Peer Pressure: How do Peer-to-Peer Lenders Affect Banks' Cost of Deposits and Liability Structure?

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Abstract

This paper shows that banks' cost of deposits increase following exposure to the Fintech sector. We exploit the exogenous, staggered removal of restrictions on investing through peer-to-peer lending platforms by US states. The entry of Lending Club and Prosper cause the cost of deposits to increase by approximately 11% as banks face more intense competition for deposit funds. Banks' liability structure also shifts towards greater reliance on non-deposit funding. The findings provide regulatory insights into the unintended consequences, and potentially destabilizing effects, of the nascent Fintech sector on the banking industry.

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1. Introduction

In 2016 approximately $25 billion was invested through online peer-to-peer (P2P) lending platforms in the United States (US). Approximately one third of these funds are supplied by private investors (Claessens et al., 2018). P2P lenders therefore present a new, and growing, challenge to banks as they compete for deposits to fund their activities.

We conjecture that exposure to P2P lenders increase banks' cost of deposits. P2P loans typically offer investors a higher, but riskier, rate of return compared to bank deposits. Following the entry of a P2P lender into a banking market, depositors with low risk aversion invest in P2P loans, leading to a contraction in the supply of deposit funds. Banks are forced to increase equilibrium deposit interest rates to prevent a drain on liquidity. Moreover, when faced with an outflow of deposits, banks may shift towards more costly non-deposit funding sources such as subordinated debt, Fed funds, and brokered deposits to maintain their ongoing projects. P2P lenders therefore provoke a shift in banks' liability structure towards greater reliance on non-deposit liabilities. Owing to greater dependence on expensive non-deposit funding, the overall effect of P2P lenders on banks' cost of debt exceeds the increase in deposit costs.

In this paper, we test these hypotheses empirically by examining the response of banks' cost of deposits and liability structure following the entry of P2P lenders into local US banking markets. Using exogenous variation in state-level P2P investing restrictions, and difference-in-difference estimation, we find robust evidence that these mechanisms are operative and economically important. Given the P2P lending industry is in the embryonic stage of its lifecycle, and is growing rapidly, the effects we detect are likely to strengthen in future.

At the heart of our identification strategy is the staggered removal of P2P investing restrictions by US states. P2P loans do not conform to the definition of a loan stipulated by the Securities Act

of 1933 and are therefore designated as 'notes'. To obtain funds from investors, each P2P platform must obtain approval from state security regulators on a state-by-state basis. Many state securities regulators require a 'merit review' before they grant P2P platforms approval to solicit funds from investors in that state. A merit review mandates that a platform has procedures in place to protect investors from fraudulent claims in borrowers' applications (Chaffee and Rapp, 2012). For example, deliberate misstatement of income or employment histories. P2P platforms must satisfy a regulator that their data collection and verification measures meet the merit review's conditions. The removal of P2P investing restrictions is thus due to regulators' concerns about protecting P2P investors from fraud and losses, and are exogenous with respect to banks' cost of deposits, liability structure, and conditions within the banking industry more generally (Chaffee and Rapp, 2012).

States removed restrictions on investing through Lending Club and Prosper, the largest P2P lenders, at different points in time such that banks located in different states were exposed to varying, exogenous, degrees of competition for deposit funds. We therefore use a difference-in-difference estimation strategy that compares how the cost of deposits and liability structure evolve across time within banks in states that remove and do not remove P2P investing restrictions. Estimates show that the entry of a P2P platform leads to an increase in the cost of deposits between 11% and 16%. These effects are statistically significant at conventional levels and comparable in magnitude across a range of specifications.

We also find heterogeneity in the magnitude of the average treatment effect across banks and P2P platforms. For example, the increase in the cost of deposits is larger when banks are subject to competition for funds with Lending Club compared to Prosper. This result is consistent with Lending Club's greater P2P market share and the fact it obtains more investment funds relative to

Prosper.[1] In essence, banks that experience larger reductions in the supply of deposits increase deposit rates to a greater extent. Furthermore, our estimates show differential treatment effects depending on banks' geographical diversification and size. The increase in deposit costs is larger among small banks and those that operate branches in a limited number of states. This is consistent with banks using cross-state branch networks as internal capital markets to mitigate competition for funds with P2P lenders by sourcing deposits from regions where P2P lenders do not operate.

In addition, we find that in the face of competition with P2P platforms, banks' liability structure shifts towards greater reliance on non-deposit funding. Following an outflow of deposits, banks make up the funding shortfall by relying more heavily on non-deposit funds. Given these funding sources are typically more expensive than retail deposits, the net effect of P2P lenders on banks' overall cost of debt is larger compared to the baseline increase in deposit costs. Specifically, while banks' costs of deposits increase, they also rely more heavily on more expensive non-deposit funding. However, economically the extent of the increase in non-deposit funding is relatively small. Removing restrictions on whether P2P platforms may solicit funds in a state causes the non-deposit share of liabilities to increase by approximately 0.21%. The small response is consistent with P2P lenders' relatively low current market penetration.

Our research design takes several steps to ensure the increase in the cost of deposits is not driven by concomitant positive deposit demand shocks. For example, the regression equations control for county-level income per capita, population, establishments per capita, unemployment rates, and bank-level covariates that have been found to affect deposit demand elsewhere in the literature (Saunders and Schumacher, 2000). Further tests show that removing P2P investing restrictions

[1] Danisewicz and Elard (2018) report that Lending Club and Prosper together have a market share of between 75% and 85% of the P2P market during our sample period. The market share of Lending Club is approximately 50%.

reduces banks' deposit growth rates and leads to an outflow of deposits. We also include quarter-year fixed effects in the estimating equations to purge all time-varying aggregate shocks that may influence demand for deposits equally across banks.

A series of robustness tests rule out potential confounds. Diagnostic checks show no pre-emptive anticipatory trends in the cost of deposits or liability structure prior to the removal of P2P investing restrictions. In addition, shocks to bank soundness, monitoring by creditors (Danisewicz et al., 2018), regulatory monitoring (Agarwal et al., 2014), equity crowd funding, and changes to competition and market power within the banking industry (Focarelli and Panetta, 2004) do not drive our inferences. Within our data set there are 75 separate instances where P2P platform investing restrictions are removed. To bias our results, an omitted variable must systematically coincide with each of the 75 distinct removal episodes. This appears implausible considering the haphazard nature of the legal and regulatory decision making process across states.

Our paper contributes to two strands of literature. First, we provide novel evidence on how the banking industry is affected by the rapid development of the Fintech sector. So far, studies in this area have sought to understand whether P2P platforms affect the lending behavior of commercial banks. Wolfe and Yoo (2018) find a 1.2% decrease in the volume of unsecured personal bank loans following a one standard deviation increase in P2P lending. Tang (2018) also presents evidence that P2P lenders encroach onto banks' market share but complement bank lending among small loans. Other work in this literature shows how Fintech lenders disrupt the shadow banking market (Buchak et al., 2018). Another set of articles examines whether Fintech lenders have lower financial intermediation costs relative to banks (Philippon, 2015; Buchak et al., 2018).

In contrast to these studies, we document an unintended consequence of the growth in the Fintech sector: its impact on banks' cost of deposits. Our findings therefore have important policy

ramifications given bank funding costs are integral to the transmission monetary policy and matter for macroprudential policy as they feed into assessments of the stability of the financial system.

A separate literature documents relationships between the cost of deposits, funding models and bank stability. Theory shows that banks must be partially equity-financed to provide managers with sufficient incentives to monitor the projects they finance (Diamond, 1984). However, the optimal division of bank debt between deposits and non-deposit liabilities is less clear. On the one hand, non-depositors have superior monitoring technologies compared to depositors (Birchler, 2000). Non-depositors also have better monitoring incentives because their claims are not protected by deposit insurance. A greater share of non-deposit liabilities may therefore lead to an improvement in bank soundness as banks are subject to more rigorous monitoring (Calomiris, 1999; Hilscher and Raviv, 2014; Danisewicz et al., 2018).

However, deposit and non-deposit funding often carry different risks in causing a liquidity crisis through a bank run or the evaporation of wholesale funding. Huang and Ratnovski (2011) show that wholesale financing may rapidly dry up following noisy signals about bank asset quality, leading even solvent banks to fail. In addition, the volume and cost of non-deposit funds can react quickly following changes in a bank's condition (Rajan, 1992), undermining soundness (Demirguc-Kunt and Huizinga, 2010). Banks that are more reliant on non-deposits fail faster than institutions funded by deposits because the holders of non-deposit claims tend to respond quicker to negative news and withdraw funds due to their lack of priority in bankruptcy (Schaeck, 2008). The recent financial crisis illustrates the risks of banks' excessive reliance upon wholesale funding as interbank money market rates can rise dramatically, and funding can quickly evaporate (Taylor and Williams, 2009; Caprio et al., 2008).

A novel outcome of our research is that by provoking an increase in non-deposits in banks' funding mix, P2P platforms may undermine bank stability. We qualify this by emphasizing the effects we find are relatively small. However, the P2P lending industry is growing rapidly, and has become a major source of credit for both households and firms both in the US and internationally (Claessens et al., 2018). This suggests the effects we detect may become larger in future, and that banks and regulators must take steps to confront this challenge.

The paper is structured as follows. Section 2 provides an overview of the data set. We provide details of the legal environment surrounding P2P investments, the legal background to P2P investing restrictions, and the staggered removal of these measures in Section 3. We outline the identification strategy in Section 4, and present econometric evidence in Section 5. Section 6 deals with alternative explanations and robustness tests. Finally, we draw conclusions in Section 7.

2. Data Description

We retrieve bank-level data from the Federal Reserve Bank of Chicago Condition and Income Report (Call Report) database. This provides quarterly information from 2004Q1 to 2016Q4 on several bank variables. For example, bank size (total assets), return on assets (ROA), total liabilities, deposit liabilities, and deposit interest expenses. Information on the state in which the bank is headquartered is also provided. Using this information we construct the cost of deposits (the ratio of deposit interest expenses to deposit liabilities) and the deposit share of liabilities (the ratio of deposit liabilities to total liabilities). Table 1 provides a definition of each variable in our data set. Table 2 reports summary statistics.[2]

[2] Our choice to begin the sample in 2004Q1 is motivated by the fact that Prosper and Lending Club were incorporated in 2005 and 2006, respectively. Setting the starting point at 2004Q1 therefore provides sufficient time to test the parallel trends assumption.

[Insert Table 1: Variable Description] [Insert Table 2: Descriptive Statistics]

We merge in additional information taken from a number of sources. The FDIC Summary of Deposits database reports annual information on the location of every branch belonging to each bank. We therefore construct the variables branches (total number of branches belonging to bank *b* during each year) and multi state (a dummy variable equal to 1 if a bank has branches in more than one state during year *t*, 0 otherwise). To capture local business cycles and demand-side determinants of the cost of deposits, we use the state-level per capita income growth rate (Bureau of Economic Analysis), population growth rate (Bureau of Economic Analysis), unemployment rate (Bureau of Labor Statistics), and the number of business establishments per capita (County Business Patterns).

As we detail below, investing restrictions on Lending Club and Prosper were removed at different times by each state. We contacted both platforms and each state securities regulator to verify the date when investing restrictions were removed. The variable LC, is equal to 1 if state *s* has removed investing restrictions on Lending Club during quarter *t*, 0 otherwise. Similarly, PR, is equal to 1 if state *s* has removed investing restrictions on Prosper during quarter *t*, 0 otherwise.

3. Institutional Background

Lending Club and Prosper are the most prominent P2P lenders in the US, and operate similar business models. Prospective borrowers register with a platform and complete an online loan application. Using digital screening algorithms, the platforms assign each application a credit risk rating that determines whether the loan is listed on the marketplace for funding. Investors then review loan requests and decide which to fund. Investors do not make direct loans to borrowers,

rather an issuing bank issues the loan to the borrower and then sells the loan to the P2P platform.[3] The platform then issues a separate note to the investor with a return on the investment contingent on the borrower repaying the original loan (Chaffee and Rapp, 2012).

Platforms do not take a stake in each loan, rather they charge service fees for originating each loan and on trading notes between investors in the secondary market. During the application process platforms screen the borrower's credit history, outstanding debt, income, employment status, and other factors. Applicants' risk rating determines the interest rates borrowers pay.[4]

The majority of borrower applications are unsecured consumer loans. These are primarily used to consolidate existing debts, although a substantial share of loans are used for home repairs and to finance personal or family purchases. While business loans are increasingly common, they remain a minority. The interest rate on P2P loans ranges between 6.46% and 29% on Lending Club and 6.95% and 35.99% on Prosper. Loan amounts range between $1,000 and $40,000 and the term structure varies between 12 and 60 months.

4. Research Design

In this section, we first provide a review of the state-level regulation of P2P investments, and then outline our identification strategy.

4.1 State P2P Investing Restrictions

P2P platforms issue loans to individual borrowers through an issuing bank, and notes are then sold to platform investors. The notes that are offered, sold, and purchased in this model therefore

[3] Lending Club and Prosper have both used WebBank as the issuing bank.

[4] Before 2010 Prosper operated an auction for each loan whereby investors would submit bids (an interest rate) for each loan. The lowest bidders would win the auction and funds from those bidders were pooled to extend loans. From 2010 Prosper shifted to a model like that described above.

constitute securities and are regulated by the Securities Act of 1933 and the Securities Exchange Act of 1934.[5] The Acts mandate that securities are registered either with a federal or state regulator. Section 18(b) of the Securities Act of 1933 stipulates that securities that may be listed by, and trade on, a national market system (a registered exchange) are exempt from state-level registration and may be federally registered. As P2P notes are not listed or traded on a national market system, the platforms must secure approval from state securities regulators to solicit funds from investors in each state (Wolfe and Yoo, 2018).

Many state securities regulators mandate security registrants meet the requirements of a 'merit review'.[6] This requires the state securities regulator find that, "the business of the issuer is not fraudulently conducted…that the plan of issuance and sale of the securities…would not defraud or deceive" (Chaffee and Rapp, 2012).[7] Information provided by borrowers in loan applications may be inaccurate, missing, or deliberately misleading. For example, they may misstate their income, current employment status, or employment history. Where P2P platforms are unable to verify the information in borrowers' loan applications, the regulator rules it is unable to conclude the business is not fraudulently conducted as required by state law. In these cases, P2P platforms are denied the opportunity to register securities by the state regulator, and are prohibited from soliciting funds from investors within the state. P2P platforms are only granted approval to solicit funds in a merit review state once the state securities regulator is convinced the platform has implemented procedures that ensure investors cannot be defrauded (Chaffee and Rapp, 2012).

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5 Section 2(a)1 of the Securities Act of 1933 and section 3(a)10 of the Securities Exchange Act of 1934 provide the definition of a 'security'. Both sections include within the definition of a security the terms 'investment contracts' and 'notes'. P2P loans fall under this umbrella.

6 The states are Alabama, Arizona, Arkansas, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, Tennessee, Texas, Pennsylvania, Vermont, Virginia, and West Virginia.

7 Ohio is a representative example of the law in merit review states (Chaffee and Rapp, 2012). See, Section 1701.09 of the Ohio Revised Code and Amendments for further details.

The remaining states permit P2P lending without restrictions. This is because these states' securities law mirrors the Securities and Exchange Commission's approach to securities offerings which does not involve merit review but simply requires disclosure (GAO, 2011).[8] As these states historically followed this approach, P2P lenders were immediately granted approval to solicit investment funds. Among these states, seven authorize investing in notes but only for 'sophisticated' investors that meet suitability requirements. This is the case for all securities, including P2P loans.[9] In most of these states, investing is limited to individuals with an income of at least $70,000 and $70,000 net worth. California imposes less stringent requirements, and only for individuals who invest more than 10% in notes. The reasons states impose these restrictions are the financial health of the platforms themselves.[10]

Our review of the legal literature shows the state-level P2P investing restrictions are due to regulators' concerns about protecting investors from fraud. The restrictions are unrelated to the cost of deposits, bank liability structure, and conditions within the banking industry generally. Changes in investing restrictions are driven by a P2P platform convincing state securities regulators that their procedures accurately verify borrowers' application claims. We therefore conclude the restrictions are exogenous with respect to our outcomes of interest.

4.2 Identification Strategy

To isolate causal inferences, we use difference-in-difference estimation that exploits time-varying changes in investing restrictions through Lending Club and Prosper across US states. We compare

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[8] See the Government Accountability Office report *Person-to-Person Lending: New Regulatory Challenges Could Emerge as the Industry Grows*, supra note 5. http://www.gao.gov/new.items/d11613.pdf.

[9] The states with suitability requirements are California, Idaho, Kentucky, New Hampshire, Oregon, Washington, and Virginia.

[10] For example, the Kentucky Department of Financial Institutions noted Lending Club's auditor's "going concern" letter mentioned its negative earnings. The department opined that investment in the site "constitutes a level of risk suitable only to Accredited Investors" (Chaffee and Rapp, 2012).

the cross-time evolution of the dependent variable in banks in states that remove P2P investing restrictions relative to banks in states that do not remove the restrictions. We estimate the equation,

$$y_{bst} = \beta LC_{st} + \gamma PR_{st} + \delta X_{bst} + \varphi_{bs} + \varphi_t + \varepsilon_{bst}, \qquad (1)$$

where y_{bst} is the dependent variable of interest (either the cost of deposits, or the deposit share) for bank b, operating in state s during quarter t; LC_{st} is a dummy variable equal to 1 if investors in state s are permitted to invest in Lending Club during quarter t; PR_{st} is a dummy variable equal to 1 if investors in state s are permitted to invest in Prosper during quarter t; X_{bst} is a vector of control variables; and ε_{bst} is the error term. We cluster the standard errors at the state level.

Equation (1) exploits the panel structure of our data set to rule out confounds. For example, we include bank fixed effects (γ_{bs}) to eliminate unobservable time-invariant bank characteristics that may influence the cost of deposits in the cross-section. The estimations also condition upon quarter-year fixed effects (γ_t) that remove time-varying shocks common across all banks during each quarter. The quarter-year fixed effects also sharpen identification in equation (1). Specifically, the average treatment effects, β and γ, are estimated based on comparisons of y_{bst} between banks in different states at the same point in time.

4.3 Diagnostic Tests: Parallel Trends

[Insert Figure 1: Pre-Treatment Cost of Deposits Trends]

[Insert Figure 2: Pre-Treatment Deposit Share Trends]

Before reporting econometric results, we test the key identifying assumption underlying difference-in-difference estimation: parallel trends. The graphical evidence in Panel A of Figure 1 shows that prior to the removal of investing restrictions through Lending Club, the cost of deposits and liability structure evolve in a highly similar fashion within the treatment and control groups.

The patterns are also similar in Panel B of Figure 1 ahead of the removal of Prosper investing restrictions. Figure 2 presents the corresponding tests for liability structure. Again, the treatment and control groups display parallel trends.

To more formally examine the parallel trends assumption we follow Roberts and Whited (2013) and estimate the equation,

$$y_{bst} = \beta_1 LC_{st-1} + \beta_2 LC_{st-2} + \beta_3 LC_{st-3} + \gamma_1 PR_{st-1} + \gamma_2 PR_{st-2} + \gamma_3 PR_{st-3} + \delta X_{bst} + \varphi_{bs} + \varphi_t + \varepsilon_{bst}, \quad (2)$$

where all variables are defined as in equation (1) except LC_{st-1}, LC_{st-2}, and LC_{st-3} which are dummy variables equal to 1 in the first, second, and third quarter before Lending Club investing restrictions are removed by state s, respectively. PR_{st-1}, PR_{st-2}, and PR_{st-3} denote the corresponding pre-treatment dummy variables for Prosper. Intuitively, one would expect the coefficients β_1, β_2, β_3, γ_1, γ_2, and γ_3 to be statistically insignificant if the parallel trends assumption holds. That is, during each pre-treatment period, there are no statistically significant changes in the outcome variables between banks in states that do and do not subsequently remove P2P investing restrictions.

[Insert Table 3: Parallel Trends Tests]

The results of these tests are reported in Panel A of Table 3. Irrespective of whether we include the pre-treatment dummy variables individually, or simultaneously, the coefficients of interest remain statistically insignificant. Hence, the parallel trends assumption holds within our data. This also confirms that banks do not anticipate the removal of P2P investing restrictions and pre-emptively change their behavior.

4.4 Diagnostic Tests: Comparability of the Treatment and Control Groups

Difference-in-difference estimates have greater salience where the treatment and control groups resemble each other before treatment. In conjunction with parallel trends, this adds credibility to the implied counterfactual. Panel B of Table 3 therefore presents the results of *t*-tests on the equality of several bank-level characteristics prior to the removal of P2P investing restrictions. We find no significant differences between the groups in terms of size, capitalization, profitability, or their branch networks. Leverage, the variance of return on assets and equity, and bank soundness (measured using the Z-score) are also highly comparable. We therefore conclude that the requirements for drawing valid inferences are met.

5. Results

In this section, we first present evidence on the relationship between P2P platforms and the cost of bank deposits. We then show this is driven by a contraction in the supply of deposit funding, and that P2P platforms provoke a change in banks' funding mix.

5.1 The Effect of P2P Platforms on the Cost of Deposits

[Insert Table 4: Peer-to-Peer Lenders and the Cost of Deposits]

Table 4 presents estimates of equation (1) using the cost of deposits as the dependent variable. Column 1 of Table 4 presents estimates from a model that conditions only on bank and quarter-year fixed effects. We find the entry of both Lending Club and Prosper to elicit statistically significant effects on the cost of deposits. Following the removal of investing restrictions through Lending Club the cost of deposits increases by approximately 14%. The average treatment effect for Prosper is 17%.[11] Economically, these are large effects. However, consistent P2P lenders' small

[11] As the dependent variable is measured in natural logarithms, the average treatment effect for Lending Club is calculated as $(e^{0.1311} - 1) \times 100\% = 14\%$. The same formula applies to calculating the Prosper average treatment effect.

share of the financial intermediation market, the Lending Club (Prosper) treatment effect equates to a 2.4 (2.9) basis point increase in the cost of deposits for the average bank.[12]

The increase in banks' deposit costs is consistent with P2P lenders causing a reduction in the supply of deposit funds. Specifically, when confronted by an outflow of deposits, banks increase equilibrium deposit interest rates. To ensure that demand conditions do not drive our inferences, we use several control variables that have been used elsewhere in the literature to approximate deposit demand (Demirguc-Kunt and Huizinga, 1999; Saunders and Schumacher, 2000). Specifically, we include the per capita income growth rate, the population growth rate, the unemployment rate, and the number of business establishments per capita to capture macroeconomic factors. The results of this test are reported in column 2 of Table 4. Despite including the additional covariates, the Lending Club and Prosper coefficients remain very similar in economic and statistical magnitude relative to the baseline estimates. This suggests that our estimates capture supply shocks due to P2P platforms and that investing restrictions are independent with respect to local demand and business cycle conditions (Roberts and Whited, 2013). The per capita income growth rate coefficient is statistically significant at the 5% level, while the population coefficient is significant at 10%. We estimate the relationships between the cost of deposits and establishhments per capita and unemployment to be insignificant.

Next, we follow two strategies to eliminate bank-level confounds. First, we append equation (1) with bank-level covariates to rule out the potentially confounding effects of bank size, capitalization and geographical diversification, measured using the number of branches. Column 3 of Table 4 shows that a 1% increase in bank size is associated with a 0.43% increase in the cost

[12] The cost of deposits at the average bank is 0.17% or 17 basis points. The Prosper average treatment effect is equivalent to increasing the mean by 14%, or 2.38 basis points.

of deposits. Better capitalized banks also pay significantly higher deposit interest rates, whereas the cost of deposits is significantly decreasing in the number of branches a bank operates.

Competition for deposits between banks and P2P lenders is localized as the Fintech sector is geographically constrained by state-level investment restrictions. Banks operating branches across multiple states may therefore be less affected by competition for deposits because they can source deposits from branches in states where P2P platforms are not allowed to operate. We test the hypothesis that the cost of deposits is less sensitive to P2P deposit competition from two angles. First, we interact the LC and PR dummy variables with the multi state variable and include these interactions in equation (1). The results of this test are reported in column 4 of Table 4. While the Lending Club and Prosper coefficients remain positive and statistically significant, the interaction coefficients are both negative. Following the removal of restrictions on investing through Lending Club, the cost of deposits rises by 4% less among banks with branches in multiple states. The Prosper-Multi state interaction coefficient is similar in magnitude but is imprecisely estimated.

Our second approach to this issue is to examine whether bank size mitigates the effect of P2P platforms on the cost of deposits. We interact the LC and PR dummy variables with the bank size variable and include the interactions in equation (1). Despite this change, the removal of Lending Club and Prosper investing restrictions continue to significantly increase the cost of deposits. However, the Lending Club effect is more muted among large banks. The Prosper-Bank size interaction coefficient is statistically insignificant. That large banks' deposit costs are less affected by competition with P2P lenders may be due to their geographical diversification, but could also reflect reputational effects as well. For example, their brand names or to-big-to-fail status mitigate deposit outflows.

5.2 Deposit Supply and Liability Structure

The pricing effects we detect are consistent with P2P lenders reducing the supply of deposits to banks. Next, we present evidence to verify this mechanism.

[Insert Table 5: Deposit Quantity and Liability Structure]

If our findings reflect a negative deposit supply shock, one would anticipate a reduction in the quantity of deposits held by banks following the removal of P2P investing restrictions. However, if a confounding demand shock drives our inferences, the increase in equilibrium deposit costs would coincide with an increase in banks' deposits. We therefore test how the removal of P2P investing restrictions affects the quantity of deposits held by banks to validate the source of the price changes.

We test this hypothesis by estimating equation (1) using two dependent variables. Column 1 of Table 5 presents estimates using the deposit growth rate as the dependent variable in equation (1). Removing restrictions on investing through Lending Club and Prosper is estimated to reduce the deposit growth rate by 3.3% and 0.3%, respectively. The evidence in column 2 of Table 5 shows the entry of P2P lenders into banking markets provokes a net outflow of deposits. In this specification we estimate equation (1) using total deposits as the dependent variable. The Lending Club and Prosper coefficients are negative and statistically significant at the 1% level. Hence, following the removal of P2P investing restrictions, the quantity of deposits held by banks decreases. Together our findings show 1) an increase in the cost of deposits, and 2) a reduction in the quantity of deposits. These effects are only consistent with a negative supply shock, which reinforces the view that our inferences are not driven by confounding demand shocks.

As banks experience an outflow of deposits in the face of P2P competition, one would anticipate a change in their liability structure. Specifically, as the supply of deposits contract, banks are forced to make up the funding shortfall by relying more heavily on more expensive non-deposit funding.

We test this conjecture using the non-deposit share (the ratio of non-deposit liabilities to total liabilities) as the dependent variable in equation (1). The estimates in column 3 of Table 5 show that removing P2P investing restrictions leads banks to rely more heavily on non-deposit funding. The Lending Club coefficient implies a 0.21% increase in the non-deposit funding share and is statistically significant at the 5% level. However, the Prosper coefficient is insignificant.

Given P2P lenders induce changes in banks' balance sheets as they substitute deposits for non-deposit funding, one would anticipate an increase in banks' cost of non-deposits. Both through greater reliance upon non-deposits (which are typically more expensive than deposits) and through higher demand for non-deposits. Indeed, this is what we find in column 4 of Table 5. Non-deposit interest costs increase by approximately 15% after Lending Club and Prosper investing restrictions are removed.

In the final column of Table 5 we investigate the overall effect of P2P lenders on banks' funding costs. We estimate equation (1) using the ratio of total interest expenses to total liabilities as the dependent variable which incorporates the cost of both deposits and non-deposit liabilities. Consistent with P2P lenders inducing an increase in the cost of deposits and a shift towards greater reliance on more expensive non-deposit funding, we find the effect of P2P lenders on banks' overall funding costs is greater than their impact on the cost of deposits. Removing investing restrictions through Lending Club triggers a 17% increase in bank funding costs versus 14% for Prosper.

6. Alternative Explanations and Robustness Tests

Within our data set there are 75 separate instances where investing restrictions on a P2P platform are removed (for example, restrictions on investing through Lending Club are removed in Arizona in 2015Q2). To bias our results, an omitted variable must systematically coincide with each of the 75 distinct removal episodes. This is much less likely compared to a setting with only one treatment event. However, the next set of tests rules out other plausible explanations for our results and confounding factors.

6.1 Alternative Explanations

The higher costs of deposits following the entry of P2P lenders may reflect deteriorating bank soundness or changes in market power within the banking industry.

[Insert Table 6: Bank Condition and Debtholder Monitoring]

We begin by inspecting whether the increase in banks' cost of deposits reflects shocks to bank condition and debtholder monitoring activity. For example, the market discipline literature predicts that debtholders monitor bank risk taking and price such effects into debt security prices (Dewatripont and Tirole, 1993; Calomiris, 1999; Morgan and Stiroh, 2001; Flannery, 2001; Martinez Peria and Schmukler, 2001; Danisewicz et al., 2018). The increase in deposit costs we detect may therefore be driven by debtholders demanding risk premia in response to changes in bank soundness and profitability. This appears unlikely given most deposits are protected by deposit insurance. To rule out this potential confound, we include banks' Z-score as an additional control in equation (1) to capture distance to default. Despite this change, the Lending Club and Prosper coefficient estimates reported in column 1 of Table 6 are similar in economic and statistical magnitude to before.

We also test whether changes in profitability, or the variance of bank returns, drive our inferences. The results in columns 2 to 5 of Table 6 demonstrate this is not the case. In column 6 of Table 6 we consider whether shocks to leverage influence our findings. We find this has no bearing on the key result. A related possibility is that our findings reflect more intense monitoring by debtholders. Theory and evidence shows that debtholders monitor bank behavior and demand compensation (Birchler, 2000; Danisewicz et al., 2018). Non-depositors are especially important monitors as they possess more sophisticated monitoring technologies relative to depositors. We follow Danisewicz et al. (2018) and approximate non-depositor monitoring using non-deposit liabilities' costs. Column 7 of Table 6 reports these estimates Again, our inferences remain similar to the baseline specifications.

[Insert Table 7: Market Power and Competition]

Higher deposit costs could be driven by changes in market power and competition within the banking industry. For example, new entrants increase demand for deposits while shocks to concentration may influence banks' pricing decisions. We therefore include banks' deposit market share within the state, and a Herfindahl-Hirschman index of deposit market competition and interactions between these variables and the LC and PR dummies in equation (1) to ensure we do not misattribute the rise in deposit costs to competitive shocks. Columns 1 and 2 of Table 7 show that while banking competition impacts the cost of deposits, the Lending Club and Prosper coefficients remain stable.

6.2 Branch Network Decisions

The entry of P2P lenders may lead banks to adjust their branch networks to avoid competing for deposit funds. If banks close branches in response to the removal of P2P investing restrictions and

relocate branches to states where P2P investing is prohibited, the average treatment effects we estimate constitute the lower bound on the P2P lender effects.

[Insert Table 8: Branch Network Effects]

We first test whether entry by Lending Club and Prosper affect branch closure and openings. Column 1 in Panel A of Table 8 shows that removing restrictions on both platforms leads to a statistically significant increase in the probability a bank closes a branch. The probability of branch closure increases by 0.97% and 0.74% following the entry of Lending Club and Prosper, respectively. Given the mean rate of branch closure in the sample is 3.23%, P2P lenders have an economically important influence on closure decisions. In column 2 of Panel A we find removing P2P investing restrictions has a negative effect on the probability that a bank opens a branch. However, both the LC and PR coefficient estimates are not statistically significant at conventional levels.

Our second test asks whether P2P lenders have a more profound effect on the banking sector by shaping entry and exit dynamics. In column 3 of Panel A we estimate Lending Club and Prosper to increase the probability a bank exits. However, the coefficient is economically trivial and only significant at the 10% level. Finally, in column 4 of the panel, we find no significant relationships between bank entry and the presence of P2P lenders.

The message emanating from these tests is that the entry of P2P lenders into a local banking market provokes branch closures, albeit to a limited degree. This finding is consistent with banks taking steps to reduce operating costs in the face of greater deposit market competition. In Panel B of Table 8 we study whether changes in branch networks, rather than the removal of P2P investing restrictions drive our key findings. Despite this change we continue to observe that the

entry of Lending Club and Prosper trigger significant increases in the cost of deposits and a shift in liability structure away from deposit funding.

6.3 Robustness Tests

Our next set of tests rules out plausible threats to identification. An attractive property of our quasi-experiment is that it exploits the staggered removal of P2P investing restrictions across two platforms in 46 states at different points in time. To bias our results, an omitted variable must systematically correlate with the removal of these restrictions in 75 separate instances. This appears implausible.

[Insert Table 9: Robustness Tests – Cost of Deposits]

Changes in the presence of P2P lending may correlate with other types of entrepreneurial finance. While venture capital (VC) funding is typically directed towards firms, and not to the typical borrowers that use P2P platforms, we append equation (1) with controls for the per capita quantity of VC funds and the number of VC deals per capita in each state-year to ensure VC activity does not drive our inferences. Despite including these controls the Lending Club and Prosper coefficients reported in columns 1 and 2 of Table 9 remain similar to the baseline estimates.

P2P lenders' entry incentives may vary according to state corporate tax rates. For example, P2P lenders may avoid states with high corporate tax rates because the post-tax returns to operating there are low. Corporate tax rates may also influence banks' deposit pricing strategy (Demirguc-Kunt and Huizinga, 1999). We find in column 3 of Table 9 that our findings remain robust to controlling for state corporate tax rates.

To capture additional macroeconomic factors, we include average house prices within the state as an additional covariate. Despite controlling for housing market fundamentals, the Lending Club and Prosper coefficients remain positive and statistically significant in column 4 of Table 9.

Next, we test the sensitivity of our findings to controlling for the state usury rate. Where usury rates are set at low levels, banks' net-interest margins are likely to be low which constrains deposit rates.[13] Column 5 of Table 9 shows that our key results are unaffected by controlling for usury rates.

Reputational concerns may lead P2P lenders to avoid regions with systematically higher rates of borrower default to ensure investors do not suffer high losses and withdraw their funds. We therefore include the rate of default (that is, the share of loans that are 90+ days in arrears) on auto loans, credit card debt, mortgages, and student debt in each state-year as further control variables in equation (1). The Lending Club and Prosper coefficients remain similar to the baseline results.

A potential substitute for P2P lending is equity crowdfunding. During our sample period restrictions on equity crowdfunding were lifted through enactment of the JOBS Act of 2012 and the introduction of Regulation A by the Securities and Exchange Commission in 2015. To ensure this source of finance does not contaminate our inferences, we conservatively restrict the sample to 2004Q1 to 2011Q4 in column 7 of Table 9. The removal of P2P investing restrictions continues to exert a positive and statistically significant effect on the cost of deposits.

Finally, we restrict the sample to observations from 2011Q1 onwards to rule out the confounding effect of the financial crisis. Again, our inferences in column 8 of Table 9 remain robust.

[13] Usury rates are unlikely to influence which states P2P lenders operate in. This is because the platforms use an issuing bank that holds a national charter. This allows them to export the usury rate of the state in which the issuing bank is headquartered. For example, WebBank is headquartered in Utah which does not have a usury rate. This allows the platforms to avoid usury legislation limiting borrower rates in all states they operate in.

[Insert Table 10: Robustness Tests – Liability Structure]

Table 10 repeats the aforementioned robustness tests for liability structure. Throughout the table we find the removal of P2P investing restrictions to induce a statistically significant increase in the deposit liability share.

[Insert Table 11: Estimates from Banks in Contiguous Border Counties]

Operating conditions may vary across banks located in different states. To ensure such differences do not contaminate our cross-state comparisons, we restrict the sample to banks located in contiguous counties along state borders. Within this area local operating conditions are highly similar, but banks on one side of the border are subject to exogenous changes in P2P investing. Table 11 reports the coefficient estimates using the narrower sample. In column 1, the removal of Lending Club and Prosper investing restrictions lead to a statistically significant increase in the cost of deposit funds. Economically, the magnitude of the effects is comparable to the sample using banks from across the US. In column 2 of the table we find Lending Club causes a decrease in the deposit share of liabilities that is significant at the 5% level. While we find the Prosper coefficient to be negative, it is not significant at conventional levels.

7. Conclusions

Cycles of innovation have repeatedly disrupted and transformed the financial intermediation market. Recently, new digital technologies have allowed P2P lending platforms to grow rapidly and provide individuals and institutions with new investment opportunities. P2P lenders pose a challenge to banks for deposit market share.

We show that in the US, following the removal of P2P investing restrictions banks experience an outflow of deposits that ultimately leads to a significant increase in cost of deposits. Moreover,

as the supply of bank deposits contracts, banks become more reliant on non-deposit funding sources that are more expensive relative to retail deposits.

Our findings have important policymaking implications. The Fintech revolution has led regulators to question the risks and advantages of financial technologies, particularly with respect to over indebtedness and bankruptcy. The debate surrounding P2P platforms centers on whether they help or harm consumer welfare (Danisewicz and Elard, 2018; Wolfe and Yoo, 2018). Our research demonstrates a hitherto neglected, unintended effect of the expanding Fintech sector. Specifically, P2P lenders trigger an increase in the cost of deposits and greater reliance on more expensive non-deposit funds. Prior research shows greater reliance on non-deposit funding can undermine bank stability and speed up time to failure (Schaeck, 2008; Demirguc-Kunt and Huizinga, 2010). P2P lending may therefore have indirect consequences upon macroprudential policy. While we qualify this by highlighting the economic magnitude of the effects we detect are relatively small, the supply of funds to P2P platforms does not appear to have reached equilibrium and is likely to continue growing.

It seems plausible that the Fintech sector may have wider ramifications on the banking industry through the labor market. Both by rendering some occupations obsolete, and creating competition for talent by diverting the supply of labor away from banks. Our work provides some suggestive evidence on the former effect as banks close parts of their branch network in response to the entry of P2P platforms. Moreover, the growth of the Fintech market presents challenges for the transmission of monetary policy. Exploring these issues is an exciting avenue for future research.

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Tables

Table 1: Variable Description

Variable	Description
LC	A dummy variable equal to 1 if individuals in state *s* in year t are allowed to invest in Lending Club, 0 otherwise
PR	A dummy variable equal to 1 if individuals in state *s* in year t are allowed to invest in Prosper, 0 otherwise
Cost of deposits	The ratio of total deposit interest expenses to total deposits (in natural logarithms)
Deposit share	The ratio of deposits to total liabilities
Deposit quantity	The natural logarithm of total deposits
Deposit growth	The quarterly bank-level deposit growth rate $(\Delta Deposits_{bst}/Deposits_{bst-1})$
Non-deposit cost	The ratio of non-deposit expenses to non-deposit liabilities
Non-deposit share	The ratio of non-deposit liability to total liabilities
Bank size	The natural logarithm of total assets
Capital ratio	The ratio of total assets minus total liabilities to total assets (in natural logarithms)
Unemployment rate	State unemployment rate
Income growth rate	The annual rate of per capita income growth in the state
Population	The natural logarithm of population in the state
Establishments per capita	Establishments per capita in the state (in natural logarithms)
Branches	The number of branches belonging to bank b during year t (in natural logarithms)
Multi state	A dummy variable equal to 1 if bank *b* operates branches in more than one state in year *t*, 0 otherwise
Leverage	Total Liability/Total Assets
ROA	Net Profit/Total Assets
ROE	Net Profit/Total Shareholders' Equity
σ_{ROA}	12 quarterly rolling standard deviation of RoA
σ_{ROE}	12 quarterly rolling standard deviation of RoE
Z-score	(ROA+Capital Ratio)/σ_{ROA}
Market share	The ratio of deposits in bank b in state s in quarter t to total deposits held by banks in state s in quarter t
HHI index	The Herfindahl–Hirschman index of banks' deposit market share
Branch closure	A dummy equal to 1 if a bank closes a branch in year *t*, 0 otherwise
Branch opening	A dummy equal to 1 if a bank opens a branch in year *t*, 0 otherwise
Exit	A dummy equal to 1 if a bank exits in year *t*, 0 otherwise
Entry	A dummy equal to 1 if a bank enters in year *t*, 0 otherwise

Table 2: Descriptive Statistics and Variable Description

Variables	Observations	Mean	SD	P50	P25	P75
LC	332,458	0.32	0.47	0.00	0.00	1.00
PR	332,458	0.03	0.17	0.00	0.00	0.00
Cost of deposits	332,458	0.0017	0.0021	0.0009	0.0004	0.0021
Deposit share	332,458	0.9342	0.0900	0.9622	0.9077	0.9916
Deposit quantity	332,458	11.6503	1.1695	11.6014	10.8983	12.3495
Deposit growth	332,458	0.0214	0.0893	0.0086	-0.0161	0.0391
Non-deposit cost	332,458	0.4175	0.5297	0.1565	0.0581	0.5499
Non-deposit share	332,458	0.0651	0.0844	0.0378	0.0084	0.0923
Bank size	332,458	11.8589	1.1693	11.7825	11.0779	12.5378
Capital ratio	332,458	0.1162	0.0667	0.1025	0.0879	0.1244
Unemployment rate	332,458	0.0600	0.0207	0.0537	0.0453	0.0725
Income growth rate	332,458	4.2455	3.2975	4.4494	2.7592	6.2436
Population	332,458	15.6868	0.8964	15.6058	15.0957	16.3527
Establishments per capita	332,458	-3.6969	0.1239	-3.7010	-3.8008	-3.6164
Branches	332,458	1.4658	0.7092	1.3863	0.6931	1.7918
Multi state	332,458	0.0006	0.0237	0.0000	0.0000	0.0000
Leverage	332,458	0.8837	0.0691	0.8976	0.8757	0.9122
Market share	332,458	0.6892	1.5527	0.2503	0.1065	0.5959
HHI index	332,458	0.0295	0.0297	0.0203	0.0120	0.0371
ROA	332,458	0.0047	0.0082	0.0045	0.0020	0.0083
ROE	332,458	0.0429	0.0850	0.0419	0.0181	0.0777
σ_{ROA}	332,458	0.0048	0.0248	0.0034	0.0024	0.0049
σ_{ROE}	332,458	0.0408	0.0355	0.0319	0.0219	0.0467
Z-score	332,458	14.6826	8.1363	13.1356	11.2448	15.8622
Market share	332,458	0.6892	1.5527	0.2503	0.1065	0.5959
HHI	332,458	0.0295	0.0297	0.0203	0.0120	0.0371
Branch closure	332,458	0.0323	0.1769	0.0000	0.0000	0.0000
Branch opening	332,458	0.0237	0.1521	0.0000	0.0000	0.0000
Exit	332,458	0.0019	0.0255	0.0000	0.0000	0.0000
Entry	332,458	0.0120	0.1281	0.0000	0.0000	0.0000

Notes: This table reports summary statistics for the variables in the econometric analysis. SD denotes standard deviation. P50 denotes the median. P25 denotes the 25th percentile. P75 denotes the 75th percentile.

Table 3: Identifying Assumptions Tests

Panel A: Parallel Trends

	1	2	3	4	5	6	7	8
Dependent variable:	Deposit Costs				Deposit Share			
LC_{st-1}	-0.0005			-0.0112	-0.0005			0.0003
	(0.0197)			(0.0158)	(0.0013)			(0.0010)
PR_{st-1}	0.0406			0.0211	0.0021			-0.0002
	(0.0404)			(0.0274)	(0.0037)			(0.0021)
LC_{st-2}		0.0055		0.0030		-0.0008		-0.0005
		(0.0165)		(0.0058)		(0.0011)		(0.0004)
PR_{st-2}		0.0395		0.0128		0.0027		0.0000
		(0.0440)		(0.0084)		(0.0035)		(0.0004)
LC_{st-3}			0.0103	0.0145			-0.0010	-0.0008
			(0.0153)	(0.0167)			(0.0010)	(0.0005)
PR_{st-3}			0.0367	0.0154			0.0037	0.0038
			(0.0542)	(0.0592)			(0.0037)	(0.0028)
Income growth	-0.0061**	-0.0061**	-0.0060**	-0.0059**	0.0006***	0.0006***	0.0006***	0.0006***
	(0.0029)	(0.0029)	(0.0029)	(0.0027)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Population	0.4143	0.4170*	0.4194*	0.4159	0.0421***	0.0420***	0.0420***	0.0420***
	(0.2490)	(0.2480)	(0.2473)	(0.2844)	(0.0130)	(0.0130)	(0.0130)	(0.0130)
Establishments per capita	0.4784	0.4840	0.4910	0.4832	-0.0355	-0.0353	-0.0351	-0.0351
	(0.6409)	(0.6435)	(0.6456)	(0.6302)	(0.0514)	(0.0513)	(0.0512)	(0.0516)
Unemployment rate	-0.0081	-0.0085	-0.0088	-0.0086	-0.0013**	-0.0012**	-0.0012**	-0.0012**
	(0.0087)	(0.0086)	(0.0087)	(0.0097)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Bank size	0.1698***	0.1699***	0.1700***	0.1696***	-0.0206***	-0.0206***	-0.0206***	-0.0206***
	(0.0284)	(0.0284)	(0.0283)	(0.0498)	(0.0038)	(0.0038)	(0.0038)	(0.0038)
Capital ratio	0.0102***	0.0102***	0.0102***	0.0102**	-0.0006**	-0.0006**	-0.0006**	-0.0006**
	(0.0009)	(0.0009)	(0.0009)	(0.0039)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Branches	0.0821**	0.0822**	0.0824**	0.0825	0.0094**	0.0094**	0.0094**	0.0094**
	(0.0323)	(0.0323)	(0.0323)	(0.0491)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.85	0.85	0.85	0.85	0.77	0.77	0.77	0.77
Observations	332,458	332,458	332,458	332,458	332,458	332,458	332,458	332,458

Panel B: Pre-treatment Characteristics

Variable	Control	Treatment	Difference	*t*-statistic
Bank size	11.7701	11.7602	0.0099	0.67
Capital ratio	0.1167	0.1164	0.0003	1.04
Branches	1.4611	1.4701	-0.0090	-0.67
ROA	0.0056	0.0055	0.0001	0.77
ROE	0.0453	0.0450	0.0003	0.93
σ_{ROA}	0.0080	0.0082	-0.0002	-0.88
σ_{ROE}	0.0476	0.0480	-0.0004	-0.95
Multi state	0.0020	0.0030	-0.0010	1.05
Z-score	14.7921	14.7721	0.0200	1.01
Leverage	0.8835	0.8841	-0.0006	-0.67

Notes: Panel A reports estimates of equation (2). The dependent variable in columns 1 to 4 is deposit costs, and in columns 5 to 8 the deposit share of liabilities. LC_{st-1} (PR_{st-1}) is a dummy variable equal to 1 in the quarter prior to the removal of investment restrictions on Lending Club (Prosper) in state *s*, 0 otherwise. LC_{st-2} (PR_{st-2}) is a dummy variable equal to 1 two quarters prior to the removal of investment restrictions on Lending Club (Prosper) in state *s*, 0 otherwise. LC_{st-3} (PR_{st-3}) is a dummy variable equal to 1 three quarters prior to the removal of investment restrictions on Lending Club (Prosper) in state *s*, 0 otherwise. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. Panel B reports estimates from *t*-tests that test equality in the mean pre-treatment values of bank characteristics between control and treated banks. Control banks are those headquartered in states at *t*-1 that impose investment restrictions on Lending Club and Prosper at time *t-1* and *t*. Control banks are those headquartered in states at *t*-1 that impose investment restrictions on Lending Club and Prosper at time *t-1* but not at time *t*. Control (Treatment) is the mean value of the variable among control (treated) banks. Difference is equal to Control – Treatment. *t*-statistic is the *t*-statistic from a *t*-test of equality between Control and Treatment. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4: The Effect of P2P Lenders on Banks' Cost of Deposits

	1	2	3	4	5
Dependent variable: cost of deposits					
LC	0.1311***	0.1433***	0.1499***	0.1502***	0.1930***
	(0.0294)	(0.0335)	(0.0341)	(0.0341)	(0.0119)
PR	0.1598***	0.1448**	0.1025*	0.1030*	0.1101*
	(0.0423)	(0.0542)	(0.0539)	(0.0542)	(0.0626)
Income growth		-0.0071**	-0.0053*	-0.0053*	-0.0047***
		(0.0031)	(0.0030)	(0.0030)	(0.0011)
Population		0.6182*	0.1739	0.0003***	0.1491
		(0.3190)	(0.2581)	(0.0001)	(0.1263)
Establishments per capita		0.7921	0.0449	0.1740	0.0738
		(0.7807)	(0.7497)	(0.2581)	(0.2911)
Unemployment rate		-0.0221	-0.0238*	0.0433	-0.0217***
		(0.0143)	(0.0134)	(0.7500)	(0.0046)
Bank size			0.4264***	-0.0238*	0.4507***
			(0.0375)	(0.0134)	(0.0257)
Capital ratio			0.0152***	0.4265***	0.0160***
			(0.0012)	(0.0375)	(0.0014)
Branches			-0.1098***	-0.1099***	-0.0992***
			(0.0340)	(0.0340)	(0.0283)
Multi state				-0.1083***	
				(0.0053)	
LC* Multi state				-0.0441***	
				(-0.0124)	
PR* Multi state				-0.0582	
				(0.1010)	
LC* Size					-0.1361***
					(0.0211)
PR* Size					0.0314
					(0.0731)
Bank FE	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.66	0.67	0.67	0.67	0.67
Observations	332,458	332,458	332,458	332,458	332,458

Notes: This table reports estimates of equation (1). The dependent variable is the cost of deposits (in natural logarithms). Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Deposit Quantity and Liability Structure

	1	2	3	4	5
Dependent variable	Deposit growth	Total deposits	Deposit share	Non-deposit cost	Total interest cost
LC	-0.0332***	-0.0118***	0.0021**	0.1404***	0.1600***
	(0.0034)	(0.0041)	(0.0008)	(0.0340)	(0.0287)
PR	-0.0034***	-0.0040***	-0.0030	0.1378***	0.1417*
	(0.0006)	(0.0004)	(0.0042)	(0.0471)	(0.0710)
Income growth	0.0009***	0.0002***	-0.0005***	-0.0032	-0.0044
	(0.0001)	(0.0001)	(0.0001)	(0.0039)	(0.0031)
Population	-0.0776***	0.0091	0.0005	-0.8103	-0.6041**
	(0.0133)	(0.0186)	(0.0134)	(0.6913)	(0.2796)
Establishments per capita	0.1108***	0.0365***	-0.0012	-0.2032	-0.8640
	(0.0126)	(0.0117)	(0.0204)	(0.8681)	(0.5628)
Unemployment rate	-0.0039***	-0.0018***	0.0008**	-0.0308***	-0.0013
	(0.0002)	(0.0002)	(0.0004)	(0.0110)	(0.0136)
Bank size	0.0261***	0.9540***	0.0246***	-0.1222***	0.3554***
	(0.0016)	(0.0022)	(0.0021)	(0.0399)	(0.0325)
Capital ratio	0.0056***	-0.0171***	0.0001	0.0110***	0.0010
	(0.0002)	(0.0002)	(0.0001)	(0.0024)	(0.0013)
Branches	-0.0396***	0.0254***	-0.0137***	-0.0169	-0.1377***
	(0.0020)	(0.0019)	(0.0024)	(0.0363)	(0.0301)
Bank FE	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.90	0.69	0.74	0.65	0.67
Observations	332,458	332,458	332,458	332,458	332,458

Notes: This table reports estimates of equation (1). The dependent variable is the deposit growth rate (column 1), total deposits (column 2), the non-deposit share of total liabilities (column 3), the cost of non-deposits (column 4), and total interest costs (column 5). All dependent variables are measured in natural logarithms. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6. Bank Conditions and Debtholder Monitoring

	1	2	3	4	5	6	7
Dependent variable: cost of deposits (ln)							
LC	0.1534***	0.2257***	0.1659***	0.1526***	0.1520***	0.1502***	0.1506***
	(0.0343)	(0.0383)	(0.0324)	(0.0344)	(0.0342)	(0.0340)	(0.0342)
PR	0.1105*	0.1840***	0.1180*	0.1023**	0.1076*	0.1121*	0.1008*
	(0.0576)	(0.0400)	(0.0635)	(0.0502)	(0.0560)	(0.0590)	(0.0526)
Income growth	-0.0044	-0.0092***	-0.0072**	-0.0046	-0.0044	-0.0050	-0.0051*
	(0.0028)	(0.0034)	(0.0033)	(0.0028)	(0.0027)	(0.0030)	(0.0030)
Population	0.1724	0.4361*	0.3233	0.1591	0.1656	0.1851	0.1820
	(0.2628)	(0.2339)	(0.2491)	(0.2639)	(0.2649)	(0.2575)	(0.2557)
Establishments per capita	0.1179	-0.1654	-0.2881	0.1061	0.1440	0.0605	0.0571
	(0.7706)	(0.7300)	(0.7571)	(0.7649)	(0.7716)	(0.7553)	(0.7484)
Unemployment rate	-0.0220	-0.0039	-0.0021	-0.0233*	-0.0229*	-0.0233*	-0.0245*
	(0.0134)	(0.0143)	(0.0131)	(0.0135)	(0.0136)	(0.0134)	(0.0134)
Bank size	0.4131***	0.2286***	0.2788***	0.4179***	0.4193***	0.4257***	0.4157***
	(0.0397)	(0.0235)	(0.0289)	(0.0405)	(0.0411)	(0.0382)	(0.0380)
Capital ratio	0.0209***	0.0213***	0.0112***	0.0209***	0.0214***	-0.0391	0.0153***
	(0.0012)	(0.0014)	(0.0010)	(0.0012)	(0.0012)	(0.0235)	(0.0012)
Branches	-0.1032***	-0.0132	-0.0073	-0.1003***	-0.1057***	-0.1053***	-0.1083***
	(0.0345)	(0.0310)	(0.0357)	(0.0348)	(0.0349)	(0.0339)	(0.0337)
Z-Score	-0.0000*						
	(0.0000)						
ROA		0.3166***					
		(0.0276)					
ROE			0.2072***				
			(0.0355)				
σ_{ROA}				0.1741			
				(0.1172)			
σ_{ROE}					0.2643*		
					(0.1372)		
Leverage						-0.0532***	
						(0.0231)	
Non-deposit cost							0.0179***
							(0.0061)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.68	0.70	0.68	0.68	0.68	0.67	0.73
Observations	332,458	332,458	332,458	332,458	332,458	332,458	332,458

Notes: This table reports estimates of equation (1). The dependent variable in all columns is deposit costs (in natural logarithms). Control variable denotes bank si capital ratio, ROA, Z-score, non-deposit cost, and non-deposit share in column 1, 2, 3, 4, 5, and 6, respectively. Standard errors are clustered at the state level and t corresponding *t*-statistics are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Market Power and Competition

	1	2
Dependent variable: cost of deposits		
LC	0.1761***	0.1963***
	(0.0329)	(0.0390)
PR	0.1373***	0.1418***
	(0.0436)	(0.0346)
Income growth	-0.0056*	-0.0055*
	(0.0030)	(0.0028)
Population	0.1113	0.0803
	(0.2480)	(0.2858)
Establishments per capita	-0.2087	0.2406
	(0.7502)	(0.7210)
Unemployment rate	-0.0250*	-0.0203
	(0.0141)	(0.0141)
Bank size	0.4507***	0.4263***
	(0.0383)	(0.0356)
Capital ratio	0.0158***	0.0150***
	(0.0011)	(0.0012)
Branches	-0.1063***	-0.1112***
	(0.0316)	(0.0331)
Market Share	-0.0182	
	(0.0168)	
LC * Market Share	-0.0357***	
	(0.0073)	
PR * Market Share	-0.0319**	
	(0.0158)	
HHI		0.1945***
		(0.06983)
LC * HHI		-01415**
		(0.0608)
PR * HHI		-0.2197**
		(01081)
Bank FE	Yes	Yes
Quarter-Year FE	Yes	Yes
Adj. R^2	0.67	0.67
Observations	332,458	332,458

Notes: This table reports estimates of equation (1). The dependent variable in all columns is deposit costs (in natural logarithms). Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8: Branch Network Effects

Panel A: Branch network responses				
	1	2	3	4
Dependent variable	Branch closure	Branch opening	Exit	Entry
LC	0.0097***	-0.0037	0.0003*	-0.0009
	(0.0020)	(0.0023)	(0.0002)	(0.0009)
PR	0.0074***	-0.0043	0.0011*	0.0003
	(0.0016)	(0.0086)	(0.0006)	(0.0046)
Income growth	0.0003*	-0.0005*	0.0000	-0.0001
	(0.0002)	(0.0003)	(0.0000)	(0.0001)
Population	0.0277**	0.0201	0.0001	0.0117
	(0.0119)	(0.0145)	(0.0011)	(0.0105)
Establishments per capita	-0.0542*	0.1672***	-0.0158***	0.0796***
	(0.0281)	(0.0506)	(0.0037)	(0.0225)
Unemployment rate	0.0012*	-0.0040***	0.0003***	-0.0029***
	(0.0006)	(0.0010)	(0.0001)	(0.0004)
Bank size	0.0095***	-0.0404***	0.0039***	-0.0424***
	(0.0026)	(0.0042)	(0.0004)	(0.0054)
Capital ratio	0.0042***	-0.0009***	0.0000**	-0.0002
	(0.0002)	(0.0002)	(0.0000)	(0.0002)
Branches	-0.0283***	0.1565***	-0.0130***	0.1264***
	(0.0029)	(0.0049)	(0.0008)	(0.0082)
Bank FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.24	0.13	0.03	0.06
Observations	332,458	332,458	332,458	332,458
Panel B: Network controls				
Dependent variable	Cost of deposits	Deposit share	Cost of deposits	Deposit share
LC	0.1466***	-0.0016***	0.1414***	-0.0016***
	(0.0340)	(0.0002)	(0.0333)	(0.0002)
PR	0.1069**	-0.0022*	0.0972*	-0.0020*
	(0.0524)	(0.0012)	(0.0493)	(0.0012)
Branch closure	-0.0993***	0.0038***		
	(0.0075)	(0.0005)		
Branch opening			-0.0775***	0.0008*
			(0.0100)	(0.0005)
Control variables	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.69	0.75	0.68	0.75
Observations	332,458	332,458	332,458	332,458

Notes: Panel A reports estimates of equation (1). The dependent variable in column 1 is the branch closure dummy variable. The dependent variable in column 2 is the branch opening dummy variable. The dependent variable in column 3 is the exit dummy variable. The dependent variable in column 4 is the entry dummy variable. Panel B reports estimates of equation (1) using the cost of deposits (columns 1 and 3) and deposit share (columns 2 and 4) as the dependent variable. The unreported control variables are income growth, population, establishments per capita, the unemployment rate, bank size, capital ratio, and branches. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9: Robustness Tests – Cost of Deposits

	1	2	3	4	5	6	7	8
Dependent variable: cost of deposits								
LC	0.1507***	0.1511***	0.2898***	0.2048***	0.1498***	0.1856***	0.1168***	0.2968***
	(0.0106)	(0.0106)	(0.0096)	(0.0109)	(0.0106)	(0.0106)	(0.0132)	(0.0091)
PR	0.1109*	0.1278**	0.3838**	0.2197***	0.1026*	0.2112***	0.1995***	0.3702**
	(0.0596)	(0.0602)	(0.1717)	(0.0622)	(0.0597)	(0.0608)	(0.0360)	(0.1550)
Income growth	-0.0051***	-0.0049***	0.0030**	-0.0030***	-0.0053***	-0.0032***	-0.0043***	0.0044***
	(0.0011)	(0.0011)	(0.0015)	(0.0012)	(0.0011)	(0.0011)	(0.0011)	(0.0016)
Population	0.1772	0.1805	-0.6967*	-0.9317**	0.1185	-0.1437	0.2398*	-0.8502*
	(0.1298)	(0.1298)	(0.3765)	(0.4211)	(0.1362)	(0.1788)	(0.1312)	(0.4455)
Establishments per capita	0.0717	0.1368	0.0819**	-0.1476***	0.0662	-0.5670*	-0.3287	0.1004***
	(0.2910)	(0.2935)	(0.0362)	(0.0323)	(0.2904)	(0.3008)	(0.3265)	(0.0362)
Unemployment	-0.0238***	-0.0227***	-0.0019	0.0058	-0.0236***	-0.0144***	-0.0423***	-0.0034
	(0.0046)	(0.0046)	(0.0054)	(0.0050)	(0.0046)	(0.0054)	(0.0053)	(0.0055)
Size	0.4268***	0.4269***	0.4726***	0.3933***	0.4274***	0.4202***	0.5066***	0.5846***
	(0.0259)	(0.0258)	(0.0452)	(0.0260)	(0.0258)	(0.0257)	(0.0261)	(0.0496)
Capital Ratio	0.0152***	0.0152***	0.0229***	0.0136***	0.0152***	0.0144***	0.0161***	0.0358***
	(0.0014)	(0.0014)	(0.0028)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0031)
Branch	-0.1097***	-0.1092***	-0.1510***	-0.0798***	-0.1102***	-0.1096***	-0.1156***	-0.2213***
	(0.0283)	(0.0283)	(0.0403)	(0.0284)	(0.0283)	(0.0282)	(0.0283)	(0.0407)
VC amount per capita	-0.0002							
	(0.0001)							
VC deals per capita		-0.5578**						
		(0.2514)						
State corporate tax rate			-0.0095**					
			(0.0040)					
House price index				0.0048***				
				(0.0003)				
Usury rate					-0.4395***			
					(0.0930)			
Auto delinquency rate						0.0037		
						(0.0081)		
Credit card delinquency rate						-0.0556***		
						(0.0054)		
Mortgage delinquency rate						0.0156***		
						(0.0036)		
Student loan delinquency rate						0.0116***		
						(0.0032)		
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.67	0.67	0.66	0.67	0.67	0.67	0.62	0.66
Observations	332,458	332,458	332,458	332,458	332,458	332,458	241,802	140,916

Notes: This table reports estimates of equation (1). The dependent variable is the cost of deposits (in natural logarithms). The estimates in column 7 use a sample that excludes observations from 2012Q1 onwards. The estimates in column 8 use a sample that includes observations from 2011Q1 onwards. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 10: Robustness Tests – Liability Structure

	1	2	3	4	5	6	7	8
Dependent variable: deposit share								
LC	-0.0021***	-0.0017***	-0.0020**	-0.0023***	-0.0021**	-0.0021**	-0.0021**	-0.0024***
	(0.0008)	(0.0002)	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0009)	(0.0007)
PR	0.0028	-0.0014	0.0037	-0.0022	0.0035	0.0027	-0.0079***	0.0002
	(0.0045)	(0.0012)	(0.0045)	(0.0044)	(0.0045)	(0.0044)	(0.0029)	(0.0047)
Income growth	0.0005***	0.0005***	0.0005***	0.0002**	0.0005***	0.0003***	0.0004***	0.0003**
	(0.0001)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Population	0.0010	-0.0105*	-0.0006	0.0397**	-0.0002	0.0102	-0.0039	0.0481***
	(0.0133)	(0.0058)	(0.0149)	(0.0200)	(0.0136)	(0.0130)	(0.0176)	(0.0171)
Establishments per capita	-0.0008	-0.0099*	-0.0014	-0.0082	0.0018	0.0105	0.0154	0.0124
	(0.0206)	(0.0052)	(0.0214)	(0.0244)	(0.0206)	(0.0215)	(0.0219)	(0.0243)
Unemployment	-0.0009**	-0.0009***	-0.0008**	-0.0011***	-0.0009**	0.0002	-0.0006	-0.0006
	(0.0004)	(0.0001)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Size	-0.0247***	-0.0241***	-0.0247***	-0.0288***	-0.0246***	-0.0246***	-0.0231***	-0.0299***
	(0.0022)	(0.0005)	(0.0022)	(0.0028)	(0.0022)	(0.0022)	(0.0019)	(0.0032)
Capital Ratio	-0.0001	0.0001***	-0.0002	0.0001	-0.0001	-0.0001	-0.0000	-0.0002
	(0.0002)	(0.0000)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0001)	(0.0003)
Branch	0.0136***	0.0138***	0.0136***	0.0188***	0.0136***	0.0139***	0.0103***	0.0176***
	(0.0025)	(0.0006)	(0.0025)	(0.0026)	(0.0025)	(0.0025)	(0.0021)	(0.0028)
VC amount per capita	0.0000							
	(0.0000)							
VC deals per capita		0.0140**						
		(0.0059)						
State corporate tax rate			0.0000					
			(0.0000)					
House price index				0.0002				
				(0.0003)				
Usury rate					-0.0117			
					(0.0085)			
Auto delinquency rate						-0.0018***		
						(0.0006)		
Credit card delinquency rate						0.0012***		
						(0.0005)		
Mortgage delinquency rate						-0.0010***		
						(0.0003)		
Student loan delinquency rate						0.0005**		
						(0.0002)		
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.74	0.74	0.74	0.83	0.74	0.74	0.77	0.84
Observations	332,458	332,458	332,458	332,458	332,458	332,458	241,802	140,916

Notes: This table reports estimates of equation (1). The dependent variable is deposit share. The estimates in column 7 use a sample that excludes observations from 2012Q1 onwards. The estimates in column 8 use a sample that includes observations from 2011Q1 onwards. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

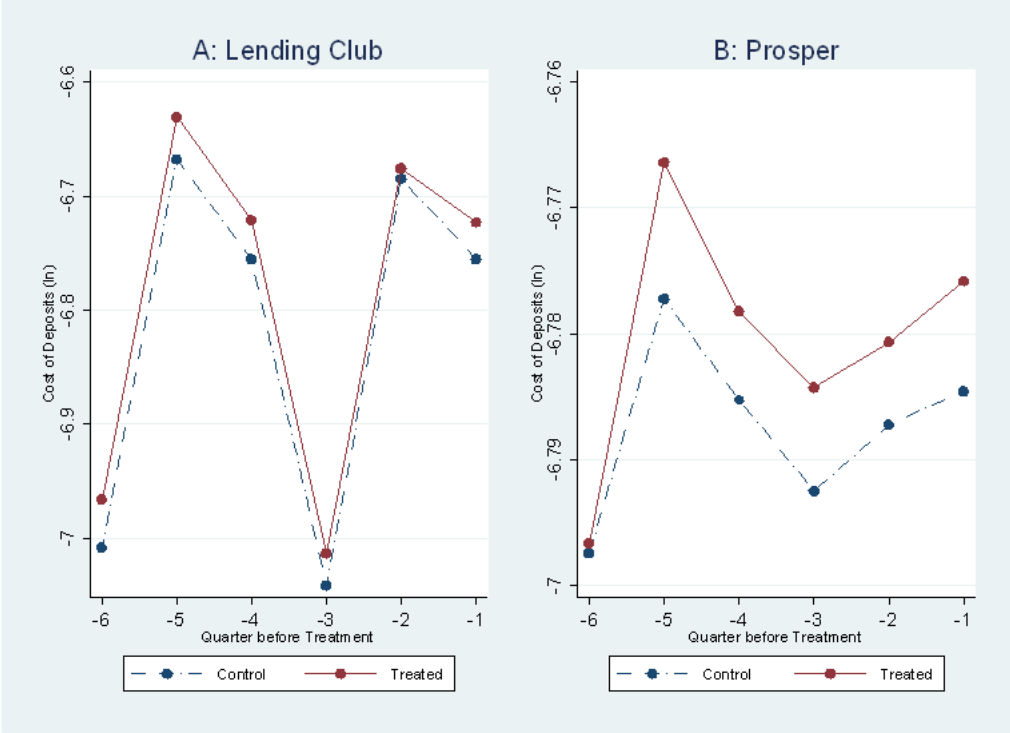
Table 11: Estimates from Banks in Contiguous Border Counties

	1	2
Dependent variable	Cost of deposits	Deposit share
LC	0.1467***	-0.0012**
	(0.0424)	(0.0005)
PR	0.0948***	-0.0159
	(0.0347)	(0.0102)
Income Growth	-0.0002	0.0004***
	(0.0032)	(0.0001)
Population	0.1369	0.0167**
	(0.2089)	(0.0083)
Establishments per capita	-0.1733**	-0.0237*
	(0.0836)	(0.0135)
Unemployment	-0.0314**	-0.0017***
	(0.0155)	(0.0003)
Size	0.4490***	-0.0298***
	(0.0647)	(0.0018)
Capital Ratio	0.0177***	-0.0009***
	(0.0029)	(0.0002)
Branch	-0.0944*	0.0132***
	(0.0558)	(0.0021)
Bank FE	Yes	Yes
Quarter-Year FE	Yes	Yes
Adj. R^2	0.67	0.79
Observations	88,409	88,409

Notes: This table presents estimates of equation (1). The dependent variable in column 1 (2) is the cost of deposits (deposit share) in natural logarithms. The sample includes banks located in contiguous border counties between treatment and control states. Standard errors are clustered at the state level and the corresponding *t*-statistics are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

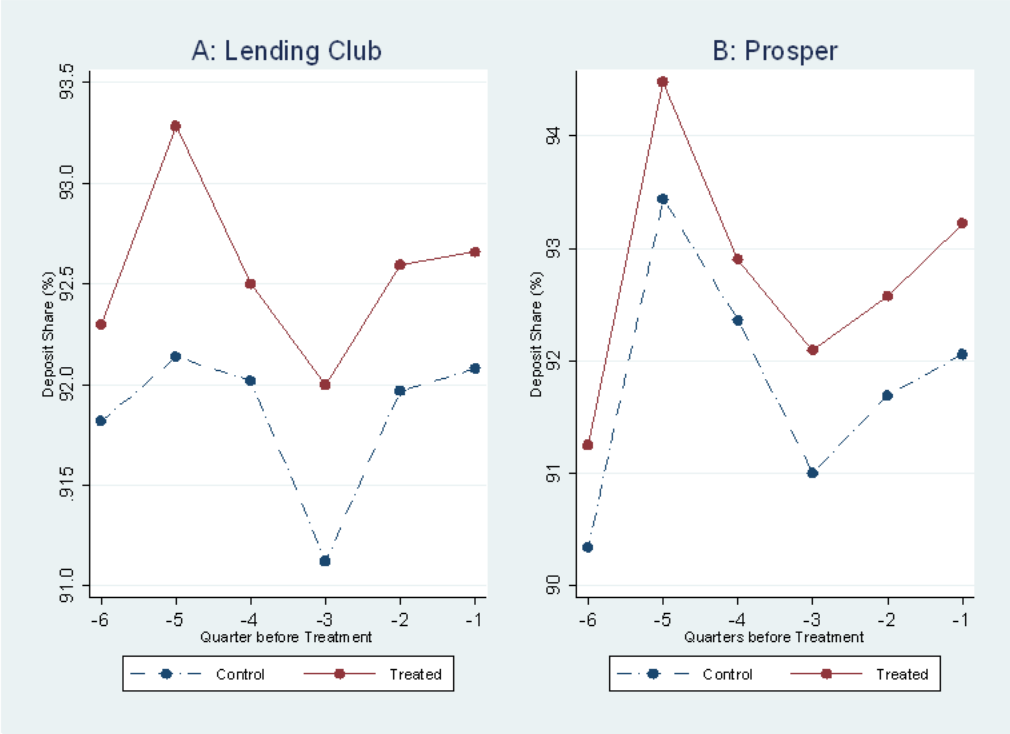
Figures

Figure 1: Pre-Treatment Cost of Deposit Trends



Notes: This figure illustrates the pre-treatment evolution of the cost of deposits before the removal of investing restrictions on Lending Club (Panel A) and Prosper (Panel B). The x-axis reports the quarter before the removal of investing restrictions. A value of -1 (-2) indicates the first (second) quarter before the removal of investing restrictions. Treated banks are those in the state that removes investing restrictions at time 0 while control banks are those in states that have not removed investing restrictions.

Figure 2: Pre-Treatment Deposit Share Trends



Notes: This figure illustrates the pre-treatment evolution of the deposit share of liabilities before the removal of investing restrictions on Lending Club (Panel A) and Prosper (Panel B). The x-axis reports the quarter before the removal of investing restrictions. A value of -1 (-2) indicates the first (second) quarter before the removal of investing restrictions. Treated banks are those in the state that removes investing restrictions at time 0 while control banks are those in states that have not removed investing restrictions.