Loan Guarantees and Credit Supply*

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Abstract

The efficiency of federal lending guarantees depends on whether guarantees increase lending supply, or simply act as a subsidy to lenders. We use notches in the guarantee rate schedule for loans backed by the Small Business Administration to estimate the elasticity of bank lending volume to loan guarantees. We document significant bunching in the loan distribution on the side of the size threshold that carries a more generous loan guarantee. The excess mass implies that increasing guarantee generosity by 1 percentage point of loan principal would increase per-loan lending volume by $19,000. Bank lending is responsive both in the cross-section and temporally- excess mass increases with the discontinuity over time, and placebo results indicate that the effect disappears when the guarantee notch is eliminated.

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1 Introduction

Indirect government loan guarantees reimburse unrecovered dollars to private lenders, and are an increasingly common type of credit subsidy. In 2019 alone, $1.4 out of the $1.5 trillion dollars in projected federal credit assistance came in the form of loan guarantees, with a projected subsidy value of $37.9 billion (CBO, 2018). In markets affected by asymmetric information and credit rationing, government loan guarantees may increase aggregate welfare if they restore lending to an efficient level (Gale, 1991; Stiglitz and Weiss, 1981; Smith, 1983; Mankiw, 1986). Whether this occurs is ultimately an empirical question, and depends in part on the responsiveness of lenders to the guarantee. Despite the large and growing volume of federally guaranteed debt, there remains relatively little work exploring the effects of federal guarantees on lending.

This paper studies how private lenders respond to federal loan guarantees. Whether federal guarantee programs have any effects on increasing access to credit, or simply act as a subsidy to lenders, ultimately depends on the elasticity of credit provision to the loan guarantee.[1] Loan guarantees can be welfare enhancing if borrowing is inefficiently low due to information asymmetries (Stiglitz and Weiss, 1981; Mankiw, 1986). If credit supply is inelastic, guarantees will not increase the level of borrowing, and simply reimburse lenders on their losses. In this case, government loan guarantees can also crowd out more efficient private borrowing and encourage excessive risk-taking.[2]

In this paper, we focus on how guarantees specifically affect the supply of credit to small businesses. Credit constraints are well-known barriers to growth for small firms, and these problems are especially severe given imperfect information and a lack of collateral (Fazzari et al., 1988; Petersen and Rajan, 1994, 1995; Kaplan and Zingales, 1997; Kerr and Nanda, 2010; Barrot, 2016). We employ data from the Small Business Administration (SBA), the government agency tasked with providing assistance to small businesses. Specifically, we utilize data on loans originated

[1] For example, Smith (1983) notes that *"To be effective, it must be demonstrated that there is some impact of these policies on supply elasticities of credit."* Gale (1991) states that *"Perhaps the single most important and controversial parameter is the elasticity of supply of funds."* Finally, Lucas (2016) notes that *"The elasticity of credit supply affects the extent to which additional borrowing in government credit programs is offset by reductions in private borrowing."*

[2] While this paper focuses on the credit supply response to loan guarantees, this is not the only parameter relevant to welfare analysis. For example, Mankiw (1986) shows that the welfare effects of government loan guarantees also depend on whether the rate of return of the marginal investment exceeds the risk-free rate. Agarwal, Chomsisengphet, Mahoney and Stroebel (2018) show that in the presence of information asymmetries, banks may not pass on credit expansions to the borrowers who want to borrow the most.

under the 7(a) Loan Program. Under the SBA 7(a) Loan Program, a portion of loans from commercial lenders are insured against losses from defaults. Loans of up to $150,000 carry a higher maximum guarantee rate than loans larger than $150,000. This feature of the federal guarantee program leads to sharply different levels of risks for lenders originating loans above and below the threshold.

We employ a bunching estimator to measure the excess mass at the threshold, and use this to estimate elasticity of loan supply to the guarantee rate.[3] We use a simple model to translate the observed excess borrowing at the mass into an elasticity of credit supply. The degree of bunching identifies the elasticity of lending supply to the guarantee - if lending supply is inelastic, and lenders do not adjust loan size in response to the guarantee, we will not observe bunching. On the other hand, if lending supply is highly elastic, we will observe bunching as a significant number of loans will be moved to the side of the threshold with higher guarantees.

We find significant bunching directly below the threshold, which translates to a highly elastic lending supply response to loan guarantees. Interpreted in dollar magnitudes, this means that a 1 percentage point change in the guarantee net subsidy rate (expressed as a percentage of loan principal) generates $19,054 dollars in additional lending. Guarantee thresholds change over time, and we find that the observed bunching is stronger in years when guarantee amounts across the threshold are higher.[4] Moreover, the guaranteed notch was eliminated during a two year period from 2009 to 2010, as part of the American Recovery and Reconstruction Act. During this period, we find no excess mass across the threshold, which serves as a placebo test to rule out the possibility that alternative factors may be changing across the threshold and driving our results.

The validity of the bunching estimate relies on two key assumptions: first, that the counterfactual distribution is smooth in the absence of a notch, and second, that there exists a well defined marginal buncher. Consistent with our identifying assumptions, we find no excess mass in years when the guarantee notch is eliminated, making it unlikely that other factors are changing at the threshold. Additionally, we find no differences in loan terms around the threshold: interest rates, maturities, revolving loan percentages and charge-off percentages appear similar at or near the

[3]Recent papers employing bunching estimators include Kleven (2016); Best and Kleven (2018); DeFusco and Paciorek (2017); Saez (2010); Kleven and Waseem (2013).

[4]We find that the elasticity varies slightly from year to year, and consistent with optimization frictions we find smaller elasticities in years immediately after guarantee notches are changed. If optimization frictions are present, this would cause us to underestimate the true structural supply elasticity.

notch. We rule out several alternative explanations or threats to identification. According to SBA rules, lenders are only able to issue one loan to borrowers who have exhausted other borrowing options. We confirm in the data that lenders are not issuing multiple loans to the same borrower to take advantage of guarantees. We rule out a potential concern is that guarantees may be passed on to borrowers through lower interest rates, generating a demand effect. We find no difference in interest rates at or around the threshold, which is likely due to a particular institutional detail– the majority of loans in this program have binding interest rate caps, and thus there is very little room to vary the interest rate.

This paper contributes to a body of work on federal lending subsidies and guarantees by estimating a key parameter from classic theory models. To our knowledge, this is the first empirical paper to estimate how lending supply responds to federal loan guarantees. This literature largely focuses on calibrated models, and different papers use a wide range of estimates of the elasticity of credit supply to guarantee rates for calibrations. Despite the growing volume of federal lending in recent years, the area remains under-explored relative to other credit markets. Notable exceptions include Gale (1990), Gale (1991), Smith (1983) and Lucas (2016).

Other work has focused on different aspects of government credit guarantees. La Porta, de Silanes and Shleifer (2002) examine the effect of government ownership of banks, and find a positive correlation between government intervention and slower subsequent financial development which is consistent with government crowding out efficient private borrowing. Bertrand, Schoar and Thesmar (2007) examine the effect of the French Banking Act of 1985, which eliminated government subsidies to banks intended to help small and medium sized firms. Atkeson, d'Avernas, Eisfeldt and Weill (2018) emphasize the role of government guarantees in bank valuation by arguing that the decline in banks' market-to-book ratio since the 2008 crisis is due to changes in the value of government guarantees. Kelly, Lustig and Van Nieuwerburgh (2016) show that government guarantees lower financial sector index prices.

Prior theory work has shown that under information asymmetries, government interventions in credit markets such as loan guarantees and loan subsidies can increase welfare (Stiglitz and Weiss, 1981; Mankiw, 1986; Greenwald and Stiglitz, 1986). More recent work by Scharfstein and Sunderam (2018) has focused on tradeoffs between private and social costs, and Fieldhouse (2018) documents that housing policies subsidizing an expansion in residential mortgage lending crowd out commercial mortgages and loans. While in theory loan guarantees can increase welfare, whether this is true in practice is ultimately an empirical and quantitative question. We show that private lending is indeed responsive to federal loans guarantees, suggesting that these programs have real effects beyond simply subsidizing lenders.

This paper also links to a literature on credit access for entrepreneurs and small firms. Financing constraints are well known to be a significant barrier to growth for small firms (Evans and Jovanovic, 1989; Whited and Wu, 2006; Rauh, 2006; Kerr and Nanda, 2010; Barrot, 2016; Adelino et al., 2017). Petersen and Rajan (1994), Petersen and Rajan (1995) and Darmouni (2017) show that, for small firms, close ties with institutional lenders increases the availability of credit. Darmouni and Sutherland (2018) show that lenders to small firms are highly responsive to competitors' offers. More recent work has focused on how federal programs can affect the supply of credit and entrepreneurship. Brown and Earle (2017) and Granja, Leuz and Rajan (2018) study the SBA program, and respectively find that access to credit has large effects on employment and that the average physical distance of borrowers from banks' branch matters for ex-post loan performance. Howell (2017) demonstrates that federal grants have large effects on future fundraising, patenting and revenue. Our paper shows that the volume of small business lending is highly responsive to loan guarantees.

The remainder of this paper is organized as follows. Section 2 discusses institutional details and economic theory surrounding SBA loans and federal guarantees, and introduces our bunching estimator, as well as the SBA data used in our analysis. Section 3 introduces the bunching estimator and describes the empirical approach. Section 4 presents the main results and demonstrates significant responsiveness to government guarantees. Section 5 discusses alternative explanations and presents placebo results. Section 6 concludes the paper and discusses avenues for further research.

2 Institutional Background and Data

2.1 Loan Guarantees

Banks receive the loan guarantee from the government and make loans to entrepreneurs. There are two key components of a federal loan guarantee program: a reimbursement rate and a fee. If a bank makes a loan that is ultimately charged-off, the government will reimburse γ percent of the losses.

In return, the bank pays a certain fee equal to σ percent of the loan principal to the government. Given a charge-off probability π, the total expected subsidy S_{ij} provided by the government on loan amount D_{ij} to bank i for entrepreneur j is given by:

$$S_{ij} = \gamma\pi D_{ij} - \sigma D_{ij} = D_{ij}\Gamma \tag{1}$$

where the guarantee is given by $\Gamma = (\gamma\pi - \sigma)$.

We assume that there is an underlying distribution of capital demanded for the entrepreneurs given by $G(n_j)$. Facing that distribution, a given bank decides how much to lend, D^*_{ij}, to entrepreneur j using the objective function which maximizes returns in D_{ij}:

$$\max_{D_{ij}} \; D_{ij}(1 + \Gamma + R - \pi) - F(D_{ij} - n_j) \tag{2}$$

where R is the interest rate on the loan; $(1 + \Gamma + R - \pi)$ is the expected return on the loan net of charge-offs and the guarantee Γ; n_j is the underlying optimal amount of capital for entrepreneur j which generates heterogeneity in our model; and $F(D_{ij} - n_j)$ is a lending cost function that is increasing and convex in the funding gap.[5]

Lenders maximize returns with respect to loan amount, not interest rate R or risk π. This is motivated by the empirical observation that banks adjust D_{ij} in response to variation in the guarantee generosity, but not interest rates or risk level. Both interest rates and charge-off rates (an ex-post measure of risk) trend smoothly through the guarantee threshold, and, more importantly, a maximum interest rate cap actively binds approximately 85% of loans in the full sample, effectively constraining banks in their ability to charge differential interest rates.

For a linear guarantee function Γ, the bank's interior optimum solution satisfies the first order condition with respect to D_{ij}:

[5] We remain agnostic as to what fundamentals drive the convexity of $F(D_{ij} - n_j)$ - it could be due to a decrease in borrower demand and/or an increase in borrower specific default probability that occurs as the offered loan amount D_{ij} deviates from the underlying loan demand n_j. For example, lending too much to an business that should optimally borrow n_j could increase the probability of loan default, or the probability that the loan is rejected for a guarantee by the SBA. Lending too much may also decrease the probability that an entrepreneur accepts a loan offer. Despite the underlying mechanism, the convexity of $F(D_{ij} - n_j)$ controls how responsive bank lending will be to a change in the guarantee rate. As it determines the efficacy and impact of an additional dollar of public funds spent subsidizing the guarantee program, it remains a key parameter in welfare and policy analysis.

$$(1+\Gamma) = \pi - R + \frac{\partial F(D_{ij} - n_j)}{\partial D_{ij}} \tag{3}$$

This condition states that at the optimal lending amount D^*_{ij}, the marginal cost of lending an additional dollar $\pi - R + \frac{\partial F(D_{ij}-n_j)}{\partial D_{ij}}$ is equal to the marginal revenue $(1 + \Gamma)$. It implies that the bank's optimal level of lending D^*_{ij} is implicitly a function of the guarantee rate Γ, as well as the charge-off probability and underlying borrower type. From the government's perspective, an increase in the guarantee subsidy will impact program costs both directly through a higher guarantee rate, and indirectly through increased bank lending. While a full accounting of the welfare effects of an increase depends on a number of factors and is beyond the scope of this paper, the elasticity of credit supply to the guarantee rate is a key parameter - the government cost of generating an additional dollar of targeted lending is predicated by the bank's lending elasticity with respect to the guarantee rate. If the elasticity is very low, then a very high external social benefit from increased lending is needed to justify the distortionary cost of funding the guarantee.

2.1.1 Welfare Implications of Lending Elasticity

A government increase in the guarantee subsidy will impact program costs both directly through a higher guarantee rate, and indirectly through increased bank lending. Therefore, the government cost of generating an additional dollar of targeted lending is predicated by the bank's lending elasticity with respect to the guarantee rate. The bank's optimal level of lending D^*_{ij} is implicitly a function of the guarantee rate Γ, as well as the charge off probability and underlying borrower type; we denote this implicit function as $\bar{D}(\Gamma)$.[6] Consider a simplified setting that focuses only on the provision and funding of the guaranteed investment. Here the social planner evaluates its guarantee subsidy Γ and tax rate τ with regards to a social welfare function W that aggregates the surplus generated by lending and a fixed budget constraint:

$$\begin{aligned} &\max_{\Gamma,\tau} W(\bar{D}(\Gamma), X(\tau), Y) \\ &s.t.\ R_0 = \bar{D}(\Gamma)\Gamma - X(\tau)\tau \end{aligned} \tag{4}$$

[6]Due to the convexity of $F(D_{ij} - n_j)$, $\bar{D}(\Gamma)$ is increasing in Γ.

where X is aggregate quantity of a taxed commodity, and Y is lump sum income. Social welfare is weakly increasing in the loan volume, and decreasing in the tax rate. Lending volume is increasing in the guarantee rate, Γ, while quantity X is decreasing in the tax rate. A small increase in Γ will increase welfare by marginal social benefit from lending (MSB), $\frac{\partial W}{\partial \bar{D}}\frac{\partial \bar{D}}{\partial \Gamma}$, while also increasing expenditures by $\frac{\partial \bar{D}}{\partial \Gamma} + \bar{D}(\Gamma)$. The change in welfare coming about from a change in the lending volume captures the potential external benefits that might occur through increased lending. How large of an increase in lending occurs, $\frac{\partial \bar{D}}{\partial \Gamma}$, is the parameter we estimate. A budget neutral change requires that the government finance this increase in the guarantee rate through an increase in t such that $\frac{\partial \bar{D}}{\partial \Gamma} + \bar{D}(\Gamma) = -\frac{\partial X}{\partial \tau} + X(\tau)$. This reduces social welfare by $\frac{\partial W}{\partial X}\frac{\partial X}{\partial \tau}$, the marginal cost of funds (MCF). Whether a budget neutral change will be welfare improving therefore depends on whether the marginal social benefit from lending is greater than the cost of raising the funds to finance the project:

$$\underbrace{\frac{\partial W}{\partial \bar{D}}\frac{\partial \bar{D}}{\partial \Gamma}}_{MSB} - \underbrace{\frac{\partial W}{\partial X}\frac{\partial X}{\partial \tau}}_{MCF} = \text{Net Change in Welfare} \tag{5}$$

Equation 5 shows that the ability of the guarantee to generate additional lending, $\frac{\partial \bar{D}}{\partial \Gamma}$, is a crucial parameter for welfare analysis. While a full accounting of welfare depends on a number of factors and is beyond the scope of this paper, the elasticity of credit supply to the guarantee rate is a key parameter in determining the welfare effects of loan guarantees. If the elasticity is very low, then a very high external social benefit from increased lending is needed to justify the distortionary cost of funding the guarantee.[7]

2.2 SBA Loan Program

2.2.1 SBA 7(a) Loans

The SBA is an independent federal government agency created in 1953 with the mission of providing assistance to small businesses. We focus on the Lending Program, designed to improve

[7] As noted in Gale (1991), who conducts a calibrated cost-benefit analysis of federal guarantee programs, *"welfare loss [can] occur because the [guarantee] programs must be financed... [Calibrated] government costs per dollar of incremental targeted investment are extraordinarily high."* While a full welfare analysis must also take into account external benefits potentially generated by the subsidized lending, measuring the government costs provides a lower bound for how large the benefits must be to offset these welfare losses. In section 2.2 we discuss how we use a feature of a large federal guarantee program, the SBA 7(a) program, to estimate the elasticity of lending with respect to the guarantee rate.

access to capital for young small businesses that may not be eligible to obtain credit through traditional lending channels. The SBA Lending Programs are guarantee programs where the SBA guarantees a portion of loans originated by commercial lending institutions against losses from defaults, rather than lending directly to qualifying borrowers. We focus on the SBA's flagship loan guarantee program, the 7(a) Loan Program.

SBA 7(a) loans have several unique features which are relevant to this study. Most importantly, the maximum guarantee rate is based on a nonlinear size cutoff rule: loans up to \$150,000 carry a maximum guarantee rate of 85%, which drops sharply to 75% for loans larger than \$150,000. The guarantee fees also increase at the same threshold, making the overall guarantee less generous for loans larger than \$150,000. We exploit this guarantee notch around \$150,000 to identify our parameters of interest. Features of the SBA 7(a) program have remained relatively stable over the last decade, except during 2009-2010, when the SBA temporarily raised the guarantee rate on either size of the \$150,000 threshold to 90% and waived fees with the signing of the American Recovery and Reinvestment Act of 2009.[8]

To qualify for a 7(a) loan, a borrower must meet several requirements. First, a business must be a for-profit business that meets SBA size standards.[9] In addition to the size requirement, a business must be independently owned and operated and not be nationally dominant in its field. The business must also be physically located and operate in the U.S. or its territories. Lastly, small businesses must demonstrate the need for loan by providing loan application history, business financial statements, and evidence of personal equity investment in the loan proposal.

In order to qualify, borrowers must exhaust other funding sources, including personal sources, before seeking financial assistance, and be willing to pledge collateral for the loan (CRS, 2018; OCC, 2014; SBA, 2015). SBA 7(a) loans are intended as a last resort, and in order to ascertain that borrowers cannot access credit elsewhere, lenders are required to conduct *credit elsewhere* tests.[10] Lenders are required to demonstrate that borrowers cannot obtain the loan on reasonable

[8]This time period provides a helpful placebo test for our analysis, since no lending response should occur in a year when there is no discrete change in the guarantee rate.

[9]Size standards vary by industry, and are based on the number of employees or the amount of annual receipts ("total income" plus "the costs of goods sold").

[10]The SBA provides further information regarding credit elsewhere tests. Addition Appendix Table A.6 shows the fraction of firms accessing multiple sources of credit in the 2003 Federal Reserve SSBF that have loans from a government agency, including the SBA. The table indicates that very few firms that have SBA loans are accessing credit from multiple sources.

terms without the SBA guarantee, and that the funds are not unavailable from the resources of the applicant. The personal resources of any applicant who owns more than 20 percent of the small business are reviewed. The SBA monitors lenders' compliance with the credit elsewhere test through targeted reviews. Failure to comply with credit elsewhere tests can lead to the denial of a guarantee, exclusion from the lending program and other enforcement actions from the Office of Credit Risk Management.

The 7(a) loans are disbursed through private lending institutions. This loan submission and disbursement procedure depends largely on the lender's level of authority (i.e., delegated or non-delegated) provided by the SBA. The SBA conducts its own analysis of the application and approves the originating lender's decision to lend, which can be expedited depending on a lender's experience. In practice, SBA lenders have meaningful bargaining power over credit supply. In a typical case, a borrower requests a loan to a lender, and the lender decides whether the SBA loan would be suitable for a given borrower upon reviewing the borrower's background. Given that lenders cannot provide more than one loan to a single borrower such that SBA-guaranteed loan is secured with a junior lien position, lenders have incentives to retain this bargaining power and be selective in choosing borrowers.

Guarantees consist of two components, a reimbursement rate and a fee and operates in a fashion similar to an insurance contract. The reimbursement rate is the fraction of each dollars charged off that the bank receives back from the SBA. The fee is the amount that the bank must pay to participate in the 7(a) program. Reimbursement rate and fees are typically determined by an Office of Management and Budget (OMB) model, and vary from year to year but have been changed through legislation such as the American Recovery and Reinvestment Act (ARRA).

2.3 Data

We obtain the 7(a) loan data from the Small Business Administration.[11] This loan origination dataset includes basic information about the participants (i.e., the identity of the borrower and the lender, their addresses, city, zip code, and industry), non-pricing terms (i.e., loan volume, guarantee

[11] The SBA requires all participating lenders in the 7(a) program to submit loan applications (Forms 1919 and 1920) to the 7(a) Loan guarantee Processing Center ("LGPC") when they request a new loan. Delegated lenders must complete the form, sign and date, and retain in their loan file before processing a loan for faster processing. The information included in these forms are then compiled into a dataset and provided publicly pursuant to the Freedom of Information Act (FOIA).

amount, or approval date), pricing term (i.e., loan spread plus base rate), ex-post loan performance, such as the total loan balance that has been charged off, and other administrative details such as the delegation status of the lender and the SBA district office that processed the loans.

For our analysis, we only consider loans originated over the last decade—2008 to 2017—under the SBA 7(a) program. We exclude SBA 7(a) Express loans and drop 22 loans that appear to be spurious (i.e., loans for which the guaranteed share is greater than 100 percent of the amount originated). Under these restrictions, the sample covers 199,013 loans originated by 3,066 lenders to 177,049 borrowers. Table 1 presents summary statistics for the main analysis variables.[12] A median SBA loan size is $460,000 and the guaranteed amount is $356,400. The median loan maturity and the interest rate at the time of origination are 10 years and 6 percent, respectively. Since the median prime rate is 3.25% in our sample, the maturity and interest rates are consistent with the SBA's maximum interest rate rule that loans with maturity of over 7 years with the amount greater than $50,000 can carry the maximum rate of 2.75% over the prime rate. The median charge-off amount is zero while the mean is $11,706, indicating that the share of loans that are eventually charged off is small. Panels B of table 1 report the same statistics for subsample of loans used for notch estimation, where we restrict the loan size to be between $75,000 and $225,000. Once we take this restriction, we include 41,460 loans in the main analysis sample.[13]

We use this data to estimate private lenders' responsiveness to federal loan guarantees. It is important to note that lenders cannot manipulate the lending structure by issuing multiple guaranteed loans to the same borrower. As discussed in the institutional details section, the SBA prohibits lenders from originating loans with a "piggyback" structure where multiple loans are issued to the same borrower at the same time, and the guaranteed loan is secured with a junior lien position. While this policy does not prevent lenders from having a shared lien position with the SBA loans (i.e., Pari Passu), we confirm in our data that more than 99 percent of the borrowers receive only one loan from the same lender at the same time. As reported in 1, the average number of loans a given borrower receives from the same lender and year is 1. Thus, the SBA 7(a) program serves

[12]Note that while the distribution is relatively similar to that in other papers using SBA data, such as Brown and Earle (2017), we only include 7(a) loans between 2008 and 2017. The difference in mean to relative to Brown and Earle (2017) come from the fact that they include 504 loans which are up to $5.5 million, whereas we only examine loans below $350,000 in our main analysis sample.

[13]For certain heterogeneity analysis, we also link our main data to Federal Deposit Insurance Corporation (FDIC) Statistics on Depository Institutions Data. This dataset and sample construction is discussed in appendix B. Additional robustness checks vary the main analysis sample, to include some loans from the sample shown in panel A.

as a close to ideal laboratory to conduct a notch estimation for studying the impact of federal loan guarantees on credit supply.

3 Empirical Approach

We estimate the elasticity of lending to a change in the guarantee rate using the discrete change in the level of the guarantee rate in the SBA 7(a) lending program. This approach uses the excess mass at the threshold to estimate an implied lending response to the change in the guarantee rate and provide nonparametric estimates of the elasticity of credit supply, following closely the methodology outlined in Kleven and Waseem (2013).[14] Recall that a bank i decides how much to lend, D_{ij}, to entrepreneur j using the objective function which maximizes returns in D_{ij}:

$$\max_{D_{ij}} D_{ij}(1 + \Gamma(D_{ij}) - \pi + R) - F(D_{ij} - n_j) \tag{6}$$

We calculate $\Gamma(D_{ij})$ as the observed ex-post return on a loan, net of realized charge-offs, guarantee fee payments, and guarantee reimbursements. We use our loan-level data to first model an indicator for loan default as a function of loan size. We multiply the predicted default probabilities (π) by the guaranteed reimbursement rate (γ) to find the expected reimbursement rate on a given loan– this implicitly assumes a 100% charge off rate on defaulted loans. We then subtract the loan fees (σ), which are paid to the SBA and are also expressed as a percentage of loan principal. This provides the net subsidy rate provided to banks by the SBA, the empirical analogue to $\Gamma = (\gamma\pi - \sigma)$ in Section 2.1.

Empirically, the default probability varies little across the threshold, whereas γ and σ vary significantly. This generates a discrete drop in the return the bank makes on lending right above the threshold. Specifically:

$$\Gamma(D_{ij}) = \begin{cases} \Gamma, & \text{if } D_{ij} \leq D^T \\ \Gamma - \Delta\Gamma, & \text{otherwise} \end{cases}$$

[14] The studies that distinguish different bunching designs consider kink points as points where there is discrete changes in the *slope* of choice sets, and notch points as points where there is discrete changes in the *level* of choice sets (Kleven, 2016). We consider the $150,000 cutoff as the notch point. There are several advantages to using a notch as it is possible to identify structural parameters net of optimization frictions.

In the absence of a notch, we assume there would have been a smooth distribution of loans made that would satisfy the banks' first order condition.[15] The notch however creates a region directly above the threshold for a subset of loans where marginal revenue $(1 + \Gamma - \Delta\Gamma)$ is strictly lower than the marginal cost $\pi + \frac{\partial F(D_{ij} - n_j)}{\partial D}$. The *marginal* bunching loan (with underlying type $n_j = n_b$) is made at the point $D^T + \Delta D$ where the bank is indifferent between making a smaller loan under the more generous guarantee and making a larger loan under the less generous guarantee:

$$D^T(1 + \Gamma - \pi + R) - F(D^T - n_b) = \\ (D^T + \Delta D)(1 + (\Gamma - \Delta\Gamma) - \pi + R) - F(D^T + \Delta D - n_b)$$

Therefore, ΔD captures the reduction in dollars lent in response to the change in the guarantee rate for this marginal buncher, and it is the key empirical parameter needed to calculate the elasticity of lending. The substantial excess mass we observe in the data at the point $D_{ij} = D^T$ comes from this region of strictly dominated lending for the bank $(D^T, D^T + \Delta D)$ directly above the notch point. This allows us to map the amount of excess mass to the loan response ΔD using the bunching methodology we discuss below in section 3.1.

Within the dominated region the bank can always increase its return by making smaller loans under the higher guarantee rate Γ. The size of the dominated region (and therefore the reduced form elasticity of lending the guarantee rate) relates to the slope of the marginal cost function $F(D_{ij} - n_j)$ - if a small change in D generates a sharp increase in costs, there will be a small dominated region and a small elasticity of lending. If a change in D has little impact on costs, then there will be a larger dominated region, more bunching at the threshold, and a larger elasticity of lending with respect to the guarantee rate.

3.1 Bunching Methodology

This section describes the estimation methodology in detail. Our objective is to estimate the reduced form lending elasticity with respect to the guarantee generousity, or the percentage change

[15]Conditional on and mapping directly to a smooth underlying distribution of loan demand, n_j.

in dollars lent that results from a corresponding percentage change in the guarantee generousity

$$\varepsilon_{D,\Gamma} \equiv \frac{\Delta D}{D^T} \times \frac{(1+\Gamma^*)}{\Delta\Gamma^*} \tag{7}$$

where $\Delta\Gamma$ is the change in the marginal guaranteed return faced by the bank. We estimate the elasticity in a reduced form by noting that a notch in the marginal guarantee rate allows us to approximate the *implicit* marginal guarantee rate , Γ^*, created by the notch: $\Gamma^* \approx \Gamma + \Delta\Gamma \frac{D^T}{\Delta D}$. We can then write the reduced form elasticity as:

$$\varepsilon_{D,\Gamma} \approx \left(\frac{\Delta D}{D^T}\right)^2 \times \frac{(1+\Gamma)}{\Delta\Gamma} \tag{8}$$

We obtain the parameters for elasticity estimation from the SBA data. The threshold D^T is \$150,000 for the years in our sample. We calculate $(1+\Gamma)$ as the observed ex-post return on a loan, net of realized charge-offs, guarantee fee payments, and guarantee reimbursements. As noted earlier, interest rates and ex-post charge-off rates trends smoothly through the threshold; therefore all systematic variation in returns come from changes in the generosity of the guarantee contract at the threshold. Over our time period, loans less than or equal to \$150,000 had lower guarantee fees and higher guarantee reimbursement rates than loans to the right of the threshold. Given that the generosity varies over time, we estimate the excess mass and elasticity separately by year.

To calculate ΔD empirically, we must locate the counterfactual loan amount provided to the marginal buncher; this occurs at the point where the excess mass at the threshold is equal to the missing mass to the right of the threshold. To measure the excess and missing mass we estimate the counterfactual loan distribution that would have occurred in the absence of a notch by fitting a polynomial of degree 6 with a vector of round number dummies for multiples of 1,5, 10, 25, and 50 thousand, and excluding a region at and to the right of the threshold:

$$N_j = \sum_{k=0}^{6} \beta_k (d_j)^k + \sum_{i=d_l}^{d_u} \delta_{ij} \mathbb{1}(d_j = i) + \sum_{n\in\{1k,5k,10k,25k,50k\}} \delta_n \mathbb{1}(d_j = n) + \eta_j \tag{9}$$

where N_j is the number of loans in bin j, d_j is the loan amount midpoint of interval j, $\{d_l, d_u\}$ is the excluded region, δ_{ij}'s are dummies for bins for the excluded region, and δ_n's are dummies for multiples of prominent round numbers. For estimation, we cut the data into \$500 dollar bins and restrict the loan size to be between \$75,000 and \$225,000 to limit the estimation range. For robustness, we repeat the estimation with \$200, \$1000, and \$2000 bins, polynomials of degree 4, 5 and 7, and for various ranges of estimation; these results are shown in the appendix.[16] The counterfactual distribution, $\hat{N}_j$, is estimated as the predicted values from equation 9 using the β_ks and the δ_ns:

$$\hat{N}_j = \sum_{k=0}^{6} \hat{\beta}_k (d_j)^k + \sum_{n \in \{1k, 5k, 10k, 25k, 50k\}} \hat{\delta}_n \mathbb{1}(d_j = n) \tag{10}$$

Excess mass is defined as the difference between the observed and counterfactual bin counts between the lower limit of the excluded region (d_l) and the threshold, $\hat{B} = \sum_{j=d_l}^{D^T}(N_j - \hat{N}_j)$, whereas the missing mass, $\hat{M} = \sum_{j=D^T}^{d_u}(N_j - \hat{N}_j)$, is defined as the same bin counts but in the range between the threshold and the upper limit of the excluded region (d_u). To identify this upper limit (i.e. $d_u = D^T + \Delta D$), the methodology requires the excess mass $\hat{B}$ be equal to the missing mass $\hat{M}$. Thus, the estimation procedure proceeds in four steps. First, the estimation begins with a starting value of d_u right above D^T. Second, we calculates $(\hat{B} - \hat{M})$. The next step is to increase d_u by a step size of \$500 if $(\hat{B} - \hat{M} \neq 0)$. Finally, we repeats these steps until the result converges.[17]

We calculate standard errors for equation (8) using a non-parametric bootstrap procedure in which we draw a large number of loan distributions following Chetty, Friedman, Olsen and Pistaferri (2011). We create new bins of loans by drawing randomly with replacement from the estimated vector of $\eta_{\mathbb{j}}$ and adding those to the estimated distribution implied by the coefficients $\{\hat{\beta}_k, \hat{d}_j, \hat{d}_u\}$ from equation (9). Finally, we apply the bunching estimator technique described above again to calculate a new estimate $\hat{\varepsilon}^b_{D,\Gamma}$. We repeat this procedure 1,000 times and define the standard error as the standard deviation of the distribution of $\hat{\varepsilon}^b_{D,\Gamma}$s created. As we observe the universe of SBA 7(a) loans over the years considered, the standard error represents error due to misspecification of the polynomial and the number of dummies included in the exclusion zone used in rather than sampling error.

Figure 1 visually illustrates the variation that we will use to identify the elasticity of credit

[16] While the results are very robust to the different bin and polynomial choices, they are sensitive to the inclusion of \$50,000 within the range. Another interest rate related threshold exists at the \$50,000 mark, which causes additional bunching, and therefore we excluded it from our ultimate estimation.

[17] We pool together all banks in our main estimation. However, to test whether the elasticity and bunching is driven by a specific bank we have also repeated the estimation on a conditional distribution that controls for bank fixed effects. The bunching and elasticities are very similar.

supply to the loan guarantee. The figure shows the raw data in 2013, where the guarantee notch is relatively small, and again in 2015 when the guarantee notch is larger. Figure 1 illustrates the striking contrast in bunching in 2013, when there was a small notch, and 2015, when there was a large notch. The left panel shows the number of loans, in discrete $2,000 bins, while the right panel shows the total expected guarantee benefits. In 2015, where the total expected guarantee is comparatively higher, we see more bunching relative to 2013.

The validity of the bunching estimate relies on two central assumptions: 1) that the counterfactual distribution would be smooth in the absence of a notch, and 2) bunchers come from a continuous set such that there exists a well defined marginal buncher. While the second assumption is technical and fairly weak, the first assumption warrants some discussion. This assumption effectively rules out that other factors are changing at the threshold, which might influences bunching. The fact that the bunching disappears completely in the placebo years when no notch exists suggests that there are no other factors generating bunching at the threshold and helps to validate the first assumption.

The bunching technique captures intensive margin responses. If banks reject applications simply because they are above the threshold, this would lead us to underestimate the credit supply response to the guarantee further away from the notch, and make our estimates more sensitive to the choice of polynomial used. While these extensive margin responses are unlikely in our setting, since the bank has considerable power when deciding how much to lend and could increase returns by reducing D_{ij} rather than not lending at all, we test the sensitivity of our estimates to the choice of parameters.[18] We show in table 3 that our results are robust to using a range of polynomial choices, which suggests that extensive margin responses do not play a large role in our setting.

[18]Kleven and Waseem (2013) show that these extensive margin responses should only occur in a region far to the right of the notch, with the intensive margin response concentrated in the area directly next to the notch. They note that extensive margin bias will mainly enter via functional form misallocation, and therefore sensitivity analysis should be conducted with respect to the polynomial.

4 Main Results

4.1 Visual Evidence

We begin by showing the change in guarantees at the $150,000 threshold. The left panel of figure 2 shows average guarantees and fees by loan amounts, as a percentage of the loan principal amount in $2,000 bins across the threshold between 2008 and 2017. Consistent with the policy rule, the guarantee benefit jumps sharply across the threshold– loans below $150,000 see a guarantee rate nearly twice as generous as loans above the threshold.[19]

To determine whether the guarantee benefit notch affects lending volumes, we analyze the density of borrowing. The right panel of figure 2 shows bunching directly below the threshold. The figure shows the number of loans in $2,000 bins across the threshold between 2008 and 2017. Visual evidence indicates that there are significantly more loans at the threshold relative to other points nearby. This is consistent with banks lending fewer dollars in response to a lower guarantee rate - i.e. moving borrowers to loan volumes below the notch.

Figure 3 shows the observed and counterfactual density of loans. The solid line shows the observed number of loans, while the dashed line shows the counterfactual number of loans. The counterfactual is determined according to the method discussed in section 3, and is estimated as specified in equation 10. Four points are immediately clear from Figure 3. First, there are clearly significantly more loans disbursed just at the threshold, which is consistent with guarantees affecting credit supply. Second, there is also missing mass to the right of the guarantee notch. In other words, the counterfactual distribution is higher than the observed observed distribution. Third, the observed numbers of loans is lower to the right of the threshold. Finally, there is significant round number bunching, which is captured by our modeling procedure.

4.2 Elasticity Estimates

Table 3 formalizes and scales the bunching noted above relative to the change in the size of the guarantee; it presents estimates of $\varepsilon_{D,\Gamma}$, as described in section 3. The first column shows the degree of the polynomial used to estimate the counterfactual distribution – we vary this to test

[19]Appendix Figure A.1 breaks down the guarantee benefit by the average expected guarantee fees and reimbursement rate separately.

sensitivity to the parameter choices and gauge whether extensive margin responses are playing a large role. The second column shows the estimated excess mass, $\hat{B}$, in terms of the number of loans. The third column shows estimates of ΔD, the distance of the marginal buncher in dollar terms from the threshold. The fourth column presents $\Delta\Gamma$, the change in the generosity of the guarantee rate at the notch.[20] The final column shows estimates of $\varepsilon_{D,\Gamma}$, the elasticity of dollars of loans made with respect to the guarantee rate.

The first row show estimates from placebo years, when the notch was eliminated as part of the ARRA stimulus of 2009. Reassuringly, we see very little excess mass when loan guarantees are identical across the notch. This assuages potential concerns that other factors may be changing across the threshold, and is discussed further in the next subsection. Note that we cannot compute elasticity estimates in 2009 and 2010, as there is no variation in the notch.

The second row shows estimates from years when the guarantee notch was binding. The estimates of the elasticity are approximately 5.1, and range from 4.6 to 5.4 depending on the polynomial used. Interpreted in dollar magnitudes, this means that a 3.7 *percentage point* change in the guarantee subsidy rate (Γ) generates $70,500 dollars in additional lending.[21]

4.3 Bunching over Time and Placebo Estimates

The observed amount of bunching varies over time with the size of the guarantee notch. Figure 4 breaks up the above bunching, for each year between 2008 and 2017. The figure shows annual guarantee generosity and bunching over time. The figure groups years into three broad groups, years during which there is a high, low or no guarantee. Between 2014 and 2017, the size of the notch was between .04 and .08 of the average expected guarantee benefit as a percentage of the loan principal. In 2008, and between 2011 and 2013 the notch was between .02 and .03 of the average expected guarantee benefit as a percentage of the loan principal. In 2009 and 2010 the notch was eliminated as part of the ARRA.

We see a very close relationship between the guarantee change and observed bunching at the threshold, which is defined as the difference in the share of individuals between the observed and counterfactual density. In years with a large change in the guarantee, we see greater excess mass

[20] Over the years in our sample, $\Delta\Gamma$ varied between 0 and .078. For this estimate we take a weighted average of $\Delta\Gamma$ in non-zero years to pool across years; in the appendix we also list estimates by year.

[21] 3.7 percentage point is the average size of the discontinuity across the years used in our main estimation.

relative to years with a lower guarantee change at the notch. We also see no bunching in years when the notch was eliminated. In the two years in which there was no change in the guarantee (the bottom row), there is no excess mass at the threshold.

Figure 5 provides additional reduced form evidence that this bunching is indeed driven by guarantees. As discussed in section 2.2, the generosity of guarantees varies over time. The generosity of the guarantee across the notch has varied significantly over time, which allows us to explore dynamic aspects of the lending response. Consistent with the bunching being driven by loan guarantees, and not by any other factors changing across the threshold, we find higher excess mass in years when the difference in the guarantee across the threshold is greater. Figure 5 shows the relationship between share of excess mass at the threshold and the guarantee rate in each year.[22] The figure shows the amount of bunching occurring at the $150,000 threshold against the size of the guarantee change at the threshold between 2008 and 2017, in ten bins absorbing bank fixed effects. The left panel plots the share of excess mass and the change in the guarantee at the threshold. There is a striking linear relationship between the share of excess mass and the guarantee rate. The right hand panel shows the relationship between the share of excess mass and guarantee rates over time. The figure shows that the observed excess mass rises and falls with the guarantee rate, and there is a strong relationship between the guarantee rate, which affects incentives to bunch and the amount of observed bunching that occurs.

Table 4 repeats the main analysis, showing estimates year by year. While estimates are relatively stable between 2008 and 2013, and similar in 2017, the estimates of $\varepsilon_{D,\Gamma}$ are about one third the size of estimates in other years in 2014 and 2015. We see little excess mass in years when the notch was eliminated, and excess mass starts to grow sharply in 2014, when the guarantee notch becomes larger. This growth in excess mass is consistent with optimization frictions– banks may take some time to increase credit supply. This can be seen in the left panel of figure 5. While there is a sharp jump in the guarantee notch between 2013 and 2014, approximately doubling and moving from .033 to .077, the increase in excess mass is more gradual and increases year by year. The pattern translates to an initially lower elasticity, which increases to around 5 in 2017.[23]

[22]For this figure, we again use our reduced form measure of excess mass: we observe some bunching at round number points, as is show in figure A.2. To account for this, we calculate excess mass at the threshold relative to intervals of $50,000 between $50,000 and $300,000.

[23]Note that we observe some loans being made in the dominated region directly to the right of the threshold; this suggests that banks face optimization frictions when trying to adjust some loan sizes. Therefore we estimate a *reduced*

The 2009 ARRA stimulus provides a placebo check. As part of the stimulus, in 2009 the SBA temporarily raised the guarantee rate to 90% and waived fees as part of the 2009 ARRA stimulus.[24] This effectively eliminated the guarantee notch at $150,000. It is immediately evident graphically that the lending response drops when guarantee notches are eliminated. In Figure 4, which shows the excess mass by year, the bottom row shows the years during which the notch was eliminated. Between 2009 and 2010, when guarantee rates were identical across the threshold, we do not observe any excess mass beyond round number bunching. The fact that excess bunching is only present in years when the guarantee rate is discontinuous assuages potential concerns that other factors may change discontinuously across the threshold.

4.4 Magnitudes

This subsection discusses the implied magnitudes of our estimates. For context, the average guarantee subsidy rate over all years/loan sizes in our data is 1.9% of loan principal – this means that a lender making a loan through the guarantee program receives a subsidy worth 1.9% of the loan size. The subsidy rate includes the expected reimbursement the lender will receive on any losses minus the guarantee fees ($\Gamma = \pi \times \gamma - \sigma$). Empirically, the guarantee subsidy ranges in generosity over years and loan size from -8% (the guarantee fees outweigh the expected reimbursement) to 11.6%.

Our elasticity suggests that if the guarantee subsidy rate (Γ) increased by 1 *percentage point* for a given loan, this would generate an intensive margin response of $19,054 dollars in additional lending. To increase the overall guarantee subsidy rate, the SBA could either increase the reimbursement portion (γ) or decrease the guarantee fees (σ). For example, increasing the reimbursement rate on a loan from 80% to 90% would increase the overall subsidy rate by $10\% \times \pi = 1.06\%$,[25] and generate $20,197 in additional lending. Decreasing the loan fee (σ) from 2.89% of loan principal (the average rate in 2008) to 0% (the rate in 2009), would increase the overall subsidy rate by 2.89% and generate $55,066 in intensive margin additional lending.

These magnitudes are also consistent with the observed risk-related costs of lending: in dollar

form elasticity that is inclusive of adjustment costs, rather than a structural elasticity.

[24] See Lucas (2016) for a discussion of the relationship between credit and fiscal policy. Lucas (2016) finds that federal credit programs had significant effects as automatic stabilizers, comparable in magnitude to the effects of the American Recovery and Reinvestment Act of 2009.

[25] The average charge-off rate over all years in our data is 10.6%.

terms, a 1 percentage point subsidy that generates $19,054 dollars in additional lending has a dollar value of $190 and generates an expected repayment loss of $2,020 for these marginal dollars. Note that the subsidy rate is quoted in terms of "percentage of principal". Since lenders under the guarantee program are responsible for only 10-15% of these losses, this suggests that the additional subsidy revenue is offset roughly 1-to-1 with an increase in costs. These estimates are consistent with elasticities used for model parameters in Lucas (2016), who notes that during this time period high levels of bank reserves and loose monetary policy suggest a high elasticity of supply around 2010. The estimates are on the higher end of estimates used in Gale (1991). This suggests that loan guarantees do indeed impact lending to small business, and do not simply act as a subsidy to lenders.

5 Alternative Channels, Robustness and Placebo Estimates

5.1 Demand and Supply Elasticities

One concern is that our estimates do not identify lenders' elasticity of supply to the guarantee rate, but rather borrowers' elasticity of demand. It is in theory possible that guarantees are passed through to borrowers in the form of lower interest rates. Specifically, borrowers may be more likely to apply for a smaller $150,000 loan if the guarantee is passed through via a lower interest rate or lower risk standards. However, there are several institutional details that make a demand channel unlikely: as noted earlier, lenders are unable to issue multiple loans to the same borrower under the SBA program, making manipulation of the notch unlikely. Furthermore, borrowers must have exhausted all other financing options to qualify for an SBA loan, which rules out the possibility that banks or borrowers are topping up their SBA loans with additional private funding.[26] The observed data is also inconsistent with this demand side hypothesis. We find that a negligible portion (.03%) of loans are categorized as "revolving" debt - i.e. a line of credit that can be drawn down by the borrower, and could also lead to demand-driven manipulation of the notch.

Despite the fact that institutional details make a demand channel unlikely, we still check whether the notch induces borrowers to bunch at the threshold by observing whether interest rates

[26]The eligibility criteria listed on the SBA website specifically states that to qualify for a 7(a) loan "the business cannot get funds from any other financial lender."

or ex-post charge-off rates (a measure of borrower risk) change discretely at the threshold. Figure 6 shows average interest rates and the guarantee notch. Interest rates evolve smoothly despite the sharp guarantee notch. Figure 7 provides some insight as to why this may be the case– the majority of loans are priced at the cap on each side of the threshold.

Figure 8 shows that both measures trend smoothly through the cutoff, suggesting that the generosity in the guarantee is not passed on to the borrower through either an intensive margin interest rate effect or an extensive margin rationing effect. This implies that borrowers have no incentives to bunch at the threshold because requesting smaller loans to bunch at the notch only gives them less capital with no added benefits. Given this lack of incentives to bunch from the perspective of the borrowers, it is unlikely that the bunching is demand driven.

It is also possible in theory that borrowers request smaller loans than they otherwise would have if they believed that bunching at the notch improves their odds of getting the loan approved. If this is the case, this is still interpretable as a supply elasticity, since it is operating through a supply side mechanism: the approval rate. If the supply side was not reducing credit supply to the right of the notch, borrowers would not modify their loan requests.

5.2 Competition and Loan Substitution

5.2.1 Loan Substitution

One concern is that we are not measuring a supply elasticity, but rather a substitution elasticity– i.e. the loan guarantee is not generating additional lending, but rather incentivizing banks to shift loans from their non-SBA small business portfolio into the SBA portfolio. The missing mass that we observe to the right of the notch could actually be caused by banks placing low-guarantee loans in their non-SBA portfolio.

If this were the case, we would expect a discontinuity in the number of loans originated at the \$150,000 size cutoff. While this channel would not generate excess mass at the \$150,000 notch, it could generate spurious missing mass to the right of the notch and thus confound our elasticity estimates. To assuage this concern, we re-estimate our main analysis, restricting to lenders that specialize in making SBA loans. We link the SBA lenders to call report data and compute the total share of SBA loans originated by each lender. See Appendix B for a description of how we compute the share by lender. A number of lenders, such as Live Oak Bank, specialize in making SBA guaranteed loans and offer few, if any, other products. These lenders are thus unable or unlikely to shift individuals to other products.

To investigate possible substitution, we merge the SBA dataset with quarterly Statistics on Depository Institutions (SDI) data from the FDIC.[27] The SDI data records the total number and amount of small business loans outstanding at a quarterly level per institution, and further splits small business lending into categories of loan size and purpose. We specifically look at small business commercial and industrial loans under $1 million, since these are most comparable to those provided through the 7(a) program.[28] We also aggregate the SDI statistics to the yearly level. Appendix B provides further information on the FDIC SDI data.

Table 5 repeats the main analysis, splitting the sample by the number of active banks and the share of SBA loans over all loans disbursed by a given bank.[29] The bottom two panels of Table 5 splits the sample by lenders. The first panel splits lenders by the whether the share of SBA loans is above or below 60%, while the final panel splits lenders by whether the share of SBA loans is above 80%. The elasticity estimates are slightly higher at SBA specialized lenders, but overall the estimates are very similar. We thus do not find evidence that our results are biased by lenders substituting loans between SBA and non-SBA products.

5.2.2 Competition

A related concern is that individuals may be borrowing more via other sources, mitigating the credit supply effects. Generally SBA 7(a) loans carry higher interest rates than most other loan products, making it unlikely that borrowers would seek these products if other financing options are available. While the SBA requires lenders to document and verify a "credit elsewhere" requirement, in other words that that borrower cannot obtain the requested funds without undue hardship, it is still possible that these tests are ineffective or lenders are not compliant. To test this channel,

[27]We match the majority of banks in our data (including federal credit unions) at an overall rate of 83%, and a rate of 96% conditional that call report data exists (prior to Q1 2010 SDI reports were only provided yearly in Q2).

[28]Commercial and industrial (C&I) loans are any type of loan made to a business or corporation as opposed to an individual. Commercial and industrial loans can be made in order to provide either working capital or to finance capital expenditures like machinery or a piece of equipment. This type of loan is usually short-term in nature and is almost always backed by some sort of collateral. The 3 other subcategories include loans secured by non-farm nonresidential properties, loans secured by farmland, and loans to finance agricultural production.

[29]Plots of the estimated counterfactual density for both splits are in A.4.

we split the sample by the number of banks operating in a county. In geographic areas with fewer banks operating, it is more difficult for firms to access other forms of credit.

The top panels of Table 5 splits the sample by the number of banks operating in a county. The first panel splits the sample by the number of banks being above or below three, while the second panel splits the sample by the number of banks being above or below 7. While the estimates in counties with fewer banks are slightly lower, suggesting some noncompliance with the credit elsewhere checks, we still observe significant excess mass and large elasticities between 3 and 5 in counties with fewer branches.

The fact that we see similar elasticities for specialized lenders is also evidence that there is a significant response from lenders who are compliant with the credit elsewhere test. Lenders can be excluded from the guarantee program if they repeatedly fail to verify credit elsewhere tests, and exclusion from the program is extremely high cost for lenders that specialize in making these loans.

5.3 Robustness

The main results are robust to a number of alternative specifications, which are presented in the appendix. Table A.4 tests the sensitivity of our elasticity estimates by varying key parameters. Our main estimates use a polynomial of degree 6 to estimate the counterfactual loan distribution and a step size of $500 when iterating through the routine to find the upper limit of the excluded zone. In Table A.4, we vary the polynomial (top panel) to degree 5 and 7 while keeping the step size constant, and vary the step size while keeping the polynomial constant. The elasticity estimates appear quite robust to the choice of polynomial, and do not seem to have a specific direction of bias (smaller or larger) when we increase the polynomial degree. The estimates are also quite similar to those in Table 4 when we vary the bin size.

Appendix Table A.5 varies the range and bin size. In the main estimation, we estimate the sample between $75,000 and $225,000, with a step size of 500. The first column denotes alternative loan size ranges, while the top row denotes alternatives bin size. The elasticities remain significant and large when using alternative ranges and bin sizes, and are between 3 and 7.

6 Concluding Remarks

The efficiency of federal credit guarantees depends crucially on how responsive the lending supply is to the subsidy. Specifically, the marginal change in costs per dollar of lending generated decreases in the elasticity of loan supply to the guarantee. This paper uses notches in SBA lending rules to provide the first estimates of the small business credit supply response to guarantees. We find that supply is responsive to loan guarantees - significantly more loans are disbursed below thresholds where guarantees are higher, and we find that this bunching is stronger in years when guarantee rates are greater, and disappears when guarantee rates are temporarily eliminated.

While we have shown that lending supply is responsive to guarantee rates– a key parameter when considering the welfare effects of federal credit programs– important questions remain unanswered. Perhaps most importantly, the efficiency of loan guarantees ultimately rests on the efficiency of the rate of return on marginal loans which are made, and whether this is greater than the risk free rate. Moreover, federal credit programs can have allocative effects, transferring credit from one rationed group to another. Future work should attempt to study both the allocative effects of federal credit programs, and the return of loans being made under these programs.

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Figure 1: Bunching at the Guarantee Notch in 2013 and 2015

Notes: The left panel shows the number of loans made in discrete $2,000 bins made in 2013 (red) and 2015 (black). The right panel shows the change in the guarantee rate at the threshold in these two years. In 2015, when the change in the guarantee at the threshold was much larger than in 2013, there was substantially more excess mass at the threshold. Source: SBA.

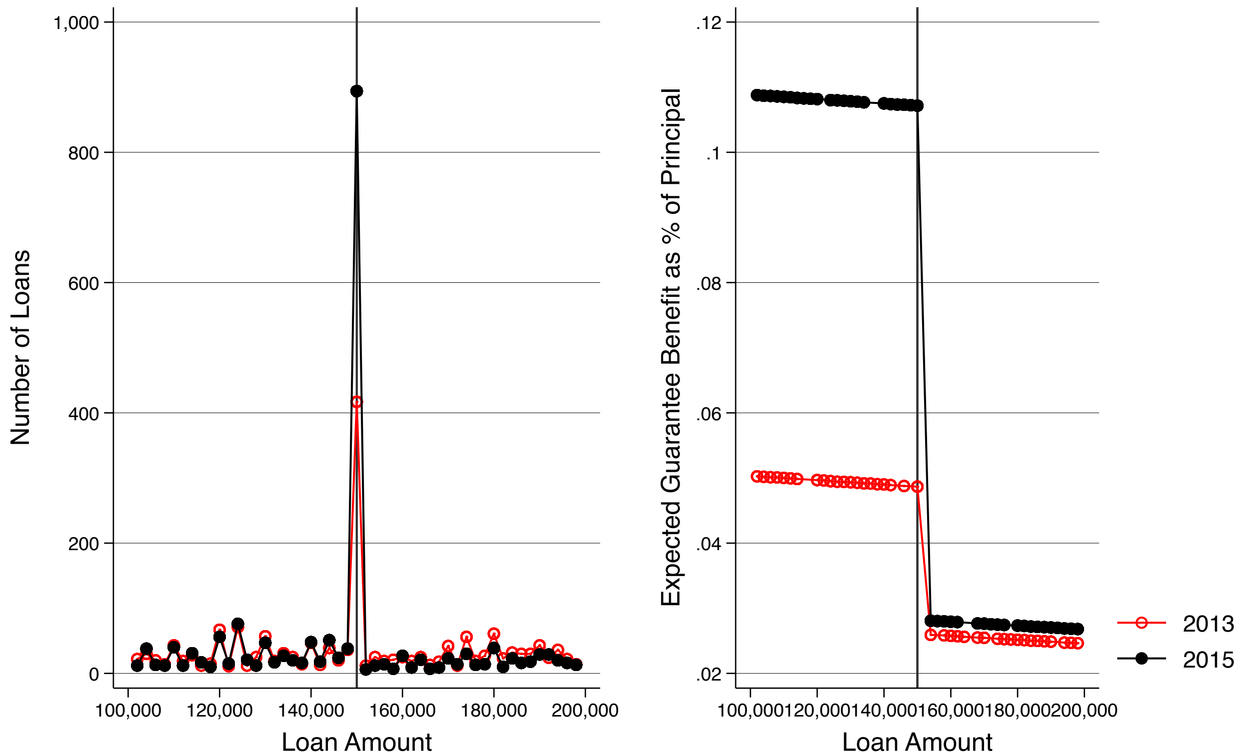

Figure 2: Guarantees and Fees by Loan Amount

Notes: The left panel shows the average expected guarantee benefit as a percentage of the loan principal amount for discrete $2,000 bins across the threshold. This net benefit is calculated as the guaranteed reimbursement on expected losses minus guarantee fees. The right panel shows the number of loans made in discrete $2,000 bins across the threshold. The figures pool over all years 2008-2017. Source: SBA.

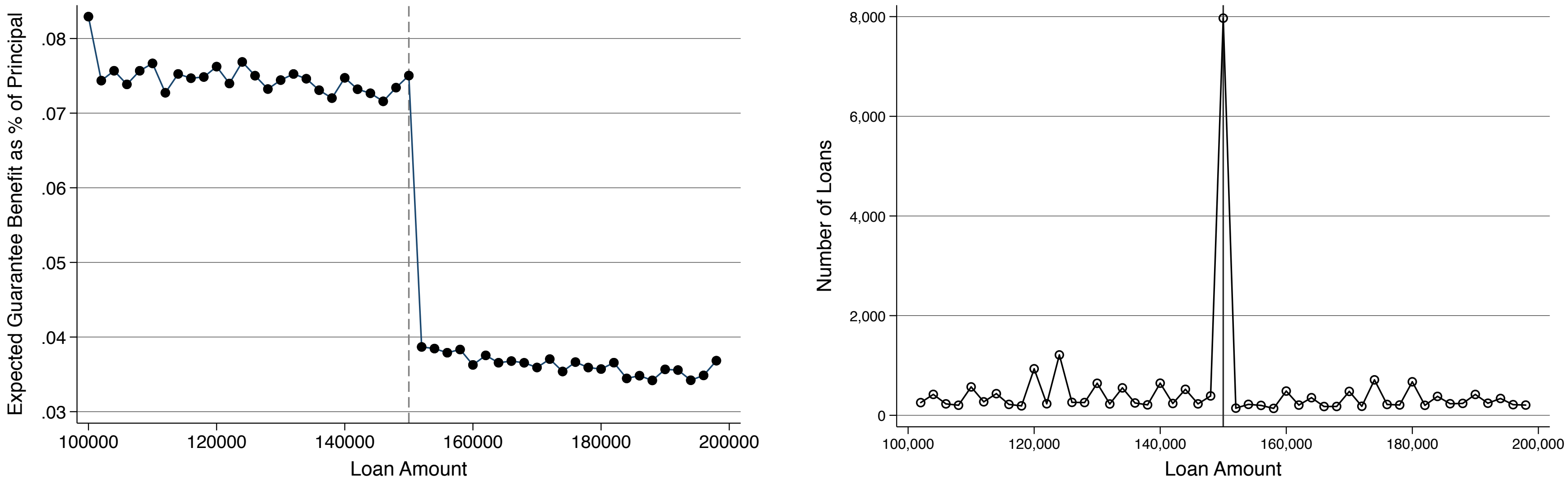

Figure 3: Observed and Counterfactual Distributions

Notes: This figure shows the observed and counterfactual density of loans. The solid line shows the observed number of loans, in $5,000 bins. The dashed line shows the counterfactual number of loans. The counterfactual is estimated for each notch separately by fitting a sixth-order polynomial with round-number fixed-effects to the empirical distribution using step size of 5,000, and excluding data around the notch, as specified in equation 10. The red vertical line shows where the marginal buncher comes from, and the dotted vertical lines marks excluded ranges $[d_L, d_U]$. Source: SBA.

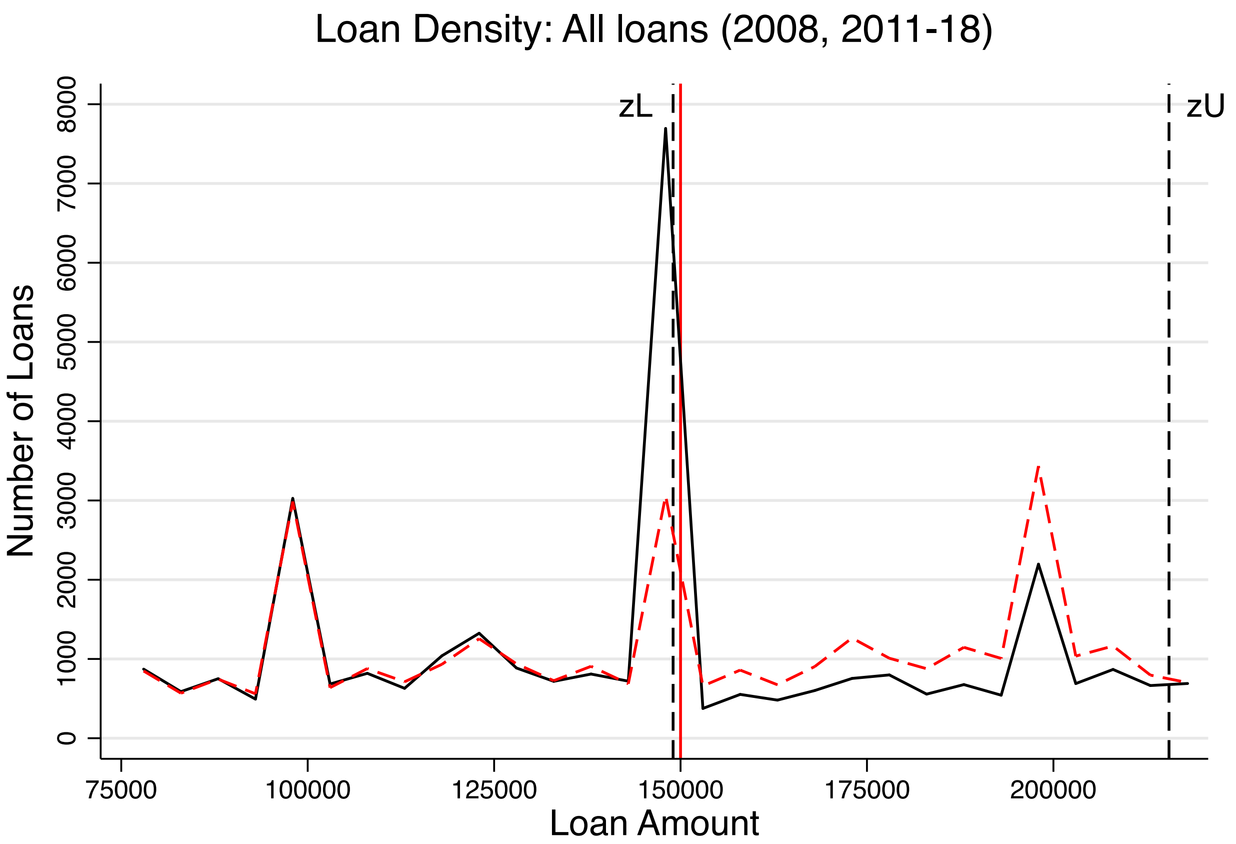

Figure 4: Bunching at the Guarantee Notch by Year

Notes: This figure shows the fraction of loans made in discrete $2,000 bins across the threshold by year. We divide the loans by years when the notch was either positive and above (high) or below (low) the median, or non-existent. Source: SBA.

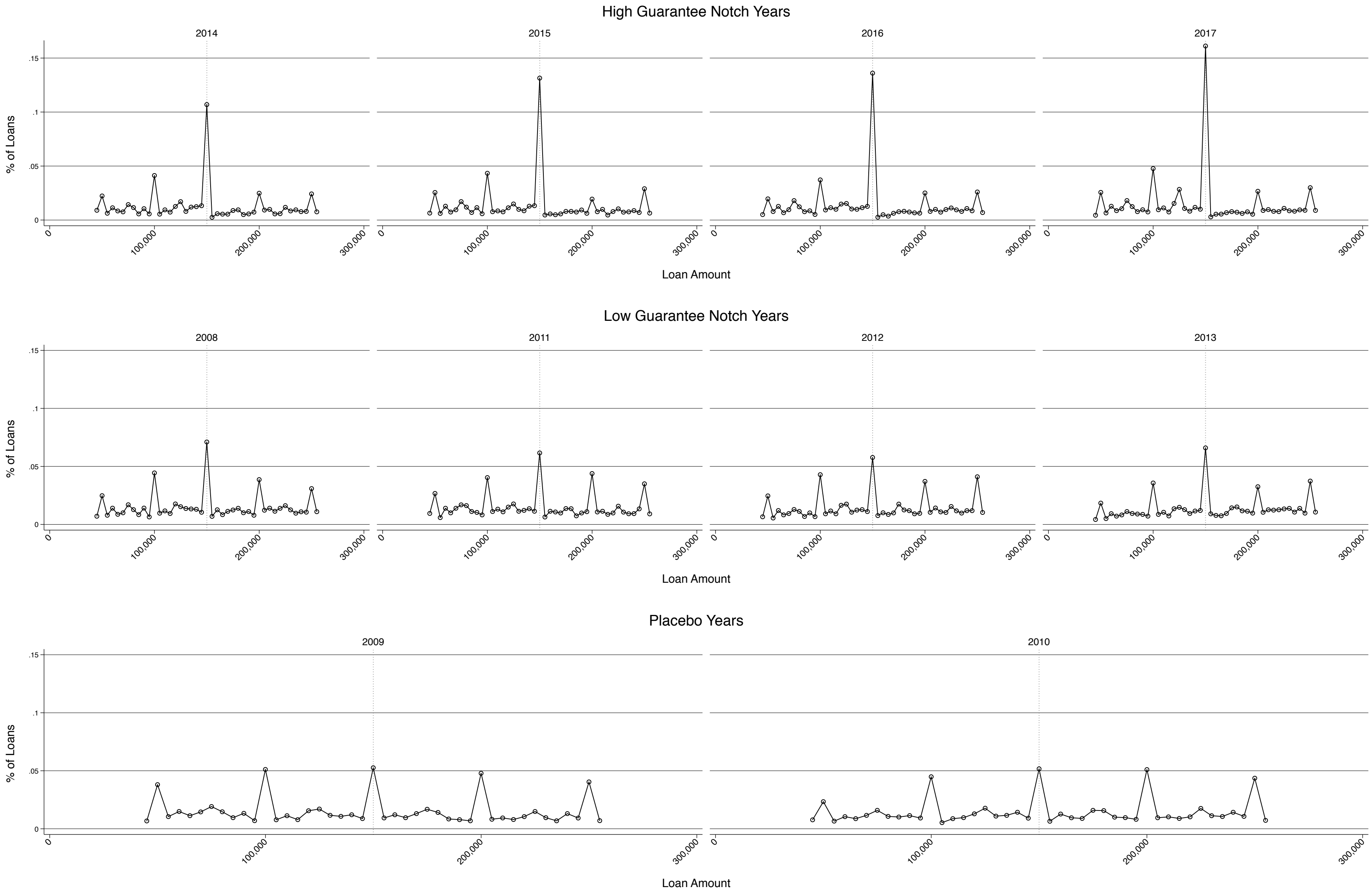

Figure 5: Relationship between size of notch and excess mass

Notes: The figure on the left plots the share of excess mass against the size of the guarantee rate change at the $150,000 threshold. The excess mass at the $150,000 threshold is measured as the difference in the percentage of loans at the threshold relative to other round numbers. The *share* of excess mass is the estimated excess mass as a share of the total number of loans in the estimation range. The change in the guarantee rate is the change in the average expected guarantee benefit as a percentage of the loan principal. The figure on the right plots the share of excess mass and the size of the guarantee rate change at the threshold over time to show the tight correlation between the two measures. Both figures show that there is a positive correlation between the incentive to bunch (the size of the guarantee rate change) and the amount of bunching. Both graphs pool over all years 2008-2017 and control for bank fixed effects. Source: SBA.

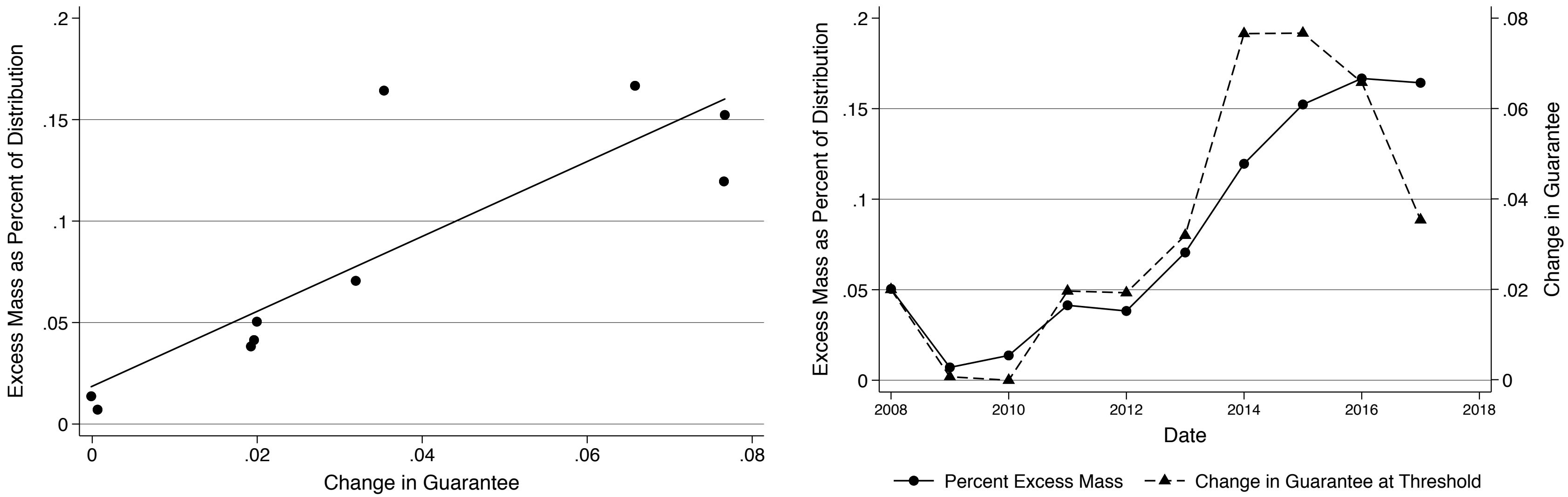

Figure 6: Average Interest Rate and Guarantee Rate Across the Threshold

Notes: This figure shows interest rates and guarantee rates in discrete $2,000 bins across the threshold. While the guarantee rate drops dramatically at the threshold, the interest rate remains flat. The guarantee rate is the average expected guarantee benefit as a percentage of the loan principal. The graph pools over all years 2008-2017. Source: SBA.

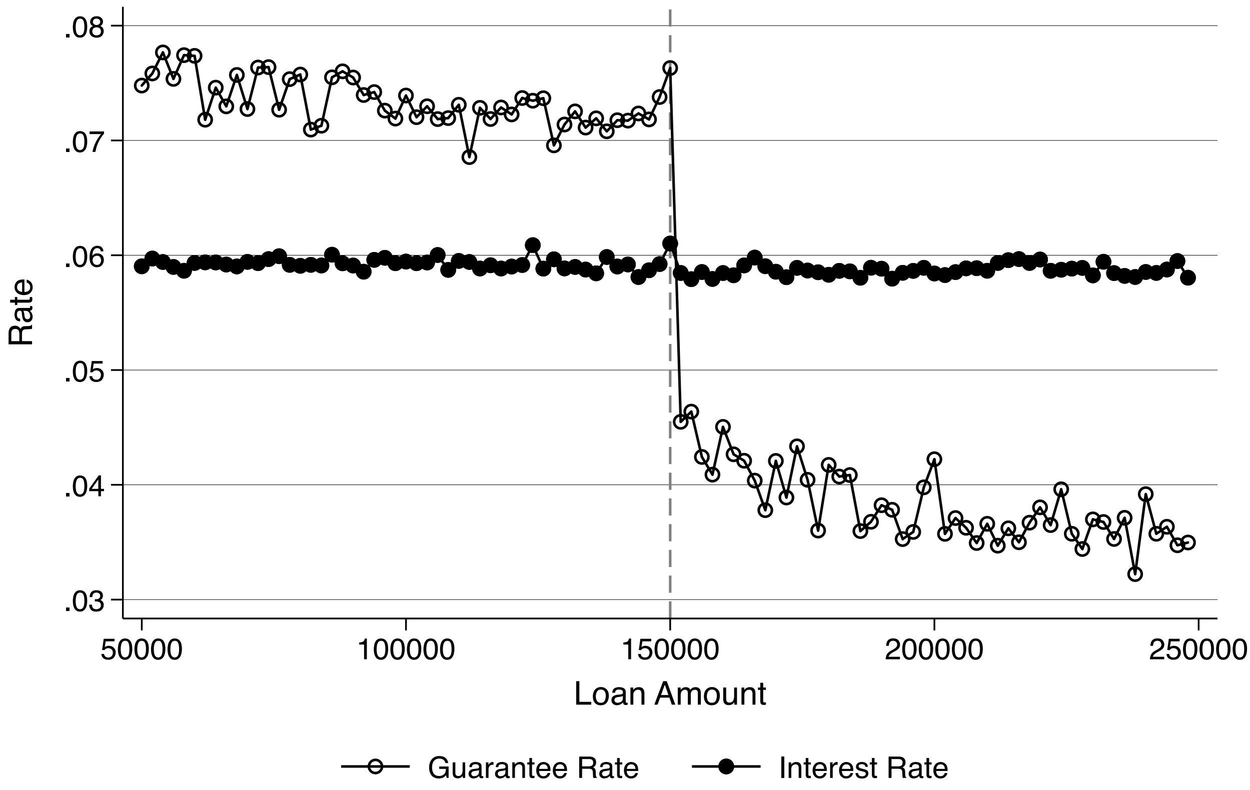

Figure 7: Percentage of Loans at the Binding Interest Rate Maximum

Notes: This figure shows the percentage of loans made at the maximum interest rate cap in discrete $2,000 bins across the threshold. The graph pools over all years 2008-2017, absorbing year-month effects and bank fixed effects. Source: SBA.

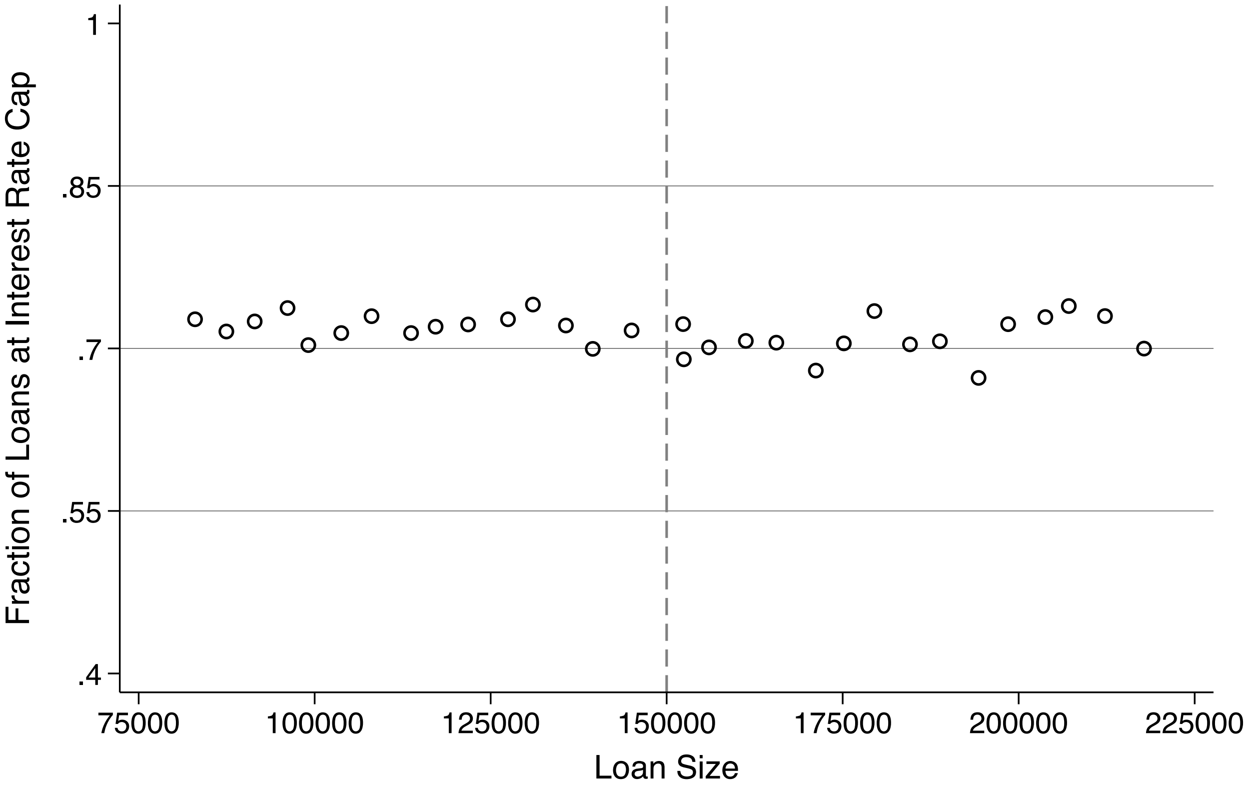

Figure 8: Other Variables at the Guarantee Notch

Notes: This figure plots the average interest rate, revolving loan percentage, charge-off percentage, and loan term across the threshold. They are normalized with respect to the value of the variable at the threshold. There is no significant difference in initial interest rate, the percentage of revolving loans, the charge-off percentage across the threshold. Note the presence of round number bunching in the bottom right panel. The graph pools over all years 2008-2017, absorbing year-month effects and bank fixed effects. Source: SBA.

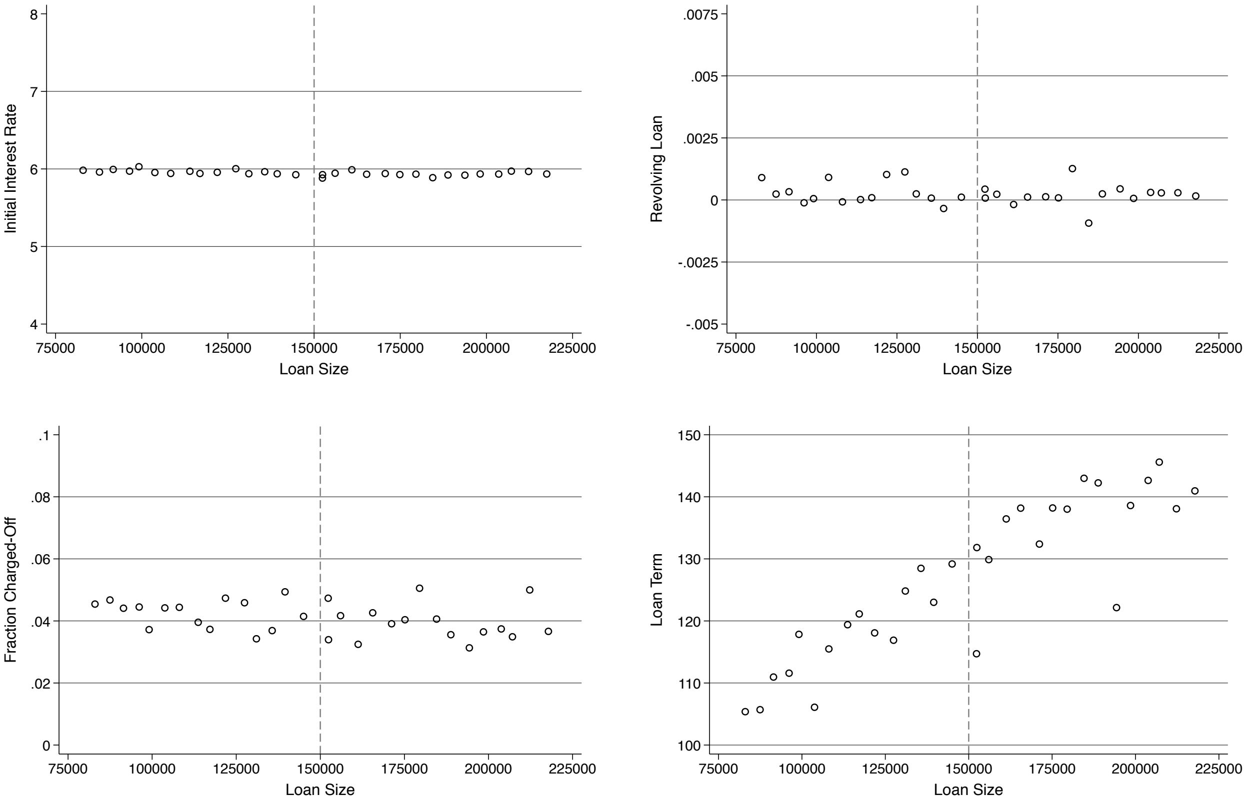

Table 1: Summary Statistics

Notes: This table shows summary statistics for the main analysis variables. The first two columns report the mean and the standard deviation, the third to fifth columns report the 25th, median, and the 75th percentile, respectively. Panel A reports summary statistics for full sample and panel B reports statistics for the sample of loans used in the notch estimation (loan size between $75,000 and $225,000). Loan amount is the size of a given loan in the sample. Reimbursement rate refers to the SBA determined reimbursement rate pooling across all years in the sample (2008 - 2017). Reimbursed amount is the guaranteed portion of the loan balance. Interest rate is the total interest rate (base plus spread) at the time of loan origination. Maturity is the length of loan terms, and charge-off amount is the total loan balance charged off, including guaranteed and non-guaranteed portion of loan. Loans per firm-lender pair reports the number of loans that a given firm borrows from the same lender in the same year. The excess mass reports an estimate of the amount of excess mass ($\hat{B}$) at the 150k notch, which we measure as the difference between the observed and counterfactual bin counts in the excluded region at and to the left of the notch. The estimate is reported as the share of bunching relative to the total number of loans in the estimation range. Excess mass is only reported in panel B, as it is estimated using the notch sample only. Source: SBA.

Outcome	Mean	Std. Dev.	25^{th} Pctile.	Median	75^{th} Pctile.
			A. Full sample		
Loan Amount ($)	746,107	826,485	215,000	460,000	950,000
Reimbursement Rate	.80	.06	.75	.75	.85
Reimbursed Amount ($)	574,195	626,519	168,750	356,400	735,000
Interest Rate (%)	5.73	0.74	5.25	5.96	6.00
Maturity (in years)	15	8	10	10	25
Charge-off Amount ($)	11,706	85,383	0	0	0
Loans per firm-lender pair	1.05	0.27	1.00	1.00	1.00
Observations	199,013	199,013	199,013	199,013	199,013
			B. Sample for notch estimation		
Loan Amount ($)	147,359	41,330	112,000	150,000	180,000
Reimbursement Rate	.84	.05	.85	.85	.90
Reimbursed Amount ($)	120,575	31,354	93,750	127,500	141,110
Interest Rate (%)	6	1	6	6	6
Maturity (in years)	10	5	7	10	10
Charge-off Amount ($)	6,221	26,704	0	0	0
Share of Excess Mass	.08	.06	.04	.05	.16
Loans per firm-lender pair	1.03	0.27	1.00	1.00	1.00
Observations	41,460	41,460	41,460	41,460	41,460

Table 2: Guarantees and Fees by Loan Amount

Notes: This table includes fees and guarantee rates for loans with maturities larger than 12 months. Fees are calculated as a percentage of the loan principal. The reimbursement rate is expressed as a percentage of charged off principal. The net benefit combines the fees and reimbursement rate to measure the average expected generosity of the guarantee, and is expressed as a percentage of the loan principal amount. This net benefit is calculated as the guaranteed reimbursement on expected losses minus guarantee fees. Loan amount smaller than $150,000 refers to loans between $0-150,000. Loan amount larger than $150,000 refers to loans between $150,000-700,000. Source: SBA

	Loan Amount Smaller than $150,000				Loan Amount Larger than $150,000			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fiscal Year	Yearly Fee	One Time Fee	Reimbursement Rate	Net Benefit	Yearly Fee	One Time Fee	Reimbursement Rate	Net Benefit
2008	0.55	2	85	4.6	0.55	3.42	75	2.6
2009	0.55	0	90	7.4	0.55	0	90	7.4
2010	0.55	0	90	7.4	0.55	0	90	7.4
2011	0.55	2	85	4.9	0.55	3.42	75	2.9
2012	0.55	2	85	4.6	0.55	3.42	75	2.7
2013	0.55	2	85	5.8	0.55	3.42	75	2.6
2014	0	0	85	10.5	0.52	3.42	75	2.9
2015	0	0	85	10.5	0.52	3.42	75	2.9
2016	0	0	85	9.6	0.47	3.42	75	2.9
2017	0.55	0	85	6.3	0.55	3.42	75	2.7

Table 3: Excess Mass and Elasticity Estimates

This table reports estimates of excess mass and the main elasticity estimates. The top panel shows placebo years (2009 and 2010) where there was *no* change in the reimbursement rate at the 150,000 threshold. The bottom panel shows years where a notch existed (2008, 2011-2017). Elasticity estimates are reported in the latter sample. For estimation, we restrict the loan sample with size between \$75,000 to \$225,000, use the step size of 500, include round number dummies for multiples of 1,5, 10, 25, and 50 thousand. The polynomial used is denoted in the second column. The change in the guarantee rate ($\Delta\Gamma$) at the threshold for years in which a notch existed is computed as the weighted average of the average expected guarantee benefit as a percentage of the loan principal, where the weights correspond to the number of loans across years 2008, 2011-2017. Standard errors are reported in italics and obtained by empirical bootstrap with 1,000 repetitions of resampling the distribution of loans made. Bunching estimation routine is run at every bootstrap iteration until convergence. Source: SBA.

Year	Polynomial	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity
		A. Placebo Years - No Notch			
2009-2010	5	67	21,000	-	-
		(21.57)	*(14,796)*	-	-
	6	66	21,000	-	-
		(41.36)	*(14,285)*	-	-
	7	0	9,500	-	-
		(16.76)	*(13,131)*	-	-
		B. Pooled Years - With Notch			
2008, 2011-2017	5	4,744	66,500	0.038	4.519
		(98.9)	*(1,326)*	-	*(0.186)*
	6	4,747	66,000	0.038	4.589
		(44.38)	*(2,806)*	-	*(0.395)*
	7	4,745	70,500	0.038	5.235
		(102.6)	*(1,240)*	-	*(0.181)*

Table 4: Excess Mass and Elasticity Estimates, by Year

This table shows elasticities for years in which a notch existed, and estimates of the excess mass for the two years (2009 and 2010) in which there was no change in the guarantee rate at the 150,000 threshold. For this estimation: the stepsize = 500, the range was limited to 75,000-225,000, we included round number dummies for multiples of 1,5, 10, 25, and 50 thousand, and we used a polynomial of degree 6. The change in the guarantee rate ($\Delta\Gamma$) at the threshold for years in which a notch existed is computed as the weighted average of the average expected guarantee benefit as a percentage of the loan principal, where the weights correspond to the number of loans across years 2008, 2011-2017. Source: SBA.

Year	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity
Placebo Years - No Notch				
2009	19.12	2,500	0	NA
2010	35.02	6,000	0	NA
Years With Notch				
2008	248.39	52,000	0.02	5.32
2011	151.81	40,500	0.02	3.36
2012	132.64	60,500	0.02	7.62
2013	199.91	71,500	0.03	6.41
2014	233.02	62,000	0.08	2.01
2015	457.83	55,500	0.08	1.61
2016	564.04	60,500	0.07	2.24
2017	1,386.12	69,500	0.04	5.47

Table 5: Estimates Split by Number of Banks and SBA Share

This table reports estimates of excess mass and the main elasticity estimates, varying the range used from the restriction in the main sample to loans between \$75,000 to \$225,000, use the step size of 500, include round number dummies for multiples of 1,5, 10, 25, and 50 thousand. The degree of the polynomial used in the estimation is denoted in the second column. The change in the guarantee rate ($\Delta\Gamma$) at the threshold for years in which a notch existed is computed as the weighted average of the average expected guarantee benefit as a percentage of the loan principal, where the weights correspond to the number of loans across years 2008, 2011-2017. Standard errors are shown in parentheses. Source: SBA and FDIC SDI.

Year	Polynomial	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity
		Unique Banks > 3				Unique Banks ≤ 3			
2008, 2011-2017	6	4,363	66,000	0.038	4.589	383	53,500	0.038	3.015
		(46.23)	(6,149)	–	(0.852)	(9.18)	(6,889)	–	(0.887)
	No. obs.	28,851				4,413			
		Unique Banks > 7				Unique Banks ≤ 7			
2008, 2011-2017	6	3,931	70,000	0.038	5.161	818	60,500	0.038	3.855
		(37.86)	(5,819)	–	(0.812)	(17.00)	(7,858)	–	(1.031)
	No. obs.	24,509				8,755			
Year	Polynomial	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity	Excess Mass	ΔD	$\Delta\Gamma$	Elasticity
		SBA share $> 60\%$				SBA share $\leq 60\%$			
2008, 2011-2017	6	2,336	69,500	0.038	5.087	2,413	55,500	0.038	3.244
		(20.63)	(3,286)	–	(0.466)	(40.18)	(7,254)	–	(0.942)
	No. obs.	8,931				24,333			
		SBA share $> 80\%$				SBA share $\leq 80\%$			
2008, 2011-2017	6	2,231	69,500	0.038	5.087	2,518	55,500	0.038	3.244
		(20.41)	(3,299)	–	(0.465)	(41.04)	(7,489)	–	(0.975)
	No. obs.	7,958				25,306			

A Administration of the 7(a) Loan Program

This section provides additional detail on the administration of SBA loan programs. The SBA oversees various assistance programs, such as the Lending Programs, Entrepreneurial Development Programs, and Federal Contracting and Assistance Programs, which provide loan guarantees to small businesses. The maximum loan size limit is capped at $5 million, and the use of proceeds ranges widely from traditional term loan to debt refinancing. Since there is no formal limit as to how much SBA loans a given lender can underwrite, the Office of Credit Risk Management monitors lender performance and oversees the growth of loan portfolios of banks.

While loan maturity depends largely on borrower's ability to repay, loans for working capital, machinery, and equipment have a maturity of up to 5 to 10 years while loans for real estate have a maturity of up to 25 years. Lenders and borrowers can negotiate the interest rate, but it may not exceed the maximum rate set by the SBA. The maximum interest rates are based on a loan amount and maturity such that they decrease in loan amount and increase in loan maturity within two tiered maturity groups defined by a 7-year maturity mark.

A new lender that is not familiar with the SBA loan submission process uses the General Program (GP). Under this program, the lender submits a full application requesting SBA guarantee to the Loan guarantee Processing Center (LGPC). The more experienced SBA lenders are given the "delegated" lender status. Experience lenders that have met certain performance standards are eligible to use the Certified Lender Program (CLP). Under the CLP, a lender undergoes the same application process as non-delegated lenders, but the SBA expedites the loan processing and services. The most experienced lenders use the the Preferred Lender Program (PLP). PLP lenders have the authority to process, service, or close any SBA loans without SBA's prior approval.

There are benefits and costs associated with becoming an SBA lender. A key benefit is that the SBA guarantee helps lenders mitigate credit risks while allowing them to expand their customer base by serving borrowers who may not meet the conventional lending requirements. From a regulatory perspective, since the risk weight of guaranteed loans is lower than for unguaranteed loans, the 7(a) guarantee lowers a lender's risk-weighting for meeting the Basel II capital requirements. SBA loans also have the potential to receive Community Reinvestment Act (CRA) consideration if the loans meet the definition of "loans to small business."

The costs for lenders include one-time guarantee fee, annual ongoing servicing fee for each loan approved and disbursed, and other applicable fees associated with ongoing SBA oversight, late payment, or packaging and other services. The lender is required to submit the one-time guarantee fee with the loan application for loans with maturities of 12 months or less, and within 90 days of the date of the loan's approval for loans with maturities exceeding 12 months. This guarantee fee is based on the loan maturity and the guaranteed portion of the loan.[30] Lenders may pass-through this one-time guarantee to borrowers, and borrowers in turn may use loan proceeds to pay the guarantee fee in the initial disbursement. The annual ongoing servicing fee is set at the time of loan approval and based on the outstanding principal balance of the guaranteed portion of the loan. In fiscal year 2018, this fee is set to 0.55% of the outstanding balance of the SBA's share. Note that this cost structure may incentivize the lenders to not always charge the maximum allowable interest rates and guarantee rate on loans to reduce the amount of fees paid to SBA.

Table A.2 reports the industry breakdown of the borrowers that receive SBA loans. In our sample, small businesses in accommodation and food services industry receive SBA loans most frequently (i.e., 18% of all loans), and the top 10 industries make up nearly 90% of all loans originated to small businesses. Small businesses in accommodation and food services industry is over-represented in the SBA data when compared to the industry composition of small businesses at the national level, where businesses in this industry only make up 8% of all small businesses. On the other hand, businesses in professional services and construction are under-represented in the SBA sample. In other industries, SBA industry composition line up well with the industry composition at the national level.

B FDIC Statistics on Depository Institutions

This section describes the FDIC Statistics on Depository Institutions (SDI) data used in the paper, and our construction of shares. The SDI data records the total number and amount of small business loans outstanding at a quarterly level per institution, and further splits small business lending into categories of loan size and purpose. We specifically look at small business commercial and

[30]For any short-term loans with maturities of 12 months or less, the fee is 0.25% of the guaranteed portion of the loan. For loans with longer maturities, loans of $150,000 or less require 2%; loans of amount greater than $150,000 but less than $700,000 require 3%; and loans of amount greater than $700,000 but less than 1 million require 3.5%; and loans of size greater than a million require 3.75% of the guaranteed portion of the loan.

industrial loans. The FDIC SDI statistics will *include* SBA lending by a particular institution– therefore when combined with the SBA data they allow us to calculate the bank-specific "share of small business lending that is through the SBA". We observe the yearly stock of loans outstanding in the SDI data, and the yearly "flow" of SBA loans in the SBA data. Therefore, we convert the SDI data into a comparable flow measure, and then calculate the bank-year specific SBA share as follows:

1. From the SDI report we observe the stock of number of small business loans from a bank in a given year.

2. We divide this stock by the average maturity (10 years) to get the approximate flow of small business loans from that bank.

3. Calculate from the SBA data the flow of SBA small business loans in a given year.

4. Calculate the bank-year specific SBA share as $\frac{flow\ of\ SBA\ loans}{flow\ of\ all\ small\ business\ loans}$ in a given year.

This calculation generates a distribution of high to low intensity SBA lenders. Banks that lend primarily through the SBA have less ability to substitute between their SBA and non-SBA portfolios. Therefore if we find a similar response to the guarantee across the SBA share distribution, it is unlikely that the portfolio substitution response has biased our elasticity estimates.

C Data Appendix: 2003 Survey of Small Business Finances

The 2003 Survey of Small Business Finances (SSBF) is the fourth survey of U.S. Small businesses conducted by the Board of Governors, and the last wave before the releases of the Small Business Credit Surveys. The survey collected information on firm and owner characteristics, an inventory of small businesses' use of financial services and of their financial service suppliers, and income and balance sheet information.

The data set for the 2003 Survey of Small Business Finances contains information on 4,240 small businesses that were in operation during December 2003 and at the time of the interview. The interview for most firms took place between June and December in 2004. The reference date for most questions is the date of the interview; the reference date for the income statement and balance sheet information is the date of the firm's most recent fiscal year-end and can range from July 1, 2003 to June 30, 2004. For the 2003 release, the SSBF data set includes five implicates. Each implicate includes 4,240 firms. In total, the entire data set contains 21,200 observations. There are 4,240 firm observations in total. There are in total 225 firms which took loans from a government agency, including the SBA.

Appendix Table A.6 shows the fraction of firms that access credit from more than one source in the past three years. The table indicates that very few firms access credit from more than one sources. Appendix figure A.5 shows the fraction of firms by the number of lending institutions dealt with. The fact that many firms deal with many lending institutions, but only borrow from one (typically an SBA lender) is indicative of inability to obtain credit elsewhere.

Figure A.1: Guarantees and Fees by Loan Amount

Notes: This figure shows the average expected guarantee fees and reimbursement rate as a percentage of the loan principal amount for discrete 2000 bins across the threshold. The graph pools over all years 2008-2017. Source: SBA.

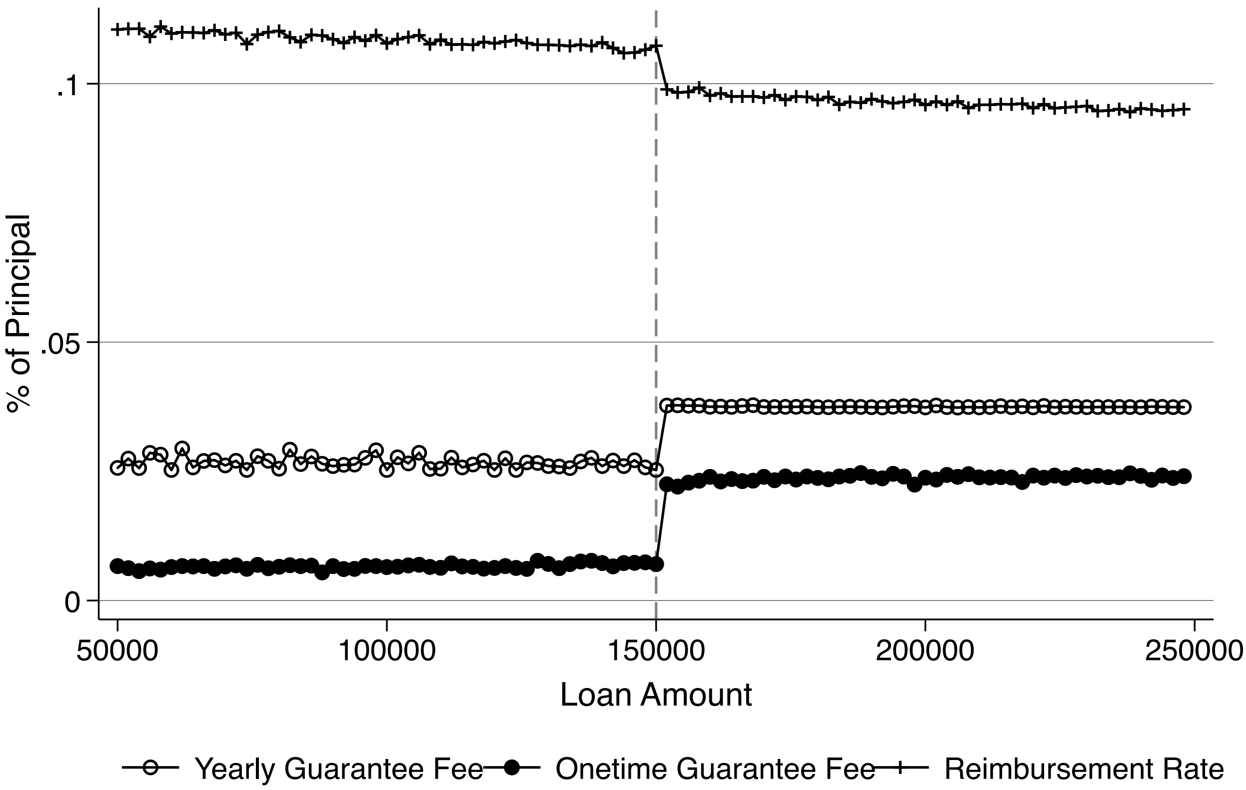

Figure A.2: Bunching at the Guarantee Notch, Wider Axis

Notes: This figure shows the number of loans made in discrete $2,000 bins across the threshold. The graph pools over all years 2008-2017 with an alternative wider axis. Note bunching at round numbers, which is controlled for in the elasticity estimate. Source: SBA.

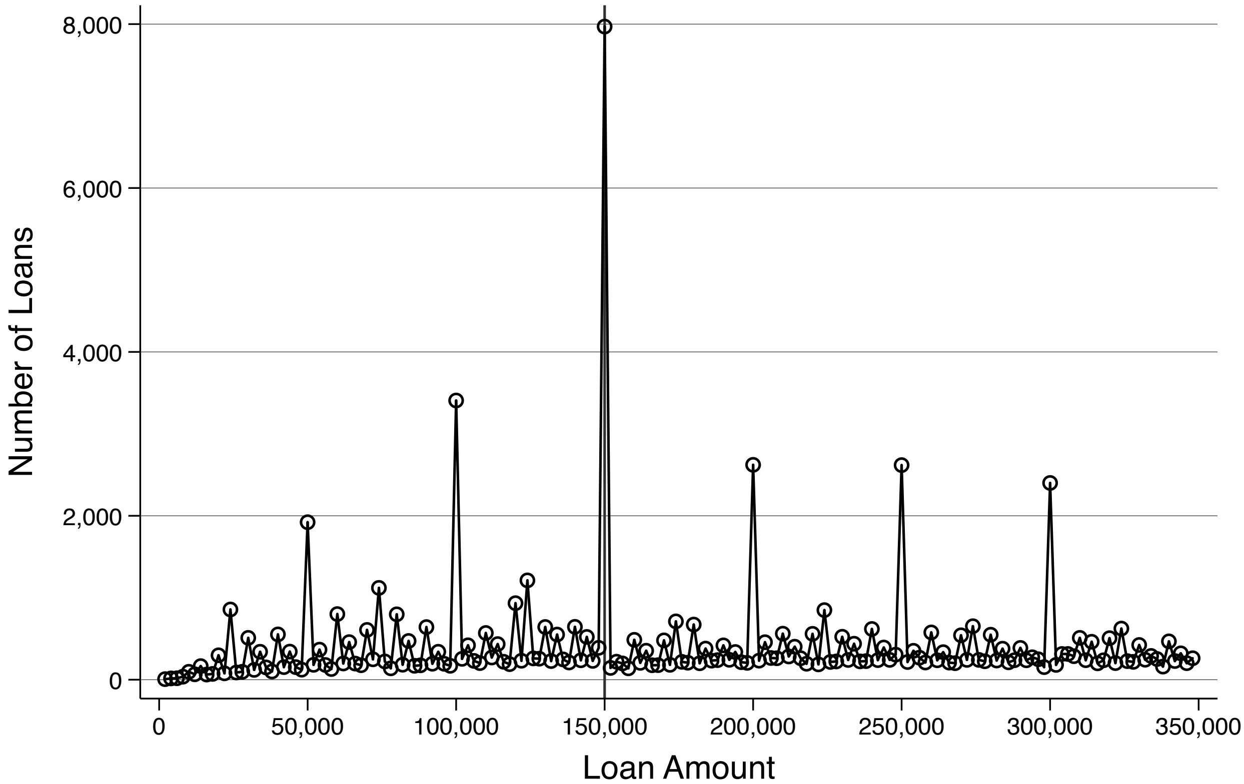

Figure A.3: Observed and Estimated Loan Density for Elasticity Estimation

Notes: This figure plots the observed loan density (black) and the estimated counterfactual density (red) for each year. We separately show the years in which a notch at the $150,000 threshold existed, and when it did not (2009 and 2010, the "placebo" years). For estimation, we restrict the loan size to be between $75,000 to $225,000. The counterfactual is estimated for each notch separately by fitting a sixth-order polynomial with round-number fixed-effects to the empirical distribution using step size of 500, and excluding data around the notch, as specified in equation 10. The missing mass at the threshold is measured as the distance between the black and red lines at $150,000.

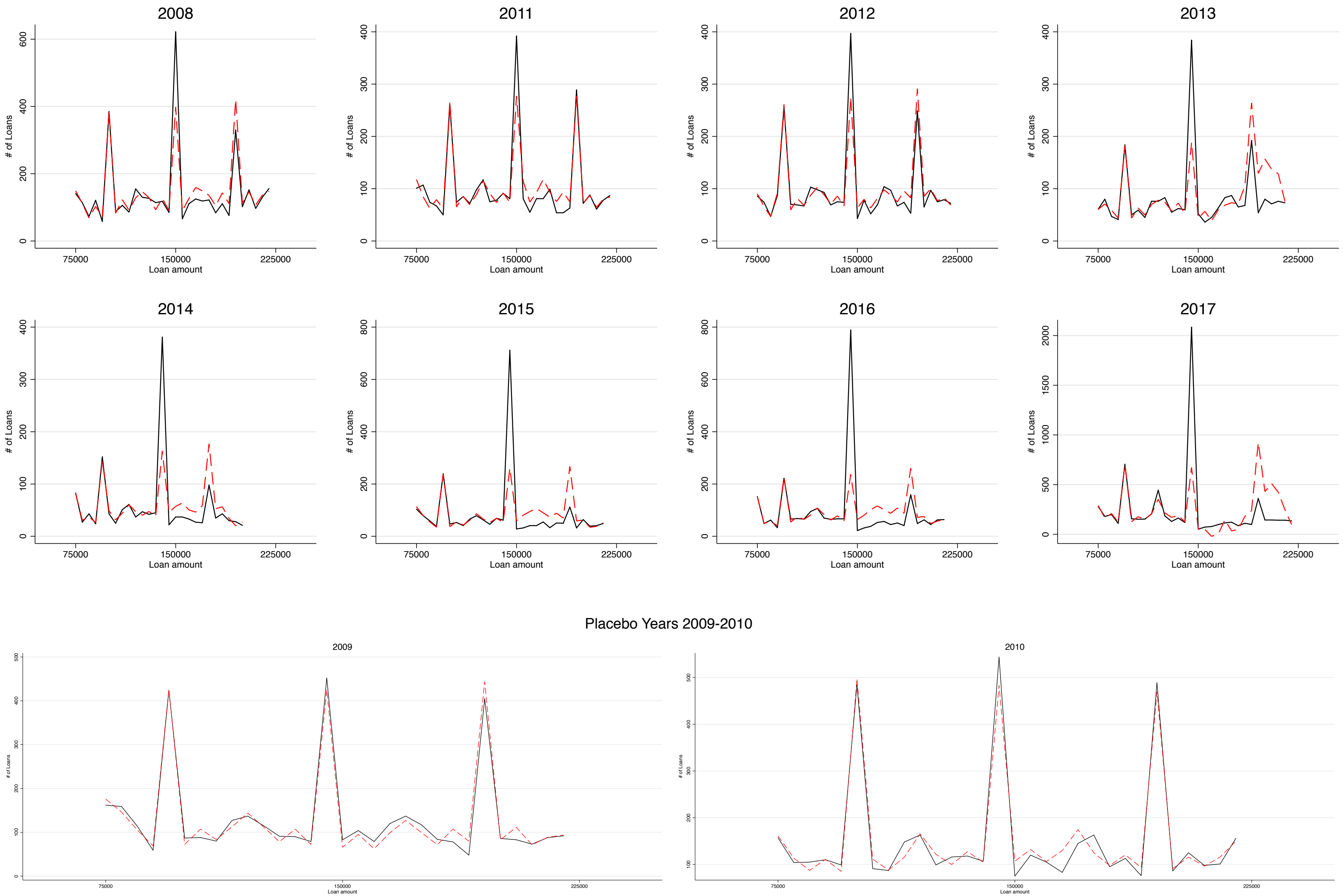

Figure A.4: Observed and Estimated Loan Density by SBA Share and Market Concentration

Notes: This figure plots the observed loan density (black) and the estimated counterfactual density (red) for subsamples of banks with high/low SBA lending shares and in high/low concentration markets. The first row splits the sample into banks who funnel fewer than 80% of their small business loans through the SBA (left), and banks with $\geq$ 80% of their small business lending through the SBA (right). The second row splits the sample by banks in regions with fewer than 7 SBA lenders (left), or $\geq$ 7 lenders (right).

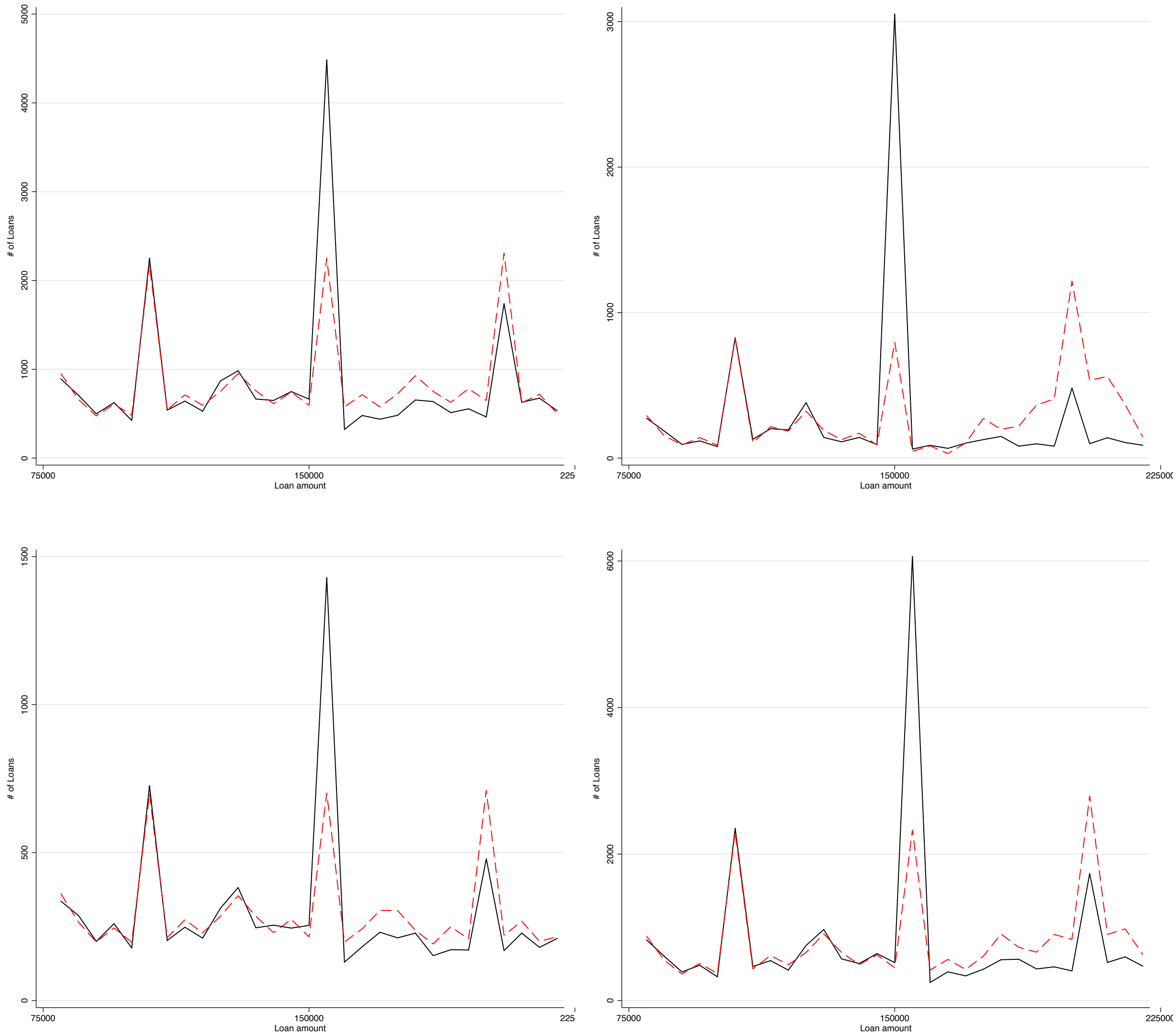

Figure A.5: Number of Lending Institutions

Notes: This figure shows the fraction of firms by the number of lending institutions that a small business dealt with in the past three years. The sample is restricted to firms with a loan from a government agency, including the SBA Source: SSBF.

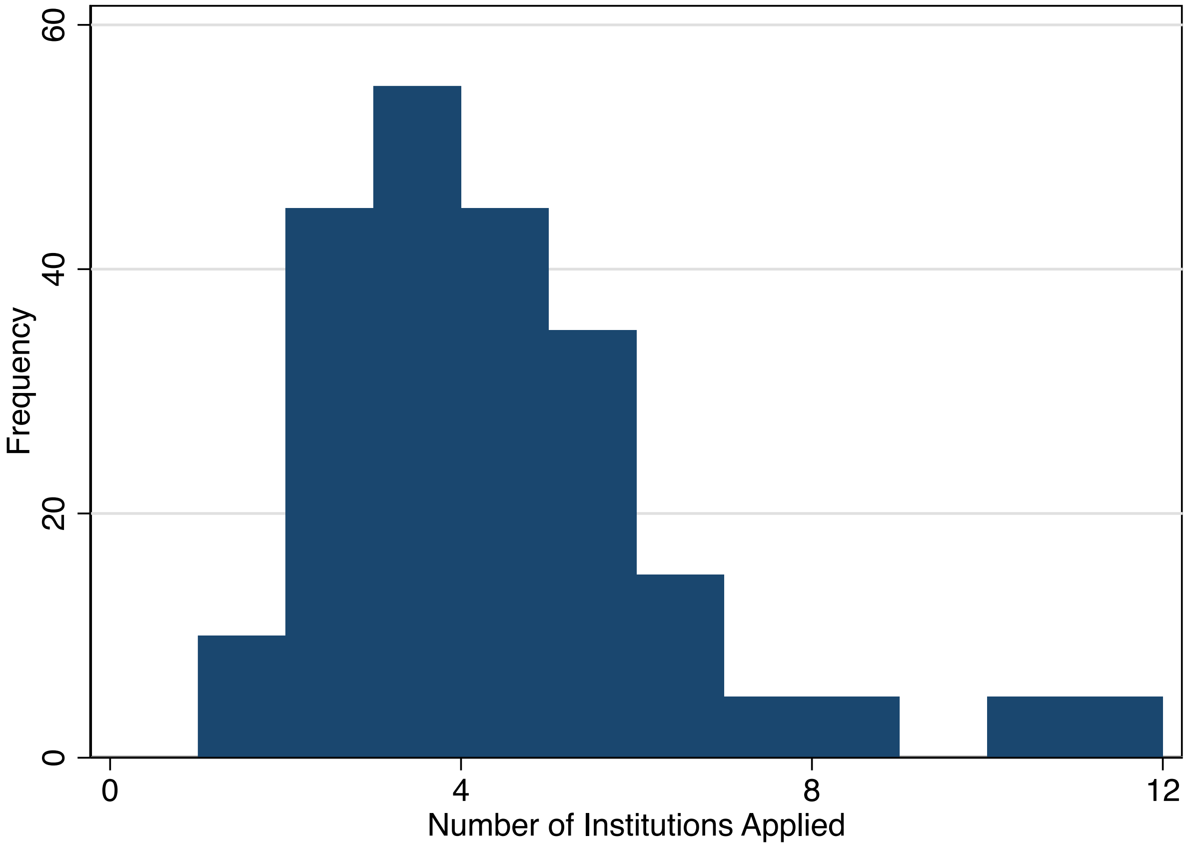

Table A.1: Variable Descriptions

Notes: This table reports the main analysis variables, their definitions, and source.

Variable Name	Definition	Source
Loan Amount	Total loan amount in dollars.	SBA
Reimbursed Amount	Amount of SBA's loan guarantee.	SBA
Charge-off Amount	Total loan balance charged-off (includes guaranteed and non-guaranteed portion of loan.)	SBA
Interest Rate	Initial interest rate at the time loan was approved (base rate plus spread.)	SBA
Reimbursement Rate	Total guarantee rate for loans. For most years, 85% guarantee for loans of $150,000 or less; 75% guarantee for loans greater than $150,000 (up to $3.75 million maximum guarantee.)	Derived from SBA
Maximum Rate	Maximum interest rate a bank can charge a borrower.	SBA. LIBOR from BNY Mellon
Maturity	Length of loan term	SBA
Yearly Fee	A yearly fee that a lender must pay to SBA for each loan guaranteed under the 7(a) program. Based on the guaranteed portion of the loan and not the total loan amount. This fee cannot be passed on to the borrower.	SBA
One-Time Fee	One-time guarantee fee that a borrower pays the SBA to obtain a loan.	SBA
Average Expected Guarantee Benefit	Predicted guarantee amount as a share of loan principal net of one-time and yearly fees, assuming 100% charge-off.	Derived from SBA
Excess Mass	The amount of bunching at the $150,000 notch computed as the difference between the observed and counterfactual bin counts between the lower limit of the excluded region (d_l) and the threshold (D^T).	Estimated following Kleven and Waseem (2013)
Share of Excess Mass	Excess mass as a share of the total number of loans in the estimation range.	Estimated

Table A.2: Industry Breakdown

Notes: This table reports the industry breakdown of the borrowers that received loans in the full sample. Industries are grouped by NAICS 2-digit sector code. The second and third columns report the number of loans by industry and the share of loans as a fraction of total loans in the SBA sample. The last two columns report the number of small businesses in each industry and their share as a fraction of total number of small businesses in the U.S. The data for the last two columns are obtained from the 2012 Statistics of U.S. Businesses (SUSB) reported by the Census Bureau. "Public Administration" is a newly added NAICS code not represented in the 2012 SUSB data. "N/A" represents missing industry information. Source: SBA and SUSB.

	SBA Sample		Population (SUSB)	
Industry	N of Loans	Share	N firms	Share
Accommodation and Food Services	35,797	0.180	495,347	0.086
Retail Trade	31,748	0.160	650,749	0.112
Health Care and Social Assistance	23,995	0.121	640,724	0.111
Other Services (excl. Public Admin)	19,939	0.100	667,176	0.115
Manufacturing	17,173	0.086	256,363	0.044
Professional Services	14,729	0.074	772,685	0.133
Construction	10,636	0.053	640,951	0.111
Wholesale Trade	9,194	0.046	315,031	0.054
Admin Support and Waste Management	6,452	0.032	327,214	0.056
Arts, Entertainment, and Recreation	6,403	0.032	114,969	0.020
Real Estate and Rental and Leasing	5,943	0.030	270,034	0.047
Transportation and Warehousing	4,773	0.024	168,057	0.029
Agriculture	3,836	0.019	21,351	0.004
Finance and Insurance	3,231	0.016	234,841	0.041
Educational Services	2,424	0.012	84,503	0.015
Information	1,879	0.009	71,108	0.012
Mining and Gas Extraction	578	0.003	22,149	0.004
Utilities	135	0.001	5,973	0.001
Management	125	0.001	26,819	0.005
Public Administration	18	0.000	0	0.000
N/A	5	0.000	7,104	0.001

Table A.3: Components of Main Elasticity Estimates

This table lists the main outputs of the bunching estimation routine for each year. For this estimation: Step size = 500, the range was limited to 75,000-225,000, we included round number dummies for multiples of 1,5, 10, 25, and 50 thousand, and we used a polynomial of degree 6. We excluded years 2009 and 2010 when there was no change in the guarantee. D_L refers to the lower bound of the excluded region, D^* is the threshold, D_U is the estimated upper bound of the excluded region, ΔD is the size of the excluded region, B is the excess number of loans estimated at the threshold, and M is the estimated number of missing loans in the excluded region.

Year	D_L	$D^\star$	D_U	ΔD	$\hat{B}$	$\hat{M}$	Step Size
2008	149,000	150,000	201,500	52,500	248.39	-335.98	500
2011	149,000	150,000	190,500	41,500	151.81	-190.00	500
2012	149,000	150,000	210,500	61,500	132.64	-167.35	500
2013	149,000	150,000	221,500	72,500	199.91	-366.70	500
2014	149,000	150,000	212,000	63,000	233.02	-269.15	500
2015	149,000	150,000	205,500	56,500	457.83	-516.82	500
2016	149,000	150,000	210,500	61,500	564.04	-562.26	500
2017	149,000	150,000	219,500	70,500	1386.12	-1462.46	500

Table A.4: Robustness Tests on Elasticity Estimate Parameters

This table reports estimates of excess mass and the main elasticity estimates in each year, varying the polynomial and bin size. The top panel denotes the polynomial used, while the bottom panel denotes the bin size. The change in the guarantee rate ($\Delta\Gamma$) at the threshold for years in which a notch existed is computed as the weighted average of the average expected guarantee benefit as a percentage of the loan principal, where the weights correspond to the number of loans across years 2008, 2011-2017. Source: SBA.

	Polynomial Degree 5			Polynomial Degree 6			Polynomial Degree 7		
Year	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity
2008	302.73	67,000	8.83	301.99	53,000	5.48	302.17	53,000	5.48
2009	19.31	3,500	-	19.12	3,500	-	19.16	3,500	-
2010	35.41	7,500	-	35.02	7,000	-	34.94	7,500	-
2011	194.49	46,500	4.56	195.37	43,500	3.98	196.40	46,500	4.56
2012	153.07	66,500	10.20	152.68	59,000	8.00	153.46	58,000	7.72
2013	238.84	62,500	4.76	240.31	72,500	6.43	240.03	63,000	4.83
2014	335.74	57,000	1.62	335.73	62,500	1.96	337.77	73,000	2.68
2015	637.79	61,500	1.96	637.69	56,500	1.65	634.36	54,000	1.51
2016	806.67	71,500	3.23	804.95	62,500	2.45	804.33	72,000	3.27
2017	2021.43	64,500	4.78	2031.94	71,000	5.80	2029.94	71,500	5.89

	Bin Size = 100			Bin Size = 200			Bin Size = 500		
Year	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity
2008	304.17	71,700	10.13	302.21	54,200	5.74	301.99	53,000	5.48
2009	21.22	3,100	-	21.42	3,200	-	19.12	- 3,500	-
2010	35.18	8,100	-	35.03	9,200	-	35.02	- 7,000	-
2011	192.56	46,100	4.48	193.87	45,600	4.38	195.37	43,500	3.98
2012	147.65	57,300	7.53	149.66	57,800	7.67	152.68	59,000	8.00
2013	231.96	65,000	5.15	232.39	64,200	5.02	240.31	72,500	6.43
2014	331.94	62,700	1.97	331.32	61,200	1.87	335.73	62,500	1.96
2015	638.19	58,100	1.75	637.65	61,200	1.94	637.69	56,500	1.65
2016	794.90	61,100	2.34	800.34	61,200	2.35	804.95	62,500	2.45
2017	2024.25	69,300	5.52	2024.26	70,200	5.67	2031.94	71,000	5.80

Table A.5: Estimates Using Alternative Range and Bin Size

This table reports estimates of excess mass and the main elasticity estimates, varying the range used from the restriction in the main sample to loans between $75,000 to $225,000, use the step size of 500, include round number dummies for multiples of 1,5, 10, 25, and 50 thousand. The estimates are run using a polynomial of degree six. The change in the guarantee rate ($\Delta\Gamma$) at the threshold for years in which a notch existed is computed as the weighted average of the average expected guarantee benefit as a percentage of the loan principal, where the weights correspond to the number of loans across years 2008, 2011-2017. Source: SBA.

Year	Range	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity	Excess Mass	ΔD	Elasticity
		Bin Size = 100			Bin Size = 200			Bin Size = 500		
2008,	65,000 - 215,000	4,732	60,400	3.842	4.732	60,600	3.863	4,744	61,000	3.919
2011-2017	65,000 - 225,000	4,737	70,100	5.176	4,736	70,200	5.191	4,747	70,500	5.235
	65,000 - 235,000	4,710	55,500	3.244	4,710	55,200	3.209	4,717	55,500	3.244
	65,000 - 245,000	4,732	90,300	8.589	4,733	91,000	8.722	4,745	91,500	8.818
	75,000 - 225,000	4,744	65,100	4.464	4,736	65,400	4.505	4,710	65,500	4.520
	75,000 - 235,000	4,722	56,400	3.350	4,722	55,600	3.256	4,731	56,000	3.303
	75,000 - 245,000	4725	80,100	6.758	4,725	80,200	6.775	4,736	80,500	6.826
	75,000 - 255,000	4,733	65,100	4.464	5,086	80,200	6.775	5,086	80,500	6.826
	85,000 - 225,000	4,733	65,100	4.464	4,733	65,200	4.477	4,745	65,500	4.519
	85,000 - 235,000	4,727	60,300	3.830	4,726	60,400	3.842	4,735	61,000	3.919
	85,000 - 245,000	4,721	80,100	6.758	4,722	80,200	6.775	4,730	80,500	6.826
	85,000 - 255,000	5,085	80,100	6.758	5,080	80,200	6.775	5,081	80,500	6.826
	85,000 - 265,000	5,085	80,100	6.758	5,077	80,200	6.775	5,080	80,500	6.826

Table A.6: Alternative Sources of Credit

This table reports the fraction of firms with a loan from a government agency, including the SBA, which have multiple sources of different types of credit in the last three years. Source: SSBF.

Outcome	Mean
Multiple Lines of Credit	0.044
Multiple Credit Related Services	0.044
Multiple Equipment Loans	0.044
Multiple Capital Leases	0.000
Multiple Other Loans	0.067
SBA Reason for Loan	0.022
Observations	225