Are Mortgage Regulations Affecting Entrepreneurship?*

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Abstract

I show that rules designed to reduce high debt-to-income mortgage lending restrict self-employed households' access to credit and reduce entrepreneurship. I identify the effects of a recent policy by using local variation in exposure to banks subject to the regulation. The policy reduced mortgage credit in high self-employment census tracts and banks receiving exemptions expanded market share in these areas. Growth in self-employment and new small business employment was lower in areas where more banks were affected. I estimate that the policy reduced self-employment by around 2 per cent and new small business employment by at least 3 per cent. This unintended effect on entrepreneurship demonstrates that mortgage finance is important for early stage businesses, and is an additional cost to be taken into account when evaluating mortgage policy.

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1. Introduction

Since the subprime crisis risky mortgage lending practices have become the subject of considerable public scrutiny. High rates of mortgage default, particularly on loans with limited income documentation and high leverage, prompted a regulatory response predicated on the view that lenders originated unaffordable mortgages. Policymakers have attempted to address this issue by incentivizing lenders to limit the size of mortgage repayments as a share of verified income. While the motivation behind such policies is clear, the costs are still not well understood.[1]

Increased documentation requirements may have implications for entrepreneurship given that small business owners were the traditional users of loans with low income documentation (Ambrose et al., 2016). The unstable and opaque nature of business income means that self-employed households often face a choice between a standard mortgage discounting their business income or a low documentation mortgage. With full documentation the self-employed household would have an inflated debt-to-income ratio relative to households with more transparent income sources. By both eliminating low documentation products and penalizing applicants with high debt-to-income ratios, mortgage regulation could therefore be particularly restrictive for self-employed households.[2] Given that small business owners frequently rely on personal credit as a source of funding, this could have important implications for self-employment and small business formation (Berger and Udell (1998); Black et al. (1996)).

In this paper I estimate the effect of verified debt-to-income restrictions on credit and entrepreneurship using a difference-in-differences approach based on local bank exposure to the Ability-to-Repay rule, a recent U.S. policy which penalizes high debt-to-income mortgage lending. Firstly, I show that banks marginally exceeding a lending cutoff used to determine exemption eligibility have a skewed lending growth distribution, suggesting that they reduced lending in order to qualify. This behavior indicates that the debt-to-income requirement is costly for lenders to implement and is therefore likely to affect credit access.

[1] Policies restricting debt-to-income ratios may attenuate housing price cycles (Greenwald, 2016) and make households more resilient, reducing the severity of recessions (Mian and Sufi (2014); Mian et al. (2013)). Restricting debt-to-income ratios may also directly reduce the rate of mortgage default; however, Foote et al. (2010) show that debt-to-income ratios measured at origination are not a strong predictor of default compared with housing prices and job loss.

[2] It is the interaction of the verification requirement with the debt-to-income restriction that is important. While the verification requirement alone is likely to raise debt-to-income ratios for small business owners, this need not affect credit access in the absence of debt-to-income restrictions.

Next I show that the Ability-to-Repay rule reduces mortgage credit to self-employed households. Using the Consumer Expenditure Survey I estimate that debt-to-income ratios for self-employed households fell by around 2 percentage points relative to other households following the regulation. The effect increases to $3\frac{1}{2}$ percentage points for self-employed households without salary income, consistent with a verification channel. Using Home Mortgage Disclosure Act (HMDA) data, I find that the number of mortgages originated in census tracts with a high share of self-employed households falls by around 3 per cent relative to other locations. The magnitude of this effect depends on local exposure to affected banks. It is negligible in counties where the affected share of banks is close to zero, but rises to 5 per cent in counties where nearly all banks are affected. There is, however, no significant relationship between the presence of exempt banks and mortgage originations in areas with low self-employment. This insight is helpful for understanding why the Ability-to-Repay rule has a sizable effect on self-employment and entrepreneurship, despite existing work suggesting it has little overall effect on credit access (Bhutta and Ringo (2015); Alexandrov (2015)). Because most households are unaffected, studies that focus on total bank lending miss the effect on the self-employed. Finally, I link the credit results more closely to the regulation by showing that banks receiving an exemption increase their market share in high self-employment census tracts following the policy. This effect is specific to loan types affected by the lender exemption, and is not true for conforming and non-conventional loans which are more broadly exempt regardless of the lender.

After showing that verified debt-to-income restrictions reduce credit access I then measure effects on entrepreneurship. Comparing counties with varying exposure to affected bank branches suggests that the debt-to-income requirement reduces self-employment by around 2 per cent. The rule also reduces the new small business employment share by at least 3 per cent. There is little effect on employment at old small businesses. Because income documentation concerns primarily affect businesses less than two years old this is consistent with the channel I propose. Interestingly, variation in the share of affected banks is important for employment outcomes even in locations where exempt banks are in principle fairly accessible. One interpretation is that the regulation and its exemptions are not well understood by applicants, and measures of proximity are important because they are closely related to how borrowers search for a lender.[3] Consequently significant

[3]Another possibility is that households benefit from existing relationships with lenders, and existing relationships with exempt lenders are more common in locations close to exempt branches. In the case of refinance loans the borrower may also be likely to return to the original lender.

differences in outcomes are possible even where distance to the nearest exempt branch differs by only a few kilometers.

My paper relates both to work evaluating household leverage policies and to research documenting the effect of credit access on entrepreneurship. Existing work looking at the impact of the Ability-to-Repay rule on the mortgage market tends to either focus on predicted effects or quantifies aspects of the policy that are not specific to the self-employed. Peirce et al. (2014) provide survey evidence that, in comparison to other recent regulatory developments, small banks viewed the Ability-to-Repay rule as particularly costly. This is consistent with my finding that banks were willing to restrict lending in order to obtain an exemption. Despite these considerations, my results suggest that there are important implications for self-employed households.

Bhutta and Ringo (2015) provide a preliminary evaluation of the policy and conclude that the lender exemptions have little effect on credit availability. In contrast I find that the lender exemptions are beneficial. This is likely because they focus on other outcomes and do not explicitly consider self-employed borrowers. Also, as they note, it is difficult to precisely identify loans affected by the Ability-to-Repay rule and loans whose treatment differs by lender. A further consideration is that comparing banks close to the eligibility cutoff may be problematic given the evidence of selection I document in Section 5.1.

DeFusco et al. (2017) estimate the effect of the Ability-to-Repay rule on the price, quantity and quality of residential mortgage credit in the jumbo market.[4] They find that the policy led to a large reduction in originations of jumbo loans with high debt-to-income ratios. However, lenders charge only a modest premium for the high debt-to-income mortgages they do originate, suggesting that they may be rationing credit or dropping out of the market entirely. The sizable credit and employment effects I document are consistent with the large quantity response documented by DeFusco et al. (2017). It is possible that the quantity response may be even larger for smaller non-conforming loans given that these borrowers tend to have higher risk characteristics than jumbo borrowers, though unfortunately I cannot test this directly.[5]

[4] Jumbo mortgages are ineligible for purchase by Fannie Mae and Freddie Mac because the loan size exceeds the conforming limit. Consequently jumbo mortgages are subject to the 43 per cent debt-to-income cutoff for qualified mortgages imposed by the Ability-to-Repay rule.

[5] It is not possible to precisely identify mortgages in the HMDA dataset that are affected by the Ability-to-Repay rule because both the back-end debt-to-income ratio and conforming status are not observed. While it is possible to identify loans that are non-conforming because they exceed a loan size limit, there are other reasons why loans may be non-conforming. This is a significant challenge for researchers attempting to evaluate the effect of bank exemptions from the Ability-to-Repay rule on credit. Other datasets, such as the CoreLogic Loan-Level Market Analytics database used by DeFusco et al. (2017), allow for more precise classification of affected loans; however, these loans cannot be linked to lenders.

Using the Ability-to-Repay rule as a source of variation in credit access I confirm previous findings that mortgage credit is important for self-employment and small business formation (Adelino et al. (2015), Herkenhoff et al. (2016), Jensen et al. (2014)). My approach is of interest for two reasons. Firstly, differential application of the Ability-to-Repay rule by bank allows me to identify the effect of mortgage credit access independently of changes in collateral values, helping to address some concerns raised with respect to previous work (Kerr et al., 2015). In general, events that increase access to mortgage credit can also raise the demand for entrepreneurship, making it hard to isolate the direct effect of additional mortgage credit to entrepreneurs specifically. However, in this paper such demand effects are unlikely because the Ability-to-Repay rule has little effect on aggregate credit access. Secondly, understanding the implications of verified debt-to-income restrictions for business owners is directly relevant for conducting a comprehensive cost-benefit analysis of the Ability-to-Repay rule and other similar policies. Given evidence that income verification standards are more beneficial in the case of salaried borrowers, there may be a case for treating the self-employed differently (Ambrose et al., 2016). In the specific context of the Ability-to-Repay rule, I show that exemptions for small banks play a important role in mitigating negative effects of the regulation on the self-employed. This provides empirical support for the recent relaxation of the criteria determining exemption eligibility.[6]

2. Institutional Background

The Ability-to-Repay rule is a key part of the U.S. regulatory response to the subprime crisis and is designed to prevent unaffordable mortgage lending. Lenders must show that mortgages they originate are affordable based on verified borrower income, employment and other financial obligations.[7] The Ability-to-Repay requirement was established under the Dodd-Frank Act and was eventually implemented by the Consumer Financial Protection Bureau (CFPB) in January 2014. The rule is enforced partly by allowing borrowers

[6]The revision, which was finalized in late 2015 in response to feedback received from lenders and implemented in 2016, substantially expanded the set of lenders eligible for an exemption from the debt-to-income component of the qualified mortgage definition. As my sample ends in 2015 I use the original definition which applied during 2014 and 2015.

[7]Specifically, lenders are required to consider and verify eight factors: (1) current and reasonable expectations of future income necessary for loan repayment, (2) employment status if applicable, (3) monthly mortgage payment on the loan, (4) monthly payments on any simultaneous loans, (5) monthly payments for taxes, insurance, and other certain costs related to the property, (6) other debts and obligations such as alimony and child support, (7) monthly debt-to-income ratio using all debt obligations listed above relative to gross monthly income, (8) credit history.

to bring legal proceedings against lenders, requiring the lender to prove that it established the borrower's ability to repay, or pay both damages and the borrower's legal costs. The CFPB estimates that damages could range from $30,000 to $60,000, depending on whether the suit is brought in foreclosure or not.

Given the uncertainty around what is needed to establish ability to repay, the rule also contains a more objective compliance option. Lenders can limit their legal risk by originating mortgages which satisfy 'qualified mortgage' criteria set out by the CFPB. If a mortgage meets these criteria, the lender is presumed to have complied with the Ability-to-Repay rule. Consequently, a lender is protected from legal risk on loans where it can prove qualified mortgage criteria have been met. While it is not clear ex ante that lenders will respond by originating only qualified mortgages, evidence so far suggests that lenders became reluctant to originate non-qualified mortgages following the regulation (DeFusco et al., 2017).

A mortgage will generally fail to satisfy qualified mortgage criteria if the back-end debt-to-income ratio (the ratio of the monthly repayment and financial obligations such as alimony, child support and property-related expenses to gross income) exceeds 43 per cent. Other aspects of the qualified mortgage definition include limits on points and fees, loan term, interest-only payments and negative amortization. There are, however, a number of cases where a mortgage can satisfy the qualified mortgage definition while violating some of these criteria. My identification strategy in this paper relies on the fact that the debt-to-income requirement is applied differently based on bank size. A bank is eligible for an exemption if, at the end of the previous year, its assets did not exceed $2 billion and it originated fewer than 500 first-lien mortgages during the previous year.[8] Mortgages eligible for purchase by Fannie Mae or Freddie Mac (conforming mortgages), and government-insured (non-conventional) mortgages are also considered to be qualified mortgages regardless of the debt-to-income ratio. This means that only conventional non-conforming mortgages are potentially affected by the debt-to-income requirement.[9]

[8]Only mortgages subject to the Truth in Lending Act count towards the 500 loan limit. For this reason I include only loans made to owner-occupiers.

[9]The Ability-to-Repay rule also only applies to closed-end mortgage loans, implying that home equity lines of credit (HELOCs) are exempt. This raises the question of why households seeking to borrow against home equity do not simply substitute to HELOCs. There are a number of reasons why this might not occur. Firstly, having a HELOC may further reduce the household's ability to move or refinance in future. This is because the HELOC would still need to be included in the DTI calculation when applying for closed end mortgages. Secondly, HELOCs generally have a variable rather than fixed rate which can leave the borrower exposed if rates increase. A further consideration is that the effects on self-employment could also come from households who were unable to refinance to a lower rate, or who found they were unable to move (or needed to put down a larger downpayment) as a result of the rule.

The conventional non-conforming market includes jumbo mortgages, which exceed the loan size cutoff imposed by Fannie Mae and Freddie Mac. It also includes mortgages below that cutoff with low credit scores, high debt-to-income ratios, or other risky characteristics. While jumbo mortgages are known to comprise around 5 per cent of the market (Bhutta and Ringo, 2015), it is unclear how many mortgages below the jumbo limit are non-conforming. It is difficult to identify these mortgages in loan-level datasets because eligibility is usually assessed using a proprietary algorithm. However, it is likely that conventional, non-conforming, non-jumbo mortgages accounted for less than 36 per cent of the market before the Ability-to-Repay rule was introduced. I arrive at this figure using 2013 HMDA originations by excluding jumbo loans (4 per cent), loans sold to Fannie Mae or Freddie Mac (39 per cent) and non-conventional loans (21 per cent). The true figure is likely considerably smaller as conforming loans may be either held in portfolio or not sold directly to Fannie Mae or Freddie Mac. Assuming instead that all loans sold within the calendar year of origination are conforming or non-conventional, the share of conventional, non-conforming, non-jumbo mortgages would be 21 per cent. Among conventional non-conforming mortgages, only those held in portfolio by exempt lenders can meet qualified mortgage criteria while exceeding the 43 per cent debt-to-income cutoff. A summary of the application of the debt-to-income requirement to different types of loans and lenders is provided in Table 1.

Table 1 – Application of ATR Debt-to-Income Requirement by Loan Type

Loan Type	Exempt Lender	Non-Exempt Lender
Non-Conventional	Does not apply	Does not apply
Conforming	Does not apply	Does not apply
Conventional Non-Conforming (Retained)	Does not apply	**Does apply**
Conventional Non-Conforming (Sold)	**Does apply**	**Does apply**

While all lenders are required to assess the borrower's ability to repay, eligibility for an exemption gives the lender flexibility to continue originating 'qualified mortgage' loans with a verified debt-to-income above 43 per cent as long as these are retained in portfolio. Although non-conventional and conforming loans are also subject to debt-to-income and other requirements, these do not vary with either the Ability-to-Repay implementation timeline or lender exemptions.

In this paper I show empirically that the Ability-to-Repay rule is particularly onerous for the self-employed, despite evidence that it has little effect on credit overall ((Bhutta

and Ringo (2015); Alexandrov (2015)). This result is consistent with what we expect given the nature of the rule. To count business income towards the debt-to-income ratio the applicant needs to provide the lender with two years of accounts verified by third party sources. Even then the lender is only able to extrapolate income based on the lower bound of recent history so recent declines in business income reduce the household's ability to borrow while recent increases are ignored. If a business-owning household deducts certain expenditures for tax purposes or has unreported cash receipts this also reduces their verifiable income and therefore their borrowing capacity given the debt-to-income requirement.[10] This means it is likely harder for households with business income to achieve a debt-to-income ratio below 43 per cent. What about the exemptions for conforming and non-conventional loans? While these exemptions apply to a large share of borrowers, Fannie Mae, Freddie Mac and the FHA impose their own debt-to-income restrictions and rules dictating when lenders can take business income into account. These alternative exemptions are therefore unlikely to circumvent the considerations for self-employed households described above.[11] Indeed, the main result of this paper – that the self-employed are particularly affected by verified debt-to-income requirements – also predicts that the self-employed will have more trouble qualifying for conforming and non-conventional loans.

3. Data

I analyze changes in self-employed credit access using data on mortgage lending provided under the Home Mortgage Disclosure Act (HMDA) and a local measure of self-employment from the American Community Survey (ACS). Linking these lending changes directly to the regulation also involves identifying whether a lender is exempt from the debt-to-income requirement, which I impute given the lender's assets and the number of first lien loans originated in the previous year. The HMDA dataset provides fairly comprehensive coverage of the U.S. residential mortgage market. Importantly I can match an application to the census tract in which the property is located. Because I focus on

[10] Chetty (2012) and Kleven and Waseem (2013) provide evidence that self-employed households manipulate income to reduce tax payments. This could lead to self-employed households' verifiable income being lower than that of salaried households. Over the longer term verified debt-to-income restrictions could lead to more accurate income reporting by self-employed households. However, if the self-employed are also affected by business history and income stability considerations such behavioral adjustments are unlikely to offset the effects I document.

[11] In August 2015 Fannie Mae relaxed its rules for counting business income, requiring only a 12 month business history to be documented.

loans to owner-occupiers the census tract self-employment share provides a measure of the probability that the applicant is self-employed. I measure the share of households with self-employment income using ACS data collected between 2005 and 2013.[12] Figure 1 shows that there is considerable local variation in census tract self-employment in Cook County IL, with self-employment shares ranging from near zero to above 20 per cent. I also collect a number of other ACS census tract statistics to include as controls. I condition on the share of poor english speakers, the share of single parent households, the home-ownership rate, the share of households aged over 65, median income, racial composition and the share with a bachelor's degree or higher. Table 1 contains summary statistics for both census tracts and counties. I supplement the HMDA credit analysis using the Consumer Expenditure Survey. Although it is not possible to precisely identify the location of the household (and therefore proximity to affected lenders), the survey contains detailed information on household self-employment, debt payments and property-related expenses included in the calculation of the debt-to-income ratio. This allows me to confirm that self-employed households experience a relative decline in debt-to-income ratios coinciding with the policy.

I use FDIC information on bank branch locations to measure exposure to affected banks. To the extent that people bank locally, places close to affected branches should be more exposed to the regulation. I measure county exposure to the regulation using either a continuous measure of the affected bank deposit share, or an indicator equal to 1 for counties with no exempt banks and 0 for counties with a very low affected bank share.[13] I measure census tract access using a binary measure equal to one if the closest branch to the tract midpoint does not have an exemption and zero otherwise. When using this measure I remove very large census tracts from the sample given that proximity measures are imprecise for these locations. Figure 2 shows variation in this measure within Cook County, IL and the effect of restricting the sample to census tracts with an area less than two square miles.

Table 2 shows how urban counties classified according to the binary affected measure

[12]Because most census tract samples are relatively small, I restrict attention to higher population tracts. Specifically, I consider census tracts where the average ACS five-year sample is at least 200 people. This covers about 90% of the U.S. population. I also use an average of the five-year estimates given the small census tract samples and my interest in cross-sectional rather than time-series variation. This approach results in more weight being placed on data collected in the middle of the period. In any case it is not possible to construct the measure on an annual basis at the census tract level since only five-year estimates are available.

[13]More precisely, the cutoffs are chosen so that 5 per cent of urban census tract years are classified in each group. The indicator is equal to 1 of counties with an affected bank deposit share exceeding 99.8% and is equal to 0 for counties with an affected bank deposit share less than 38%.

differ with respect to observable characteristics. Overall the locations are broadly similar with respect to median income, though affected locations have a higher share of poor english speakers, a larger hispanic population and lower homeownership. The affected counties also have a larger population. Table 3 compares urban counties with above and below median affected deposit share. These groups are also similar with respect to median income, though areas with more affected banks still tend to have somewhat higher minority and poor english shares and in addition have a substantially higher level of education. Census tracts closer to affected branches are broadly similar, though still have a slightly higher share of poor english speakers and minorities (Table 4). To help address the fact that locations with different exposure to the regulation also differ along other dimensions, I use variation within states or counties and include the controls described above.

I focus on commercial banks and savings institution locations and exclude credit union locations. This is partly motivated by the relatively weak relationship between credit union proximity and application probability (Figure 3), possibly reflecting special eligibility requirements such as belonging to a particular profession or working for a particular employer. Although in practice many credit unions offer options for people outside of the group they traditionally serve, it is possible that perceptions of ineligibility still affect borrowers' application behavior. Perhaps more importantly, evidence from the Survey of Consumer Finances (2010;2013) suggests that credit unions are not an important source of the types of loans that facilitate small business formation. Table 5 shows that while 15.8 per cent of business-owning households used a personal loan to start their business, only 0.1 per cent obtained the loan from a credit union. This is in sharp contrast to the overall market share of credit unions in HMDA: credit unions and their subsidiaries accounted for around 9 per cent of HMDA applications in 2014. Data on first mortgages in the Survey of Consumer Finances (2004–2013) also indicate that credit unions are less active in serving self-employed households. While 5.3 per cent of households without a self-employed member obtained their first mortgage from a credit union this share falls to 2.1 per cent for households with a member who became self-employed in the previous two years (Table 6).

To look at how the regulation affects employment outcomes I use statistics from the U.S. Bureau of Economic Analysis on county non-farm proprietors' employment and LEHD Origin-Destination Employment Statistics (LODES) data on employment at businesses with fewer than 20 employees that are 0–1 years old. Figure 4 shows the non-farm proprietors' employment share is currently around $21\frac{1}{2}$ per cent. Figure 4 also shows the

aggregate trend in the new small firm employment share, which has been declining since the 1980s and is currently just over 2 per cent. Without the restricted use microdata I am unable to directly identify new small business employment at a local level. However, given the fine-grained nature of the data it is possible to impute this measure for a sizeable share of census blocks. To ensure consistency over time I restrict the sample to census blocks where new small business employment can be identified over 2011–2015. Although this is an incomplete measure I am able to obtain some coverage of 99 per cent of census tracts with an average census block coverage of around 45 per cent. I then aggregate to the census tract level.

4. Identification

To identify the effect of verified debt-to-income ratio restrictions on credit access and entrepreneurship I compare outcomes before and after the policy across locations with different exposure to affected banks. This difference-in-differences approach relies on two main assumptions. Firstly, I assume that changes in the outcome of interest would have been the same across locations with different policy exposure in the absence of the policy. Secondly, I claim that exposure to affected banks influences outcomes through a specific channel. The channel I propose is that credit falls more in locations where more banks are subject to the DTI requirement, because these banks respond by cutting loans that do not meet the qualified mortgage definition. Potentially self-employed households who do not meet qualified mortgage criteria experience a reduction in credit as a result of the policy, and change their decision to be self-employed.

I take a number of steps to address challenges to these claims. One concern is that because locations with different exposure to affected branches are observably different, outcomes may have evolved differently in the absence of the policy. To address this concern as much as possible I plot annual coefficient estimates illustrating that outcomes did not diverge substantially across these locations before the policy was introduced, and that outcomes diverge sharply in the implementation year. In order to improve comparability between locations I control for a number of characteristics and use variation in affected bank exposure within counties or states. In particular, when relating county policy exposure to county self-employment it is important to control for small bank access given that self-employment has a somewhat different trajectory in counties with more small banks. For this I use a measure that is fairly close to the Ability-to-Repay eligibility criteria. I calculate the small bank share as the average 2006 – 2013 deposit share of

banks with fewer than 500 mortgage originations in the previous calendar year and less than $2 billion in assets at the end of previous calendar year. The actual deposit share of banks exempt from the Ability-to-Repay rule differs from this measure for several reasons. Firstly, bank assets and mortgage originations fluctuate above and below the cutoffs over time. Secondly, banks move in and out of counties over time as they expand or close branches. Thirdly, the Ability-to-Repay rule applies the 500 loan cutoff to holding company originations not individual bank originations. A potential issue is that some of this variation comes from banks who actively avoid the regulation. This could be problematic if banks chose to avoid the regulation because they were expecting an increase in entrepreneurial activity. I therefore also include the county share of exempt banks who would not have been exempt if the policy were implemented in 2013 rather than 2014. This does not change the estimated policy effect substantively.

I present several pieces of evidence supporting the channel I propose. One alternative story is that exposure to affected banks could reduce entrepreneurship because it reduces credit access more broadly and therefore demand for entrepreneurship; however, exemptions for conforming and government-insured mortgages make this channel highly unlikely. These mortgages account for the majority of the market and are not subject to the debt-to-income component of the qualified mortgage definition over the period I look at. I also show that the credit effects of exposure to the policy are specific to areas with high self-employment. Exposure to affected banks is not associated with a reduction in credit more broadly. In addition, I show the policy does not affect employment at old small businesses, consistent with the proposed channel.

Another common concern with the difference-in-differences approach is that more entrepreneurial households may respond by migrating to locations close to exempt banks. In this context, however, most locations have access to at least one exempt bank. Continuous variation is policy exposure is still strongly associated with outcomes even among locations with a relatively large share of exempt banks. This suggests that households do not actively target banks with exemptions, possibly because they do not understand the rule and how it is applied.

It is also possible that the association between county exposure to affected banks and credit outcomes is not directly related to the policy. I provide additional support for this result by showing that the market share of exempt banks increases particularly strongly in census tracts with high self-employment. For this analysis I construct a sample of affected banks that are similar to exempt banks. Simply comparing exempt and non-exempt bank lending behavior may be problematic because small and large banks have

different business models. In particular, large banks sell a higher proportion of their loans to Fannie Mae and Freddie Mac, meaning that much of their lending is unlikely to be affected by the policy. The strong relationship between bank size and (approximate) exposure to the regulation as measured by the share of conventional retained HMDA originations is illustrated in Figure 5. For banks originating more than 2000 loans each year it is likely that the 43 per cent debt-to-income cutoff for qualified mortgage status will apply to less than 10 per cent of their total lending volume. Given the threshold nature of the eligibility criteria, restricting attention to banks close to the cutoffs may help to improve comparability. This approach has been used by other authors (Bhutta and Ringo (2015); Alexandrov (2015)); however, it may present problems for two reasons. Firstly, Figure 5 suggests that the potentially affected share of a bank's originations declines rapidly with size – meaning that banks close to the origination and asset cutoffs could be less affected by the policy than banks well below the cutoff. Secondly, I provide some evidence that more exposed banks close to the cutoff reduced lending to qualify for an exemption. If banks with a large share of affected loans reduce lending to become eligible, banks remaining just above the threshold after implementation are less likely to benefit from the exemption. I provide some evidence supporting this claim in Section 5.1.

In light of these issues I focus on a subset of small lenders who failed to receive an exemption because they are part of a holding company originating more than 500 first lien mortgages. Although these banks individually originate fewer than 500 first lien mortgages, they are not eligible for the exemption because eligibility criteria are applied at the holding company level. These banks should be similar to exempt banks but find it more difficult to obtain an exemption by adjusting lending because their eligibility is based on combined holding company originations. In defining the group of affected small banks I also restrict attention to banks that are part of smaller holding companies with total assets less than $20 billion. These holding companies generally own a small number of community banks which have separate charters.[14] Making this restriction leaves 91 banks in the non-exempt category, with operations across the U.S. Using the small bank sample I construct the census tract market share of exempt banks by originations. That is:

$$\mathrm{M}_{\mathrm{Exempt},c,t} = \frac{\sum_{b \in \mathrm{Exempt}} \#\text{Retained conventional loans}_{b,c,t}}{\sum_{b \in \mathrm{Exempt} \cup \mathrm{Exempt}} \#\text{Retained conventional loans}_{b,c,t}}$$

[14] Even if behavior within small bank holding companies is coordinated this should push the estimated effect closer to zero because of selection around the eligibility cutoff. The advantage of selecting small holding companies is that even if the holding company acts as a single entity, behavior should still be broadly comparable to other small banks in the sample.

where $b \in$ Exempt if bank b is part of a multibank holding company with total assets less than $20 billion and which (individually) had assets less than $2 billion at the end of 2013 and fewer than 500 first lien originations in 2013. I focus on retained conventional loans as this is the set of loans for which the debt-to-income requirement is applied differentially for exempt and affected banks. I also present results from a test using conforming and non-conventional loans to further strengthen the connection to the regulation.

5. Credit Effects

In this section I provide evidence that the Ability-to-Repay rule disproportionately reduced mortgage credit access for self-employed households. This complements evidence of a negative effect on the jumbo market reported by DeFusco et al. (2017), and is important for justifying the sizable employment effects I document in Section 6. Before reporting the main results I document lenders' pre-policy responses following the finalization of exemption criteria. This represents both an indirect cost of the policy and provides some insight into the value lenders place on exempt status. Lenders' willingness to change their behavior in order to obtain exemptions indicates that the policy is likely to be costly for them.

5.1 Do Banks Adjust Behavior to Qualify for Exemptions?

Figure 6 shows the share of banks meeting small creditor eligibility criteria by year. The orange line shows the share of banks actually exempt when the Ability-to-Repay rule was implemented in January 2014. The blue line shows the share of banks that would have been exempt if the rule had been applied in 2013. For banks with assets less than $1.5 billion there is a clear increase in the exempt share in the implementation year, suggesting that banks close to the origination threshold could be reducing lending in order to obtain an exemption. The effect is not obvious for larger banks – possibly because it is too costly for them to try to become exempt given their size.

Of course, the increase in the share of banks below the cutoff could simply be the result of negative aggregate lending growth between 2012 and 2013. To rule this out I compare the distribution of lending growth for banks slightly above the cutoff in 2012 to those below. Figure 7 shows the distribution of 2012 – 2013 lending growth for banks somewhat above and below the 500 loan threshold in 2012. Very few banks originating between 500 and 550 mortgages in 2012 grew their originations between 2012 and 2013.

Although small bank lending growth was negative on average over the same period, there are clear differences in behavior relative to banks already below the eligibility cutoff suggesting that banks were actively trying to gain exemptions from the policy. Even looking at banks with 2012 loans between 550 and 600 there is still evidence of some behavioral adjustment. Figure 7 also shows that lending distributions above and below the threshold were broadly similar in previous years suggesting that the two groups of banks would likely have behaved similarly in the absence of the rule.

Banks actively moving below the eligibility cutoff has implications for a bank-level regression discontinuity approach as lenders remaining slightly above the origination threshold at the time of implementation likely place a lower value on the exemption. This could be because only a small share of their lending volume would benefit from the exemption. We would not expect the behavior of these lenders to change relative to lenders below the cutoff following the implementation of the policy, and estimates obtained using a regression discontinuity approach will likely understate the true effect. Documenting this effect in more detail is relevant not only for this paper, but also for other papers that use a regression discontinuity approach to evaluate the effects of the Ability-to-Repay rule (Bhutta and Ringo (2015); Alexandrov (2015)).[15]

5.2 Mortgage Credit

The value banks place on the exemption suggests that loans subject to the regulation are important for their profitability. As discussed above, the self-employed are likely to be overrepresented in the affected group as business income is discounted in the debt-to-income ratio calculation. Income from new businesses cannot be counted at all. Households borrowing to start a business may also be taking a temporary income cut, and debt-to-income restrictions limit their ability to compensate for this in other parts of the application. To get a sense for the size of the overall effect on the self-employed relative to other borrowers, I first examine the relationship between census tract lending and the share of households with self-employment income. To address the concern that self-employment may be correlated with other variables affecting lending I use self-employment variation within a county. I estimate:

[15]Unfortunately it is not possible to observe the debt-to-income ratio for loans made by banks close to the cutoff, making it hard to determine whether lenders moving below the cutoff are actually more exposed. It is also not possible to determine whether loans are even subject to the debt-to-income requirement at all given that I do not know whether loans held in portfolio or sold to other institutions are conforming or not.

$$\log(\text{Loans})_{c,t} = \gamma_c + \alpha_n \mathbb{1}[t \geq 2014] + \beta_1 \mathbb{1}[\text{Self Employment}_{c,2005-2013} > 15\%]\mathbb{1}[t \geq 2014] + \beta_2 X_{c,2005-2013}\mathbb{1}[t \geq 2014] + \epsilon_{c,t}$$

where $\log(\text{Loans})_{c,t}$ is the log number of loans originated in census tract c in county n in year t and X_c is a set of census tract controls. Both census tract self-employment and the other census tract variables are calculated using ACS data collected between 2005 and 2013. The first column of Table 7 indicates that the number of HMDA mortgage originations fell by around 3 per cent in census tracts with high self-employment after the policy relative to other census tracts in the same county. Figure 8(a) plots annual coefficients from the analogous specification:

$$\log(\text{Loans})_{c,t} = \gamma_c + \alpha_{n,t} + \beta_{1,t}\mathbb{1}[\text{Self Employment}_{c,2005-2013} > 15\%] + \beta_{2,t} X_{c,2005-2013} + \epsilon_{c,t}$$

The estimates indicate that there is a sharp decline coinciding precisely with the introduction of the policy. This is also true when using a continuous measure of census tract self-employment rather than a high/low indicator. Column 1 of Table 8 indicates that the effect is significantly stronger for refinance loans than purchase loans.

Using the Consumer Expenditure Survey I provide additional support for the claim that the self-employed are more affected by the Ability-to-Repay rule. The survey allows me to directly measure debt-to-income ratios for households with self-employment income. I calculate debt-to-income ratios for households with and without self-employment income and compare the two groups before and after policy implementation. The numerator is the sum of the household's mortgage repayment, property tax, credit card, student loan and other financial charges. The denominator is total household income. Results in Table 9 show that the debt-to-income ratio of households with at least one self-employed member falls by about 2 percentage points relative to other households after the policy is implemented. The effect increases to $3\frac{1}{2}$ percentage points for self-employed households who do not report any wage or salary income, in line with the effect being driven by reliance on business income. Figure 8(d) plots the annual coefficients relative to 2013, and shows a clear drop in self-employed debt-to-income ratios coinciding with the policy. The strong overall relationship between self-employment and lending growth suggests that whatever the benefits of the small bank exemption for the self-employed, it has probably

not been sufficient to offset the effect of the regulation.

Next I create a stronger link to the regulation by showing that the decline in credit to the self-employed varies with proximity to banks subject to the 43 per cent debt-to-income cutoff for qualified mortgage status. I estimate for census tract c in county n in state s:

$$\begin{aligned}\log(\text{Loans})_{c,t} = \gamma_c + \alpha_s \cdot \mathbb{1}[t \geq 2014] + \beta_1 \mathbb{1}[\text{SelfEmployment}_{c,2005-2013} > 15\%] \cdot \mathbb{1}[t \geq 2014] \\ + \beta_2 \text{Affected}_{n,2014} \cdot \mathbb{1}[\text{SelfEmployment}_{c,2005-2013} > 15\%] \cdot \mathbb{1}[t \geq 2014] \\ + \beta_3 \text{Affected}_{n,2014} \cdot \mathbb{1}[t \geq 2014] \\ + \beta_4 X_c \cdot \mathbb{1}[t \geq 2014] + \epsilon_{c,t}\end{aligned}$$

Where $\text{Affected}_{n,2014}$ is an indicator equal to 1 for counties where nearly all banks are affected in 2014 and 0 for counties with a very low affected bank share. The interaction of exposure to affected banks and self-employment on the right hand side of the lending equation is important because the outcome I am interested in is credit *to the self-employed*. Unfortunately, this outcome is not observable in the HMDA dataset so instead I look at how credit outcomes differ across census tracts with varying self-employment shares. In settings where the event of interest affects the entire population in a similar way this interaction is not necessary; however, here I argue that the policy has a disproportionate effect on the self-employed, and actually has little effect on credit access overall. I measure census tract self-employment shares using data collected before the policy was implemented.

Column 4 of Table 7 shows that there is no significant reduction in credit to the self-employed in counties with a very low affected bank share. In contrast, in counties where nearly all banks are affected there is a 5 per cent relative reduction in the number of loans in high self-employment census tracts. Interestingly, there is no significant relationship between credit and affected bank exposure outside of high self-employment areas. Figure 8(b) plots coefficients from an annual specification.

To further support a causal connection to the policy I compare the lending behavior of exempt and affected small banks before and after implementation. The affected group I consider fails to qualify because it is part of a multibank holding company with originations exceeding the 500 loan threshold. Because these banks are also small the assumption that lending behavior would have been similar in the absence of the policy is more likely to hold. When comparing exempt and non-exempt lenders I exclude non-conventional loans as well as loans which are sold by the originator because the debt-to-income requirements

for these loans are not lender dependent (and so we would not expect treated banks to behave differently with respect to these loans). I then calculate census tract market shares $M_{Exempt,c,t}$ of exempt banks within the small bank sample and estimate:

$$\begin{aligned} M_{Exempt,c,t} = \gamma_c + \alpha \mathbb{1}[t \geq 2014] + \beta_1 \mathbb{1}[\text{SelfEmployment}_{c,2005-2013} > 15\%] \cdot \mathbb{1}[t \geq 2014] \\ + \beta_2 \cdot X_c \mathbb{1}[t \geq 2014] + \epsilon_{c,t} \end{aligned}$$

Columns 1 and 2 of Table 10 show that the market share of exempt banks increases by 4.3 percentage points in locations with high self-employment relative to other areas. In the analogous specification with continuous self-employment, an additional percentage point of self-employment is associated with around an 0.6 percentage point increase in the market share of exempt small banks following the policy. The analogous specification with annual coefficients is:

$$M_{Exempt,c,t} = \gamma_c + \alpha_t + \beta_{1,t} \mathbb{1}[\text{SelfEmployment}_{c,2005-2013} > 15\%] + \beta_{2,t} X_c + \epsilon_{c,t}$$

Figure 8(c) plots estimates of $\beta_{1,t}$, showing that market share of exempt banks does not vary with census tract self-employment prior to the policy. Columns 3 and 4 of Table 10 show coefficients estimated using a sample of loans for which treatment under the Ability-to-Repay rule does not depend on the bank exemption. That is, banks receiving an exemption should not have a lower cost of originating these loans. Consistent with the changes in exempt bank market share being driven by the policy, the exempt bank share of loans in this subgroup does not increase following the policy. If anything, it declines – consistent with banks substituting towards loan types where they have a relative advantage.

6. Effects on Self-employment and Entrepreneurship

By reducing access to mortgage credit the Ability-to-Repay rule could have implications for business formation. The size of this effect depends on how important residential mortgage credit is for starting a business relative to other funding sources. Previous work has suggested that personal credit is an important source of funding for small busi-

ness owners and can facilitate entrepreneurship (Adelino et al. (2015); Herkenhoff et al. (2016), Jensen et al. (2014)). This is also supported by a positive correlation between self-employment and the share of refinance loans with cash out observed in the CoreLogic Loan Level Market Analytics dataset.[16] Table 11 shows that a one percentage point increase in the ZIP Code share of households with self-employment income is associated with an 0.2 percentage point increase in the share of refinance loans with cash out. Furthermore, this correlation exists both within and across three digit zip codes and is robust to the inclusion of housing price growth and socioeconomic control variables. The average cash out share in the sample is around 30 per cent of all refinance originations.

The Survey of Consumer Finances also contains information about sources of business funding. Based on the 2010 and 2013 samples nearly 16% of business owners stated that they used a personal loan to start their business (Table 5). It is also possible that this figure understates the importance of mortgage credit. If additional mortgage credit is used for other expenses or to reduce the downpayment when moving this leaves more cash available for other purposes. The Ability-to-Repay rule is likely to affect mainly new small businesses because their limited business history makes it more difficult for them both to satisfy the debt-to-income requirement and to switch to a business loan. Older businesses may be less affected because the owners are more likely to be able to include business income in the debt-to-income ratio and are less reliant on personal loans (Table 5). I calculate debt-to-income ratios by household, excluding business income for businesses less than two years old. Figure 10(a) shows that 11 per cent of self-employed households with older businesses in the 2013 Survey of Consumer Finances have a debt-to-income ratio exceeding the qualified mortgage cutoff. This rises to 21 per cent for households with a business less than two years old. Appendix A contains a detailed description of how I construct Figure 10(a), along with more bottom-up calculations using the Survey of Consumer Finances.

It therefore seems likely that the effect on mortgage credit I documented earlier should translate into an effect on entrepreneurship. In this section I estimate the effects of the rule on both non-farm proprietors' employment and small business employment. The first measure includes owners of unincorporated businesses while the second focuses specifically on businesses with employees. I use a difference-in-differences approach based on variation

[16]The CoreLogic Loan Level Market Analytics dataset is based on information provided to CoreLogic by anonymous contributors and covers around 60 per cent of first mortgages originated in the U.S. The dataset contains a number of borrower and loan characteristics which are not available in HMDA, including the borrower's debt-to-income ratio, FICO score and whether equity is withdrawn at the time of refinancing. However, it is not possible to identify the contributing financial institutions.

in exposure to affected banks to identify the effects of rule. I estimate:

$$\begin{aligned}\log(\text{Self Emp.}_{n,t}) = \gamma_n + \alpha_s \mathbb{1}[t \geq 2014] + \beta_1 \text{Affected Share}_{n,2014} \mathbb{1}[t \geq 2014] \\ + \beta_2 X_n \mathbb{1}[t \geq 2014] + \epsilon_{n,t}\end{aligned}$$

where Self Emp.$_{n,t}$ is the non-farm proprietors' employment share in county n in year t and Affected Share$_n$ is the 2014 affected bank deposit share in county n. X_n contains a number of county characteristics, including race, education, age, english language ability, single parent and home ownership shares. I condition on the deposit share of small banks to address the concern that the size of local banks may be related to other economic characteristics that affect self-employment trends. I also condition on the 2014 share of 'avoider banks' – that is banks who switched from affected to exempt in the year before the policy was introduced. The results are based on within state variation in affected bank shares. If the 43 per cent debt-to-income requirement affects self-employment I expect the self-employment share to evolve differently after the policy was implemented in areas with a strong affected bank presence compared to areas with few affected banks. This is captured by the coefficient β_1.

Column 2 of Table 12 shows that moving from a county with an affected share of zero to an affected share of one is associated with a $1\frac{1}{2}$ per cent reduction in non-farm proprietors' employment. Column 4 of Table 12 shows that the estimate is around 2 per cent when restricting the sample to counties in metropolitan or micropolitan areas. Figure 9(a) provides a graphical representation of the estimated coefficients from an analogous specification with annual coefficients:

$$\log(\text{Self Emp.}_{n,t}) = \gamma_n + \alpha_{s,t} + \beta_{1,t} \text{Affected Share}_n + \beta_{2,t} X_n + \epsilon_{n,t}$$

The plot shows a sharp reduction in the estimated coefficient on affected bank exposure coinciding with the policy change. Figure 9(b) is constructed using a binary measure of exempt bank exposure and uses a limited sample of counties with an affected share close to zero or one. Although this sample is much smaller the results are broadly consistent. Figures 9(c) and 9(d) show that relationship also looks similar even when I restrict the sample to counties with at least some exempt banks or with below median affected deposit share. This seems consistent with the idea that households in counties more exposed to affected banks are are simply more likely to select an affected bank regardless of their understanding of the rule or knowledge of the bank's status. In contrast, if mortgage

applicants actively targeted exempt backs we might expect to see the relationship being driven by counties with an affected bank share close to one.

In addition to affecting individual self-employment choice, the Ability-to-Repay rule also restricts new small business employment. I test this by constructing a measure of new small business employment at the census tract level. This allows me to use within county variation in exposure to affected bank branches. For each census tract I calculate the distance to the nearest exempt and affected bank branches within the same CBSA. Given that most census tracts in the sample have an exempt bank branch within 10km (Figure 10), the relevance of this variation for outcomes depends on how much applicants know about the regulation and the exempt status of banks. As discussed above, the results for self-employment are consistent with applicants being relatively uninformed or with existing banking relationships being important. I interpret distance from an affected branch as a measure of the probability that a potential business owner in the area applies at an affected bank. Figure 3 illustrates that application behavior, at least for households applying to commercial banks and savings institutions, is indeed largely driven by whichever branch is closest. Consistent with this, my preferred choice of proximity measure is an indicator equal to one when the closest bank is affected and zero otherwise. However, the results are broadly robust to using other relative distance measures or pre-policy application shares. I express new small firm employment as a share of total employment in the same census tract to abstract from general employment trends. The main specification is:

$$\log\left(\frac{\text{New Small Firm Emp.}_{c,t}}{\text{Total Emp.}_{c,t}}\right) = \alpha_c + \gamma_n \mathbb{1}[t \geq 2014] + \beta_1 \mathbb{1}[\text{Branch Affected}]_{c,2014} \mathbb{1}[t \geq 2014] + \beta_2 X_c \mathbb{1}[t \geq 2014] + \epsilon_{c,t}$$

where $\frac{\text{New Small Firm Emp.}_{c,t}}{\text{Total Emp.}_{c,t}}$ is the ratio of new small firm employment to total employment in census tract c in county n in year t. I restrict the sample to census tracts with areas less than two square miles as the proximity measure becomes less precise for large tracts. This restriction effectively means that I use only areas with a relatively high population density.

The results in Column 1 of Table 13 support a significant effect of exposure to affected bank branches on new small business employment as a share of total employment. Being closer to an affected branch is associated with a 4.8 per cent decline in the new small firm employment share following the policy. As the proposed channel depends on the

applicant's ability to verify a sufficiently large and stable income stream over several years, we expect young small firms to be most affected. Older firms may be more likely to have established business lending relationships with banks, reducing their exposure to the regulation. In line with this, the results in Column 2 of Table 13 suggest the policy had little effect on small businesses established more than 10 years ago. Figure 9(e) plots annual coefficients from the regression:

$$\log\left(\frac{\text{New Small Firm Emp.}_{c,t}}{\text{Total Emp.}_{c,t}}\right) = \alpha_c + \gamma_{n,t} + \beta_{1,t}\mathbb{1}[\text{Branch Affected}]_{c,2014} + \beta_{2,t}X_c + \epsilon_{c,t}$$

Replacing the dependent variable with $\log\left(\frac{\text{New Small Firm Emp.}_{c,t}+1}{\text{Total Emp.}_{c,t}}\right)$ avoids dropping tract years where new small firm employment was zero. The estimate of β_1 in this case is -3.3 per cent. The annual coefficient estimates are shown in Figure 9(f). Interpreting these estimates as an overall policy effect requires an assumption regarding the share of applicants for whom the exemption status of the closest bank matters. If all applicants apply to the closest bank, the estimates would be directly interpretable as the policy effect. However, to the extent that some households do not behave this way the true policy effect may be larger. Consequently the estimates of β_1 should be interpreted as a lower bound.

7. Conclusion

I find that the Ability-to-Repay rule significantly restricts self-employed households' access to mortgage credit. This is likely attributable to two factors. Firstly, households reliant on business income may find it more difficult to verify a debt-to-income ratio of less than 43 per cent required for qualified mortgage status under the Ability-to-Repay rule. Secondly, applicants with business income are less likely to qualify for government-insured and conforming loans which are not directly affected by Ability-to-Repay debt-to-income rules – probably because eligibility for these loans is already based on a debt-to-income criterion. By extending debt-to-income requirements to the rest of the mortgage market the Ability-to-Repay rule imposes particularly large costs on the self-employed.

By restricting credit access, verified debt-to-income requirements lead to a reduction in self-employment and small business employment. The effects on small business employment are limited to new businesses, suggesting that the most important factor restricting

credit access is likely to be the length of business history required to count income towards the debt-to-income ratio.

Variation in proximity to exempt lenders is important even where there is an exempt lender within easy driving distance, suggesting that households may be uninformed about the regulation or the exempt status of branches. Another possibility is that households affected by the rule benefit from having an existing relationship with the lender and existing relationships with exempt lenders are likely to be more common in locations close to exempt branches.

Overall, the results show that mortgage finance is important for early stage businesses and that mortgage regulations – particularly those emphasising documentation of stable income – are likely to weigh on small business activity.

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A. Appendix

A. Bottom-up Calculations using the SCF

I construct a back-end debt-to-income ratio for households in the Survey of Consumer Finances and combine this with information about mortgage originations to compute the approximate share of self-employed households affected by the Ability-to-Repay rule. The purpose of this analysis is to understand whether the main estimates are of a plausible order of magnitude. It should only be considered suggestive for a couple of reasons. The debt-to-income ratio I calculate may deviate from that calculated by banks for several reasons. Even households with several years of business history may not be able to count all their business income in practice. Some components of income such as commissions, bonuses and income from part-time jobs may also be harder to count. As it is not possible for me to exactly replicate the bank's calculation I include most income sources with the exception of income from new businesses. This means that my calculations will likely understate debt-to-income ratios and the affected share of households. Furthermore, the sample of households is relatively small and it is hard to make precise statements about subgroups of interest. Overall, the exercise suggests that a total effect on self-employment of $1\frac{1}{2}$ - 2 per cent is plausible. However, taking the calculations seriously it seems unlikely that the effect arises purely from cash-out refinancing. Either the affected share of households is substantially understated, or the policy also reduces self-employment by making it harder for self-employed households to refinance to a lower rate or move to a different property without reducing their loan size.

I start by identifying whether households in the 2010 or 2013 surveys had a DTI above the Ability-to-Repay Qualified Mortgage cutoff. I focus on the post-crisis survey years as DTI standards were more relaxed prior to the crisis and the DTI distribution in earlier years is unlikely to be representative of the one prevailing at the time of the regulation. I consider a household with a loan balance below the conforming limit of $417,000 to be potentially affected if it has a DTI exceeding 45 per cent. I consider a household with a loan balance above the conforming limit to be potentially affected if it has a DTI exceeding 43 per cent. That is, conditional on loan size being below the conforming limit I assume the household could qualify for a conforming loan as long as its DTI does not exceed 45 per cent.[17] Such a loan would be classified as a qualified mortgage even with a DTI exceeding

[17]This 45 per cent cutoff, which applied to most loans during the period I consider, is referred to in Fannie Mae and Freddie Mac's seller/servicer guides and is also apparent in their single family loan performance datasets.

43 per cent. I construct the numerator of the DTI ratio by adding property tax, alimony and child support to payments on mortgages, student loans, auto loans and other loans. I construct the denominator of the ratio by adding wage and salary income, dividends, interest, net annual income from sole proprietorships, income from other businesses and investments, pensions and retirement income, and alimony and child support received.

Guidelines suggest the ratio should be constructed based on a conservative measure of stable income, with recent increases in income being incorporated while recent declines are ignored. In light of this I exclude the 10 per cent of households who state that their income when surveyed was unusually high. Guidelines also suggest that business income should only be counted when at least two years of documentation are provided. I therefore subtract non-negative net income of any actively managed business founded within the two years prior to the survey year (multiplied by the household's share of the business), up to a maximum of the household's total business and investment income. I also subtract any salary income that members of the household received from the business. If a member of the household works for multiple businesses I assume that the full amount of that person's salary can be counted. I also assume that any income from older businesses can be counted in full.

I use a definition of self-employment similar to the non-farm proprietors' measure used in Section 6. This includes households with an actively managed sole proprietorship or partnership, though the results are similar when including households with actively managed incorporated businesses. I drop households operating a ranch or farm business. Broadly in line with the BEA statistics, around 21 per cent of households are self-employed according to this definition, with around 4 per cent of households owning a business established in the two years prior to the survey year.

Figure 10(a) plots the share of potentially affected households by type. Around 7 per cent of non-self employed households have a debt-to-income ratio exceeding the cutoff. This increases to 11 per cent for households with a business established over two years ago and 21 per cent for households with a recently established business. It is not clear, however, what share of these households would have had a different self-employment status had the policy been in place. It seems likely that households who also refinanced their mortgage in the years immediately prior to the survey would be more affected. One possibility would be to document recent refinancing behavior directly for households above the cutoff by type. However, the sample size is not really large enough for this to be credible. Instead I calculate refinancing rates for the two years prior to the survey by household type and loan purpose for all households in the 2004, 2007, 2010 and 2013

surveys. Figure 10(b) plots the share of households by type who had a debt-to-income ratio exceeding the cutoff multiplied by the recent refinance rate for that household type. This suggests that around 3 per cent of households with an established business and around 8 per cent of households with a new business may not have been approved for the mortgage they in practice took out.Figures 10(c) and 10(d) show the distribution of the affected share by loan type for old and new businesses.

There are multiple ways to reconstruct the $1\frac{1}{2}$ - 2 per cent policy effect estimated using the BEA data. Assuming that all self-employed with a DTI exceeding the cutoff and a recent cash-out origination would not be self-employed under the policy yields an effect of 1.2 per cent. However, it seems likely that at least some of these households might not have changed their decision. Alternatively, assuming that half of households with a DTI exceeding the cutoff with recent origination of any type would not be self-employed under the policy gives an effect of 1.9 per cent.

Table 1 – Descriptive Statistics

	Tracts			Counties		
	mean	p50	sd	mean	p50	sd
Self-employment (%)	11.8	11.0	(5.7)	12.0	11.3	(3.8)
Poor english (%)	7.9	3.3	(11.2)	4.0	2.2	(5.2)
Single parent family (%)	17.1	15.1	(9.0)	23.6	22.7	(6.6)
Home ownership (%)	68.1	73.3	(21.0)	71.6	72.5	(8.2)
Median income (000s)	28.5	26.3	(11.3)	24.6	23.9	(5.2)
College degree (%)	25.1	20.2	(16.7)	19.6	17.5	(8.4)
Householder 65 plus (%)	21.6	21.4	(9.5)	23.3	23.4	(4.7)
Black (%)	10.8	3.2	(18.4)	9.8	3.5	(13.8)
Hispanic (%)	14.4	5.6	(20.6)	8.9	4.0	(13.3)
Population (000s)	5.1	4.6	(2.6)	165.3	55.5	(414.3)
Small bank deposits (%)				41.4	37.3	(28.0)
Exempt bank deposits (%)				33.3	24.5	(29.7)
Avoider bank deposits (%)				2.9	0.0	(10.2)
Non-farm proprietors employment (%)				22.1	21.2	(6.2)

Notes: Column 1 contains summary statistics for the sample of census tracts where the average ACS sample exceeds 200. Column 2 contains statistics for all counties in metropolitan or micropolitan areas. The census tract variables are constructed by averaging ACS 5-year estimates from 2009–2013. The exempt bank share is calculated as the 2014 deposit share of lenders with assets at end 2013 less then $2 billion with fewer than 500 first lien (holding company) originations during 2013. The small bank share is calculated as the average deposit share of lenders with fewer than 500 annual first lien originations during the previous year and less than $2 billion in assets at the end of the previous year from 2006–2013. The avoider bank share is calculated as the 2014 deposit share of lenders who would have failed to receive an exemption based on 2012 assets and originations, but did receive an exemption based on 2013 assets and originations. Local deposit statistics come from the FDIC. Non-farm proprietors' employment statistics are obtained from the BEA.

Table 2 – Comparing Urban Counties by Presence of Exempt Bank Branches

	Unaffected			Affected		
	mean	p50	sd	mean	p50	sd
Self-employment (%)	13.5	12.8	(4.6)	12.5	11.8	(4.1)
Poor english (%)	2.3	1.1	(3.4)	4.5	2.4	(5.5)
Single parent family (%)	22.1	21.0	(7.0)	23.4	22.4	(6.6)
Home ownership (%)	75.2	76.4	(6.8)	71.9	72.5	(8.2)
Median income (000s)	23.6	23.3	(4.2)	23.2	22.2	(4.4)
College degree (%)	15.4	14.4	(5.5)	17.7	16.0	(7.7)
Householder 65 plus (%)	24.6	25.1	(3.7)	24.5	25.3	(4.7)
Black (%)	8.5	2.1	(14.9)	8.5	1.8	(13.8)
Hispanic (%)	5.8	2.2	(11.3)	10.3	4.7	(13.4)
Population (000s)	32.9	24.6	(28.1)	65.6	32.1	(164.3)
Number of Observations	338			178		

Notes: A county is classified as affected if the affected deposit share in 2014 was greater than 99.8%. A county is classified as unaffected if the affected deposit share in 2014 was less than 38%. Includes counties in metropolitan or micropolitan areas. Source is 2013 ACS 5-year estimates.

Table 3 – Urban Counties with Above and Below Median Exempt Bank Deposit Share

	Below Median Affected			Above Median Affected		
	mean	p50	sd	mean	p50	sd
Self-employment (%)	12.3	11.8	(3.9)	11.6	10.9	(3.3)
Poor english (%)	2.9	1.6	(4.2)	5.0	3.1	(5.7)
Single parent family (%)	23.0	22.1	(6.5)	24.3	23.5	(6.4)
Home ownership (%)	73.3	74.1	(6.9)	69.7	70.9	(8.8)
Median income (000s)	24.0	23.5	(4.5)	25.4	24.4	(5.8)
College degree (%)	17.2	15.7	(6.5)	22.2	20.3	(9.3)
Householder 65 plus (%)	23.7	23.9	(4.1)	22.7	22.6	(5.2)
Black (%)	8.9	2.7	(13.8)	10.6	4.8	(13.6)
Hispanic (%)	7.2	2.9	(12.4)	10.4	5.4	(13.3)
Population (000s)	72.1	41.0	(103.2)	267.1	93.1	(571.3)
Number of Observations	867			866		

Notes: Includes counties in metropolitan or micropolitan areas. Source is 2013 ACS 5-year estimates.

Table 4 – Comparing Census Tracts by Exempt Status of Nearest Branch

	Closer to Exempt			Closer to Affected		
	mean	p50	sd	mean	p50	sd
Self-employment (%)	10.2	9.5	(4.9)	10.7	9.9	(5.3)
Poor english (%)	10.3	5.2	(12.5)	13.3	7.8	(13.8)
Single parent family (%)	19.1	17.3	(9.7)	20.3	18.4	(10.7)
Home ownership (%)	60.1	62.2	(21.9)	58.2	60.5	(23.7)
Median income (000s)	28.6	27.3	(11.2)	29.6	27.4	(12.7)
College degree (%)	27.8	24.1	(17.7)	28.1	23.6	(18.9)
Householder 65 plus (%)	20.9	20.2	(9.2)	19.9	18.9	(9.6)
Black (%)	12.8	4.4	(20.4)	15.2	5.6	(22.5)
Hispanic (%)	17.4	7.5	(22.5)	22.2	11.9	(24.5)
Number of Observations	3,236			20,873		

Notes: Includes only counties with census tracts of both types. Includes only census tracts with an area less than 2 square miles and an average ACS sample size exceeding 200.

Table 5 – Business Funding Sources in the Survey of Consumer Finances

	Startup	Continuation
Personal Loan from Bank/Savings Institution	0.081	0.036
Personal Loan from Credit Union	0.001	0.002
Personal Loan from Other	0.076	0.030
N	1,766	1,766

Statistics are calculated using information from the SCF (2010; 2013). The sample includes households who currently own a business.

Table 6 – First Mortgage Sources in the Survey of Consumer Finances

	Not Self-employed	Old Self-employed	New Self-employed
Mortgage from Credit Union	0.053	0.043	0.021
Mortgage from Bank/Savings Institution	0.486	0.516	0.494
N	4,863	2,708	462

Source: Survey of Consumer Finances 2004; 2007; 2010; 2013. New self-employed includes households with a self-employed member and a business established within the past two years. Old self-employed includes households with a self-employed member and a business established more than two years ago.

Table 7 – Credit Effects of Policy are Larger in Areas with High Self-employment

	(1)		(2)		(3)		(4)	
			100 × log(Number of Loans)					
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Post × High Self-emp.	-2.90***	(0.33)	-3.60***	(0.40)	-2.55**	(1.28)	-0.25	(1.31)
Post × Affected					3.17	(2.01)	1.79	(1.96)
Post × Affected × High Self-emp.					-12.03***	(2.81)	-4.99***	(1.86)
Number of Tracts	54,101		54,101		5,222		5,222	
Number of Counties	1,801		1,801		525		525	
Number of States	51		51		46		46	
Number of Observations	215,931		215,931		20,840		20,840	
County × Post FE	X							
State × Post FE			X		X		X	
Tract FE	X		X		X		X	
Tract controls × Post	X		X				X	

Notes: The dependent variable is $\log(\#\text{ loans})_{c,t}$ where c is the census tract and t is the year. Self-employment is the share of households with income from self-employment, calculated by averaging ACS 5-year estimates from 2009 – 2013 for census tracts with a total sample exceeding 200. Post is an indicator equal to one for 2014 and later. A census tract has high self-employment if the self-employed share exceeds 15 per cent. This corresponds to around the 75th percentile. A county is 'affected' if the affected bank share exceeds 99.8% and is 'unaffected' if the affected bank share is less than 38%. The sample period is 2012 – 2015. Standard errors are clustered by county.

Table 8 – Relative Refinance Effect

	(1)		(2)		(3)		(4)	
	100 × (Number of Refinance Loans/Number of Purchase Loans)							
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Post × High Self-emp.	-15.727***	(2.463)	-19.201***	(2.716)	0.778	(1.979)	2.608	(2.004)
Post × Affected					-4.385	(3.320)	-5.154	(3.156)
Post × Affected × High Self-emp.					-7.966**	(4.006)	-3.663	(3.038)
Number of Tracts	53,814		53,814		4,617		4,617	
Number of Counties	1,801		1,801		524		524	
Number of States	51		51		46		46	
Number of Observations	213,976		213,977		18,395		18,395	
County × Post FE	X							
State × Post FE			X		X		X	
Tract FE	X		X		X		X	
Tract controls × Post	X		X				X	

Notes: The dependent variable is the ratio of refinance to purchase loan counts in census tract c in year t. Self-employment is the share of households with income from self-employment, calculated by averaging ACS 5-year estimates from 2009 – 2013 for census tracts with a total sample exceeding 200. Post is an indicator equal to one for 2014 and later. A census tract has high self-employment if the self-employed share exceeds 15 per cent. This corresponds to around the 75th percentile. A county is 'affected' if the affected bank share exceeds 99.8% and is 'unaffected' if the affected bank share is less than 38%. The sample period is 2012 – 2015. Standard errors are clustered by county.

Table 9 – Self-employed Have Lower Debt-to-Income Ratios After Policy

	(1)		(2)	
	Debt to Income Ratio (%)			
	All self-employed		Self-employed w/o salary	
Explanatory Variables	Coef.	SE	Coef.	SE
Excludes DTI = 0				
Post × Self-employed	-1.89**	(0.80)	-3.83**	(1.55)
Number of Observations	59,262		54,717	
Includes DTI = 0				
Post × Self-employed	-2.09***	(0.64)	-3.57***	(1.19)
Number of Observations	108,951		102,422	
State × Year, Self-employed FE	X		X	
Controls × Year	X		X	

Notes: Column 1 contains results for the full sample of households. Column 2 compares self-employed households with no wage or salary income to households without a self-employed member. The sample includes only households with a positive debt-to-income ratio. Excludes the top 1% of the debt-to-income distribution. Standard errors are clustered by consumer unit. Controls include race, age quartile, education and occupation of reference person. Sample period is 2012 – 2015.

Table 10 – Credit Effects of Policy are Larger in Areas with High Self-employment

	(1)		(2)		(3)		(4)	
	Market Share of Exempt Banks							
	Conventional Portfolio Loans				Non-Conventional and GSE Loans			
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Post	5.98	(9.19)	-0.77	(9.28)	-15.94*	(8.75)	-9.54	(8.95)
Post × High Self-emp.	4.27**	(1.68)			-0.72	(2.96)		
Post × Self-emp.			0.62***	(0.22)			-0.49**	(0.23)
Number of Tracts	841		841		841		841	
Number of Counties	180		180		180		180	
Number of States	29		29		29		29	
Number of Observations	2,189		2,189		2,189		2,189	
Post FE					X		X	
Tract FE	X		X		X		X	
Tract controls × Post			X				X	

Notes: The dependent variable is the census tract market share of exempt banks by number of loans. The sample is restricted to census tracts where both exempt and non-exempt banks in the restricted small bank group made loans of both types at some point during 2006 – 2015. Sample period is 2012 – 2015. Self-employment is the share of households with income from self-employment, calculated by averaging ACS 5-year estimates from 2009 – 2013 for census tracts with a total sample exceeding 200. A census tract has high self-employment if more than 15% of of the sample has self-employment income. This corresponds to around the 75th percentile. Standard errors are clustered by county.

Table 11 – Share of Refinance Loans with Cash Out

	(1)		(2)		(3)	
	Share of Refinance Loans with Cash Out					
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE
Self-Employment Share	0.187***	(0.022)	0.175***	(0.022)	0.230***	(0.032)
Housing Price Growth			0.001***	(0.000)	0.002***	(0.000)
Number of Observations	98,214		98,214		98,214	
ZIP3 FE	X		X			
ZIP5 Controls			X		X	

Notes: Sample includes conventional mortgage loans to owner-occupiers originated by CoreLogic reporters between 2008 and 2015. Standard errors clustered by ZIP3. Self-employment is measured at ZIP5.

Table 12 – Self-employment Declines in Areas more Exposed to the Policy

	(1)		(2)		(3)		(4)	
	100 × log(Self Employment Share)							
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Post × Affected Bank Share	-1.54***	(0.56)	-1.46***	(0.56)	-2.14***	(0.79)	-1.95**	(0.76)
Post × Rural County	0.48	(0.36)	0.33	(0.37)				
Post × Rural × Affected Bank Share	0.34	(0.53)	0.43	(0.53)				
Number of Counties	2,796		2,796		1,719		1,719	
Number of States	50		50		50		50	
Number of Observations	11,183		11,183		6,876		6,876	
State × Post FE	X		X		X		X	
County FE	X		X		X		X	
County controls × Post			X				X	

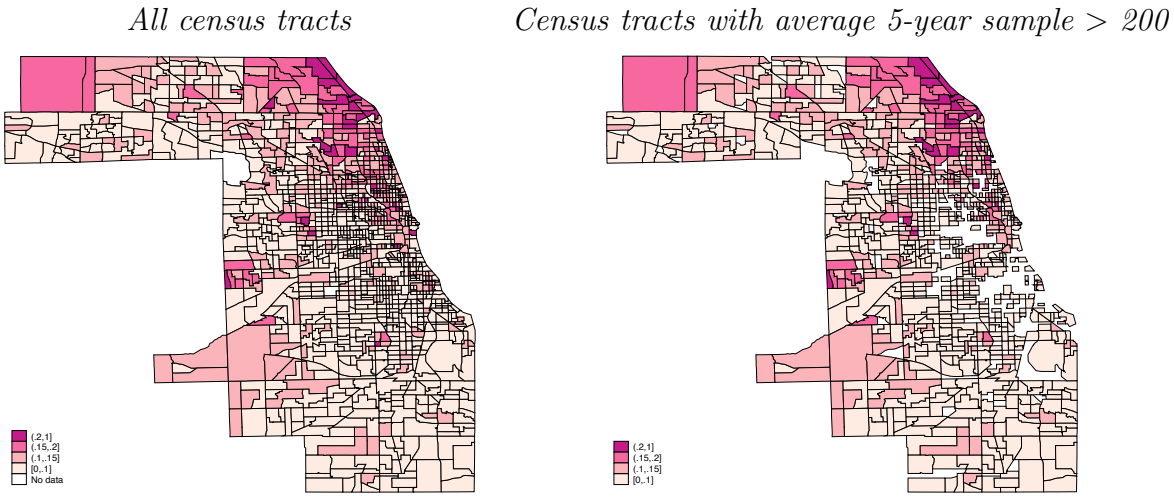
Notes: Dependent variable is log(Self Employment Share$_{n,t}$) where Self Employment Share$_{n,t}$ is BEA non-farm proprietors' employment as a share of total employment in county n in year t. Sample period is 2012 – 2015. Standard errors are clustered by county.

Table 13 – New Small Business Employment Declines in Areas more Exposed to the Policy

	(1)		(2)		(3)		(4)	
	$\log(\frac{x}{\text{Total Emp.}})$				$\log(\frac{x+1}{\text{Total Emp.}})$			
	New Small		Old Small		New Small		Old Small	
Explanatory Variables	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Post × Branch Affected	-4.78**	(2.37)	1.15	(0.93)	-3.33**	(1.49)	0.72	(0.91)
Number of Tracts	21,009		30,374		34,966		33,928	
Number of Counties	847		971		980		978	
Number of States	49		49		49		49	
Number of Observations	65,006		118,712		139,864		135,712	
County × Post FE	X		X		X		X	
Tract FE	X		X		X		X	

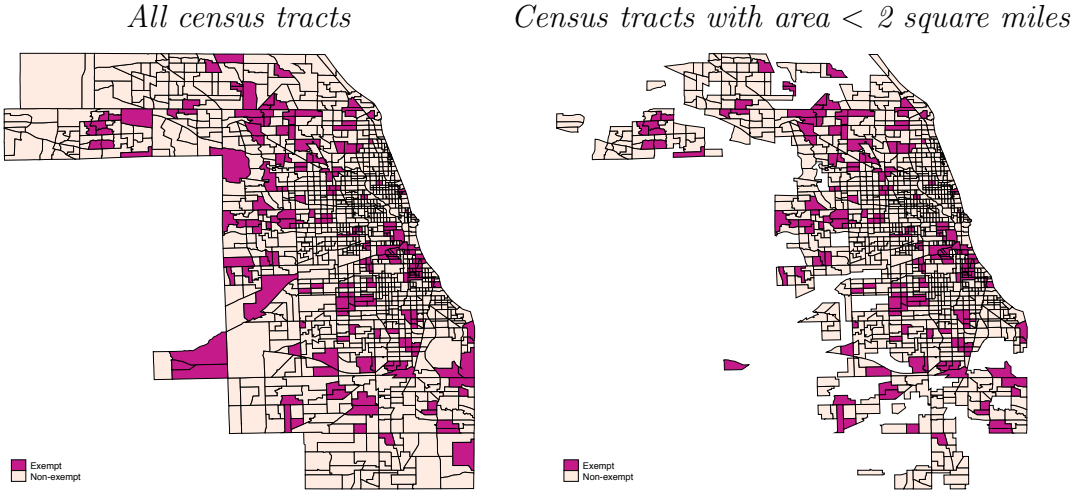
Notes: A new small business is defined as a business 0 – 1 years old with fewer than 20 employees. An old small business is defined as a business at least 11 years old with fewer than 20 employees. The sample includes census tracts with an area less than two square miles located in a CBSA. The sample period is 2012 – 2015. Standard errors are clustered by CBSA.

Figure 1 – Share of Households with Self-employment Income – Cook County, IL



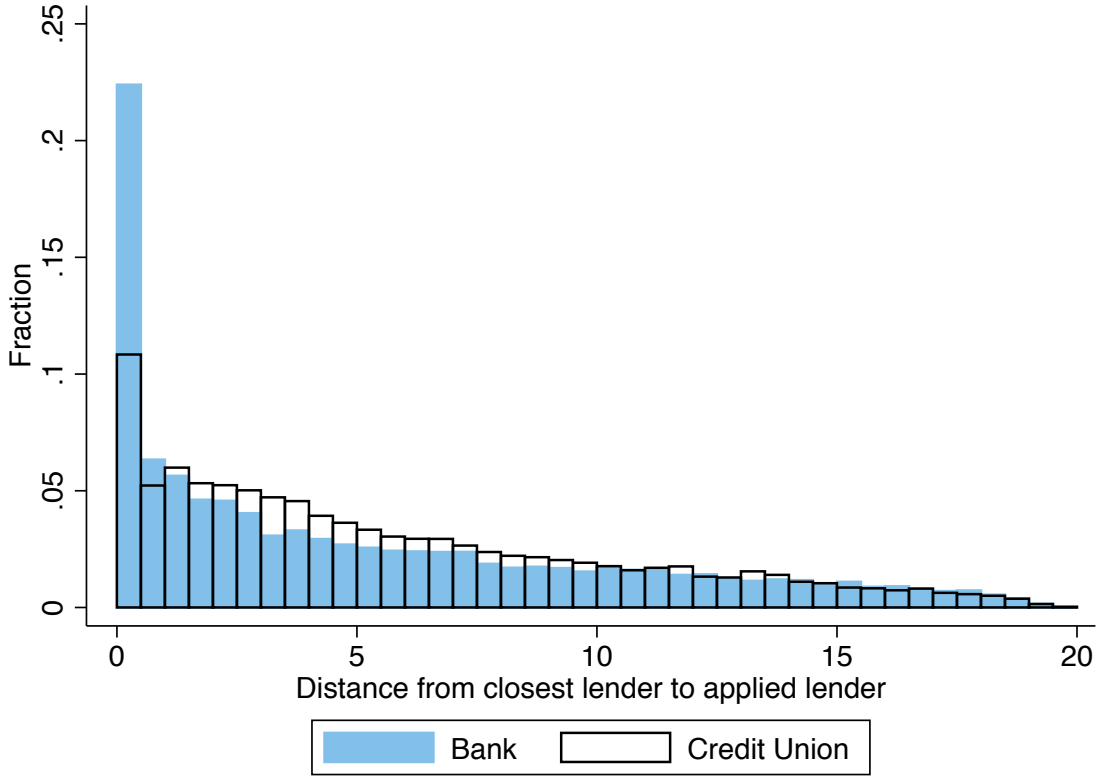
This figure shows variation in the share of households with self-employment income in Cook County, IL. The self-employment measure is constructed by averaging estimates from the 2009 – 2013 ACS 5-year tables.

Figure 2 – Exemption eligibility of closest bank branch – Cook County, IL



Tracts where the closest branch has an exemption are shaded dark. Tracts where the closest branch does not have an exemption are shaded light. Distances are constructed using 2014 FDIC branch locations.

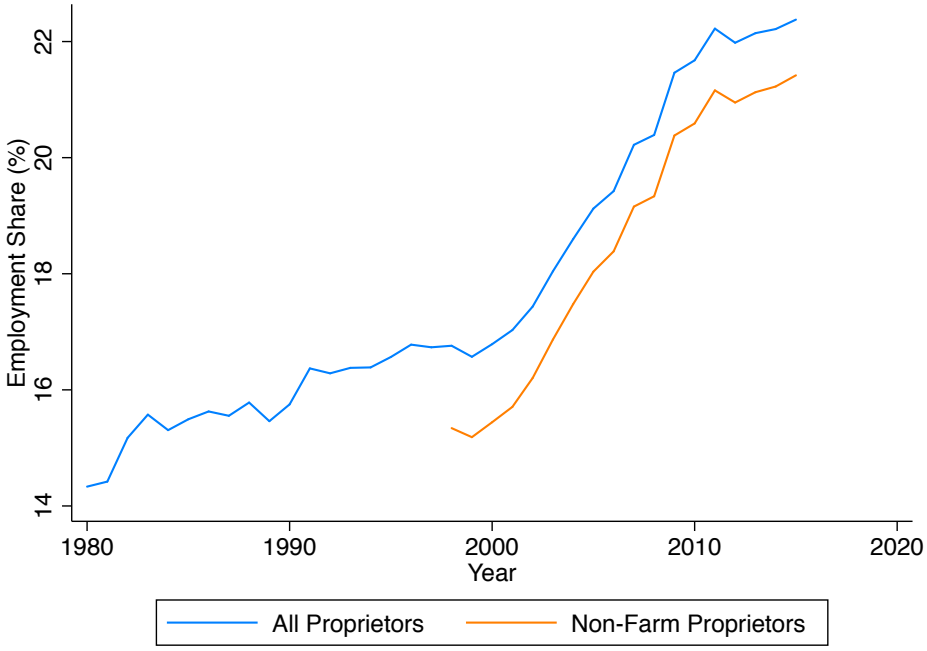
Figure 3 – Applicant Behavior by Lender Type - Lenders with ≤ 5 Branches



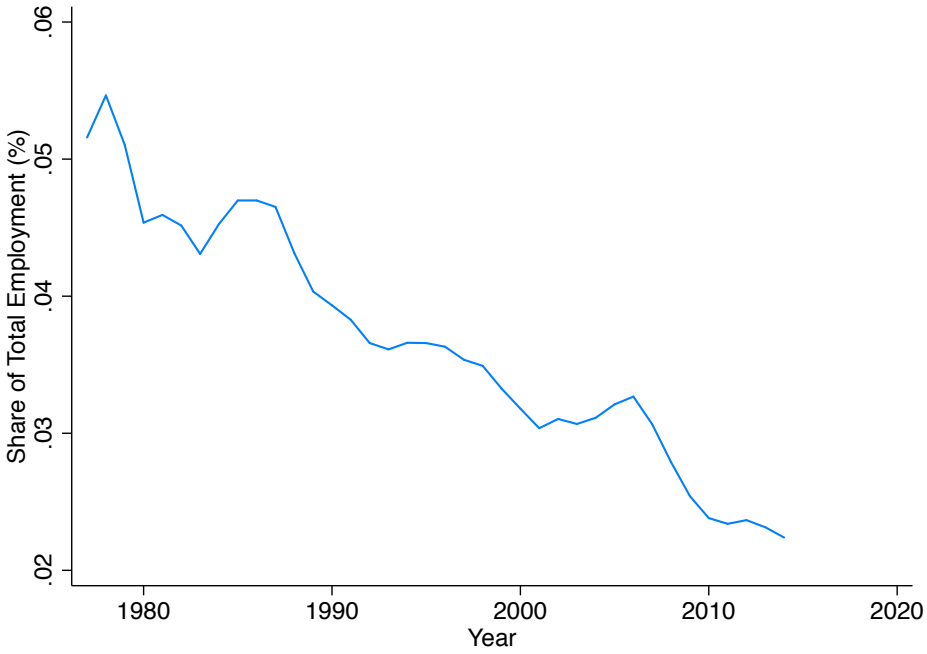
This figure shows the distribution of the distance between the branch closest to the census tract where the property is located and the nearest branch of the lender applied to in HMDA.

Figure 4 – Proprietors' and New Small Firm Employment Share

Proprietors' Employment Share

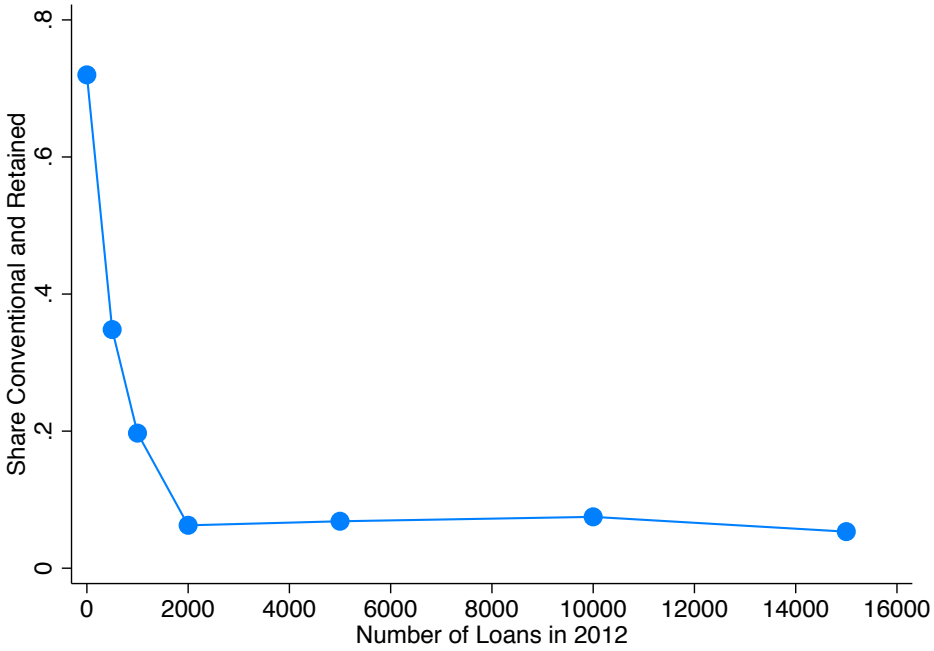


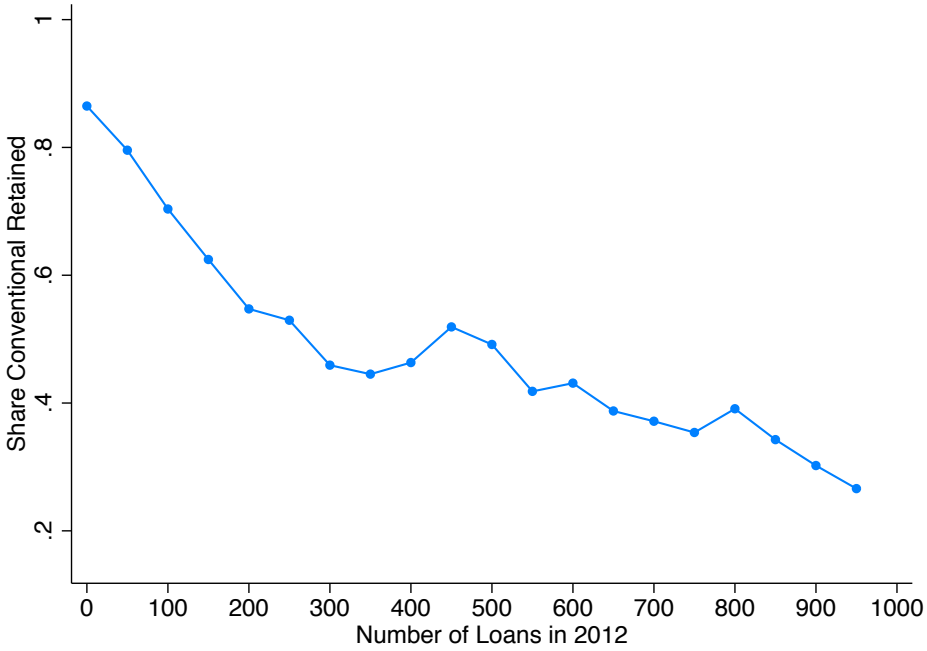
New Small Firm Employment Share



The top panel shows BEA proprietors' and non-farm proprietors' employment shares. The bottom panel shows new small firm employment as a share of total employment calculated using the Business Dynamic Statistics database. A new small firm is 0-1 years old and has fewer than 20 employees.

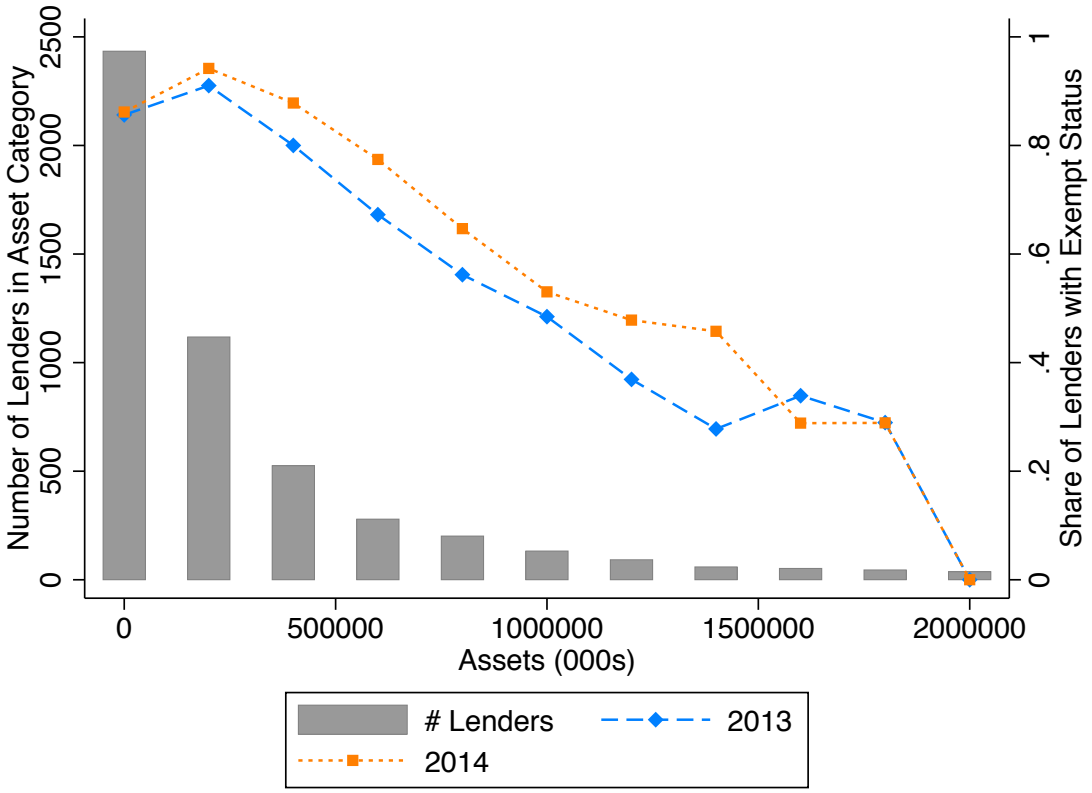
Figure 5 – Affected Loan Share Measures by Bank Size





This figure is constructed by grouping lenders according to the number of first lien mortgages they originated in 2012 and, within each group, calculating the share of HMDA mortgage originations that are both conventional and not sold in the calendar year of origination.

Figure 6 – Small Creditor Exemption Eligibility

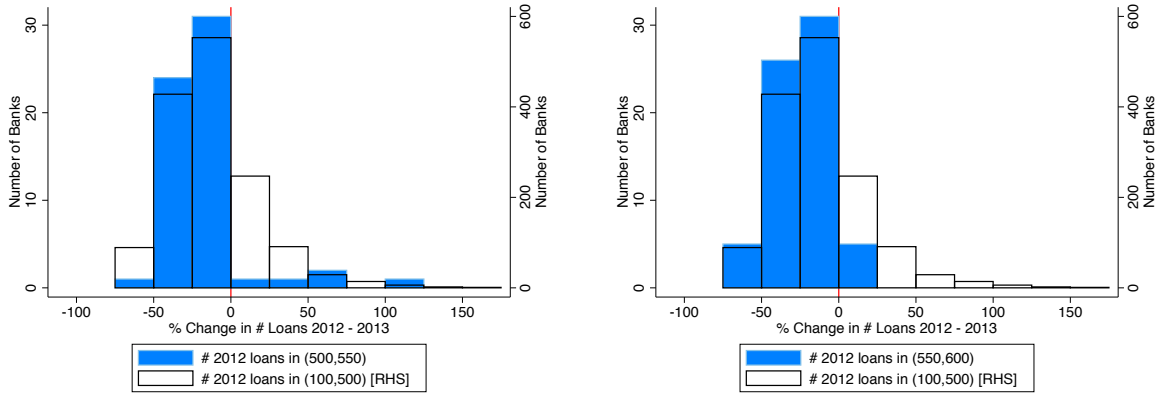


This figure shows the size distribution of HMDA reporters and the share of lenders in each size class meeting the eligibility criteria for a small creditor exemption in 2013 and 2014. Lenders that are part of a multibank holding company are excluded.

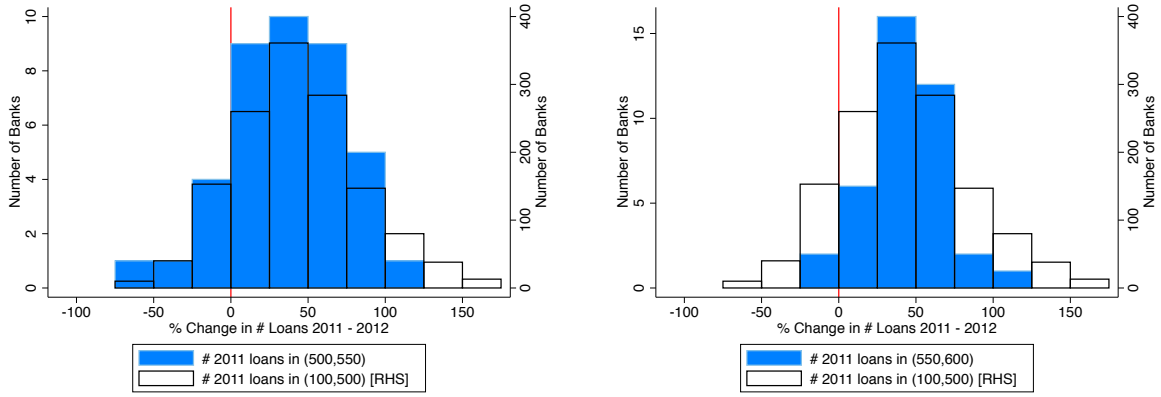
Figure 7 – Behavior around the cutoff

Lending Growth

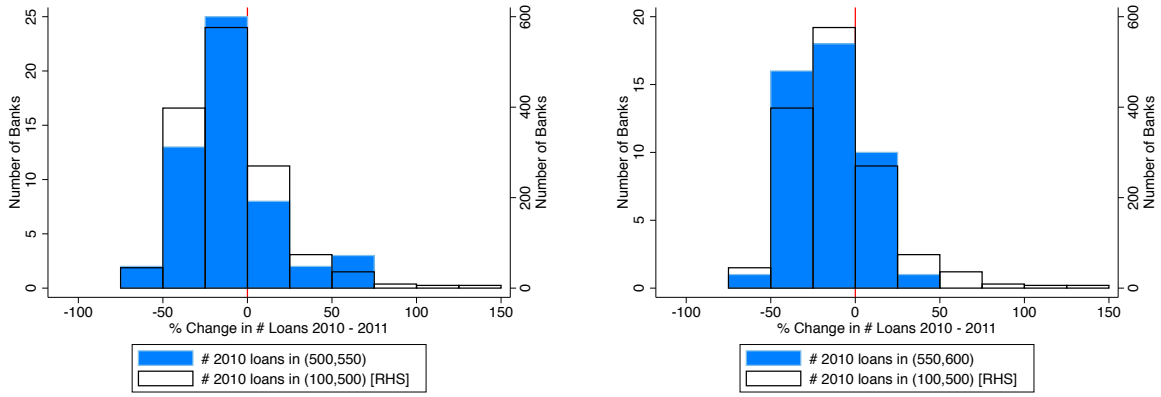
2012–2013



2011–2012



2010–2011

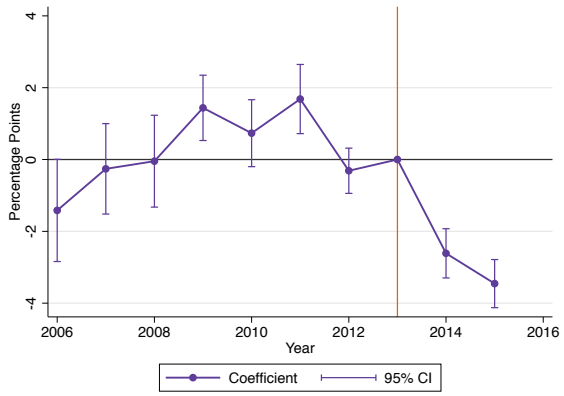


Lender eligibility status and loan growth are constructed using HMDA originations and asset information provided by reporters. Lenders that are part of a multibank holding company are excluded. Observations above the 97.5th percentile or below the 2.5th percentile of the lending growth distribution are removed.

Figure 8 – Annual Coefficient Estimates – Credit

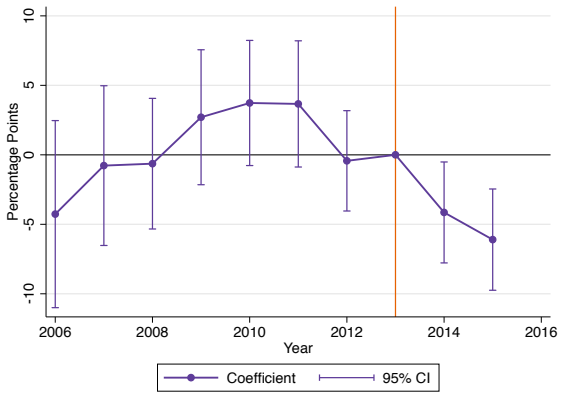
$$\log(\text{Loans})_{c,t} = \gamma_c + \alpha_{n,t} + \beta_{1,t} 1(\text{Self Emp.}_c > 15\%) + \ldots$$

(a) $\hat{\beta}_{1,t}$ (Self-emp. $> 15\%$)



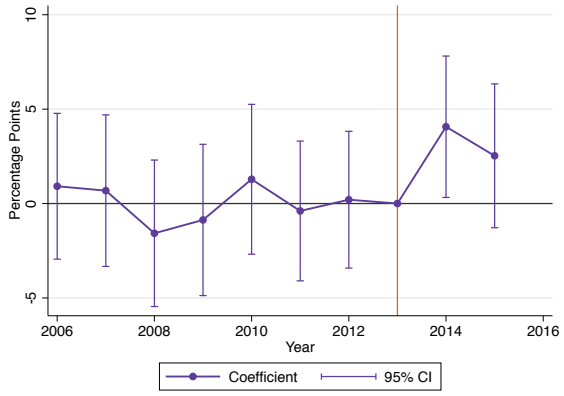
$$\log(\text{Loans})_{c,t} = \gamma_c + \alpha_{s,t} + \ldots + \beta_{2,t} \text{Affected}_n 1(\text{Self Emp.}_c > 15\%) + \ldots$$

(b) $\hat{\beta}_{2,t}$ (Affected $\times$ Self-emp. $> 15\%$)



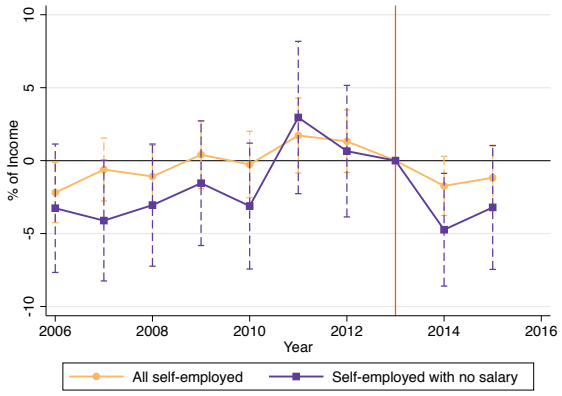
$$\text{M}_{\text{Exempt},c,t} = \gamma_c + \alpha_t + \beta_{1,t} 1(\text{Self Emp.}_c > 15\%) + \ldots$$

(c) $\hat{\beta}_{1,t}$ (Self-employment $> 15\%$)



$$\text{DTI}_{i,t} = \alpha_{s,t} + \beta_{1,t} \text{Self Employed}_{i,t} + \ldots$$

(d) $\hat{\beta}_{1,t}$ (Self-employed)

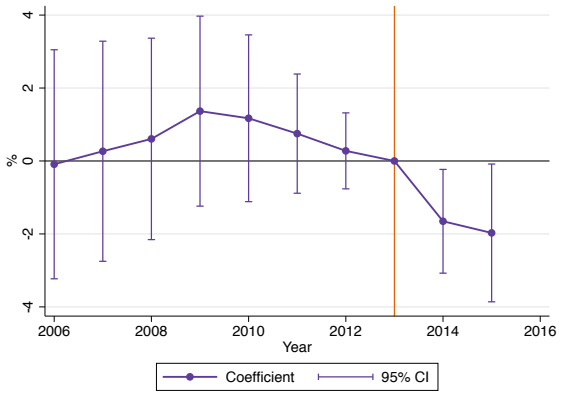


This figure shows estimates of the relationship between the census tract self-employment share and mortgage outcomes with 95% confidence intervals. $\log(\text{Loans})_{c,t}$ is the number of mortages originated in census tract c in year t. $\text{M}_{\text{Exempt},c,t}$ is the market share of exempt banks in census tract c in year t by number of mortgages originated in year t. $\text{DTI}_{i,t}$ is the back-end debt to income ratio of household i at time t.

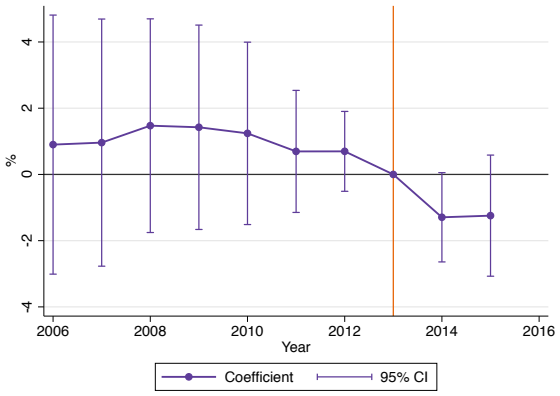
Figure 9 – Annual Coefficient Estimates – Employment

$$\textbf{log (Self Emp.}_{n,t}) = \gamma_n + \alpha_{s,t} + \beta_{1,t}\textbf{Affected Share}_n + ...$$

(a) $\hat{\beta}_{1,t}$; All urban counties

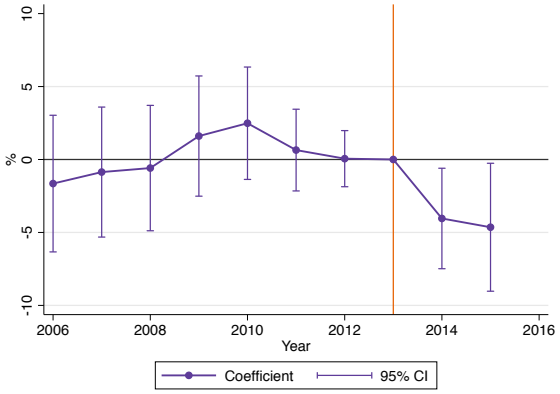


(b) $\hat{\beta}_{1,t}$; Binary affected measure



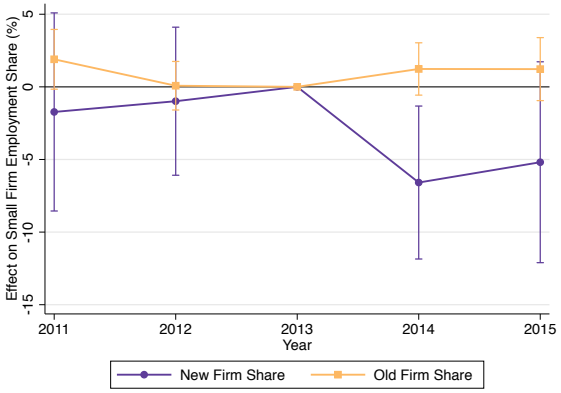
(c) $\hat{\beta}_{1,t}$; Affected < 1

(d) $\hat{\beta}_{1,t}$; Affected ≤ 0.75

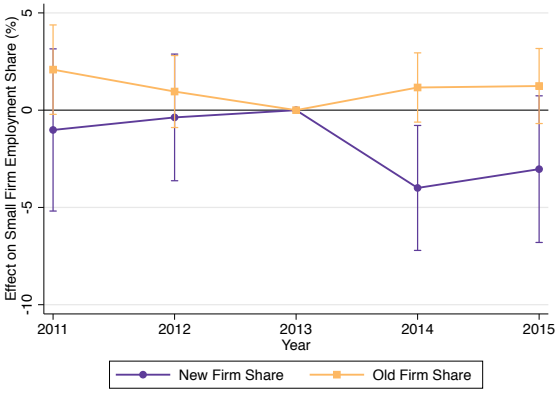


$$\textbf{log (New Small Firm Emp. Share}_{c,t}) = \alpha_c + \gamma_{n,t} + \beta_{1,t}\textbf{1(Affected Closest)}_c + ...$$

(e) $\hat{\beta}_{1,t}$; Unadjusted

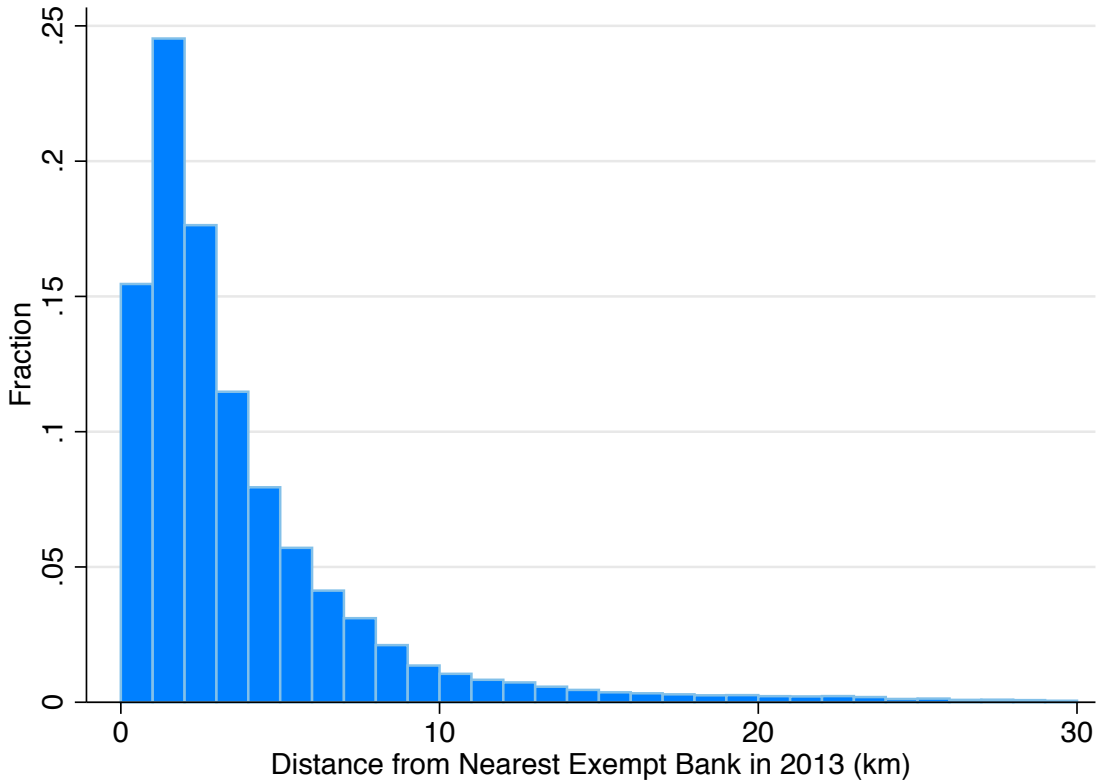


(f) $\hat{\beta}_{1,t}$; Adjustment for case where share $= 0$



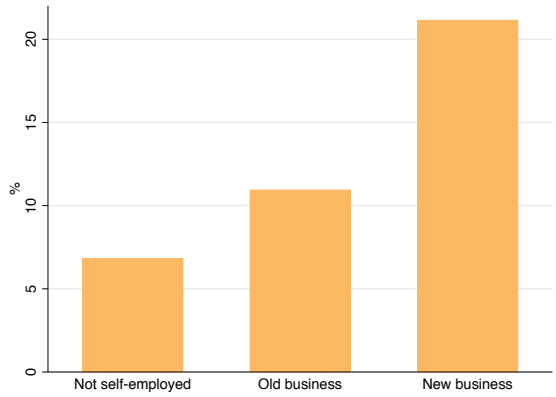
This figure shows estimates of the relationship between the census tract self-employment share and mortgage outcomes with 95% confidence intervals.

Figure 10 – Distribution of Distance from Closest Exempt Bank Branch

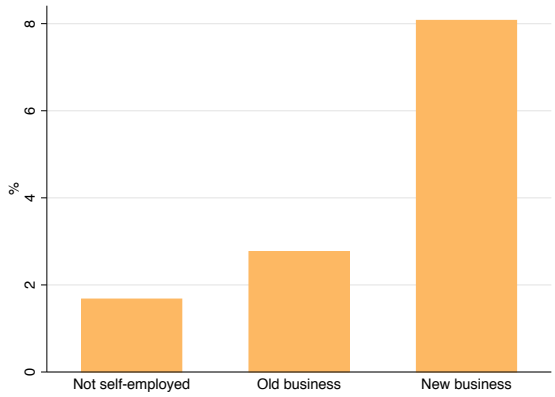


This figure shows the distribution of distance from census tract midpoints to the nearest exempt bank branch using 2014 branch locations.

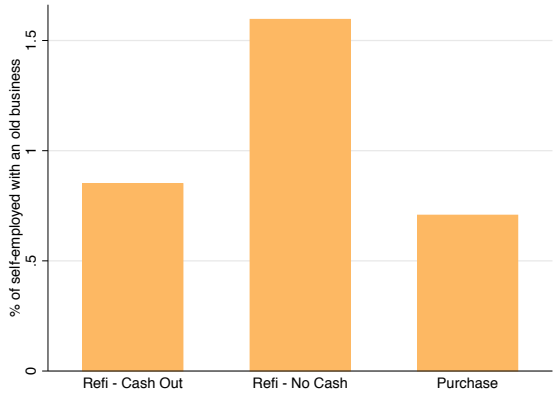
(a) Share with affected DTI



(b) Affected DTI and recent mortgage



(c) Affected DTI by loan purpose – Old business



(d) Affected DTI by loan purpose – New business

Panel (a) shows the share of households in the 2010 and 2013 Survey of Consumer Finances with a debt-to-income ratio exceeding the qualified mortgage cutoff. A household is classified as self-employed if the main respondent or their spouse is self-employed. Business income is not counted towards the debt-to-income ratio if the household's business was established in the past two years. Otherwise, business income is fully incorporated. Panel (b) shows estimates of the share of households in each group with both an affected DTI and a recent mortgage origination (given the small sample size, I calculate the probability of a recent origination for each household type from the 2004, 2007, 2010 and 2013 surveys and apply the average rate for each type). Panels (c) and (d) decompose the second and third columns of Panel (b) by loan type.