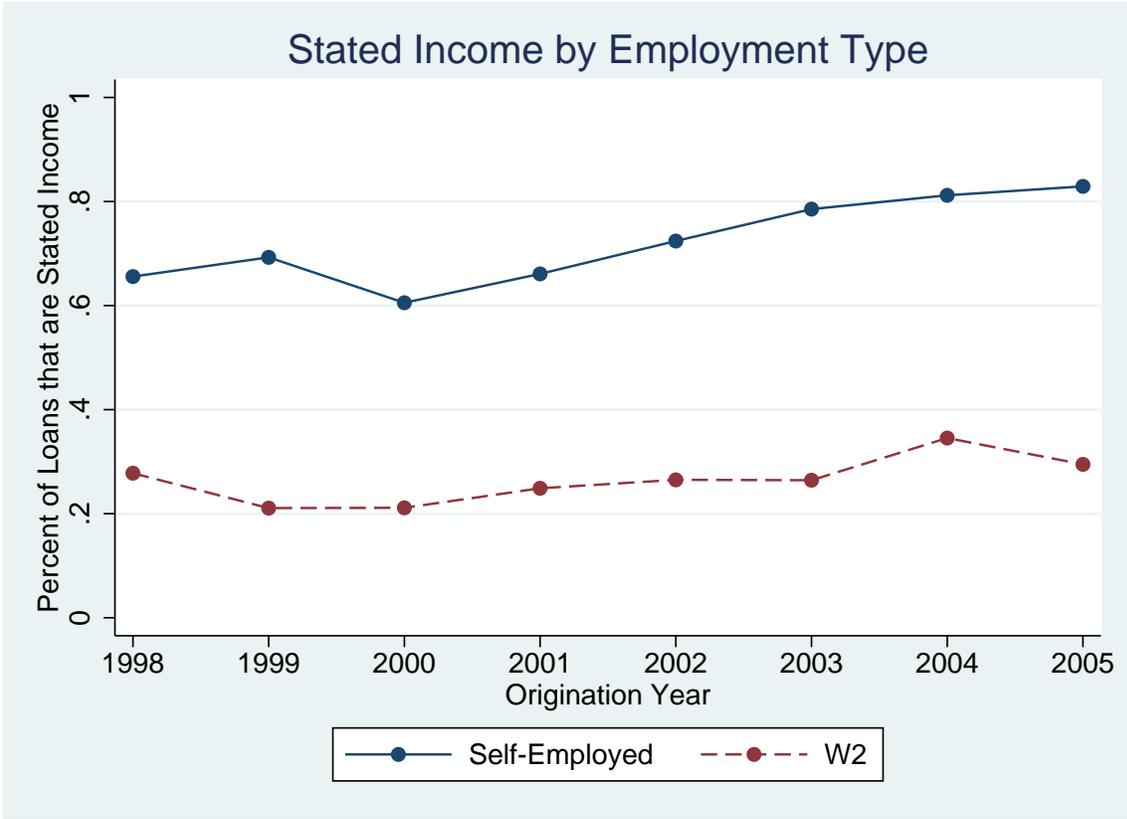


Figure 1: Share of Originations that are Stated Income by Employment Type

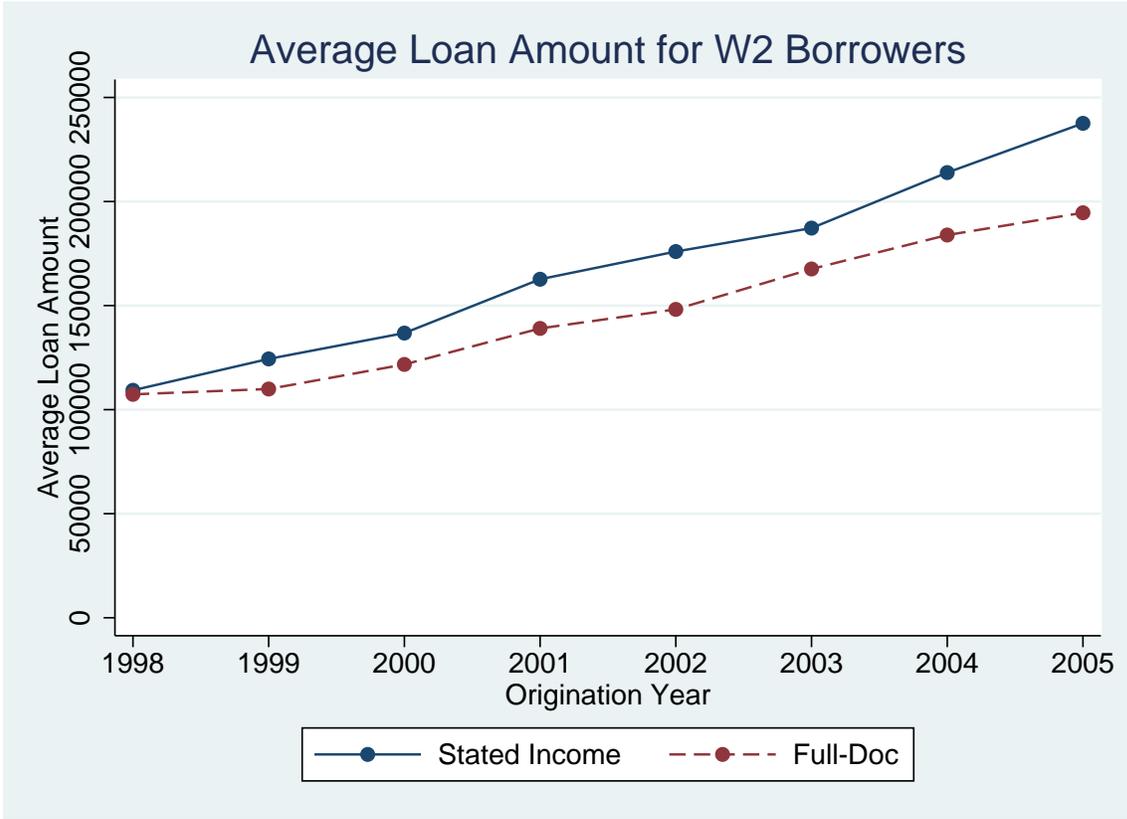


Figure 2: Loan Amount by Doc-Type for W2

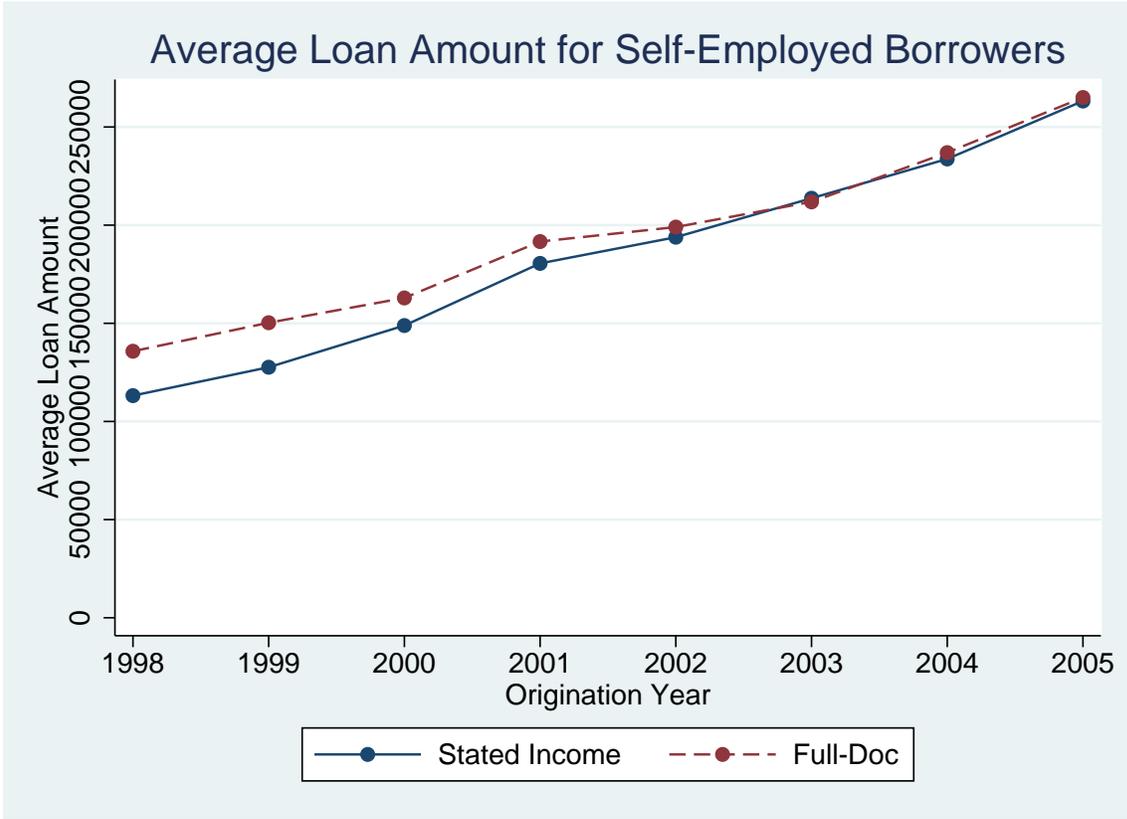


Figure 3: Loan Amount by Doc-Type for Self-Employed

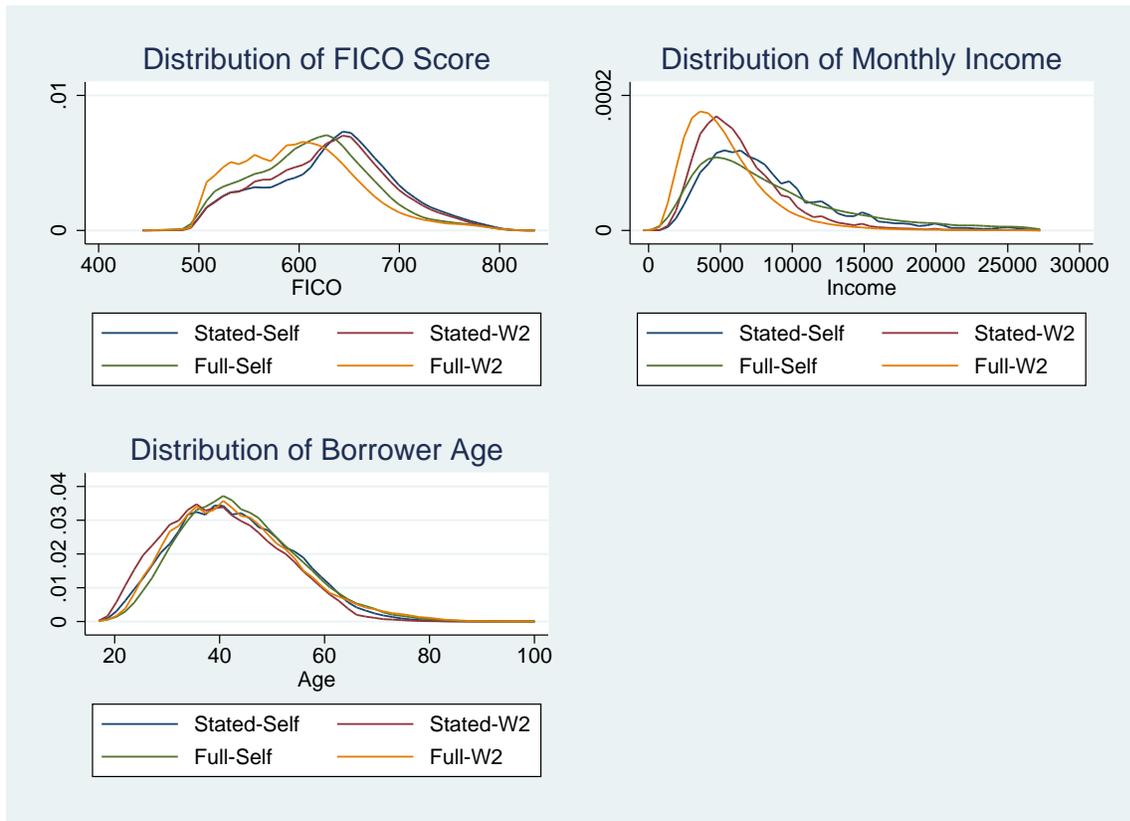


Figure 5: Distribution of Borrower Characteristics

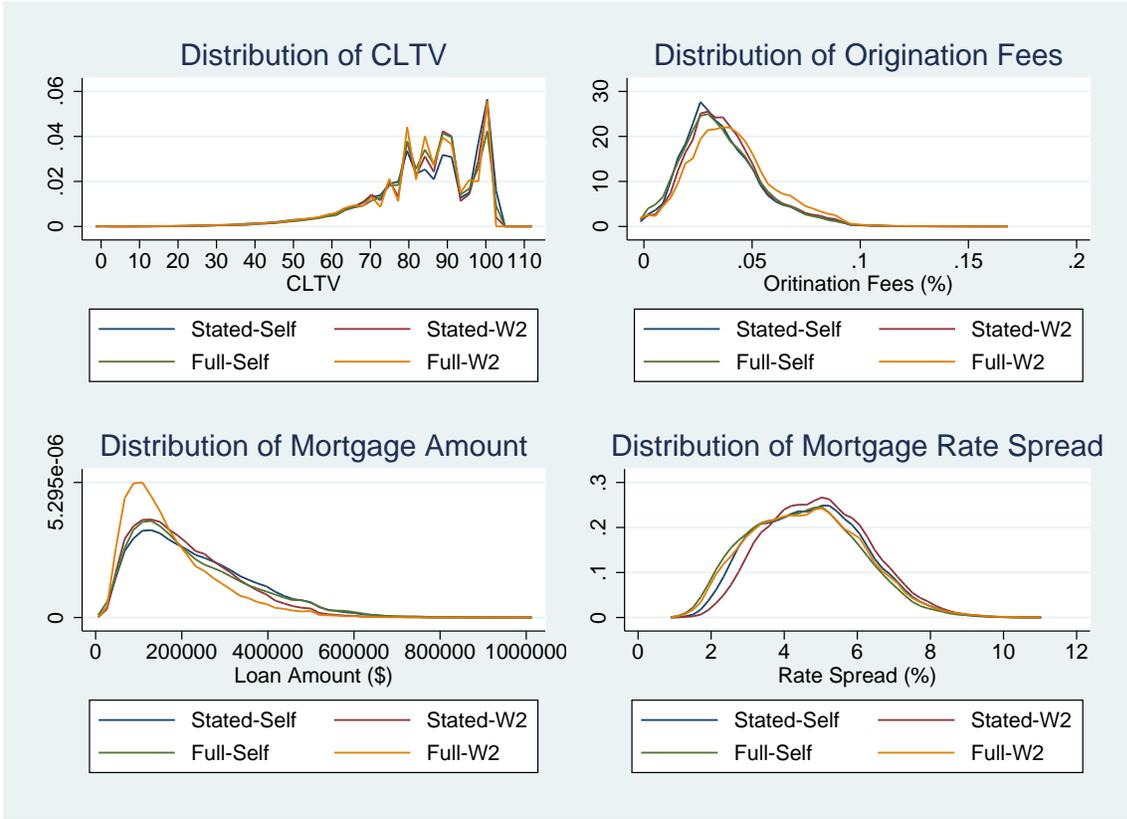


Figure 6: Distribution of Loan Characteristics

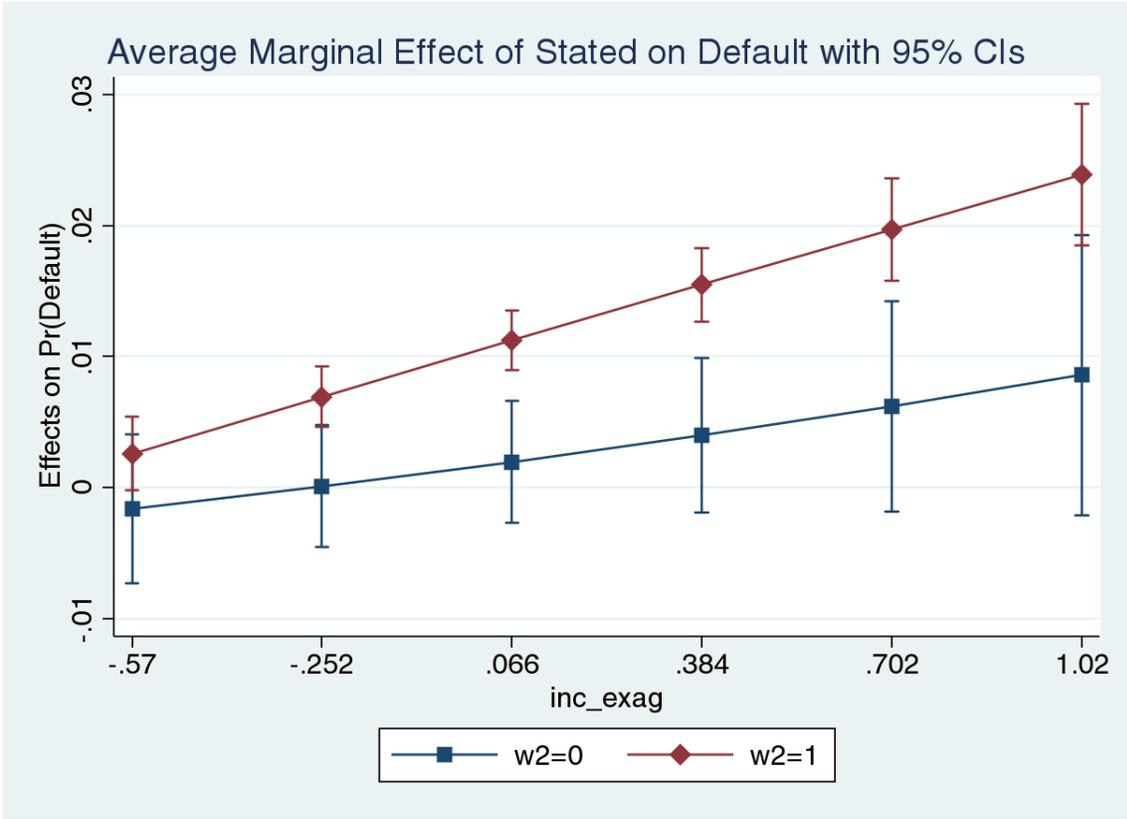


Figure 7: Marginal Effect of Stated on Default by Income Exaggeration

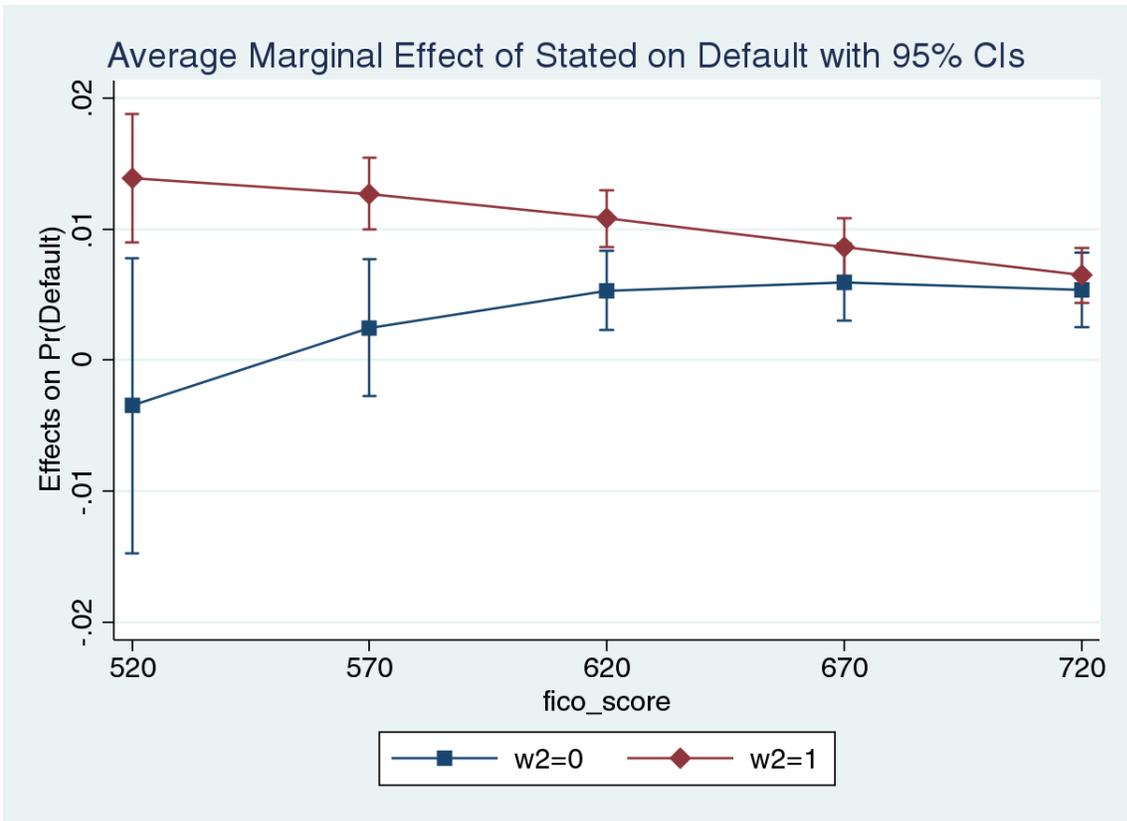


Figure 8: Marginal Effect of Stated on Default by Borrower FICO Score

6 Appendix

Table 9: Relationship Between Stated Doc, Employment Type, and Mortgage Performance

		[1]	
Dependent Variable: Default		Coef.	Std. Err.
Employment Type			
Indicator set to one if the borrower is not self employed (W2)		-0.0055***	(0.0012)
Income Documentation			
An indicator set to one if the loan was a stated income loan (STATED)		0.0027**	(0.0013)
STATED x W2		0.0060***	(0.0015)
Loan Characteristics			
The spread between the rate on the mortgage and the two year Treasury at origination (RATE)		0.0086***	(0.0004)
Combined loan to value ratio at origination (CLTV)		0.0006***	(0.0000)
Log loan amount at origination (LOAN_AMOUNT)		0.0077***	(0.0018)
Fees as a percentage of loan amount (FEES)		0.2347***	(0.0303)
An indicator set to one if the loan was an adjustable rate mortgage (ARM)		0.0111***	(0.0009)
An indicator set to one if the loan was a prepayment penalty on the loan (PREPAY)		0.0016	(0.0015)
An indicator variable set to one if the loan was for a home purchase (PURCH)		0.0040***	(0.0013)
An indicator variable set to one if the loan was a cash-out refinance (CASH)		-0.0065***	(0.0008)
The FICO score of the primary borrower at origination (FICO)		-0.0003***	(0.0000)
An indicator set to one if the loan had interest only payments (IO)		0.0042***	(0.0010)
Months since origination (MONTHS)		0.0022***	(0.0001)
Property Characteristics			
An indicator set to one if the property was an investment property (INVESTMENT)		0.0067***	(0.0018)
An indicator set to one if the property was a two-unit property (TWO_UNIT)		0.0021	(0.0018)
An indicator set to one if the property was a condo (CONDO)		-0.0064***	(0.0011)
Borrower Characteristics			
The age of the primary borrower (AGE)		-0.0002***	(0.0000)
An indicator set to one if the borrower was a minority (MINORITY)		0.0052***	(0.0011)
The natural logarithm of one plus the borrower's income (INCOME)		-0.0000***	(0.0000)
Face-to-face interview between broker and borrower (FACE)		-0.0014**	(0.0006)
Interest rate environment			
The average monthly prime 30-year fixed rate at the time of origination (RATE_30)		0.0050***	(0.0017)
Area Characteristics			
Monthly unemployment rate at the MSA level (UNEMP)		0.0001	(0.0012)
MSA level Herfindahl-Hirschman index for broker competition (HHI)		0.0065*	(0.0039)
Pahl-Index for state level broker regulations (REG)		-0.0008***	(0.0003)
MIDWEST		0.0092***	(0.0029)
SOUTH		0.0053	(0.0038)
NORTHEAST		0.0062***	(0.0022)
PACIFIC		-0.0097***	(0.0022)
Origination Year			
1999		0.0176***	(0.0034)
2000		-0.0009	(0.0031)
2001		-0.0170***	(0.0018)
2002		-0.0287***	(0.0015)
2003		-0.0356***	(0.0024)
2004		-0.0151***	(0.0035)
2005		0.0039	(0.0046)
MSA Fixed Effects			
No			
460301			
0.0511			
0.0477			
-78582.0177			

Note: This table presents marginal effects at the mean values (MEM) for a probit model of mortgage performance on type of income documentation, loan characteristics, borrower characteristics, property characteristics, and area characteristics for the funded loans from the New Century database. Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 10: Relationship Between INC_OVER and Reputation

		[1]	
		INC_OVER	
	Dependent Variable: INC_OVER	Coeff.	Std. Err.
Employment Type			
Indicator set to one if the borrower is not self employed (W2)		0.3939***	(0.0085)
Income Documentation			
An indicator set to one if the loan was a stated income loan (STATED)		0.0139***	(0.0046)
STATED x W2		0.0176***	(0.0064)
Loan Characteristics			
The spread between the rate on the mortgage and the two year Treasury at origination (RATE)		0.0063***	(0.0014)
Combined loan to value ratio at origination (CLTV)		0.0014***	(0.0003)
Log loan amount at origination (LOAN-AMOUNT)		-0.0247	(0.0176)
Fees as a percentage of loan amount (FEES)		-0.6704***	(0.1588)
An indicator set to one if the loan was an adjustable rate mortgage (ARM)		0.0130***	(0.0065)
An indicator set to one if the loan was a prepayment penalty on the loan (PREPAY)		0.0560***	(0.0107)
An indicator variable set to one if the loan was for a home purchase (PURCH)		-0.0110*	(0.0056)
An indicator variable set to one if the loan was a cash-out refinance (CASH)		-0.0053	(0.0062)
The FICO score of the primary borrower at origination (FICO)		-0.0011***	(0.0000)
An indicator set to one if the loan had interest only payments (IO)		-0.0218***	(0.0060)
Property Characteristics			
An indicator set to one if the property was an investment property (INVESTMENT)		0.0220***	(0.0060)
An indicator set to one if the property was a two-unit property (TWO-UNIT)		-0.0059	(0.0085)
An indicator set to one if the property was a condo (CONDO)		-0.0189**	(0.0093)
Borrower Characteristics			
The age of the primary borrower (AGE)		0.0020***	(0.0001)
An indicator set to one if the borrower was a minority (MINORITY)		0.0001***	(0.0000)
The natural logarithm of one plus the borrower's income (INCOME)		0.0162**	(0.0067)
Face-to-face interview between broker and borrower (FACE)		-0.0061	(0.0044)
Interest rate environment			
The average monthly prime 30-year fixed rate at the time of origination (RATE_30)		0.0045*	(0.0024)
Area Characteristics			
Monthly unemployment rate at the MSA level (UNEMP)		0.0120**	(0.0047)
MSA level Herfindahl-Hirschman index for broker competition (HHI)		0.1630***	(0.0471)
Pahl-Index for state level broker regulations (REG)		-0.0047	(0.0059)
MIDWEST		0.1733***	(0.0276)
SOUTH		0.1955***	(0.0395)
NORTHEAST		0.0612**	(0.0303)
PACIFIC		-0.0422	(0.0275)
Origination Year			
1999		0.0359***	(0.0114)
2000		-0.0311***	(0.0108)
2001		-0.1046***	(0.0132)
2002		-0.1035***	(0.0142)
2003		-0.1138***	(0.0183)
2004		-0.0956***	(0.0197)
2005		-0.1354***	(0.0211)
Constant		-0.4976**	(0.2035)
N		311749	
Adj. R ²		0.858	

Note: This table presents coefficient estimates from an OLS regression of estimated income exaggeration on type of income documentation, reputation, loan characteristics, borrower characteristics, property characteristics, and area characteristics for the funded loans from the New Century database. Standard errors are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.