Who Bears the Burden of Banks' Corporate Taxes?*

Leming Lin† George Pennacchi‡

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Abstract

Our model of spatial competition predicts that the incidence of a bank's corporate income tax falls on retail depositors when the bank operates in a market where there is excess retail savings relative to retail lending opportunities. In contrast, the incidence falls on retail borrowers in a market where retail lending exceeds retail savings. Moreover, bank employees bear a burden from higher taxes in proportion to the decline in total lending and deposits. Using branch-level retail interest rate data of U.S. banks over the period 1997 to 2013, we find empirical support for this theory. An increase in a state's corporate income tax leads to a decline in rates paid on retail deposits when the state's banks operate in counties where retail savings is likely to be relatively high. Yet in the state's counties where retail lending tends to exceed retail savings, retail loan rates rise when corporate income taxes are raised. Some evidence that corporate taxes affect bank employment and wages is also found.

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†Joseph M. Katz Graduate School of Business, 346 Mervis Hall, University of Pittsburgh, Pittsburgh, Pennsylvania 15260. Phone: (412) 648-1642. Email: llin@katz.pitt.edu.

‡Department of Finance, University of Illinois, Gies College of Business, 4041 BIF, 515 East Gregory Drive, Champaign, Illinois 61820. Phone: (217) 244-0952. Email: gpennacc@illinois.edu.

1 Introduction

This paper develops theory and provides empirical evidence on the incidence of corporate income taxes paid by banks. It models markets for financial services where banks and nonbanks compete for retail loans, retail deposits, and employees. The model predicts that retail borrowers bear a burden from corporate taxes via higher loan rates when the local market has an abundance of retail lending opportunities but relatively few retail deposits. In contrast, retail depositors bear a corporate tax burden in the form of lower deposit rates when the local market has few retail lending opportunities but relatively many retail deposits. Further, whenever higher corporate taxes reduce banks' market shares of retail loans or deposits versus nonbank competitors, bank employees experience lower levels of employment and wages. Using a time series of individual U.S. banks' retail loan and deposit interest rates and employment data, we find that these banks' response to changes in state-level corporate income taxes are broadly consistent with our model.

Research dating back to Harberger (1962) examines the incidence of corporate income taxes paid by non-financial firms. This literature, reviewed in Fullerton and Metcalf (2002) and Auerbach (2006), analyzes whether the corporate tax burden falls on investors via lower rates of return, on labor through lower wage rates, on suppliers due to lower input prices, or on customers in the form of higher goods and services prices. Which party bears the tax burden generally depends on several factors, including the mobility of the factors of production between taxed and untaxed sectors, the elasticities of substitution between these factors, and the elasticities of substitution between the goods and services produced in each sector. In general, a firm is able to pass on some of the cost of corporate taxes to its customers in the form of higher prices when they cannot easily substitute to the goods and services of nontaxed providers. Similarly, when a firm's employees cannot costlessly switch to work for an alternative nontaxed employer, they may bear a burden from a corporate tax change via an adjustment in their wages. Thus, even when a firm has some nontaxed competitors, imperfect competition, either in a firm's product market or labor market, opens up the possibility of its passing on the cost of corporate taxes.

Banks have unique characteristics that affect the incidence of their corporate income taxes. Like other firms, banks can finance their assets by issuing competitively-priced debt and equity to wholesale investors, and they can invest funds in wholesale securities at competitive rates of return. However, they differ in their ability to issue debt (deposits) to retail investors, and to make loans to retail borrowers, at imperfectly competitive interest rates. Extensive empirical evidence documents that banks exert market power since greater market concentration is associated with higher retail loan rates and lower retail deposit rates.[1]

A rapidly growing literature examines how taxes affect bank behavior. Much of this research focuses on how corporate income taxes influence the capital structure decisions of banks. Consistent with corporate income taxes raising the cost of equity financing, Ashcraft (2008), Mooij and Keen (2016), Hemmelgarn and Teichmann (2014), Schepens (2016), Schandlbauer (2017), Milonas (2017), Celerier et al. (2018), and Gambacorta et al. (2017) find an inverse relationship between corporate income tax rates and banks' equity capital ratios. This research also tends to find that lower taxes expand bank lending. Other research, including Han et al. (2015) and Gong et al. (2015), examines how corporate income taxes create incentives for banks to securitize loans rather than fund them on balance sheet.

The current paper investigates a different issue, namely, the incidence of corporate income taxes paid by banks. The banking industry is potentially an excellent environment to compare the reaction of prices to corporate taxes because bank loans and deposits are relatively uniform types of services compared to the products or services of firms in other industries. Yet prior research on this topic has produced conflicting results with regard to how corporate taxes affect the interest rates on loans and deposits.

[1]This evidence dates back to at least Berger and Hannan (1989). See Berger et al. (1999) for a survey of the early research on market power in banking. Despite greater competition from liberalized bank branching and the entry of nonbank financial institutions, more recent evidence continues to find that banks exert market power in retail loan and deposit markets, e.g., Kahn et al. (2005) and Park and Pennacchi (2009).

Albertazzi and Gambacorta (2010) analyze country-level data on banks from 8 euro area countries during the period 1981 to 2003 and find that higher corporate income taxes tend to raise loan interest rates but leave deposit interest rates unaffected. In contrast, Banerji et al. (2017) examine the imposition of a gross profits tax on Tokyo banks in the year 2000 and find that it lowered deposit interest rates, but it also lowered loan interest rates. Buch et al. (2016) and Kogler (2016) investigate the effects of corporate taxes that some European governments imposed on banks' non-deposit debt liabilities following the 2008-9 financial crisis. Buch et al. (2016) find that a 2011 German bank levy led to no significant change in individual banks' loan interest rates but some evidence of a rise in deposit rates. Kogler (2016) analyzes data on individual banks from 23 European countries from 2007 to 2013 and finds that higher bank levies raised both loan interest rates and deposit interest rates.[2]

Several studies examine how corporate taxes affect banks' net interest margins but do not distinguish between the separate affects on loan rates versus deposit rates. However, even this work produces inconsistent results. Demirguc-Kunt and Huizinga (1999) and Chiorazzo and Milani (2011) find that higher taxes raise net interest margins, consistent with bank customers bearing a tax burden. Yet Huizinga et al. (2014) and Capelle-Blancard and Havrylchyk (2014) find no relationship between net interest margins and corporate taxes.[3]

Our paper is different, both theoretically and empirically, from the existing literature. Most of the prior theory on tax incidence uses a variation of the model of Monti (1972) and Klein (1971) in which a bank's choice of loan interest rates is separable from its choice of deposit interest rates. That separation does not hold for our model where corporate income taxes, along with a capital requirement, create a tax wedge between retail loan and deposit rates. For some market structures, this wedge results in higher retail loan

[2]An explanation for the rise in deposit rates is that since most countries excluded customer deposits from the tax, they were relatively attractive to banks.

[3]Huizinga et al. (2014) find no significant relationship for domestically-owned banks. However, foreign-owned banks, which tend to be tax disadvantaged relative to domestic banks, have net interest rate margins that do reflect corporate taxes.

rates. But in others, it lowers retail deposit rates. Consequently, our model has more subtle predictions that are conditioned on market structure, making it potentially able to explain the mixed results of prior empirical work. Indeed, our empirical work, which uses an arguably more accurate dataset of retail loan and deposit rates than that of prior research, is generally consistent with the model's predictions.

Our model of a financial services market is a generalization of the Salop (1979) circular city and includes features found in the banking theories of Chiappori et al. (1995), Park and Pennacchi (2009), Martinez-Miera and Schliephake (2016), and Pennacchi (2017). One innovation is our inclusion of a market for labor where bank employees can serve in two different activities. They can work to reduce loan default losses by credit screening and monitoring retail borrowers or, alternatively, they can provide deposit services that are valued by retail savers. The model also explicitly considers competition from nonbank financial services providers that, as in practice, are exempt from corporate income taxes. The model predicts that if the financial services market is characterized by relatively more retail lending opportunities compared to available retail savings, then a change in banks' corporate income tax rates raises the equilibrium interest rate charged on retail loans. In contrast, if the market structure has relatively more retail savings than retail lending opportunities, a change in banks' corporate income tax rates can lower the equilibrium interest rate paid on retail deposits. In addition, higher taxes increase the market share of either nonbank lenders or nonbank savings providers and lead to lower overall bank employment and wages.

All prior empirical research of which we are aware examine the incidence of corporate taxes using "implicit" loan and deposit interest rates that are derived from banks' income and balance sheet data. Loan interest rates are proxied by total interest income per total loans and deposit interest rates are proxied by total interest expense per total deposits. While these interest rate measures are broad and all-encompassing, they have some drawbacks. Over any period of time, interest income (*expense*) and total loans (*deposits*) reflect both old and new loans (*deposits*). Moreover, financial statement measures reflect a mixture of different types of loans and deposits that can vary by risk and maturity. These measures also may reflect loans and deposits from multiple local markets that vary in terms of their competitive structures. If changes in tax rates lead banks to shift the risk, maturities, or locations of loans and deposits, some variation in implicit interest rates will be unrelated to tax incidence.

Our empirical work differs by its use of survey data on individual banks' retail loan and deposit rates. This data is specific to an individual bank branch and a particular type of loan or deposit. Hence, our data allows for more uniform comparisons of interest rates across banks, markets, and time. Our tests analyze rates on one of the most common types of retail loans and two of the most common types of retail deposits set by several thousand U.S. banks over the period 1997 to 2013.

We test our model's predictions by examining banks' rate-setting reactions when the state in which they operate changes its state corporate income tax rate. As controls, we use other banks whose states did not change rates. We find that banks subject to corporate income tax rate changes adjust retail loan and deposit rates as the model would predict. Specifically, when banks operate in counties where retail lending opportunities are likely to exceed retail savings, banks react to a tax rate increase by raising rates on home equity lines of credit. In other counties where retail savings is likely to exceed retail lending, banks respond to a rise in tax rates by lowering certificate of deposit (CD) and money market deposit account (MMDA) rates. Consequently, as the theory predicts, those retail customers having the relatively larger market presence bear the burden of banks' corporate income taxes. Also consistent with our model, we find evidence bank employment reacts negatively to a rise in corporate income taxes.

The next section outlines our model's assumptions and describes its predictions on how corporate income taxes affect retail deposit rates, retail loan rates, and bank employment. Section 3 describes the data used in our empirical tests and provides summary statistics. Section 4 presents the results of our empirical tests while Section 5 concludes.

2 The Model

We begin by outlining the assumptions of the model and then characterize equilibria under different market conditions. Details of the model's derivation are given in the Appendix.

2.1 Assumptions

The assumptions of the model characterize the markets for retail customers and for employees (labor). They also describe the operations of banks and their nonbank competitors. Markets for banks' retail customers and labor are assumed to be confined to a local area, which in the United States is typically considered to be a county or metropolitan statistical area (MSA). Nonbanks are assumed to operate online or in multiple markets and set prices at a non-local national or global level.

2.1.1 Retail Customers

Two continua of retail financial services customers are uniformly located around a unit circle, which as in Salop (1979) represents a local market. One continuum are savers (depositors) who have a total amount of savings equal to D. The other continuum are borrowers who have a total amount of desired loans equal to L. These retail individuals incur linear "traveling" costs to obtain a service from a provider, where the cost per unit distance traveled is t_D for savers and t_L for borrowers. It is assumed that customers obtain sufficient surplus to always be willing to absorb these traveling costs from their preferred provider so that, in equilibrium, all of the market's customers are served.

2.1.2 Labor

A continuum of laborers (employees) are also uniformly located around the unit circle. They inelastically supply a total of H hours of labor and incur linear "commuting" costs to work at a bank or nonbank employer, where the cost per unit distance traveled is t_H.

2.1.3 Banks

There are $n \geq 2$ banks located uniformly around the unit circle. Consider one of these banks, namely bank i, where $i = 1, ..., n$.

Bank Retail Deposits The interest rate that bank i sets on its retail deposits is denoted $r_{D,i}$, and the amount of retail deposits that it issues is denoted D_i. Retail deposits are government-insured at a fair insurance premium.[4] The bank can enhance the attractiveness of retail deposits by providing nonpecuniary services that depositors value at $s(h_{i,D})$ per deposit, where $h_{i,D}$ is the number of employee hours devoted to services such as bank tellers and online and mobile banking. Thus, savers' rate of return on deposits from explicit interest and implicit services is $r_{D,i} + s(h_{i,D})$. The value of services is assumed to be the following increasing and concave function of employee hours:

$$s(h) = \underline{s}e^{-h} + \overline{s}\left(1 - e^{-h}\right) \ . \tag{1}$$

Thus, $\underline{s}$ is the minimum value of deposit services (when $h = 0$) while $\overline{s} > \underline{s}$ is the maximum value of deposit services (when $h = \infty$).

Bank Retail Loans The interest rate that bank i sets on its retail loans is denoted $r_{L,i}$, and the amount of retail loans that it makes is denoted L_i. Retail loans incur per-loan default losses that have a certainty-equivalent cost to the bank of $c(h_{i,L})$, where $h_{i,L}$ is the number of hours that employees devote to credit screening and monitoring borrowers. The cost of default losses is a decreasing and convex function of employee hours:

$$c(h) = \overline{c}e^{-h} + \underline{c}\left(1 - e^{-h}\right) \ , \tag{2}$$

where $\overline{c}$ and $\underline{c} < \overline{c}$ are the respective maximum and minimum default losses.

[4] Since our focus is on how a bank's setting of retail loan and deposit interest rates affects tax incidence, we ignore how possible mispricing of deposit insurance may affect the bank's decisions.

Bank Labor Denote the total hours of labor hired by bank i as $H_i = h_{i,L} + h_{i,D}$. To attract this labor, the bank offers an hourly wage rate denoted as w_i.

Additional Bank Assumptions Bank i can also issue W_i in wholesale deposits or, if $W_i < 0$, invest in wholesale debt. The bank is a price-taker in wholesale funds markets, so that its certainty-equivalent cost of issuing wholesale debt or investing in wholesale debt is the competitive money market rate, denoted by r_M. This competitive rate on debt is set in national or global financial markets and is exogenous to the model.

In addition to retail deposits and wholesale debt, bank i can fund its assets with equity, denoted E_i. Like wholesale debt, investors' certainty-equivalent required rate of return on equity, r_E, is assumed to be exogenously set in a broader national or global financial market.[5] With these assumptions, the bank's balance sheet constraint is

$$L_i = D_i + W_i + E_i \tag{3}$$

The bank is also subject to a minimum equity capital-to-asset constraint set by the bank's regulator or deposit insurer given by[6]

$$E_i \geq \frac{\kappa}{1-\kappa} \left[D_i + \max\left(W_i, 0\right) \right] \ , \tag{4}$$

where κ is the minimum required equity capital to asset ratio and, therefore, $\kappa / \left(1-\kappa\right)$ is the minimum equity capital to total debt ratio. Thus, inequality (4) is equivalent to a "leverage" requirement. In practice, banks are subject to both a leverage requirement and a risk-based capital requirement. Our results are qualitatively the same if we assume a risk-based capital requirement where a bank's investment in securities has a strictly

[5] In general, investors' certainty equivalent required rate of return on equity, r_E, can differ from that of wholesale debt, r_M, if equity and debt are taxed differently at the personal income tax level. If all investors are identical and their personal income tax rates for debt and equity are τ_D and τ_E, respectively, then in equilibrium $r_E = r_M \left(1-\tau_D\right) / \left(1-\tau_E\right)$. In other words, investors' certainty equivalent required returns on equity and debt are equilized on an after-personal income tax basis.

[6] Since retail deposits are insured, it is natural to think that the government would impose a capital constraints on banks to control its losses due to the bank failures.

positive risk weight. However, as shown in Pennacchi (2017), if only retail loans have a positive risk weight and securities have a zero risk weight, then only retail borrowers, and never retail depositors, bear a burden from the bank's corporate taxes. This explains why other models that assume a capital requirement based only on a bank's loans predict that corporate income taxes can only affect loan rates.[7] As will be shown, our model predicts that corporate taxes can sometimes affect deposit rates.

Banks are taxed on their corporate income at the marginal tax rate τ. Extensive empirical evidence supports our assumption that the total tax burden on equity exceeds that on debt so that $r_E > r_M(1-\tau)$.[8] In other words, debt's benefit from the corporate tax deduction of its interest expense offsets its potential disadvantage from heavier taxation than equity at the personal income level.

Each of the n banks is assumed to choose its retail deposit rate, retail loan rate, the hours of labor employed in deposit services and loan loss reduction, and its amounts of outside equity and wholesale funds in order to maximize its after-tax value of inside equity. For bank i, this objective function is:[9]

$$\underset{r_{D,i},\, r_{L,i},\, h_{i,D},\, h_{i,L},\, E_i,\, W_i}{\text{Max}} \left[L_i\left(r_{L,i} - c\left(h_{i,L}\right)\right) - D_i r_{D,i} - W_i r_M - H_i w_i\right](1-\tau) - E_i r_E \tag{5}$$

2.1.4 Nonbank Competitors

Three types of nonbank firms may compete with banks. They are nonbank savings vehicles, lending vehicles, and employers. Nonbank savings and lending institutions are assumed to operate in national or global markets and set interest rates that are independent of a local

[7]See Albertazzi and Gambacorta (2010) who uses an extension of the Monti (1972) - Klein (1971) model and assumes banks are subject to a minimum capital-to-loan ratio. Kogler (2016) uses a version of the Monti - Klein model but assumes that a bank's corporate tax is proportional to total non-equity liabilities, rather than a standard corporate income tax. In this case, deposits can reflect the corporate tax rate.

[8]Graham (2000) provides a review of this evidence.

[9]Han et al. (2015) show how this objective function can be derived when loans are default-risky but markets are complete and the bank's insured and uninsured liabilities are fairly priced.

market's competitive conditions.[10] Below we consider two cases. The first is where these nonbank savings providers and lenders are sufficiently "far" from the local banking market such that they do not compete with the banks. The second is where they are close enough to attract positive amounts of the local market's retail loans and retail deposits. For this second case, banks' interest rates affect the equilibrium quantities of bank deposits and loans, making them imperfectly elastic rather than fully inelastic.

Regarding nonbank employers, it is assumed that they are always sufficiently close to the local market such that they employ some of the local market's labor. These nonbank employers set a wage rate that is taken as exogenous, which might be justified if these employers represent large firms that operate in many local markets and set uniform wages.

Nonbank Savings Vehicles A nonbank savings vehicle is interpreted as a mutual fund or an exchange-traded fund (ETF). The prime example is a money market mutual fund (MMF). A MMF invests in wholesale debt at the certainty equivalent rate r_M and provides a perfectly-competitive rate of return to savers of r_M. MMFs are assumed to provide minimal services which we take to be zero. Unlike banks, MMFs have no physical presence but an online (internet) presence. Each retail saver is assumed to have an effective traveling distance of δ_D to a MMF.[11] Notably, mutual funds and ETFs, including MMFs, are exempt from corporate income taxes due to their status as investment vehicles.

Nonbank Lenders Nonbank lenders take the form of loan (e.g., mortgage) brokers or online peer-to-peer lenders whose loans are sold (funded) by a securitization vehicle that

[10] Park and Pennacchi (2009) provide a model of multi-market deposit and loan competition where some banks operate in a single local market and other banks set uniform rates but operate in multiple local markets. The profit maximizing rates of multi-market banks turn out to be a value-weighted average of the profit-maximizing local rates. Our model can be justified on these grounds by assuming that the local market in our model is small relative to the number and/or sizes of other markets in which nonbank competitors operate.

[11] The assumption that nonbanks are a fixed distance from all customers is made by Martinez-Miera and Schliephake (2016). They assume nonbanks are located in a ring at the center of the circular city, which gives them an identical, fixed distance from each customer located around the circle. Alternatively, nonbanks might be located at a uniform distance outside the circular city.

issues mortgage-backed or asset-backed securities. Notably, these loan funding vehicles are free from corporate income taxes and pass through retail loan returns to their investors. We assume these investors require a certainty-equivalent required rate of return equal to the wholesale rate r_M.[12] Assuming perfect competition and loan costs of $\widehat{c}$, nonbank lenders offer loan rates of $r_M + \widehat{c}$.[13] Similar to nonbank savings providers, nonbank lenders have an online presence, and each retail borrower is assumed to have an effective traveling distance of δ_L to them.

Nonbank Employers Banks compete for labor in the local market with nonbank firms that are assumed to operate in multiple markets and set a uniform wage rate of $\widehat{w}$. Each employee in the local market has an effective commuting distance of δ_H to a nonbank employer.[14]

2.2 Model Results

This section summarizes the model's results for various symmetric Bertrand-Nash loan and deposit market equilibria. Derivations of these results are given in the Appendix.

2.2.1 Equilibria When Only Banks Compete for Loans and Savings

We first consider banks' equilibrium decisions when nonbank lending and savings institutions are sufficiently distant such that they provide no competition for banks.[15] Hence, a

[12]Peer-to-peer lenders such as Prosper or Lending Club pass through loan returns to investors net of a servicing/managment fee, and these returns are taxed at the investors' personal income level as debt. Similarly, most mortgage-backed and asset-backed securities are debt. While some are equity (tranches), they are not tax-disadvantaged because the securitization vehicle is exempt from corporate income taxes. Allowing for a proportion of nonbank lending to be funded by equity, in addition to debt, would not change the results due to the corporate tax exemption.

[13]We can interpret this process as brokers originating the loans and then transfering them to securitization underwriters. The loan spread $\widehat{c}$ incorporates the cost of default losses and brokerage, underwriting, and loan servicing fees.

[14]An alternative interpretation is that δ_H is the local worker's effective hourly cost of obtaining employment in another market that offers the wage $\widehat{w}$.

[15]The Appendix gives minimum distances for δ_L and δ_D such that nonbank lenders and savings providers attract none of the local market's retail customers.

given bank directly competes for retail savings and loans with only its neighboring banks in the local market. The only source of nonbank competition comes in the labor market. The following proposition gives the Bertrand-Nash equilibria and shows that the incidence of corporate taxes depends on the market's retail lending opportunities relative to its retail savings.

Proposition 1: *Consider a market where only banks compete for retail lending and savings. If* $L(1-\kappa) \geq D$*, banks issue wholesale debt (*$W_i \geq 0$*) and their symmetric equilibrium loan and deposit rates equal*

$$r_{L,i} = r_M + \kappa \left(\frac{r_E}{1-\tau} - r_M \right) + c\left(h_L^*\right) + \frac{t_L}{n} \quad (6)$$

$$r_{D,i} = r_M - \frac{t_D}{n}. \quad (7)$$

Instead, if $L(1-\kappa) < D$*, banks invest in wholesale debt (*$W_i < 0$*) and their symmetric equilibrium loan and deposit rates equal*

$$r_{L,i} = r_M + c\left(h_L^*\right) + \frac{t_L}{n} \quad (8)$$

$$r_{D,i} = r_M - \frac{\kappa}{1-\kappa} \left(\frac{r_E}{1-\tau} - r_M \right) - \frac{t_D}{n} \quad (9)$$

For both cases, the equilibrium wage and hours employed are

$$\begin{aligned} w_i &= \frac{1}{2}\left[\widehat{w} - t_H \delta_H + \frac{L}{n}\left(\bar{c} - \underline{c}\right) e^{-h_L^*}\right] \\ &= \frac{1}{2}\left[\widehat{w} - t_H \delta_H + \frac{D}{n}\left(\bar{s} - \underline{s}\right) e^{-h_D^*}\right] \quad (10) \\ H_i &= h_L^* + h_D^* \quad (11) \end{aligned}$$

where $h_L^* = \ln\left(\frac{L(\bar{c}-\underline{c})}{D(\bar{s}-\underline{s})}\right) + h_D^*$ *and* h_D^* *is the unique solution to the equation*

$$2h_D^* - \frac{H}{t_H}\frac{D}{n}\left(\bar{s} - \underline{s}\right) e^{-h_D^*} = \ln\left(\frac{D\left(\bar{s} - \underline{s}\right)}{L\left(\bar{c} - \underline{c}\right)}\right) + H\delta_H - \frac{H}{t_H}\widehat{w}\ . \quad (12)$$

Proposition 1 states that if $L(1-\kappa) > D$, a market that can be described as "loan rich and deposit poor," then equation (6) shows that the incidence of corporate taxes falls on retail borrowers in the form of higher loan rates via the term $\kappa\left(\frac{r_E}{1-\tau} - r_M\right) > 0$. Instead if $L(1-\kappa) < D$, a market that can be described as "loan poor and deposit rich," then equation (9) shows that retail depositors bear the burden of corporate taxes due to lower equilibrium deposit rates.

The intuition for these results is the following. When retail loan demand is high relative to retail deposits, banks must satisfy the excess loan demand by issuing wholesale debt. Since wholesale debt requires a competitive rate, the marginal cost of retail deposits is bid up to this same competitive rate. Therefore, as shown in equation (7), the equilibrium retail deposit rate does not reflect the burden of banks' corporate taxes. Rather, the tax incidence falls on retail borrowers via loan rates as shown in equation (6).

Conversely, if retail deposits exceed the non-equity funding needs of retail loans, banks choose to invest the excess deposits in wholesale debt and the marginal revenue of retail loans equals the competitive return on debt. In this situation, equations (8) and (9) show that the incidence of corporate taxes is not borne by retail borrowers but by retail savers via a lower deposit rate.

Even though banks compete with nonbanks for employees, equations (10), (11), and (12) show that banks' equilibrium wages and employment are independent of the tax rate. This occurs because banks' total retail loans, L, and total retail deposits, D, are assumed to be perfectly inelastic and, in equilibrium, are independent of loan and deposit rates. Thus, since wage expense is tax deductible and the equilibrium marginal product of labor is proportional to L and D, corporate tax rates have no effect on banks' demand for labor.

By introducing competition from nonbank lenders and savings providers, the next section allows for imperfect elasticity in banks' amounts of loans made and deposits issued. In this case, banks' loan and savings market shares depend on the interest rates that they set which, in turn, affect the equilibrium amount of labor hired by banks. As a result, some of the corporate tax incidence will now fall on labor.

2.2.2 Equilibria with Nonbank Competition for Loans and Savings

When only banks compete, each bank sets its retail loan and deposit rates by comparing them to the rates of its two closest neighbor banks. Thus, a bank competes for market share only with other banks. Now consider how a bank's equilibrium loan and deposit rates differ when nonbanks are sufficiently close to provide competition in both loan and deposit markets.[16] In this situation each bank competes for market share with a nonbank that sets a competitive interest rate. As in the bank-only situation, the market's relative retail lending opportunities versus retail savings matters for the type of equilibrium and the incidence of corporate taxes. The following proposition gives banks' equilibrium loan and deposit rates when nonbanks provide effective competition.

Proposition 2: *Consider a market where both banks and nonbanks compete for retail lending and savings. If* $L(1-\kappa) > D\left[\delta_D + \frac{s\left(h_D^*\right)}{t_D}\right] / \left[\delta_L + \frac{\widehat{c}-c\left(h_L^*\right)}{t_L} - \frac{\kappa}{t_L}\left(\frac{r_E}{1-\tau} - r_M\right)\right]$, *banks issue wholesale debt* ($W_i > 0$) *and their symmetric equilibrium loan and deposit rates equal*

$$r_{L,i} = r_M + \frac{1}{2}\left[\widehat{c} + c\left(h_L^*\right) + t_L\delta_L + \kappa\left(\frac{r_E}{1-\tau} - r_M\right)\right] \quad (13)$$

$$r_{D,i} = r_M - \frac{1}{2}\left[s\left(h_D^*\right) + t_D\delta_D\right] \; . \quad (14)$$

Instead, if $L(1-\kappa) < D\left[\delta_D + \frac{s\left(h_D^*\right)}{t_D} - \frac{\kappa}{(1-\kappa)t_D}\left(\frac{r_E}{1-\tau} - r_M\right)\right] / \left[\delta_L + \frac{\widehat{c}-c\left(h_L^*\right)}{t_L}\right]$, *banks invest in wholesale debt* ($W_i < 0$) *and their symmetric equilibrium loan and deposit rates equal*

$$r_{L,i} = r_M + \frac{1}{2}\left[\widehat{c} + c\left(h_L^*\right) + t_L\delta_L\right] \quad (15)$$

$$r_{D,i} = r_M - \frac{1}{2}\left[s\left(h_D^*\right) + t_D\delta_S + \frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)\right] \quad (16)$$

Moreover, the equilibrium levels of employment h_L^* *and* h_D^* *are the solutions to the equa-*

[16] The Appendix gives maximum values for δ_L and δ_D such that nonbank lenders and savings providers have strictly positive market shares.

tions $MR_s(h_D^*) = MR_c(h_L^*) = MC(h_D^* + h_L^*)$, *where*

$$MR_s(h_D^*) = \frac{D}{t_D}(\overline{s} - \underline{s})e^{-h_D^*}\left[t_D\delta_D + \overline{s} - (\overline{s} - \underline{s})e^{-h_D^*} - \frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0}\right] \tag{17}$$

$$MR_c(h_L^*) = \frac{L}{t_L}(\overline{c} - \underline{c})e^{-h_L^*}\left[t_L\delta_L + \widehat{c} - \underline{c} - (\overline{c} - \underline{c})e^{-h_L^*} - \kappa\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i>0}\right] \tag{18}$$

$$MC(h_D^* + h_L^*) = \widehat{w} - t_H\delta_H + \frac{t_H}{H}(h_D^* + h_L^*) \tag{19}$$

Proposition 2's equilibrium loan and deposits rates are qualitatively similar to those in Proposition 1. When the market's retail loans are high relative to retail deposits, retail borrowers bear a burden of corporate taxes via higher loan rates. It is the opposite when the market's retail deposits are high compared to retail loans. Then retail depositors bear a burden of corporate taxes by receiving a lower equilibrium deposit rate. In either case, the tax burden passed on to customers is only $\frac{1}{2}$ the amount of that when only banks compete, a result that reflects the greater nonbank competition.

As detailed in the Appendix, there are some other subtle differences in that when a market has retail loans and retail deposits that are relatively close to each other, banks may issue no wholesale debt nor invest in wholesale debt ($W_i = 0$). In this case, retail loans rates will be intermediate between those in equations (13) and (15), and retail deposit rates will be intermediate between those in equations (14) and (16).

The major qualitative difference between Proposition 1's bank-only equilibria and Proposition 2's nonbank equilibria relates to the labor market. In both cases banks chose labor such that the marginal revenue of labor employed in deposit services equals the marginal revenue of labor employed in loan loss reduction, which both equal the marginal cost of labor. For the bank-only equilibria, these marginal revenues are independent of corporate taxes or capital requirements. But that is not true when nonbanks compete. Equation (17) shows that the marginal revenue from labor employed in deposit services is decreasing in corporate taxes and capital requirements when the market is loan poor and deposit rich ($W_i < 0$). Moreover, equation (18) shows that the marginal revenue from labor employed in loan loss reduction is decreasing in corporate taxes and capital requirements when the market is loan rich and deposit poor ($W_i > 0$). The following corollary formalizes the link between taxes, capital requirements, and labor.

Corollary 1: *Consider the equilibria given in Proposition 2 where banks compete with nonbanks. Then for parametric conditions given in the Appendix under which the marginal revenues of loan loss reduction and deposit services are declining in labor, an increase in the corporate tax rate, τ, or in the required capital-to-asset ratio, κ, reduces equilibrium bank employment, $H_i = h_D^* + h_L^*$, and the wage paid by banks, $w_i = w^*$.*

The Appendix shows that under the conditions stated in the corollary, higher corporate taxes or required capital reduce h_D^* and increase h_L^* when the market is loan poor and deposit rich ($W_i < 0$). In contrast, higher corporate taxes or required capital reduce h_L^* and increase h_D^* when the market is loan rich and deposit poor ($W_i > 0$). Yet for either market structure, higher corporate taxes or required capital always reduce total employment, $H_i = h_D^* + h_L^*$. In turn, since the equilibrium wage paid by banks is increasing in labor, the equilibrium wage falls.

In summary, our model predicts that in a loan rich, deposit poor market, higher corporate tax rates raise retail loan rates but leave retail deposit rates unaffected. In contrast, when the market is loan poor and deposit rich, higher corporate tax rates decrease retail deposit rates but have no effect on retail loan rates. For either market structure and as long as banks face some nonbank competition, higher corporate taxes reduce overall bank employment and wages.

3 Data and Summary Statistics

We obtain year-end bank level data from 1997 to 2013 from the Consolidated Report of Condition and Income, commonly known as the Call Reports. Call reports contain detailed quarterly financial statement data for every FDIC-insured bank. We restrict our analysis to commercial banks (rssd9048=200) that are not an "S corporation" or a "qualifying subchapter S subsidiary" (RIADa530=0). To accurately identify the state corporate income tax rate that each bank faces, we limit our sample to banks with single-state operations, defined as a bank that does not have branches in multiple states or belongs to a bank holding company that has branches in multiple states. Bank branch data are obtained from the FDIC's Summary of Deposits. We exclude banks in Connecticut where the tax rate changes almost every year during our sample period. Also, because we focus on income taxes, we exclude any bank-year observations over a five-year window whenever a bank is subject to a change in a non-income state tax rate, such as occurred in Michigan and Texas.

From call reports, we obtain the number of full time employees (RIAD4150), total salaries (RIAD4135), total assets (RCON1766), equity capital (RCON3210), and net income (RIAD4340). Since call reports do not report the average wage per employee, we measure wages by dividing total salary expenses by the average number of employees at the beginning and the end of the year.

We obtain weekly branch-level deposit rates data from RateWatch for a large subset of banks from December 1997 to December 2013. We end our sample period in 2013 because in recent years the Federal Reserve's maintenance of a near-zero short term federal funds rates kept many banks' deposit rates at or near zero.[17] The deposit rates are available for a wide variety of deposit products such as Certificates of Deposit (CDs), checking, savings, money market deposit accounts (MMDAs), for different amounts and different maturities. RateWatch data are used by a large number of banks and credit unions as well as the FDIC. As in Drechsler et al. (2016), we focus on the rates of the two most popular deposit products, MMDAs with an account size of $25,000 and 12-month CDs with an account size of $10,000. We take the average weekly deposit rates at each branch to obtain average annual deposit rates for that branch. Starting in 2002, RateWatch also reports the interest

[17] An extension of our model considers banks' equilibrium rates when they are constrained to be at least zero. This extension is available upon request.

rates on various loan products for a smaller number of branches. We examine the rates of 60-month home equity loan up to 80% LTV of $20,000, which is among the loan products with the most coverage in RateWatch.

Table 1 lists the number of branches and the average rates by year. The last column reports the average annual effective federal fund (FF) rate. Deposit rates move closely with the FF rate, with CD rates slightly higher than FF rates in some years and lower in other years. Banks pay substantially lower rates on MMDAs. Loans rates are in general less sensitive to FF rates, which means the rate spread tends to be higher during times of low FF rates.

We obtain state corporate income tax rates applicable to banks from the Commerce Clearing House's State Tax Reporters and State Tax Guide. In certain cases, we also obtain the tax rates from states' revenue or treasury departments. Most states tax financial institutions the same as other corporations, but several states impose a different tax scheme or rate on banks than on other corporations. For example, California imposes a 10.84% income tax on banks and 8.84% income tax on other corporations, and Nebraska imposes a 7.81% income tax on non-bank corporations, but tax banks based on deposits, with the rate being $.47 per $1,000 of average deposits. Because our theory focuses on income taxes, our treated sample does not include non-corporate-income taxes during the sample period in several states including Louisiana, Michigan, Ohio, and Texas. However, branches located in states with non-income taxes are still used as controls if no changes in these taxes were made. Table A1 lists the changes in the rates of state income taxes on financial institutions during our sample period, as well as the number of affected single-state banks and RateWatch branches in our sample.

Table 2 lists the number of single-state bank-year observations from call reports and branch-year observations from RateWatch in our sample by state. In total, our sample consists of 66,817 bank observations and 43,100 branch observations.

Following Becker (2007) and Han et al. (2015), we proxy for a banking market's relative deposit supply to loan demand using the proportion of a county's population that is aged 65 and above. The proportion of seniors at the county level is from the Census Bureau `https://www.census.gov/programs-surveys/popest/data/data-sets.html`. "Loan poor, deposit rich" counties are those with a proportion of seniors that is higher than the sample median, while "Loan rich, deposit poor" counties are those with a proportion of seniors that is less than the sample median. The logic for this categorization derives from the "lifecycle " notion that older individuals tend to have less borrowing and greater savings relative to younger individuals. Indeed, seniors tend to be the primary customer base for many retail deposits while younger individuals tend to be the primary customers for retail loans. Thus, a county's age demographics can be used as an exogenous indicator of the relative desires for savings versus borrowing.

Table 3 reports the summary statistics of deposit and loan rates and bank and state level variables for deposit-rich and deposit-poor counties, respectively. Bank equity ratio and income ratio are winsorized at 1% and 99% to remove outliers. Note that because our tests using state tax rate changes are most accurate when using banks with branches in a single state, our sample banks are relatively small. However, banks with branches in loan-rich counties tend to be slightly larger (average assets $391.8 million) and pay slightly higher interest rates on home-equity loans. Banks with branches in deposit-rich counties are slightly smaller (average assets $256.8 million) and pay slightly lower rates on deposits. These banks are otherwise quite similar in terms of capitalization, and profitability. On average, bank equity capital accounts for 10% of bank assets, and bank income is about 1% of bank assets. On average, total personal income grow by about 4% per year at the state level, and unemployment rate averages to be about 5.6% during our sample period.

4 Empirical Results

This section starts by describing our empirical strategy and then presents our main empirical results.

4.1 Empirical Strategy

We estimate the effects of state income tax rate changes on bank deposit rates and loan rates. The advantage of using changes in state taxes over federal taxes is that changes in federal taxes are infrequent events that affect all banks at the same time, making it hard to identify control groups. In contrast, state tax changes are more frequent but adopted by different states at different points in time. The non-synchronous timing of state tax changes permits the use of states with no tax changes as controls within a difference-in-difference (DID) estimation framework.

One natural concern is that changes in state tax rates are correlated with confounding factors such as shocks to state economic conditions that could also affect bank behavior. While this is certainly possible, recent studies using state income tax changes have found no evidence that tax changes are correlated with prior economic conditions (Heider and Ljungqvist (2015), Surez Serrato and Zidar (2016)). In our estimation, we control for recent changes in a state's personal income and unemployment rate to account for state economic conditions. More importantly, our unique theoretical prediction is that banks in loan-rich counties respond differently to state tax rate changes compared to banks in deposit-rich counties, whereas the confounding factors such as local economic shocks are not expected to cause such differential responses. Therefore, by presenting evidence consistent with this prediction, concerns about biases originated from omitted variables should be minimized.

When the tax rate, τ, is relatively small, which is the case for state income taxes, our theoretical predictions, equations (6) to (9), imply an approximately linear relation between deposit and loan rates and the tax rate, because $\frac{1}{1-\tau} \approx 1+\tau$. Therefore, we estimate a linear DID model of the form

$$\Delta Y_{i,t} = \alpha + \beta_1 \Delta TaxRate_{i,t} + \gamma \Delta X_{i,t-1} + \mu_t + \epsilon_{i,t} \tag{20}$$

where i indexes branch, and t indexes year. The dependent variable is the change in deposit rates, loan rates, employment, or wages. Deposit and loan rates are the average weekly rates in year t. $TaxRate$ is an individual bank's corporate tax in a given year, effective as of the beginning of the year. So this model estimates whether the average deposit and loan rates in year t is different from the average rates in year $t-1$ when a new tax rate becomes effective at the beginning of year t. The change in employment and wages is from the end of year $t-1$ to the end of year t. X is a vector of bank level control variables that includes the log of total assets, the income to asset ratio, the equity to asset ratio, and state control variables such as personal income growth and the unemployment rate. The variable μ_t indicates year fixed effects. The first-difference estimation also removes all time-invariant branch characteristics that are correlated with branch deposit or loan rates. In what follows we also estimate an extended version of the model in equation (20) by including leads and lags of tax rate changes.

4.2 Baseline Results

We start by estimating the effect of tax changes on deposit and loan rates using the full sample of banks that does not distinguish between those in loan-rich counties versus deposit-rich counties. Panel A of Table 4 reports the results. Columns 1 and 2 show that the point estimate of the coefficient on an increase in the tax rate is negative when the dependent variable is the MM25K rate or the 12MCD rate, but neither estimate is statistically significant at conventional levels. Column 3 shows that an increase in the income tax rate leads to a statistically significant rise in the rate that the bank charges on its home equity loans. Note that this finding that higher income taxes raise loan rates but do not significantly affect deposit rates is consistent with the prior cross-country evidence in Albertazzi and Gambacorta (2010).

Column 4 shows that banks cut employment when income taxes increase. A 100 basis point increase in the corporate tax rate leads to a reduction in employment of 1.1%. According to our theory, this finding suggests that banks, on average, face some competition from non-bank firms, which reduces a bank's marginal revenue from labor employed in deposit or loan services when corporate taxes are higher. Unfortunately we do not observe separately labor employed for deposit services and loan services, which would have allowed us to test the sharper prediction of our theory about what type of labor should be affected the most depending on local deposit and loan market structure. The last column shows that the drop in employment when taxes go up is not accompanied by a reduction in the average wage per worker.

Our theory predicts that the relatively muted response of bank interest rates to tax changes might be due to the fact that the full sample includes banks that should not adjust all of their interest rates to tax shocks because of their local market's structure. We next estimate the effects of tax rates on deposit rates and loan rates that separates banks in loan-rich/deposit-poor counties from banks in loan-poor/deposit-rich counties. Panel B reports the results. In loan-rich (deposit-poor) counties, tax rate changes have no significant effect on the rates of MMDAs or 12-month CDs. In deposit-rich (loan-poor) counties, on the other hand, the point estimate of the sensitivity of deposit rates to tax rate changes is about four times as large as that for deposit-poor counties and is statistically significant. A 100 basis point increase in the income tax rate leads to a significant reduction in the deposit rate by about 3 basis points.

The next two columns report the results for home equity loan rates. As our model predicts, tax rate changes significantly affect loan rates only in loan rich counties. The point estimate of the sensitivity of loan rates to tax rates is almost twice as large for loan rich counties compared to deposit rich counties. A 100 basis point rise in the corporate income tax rate tends to increase loan rates by 10 basis points in loan rich counties.

Lastly, we also examine whether employment and wages also might respond differently to tax changes in deposit-rich vs loan-rich markets. While our model assumes banks employ workers in both loan screening and deposit services, if they mainly employed workers in only one of the sectors, then it might be the case that taxes affect wages and employment only in loan rich or only deposit rich markets. The last four columns show that the effect of taxes on bank labor appears to be stronger in deposit rich markets, suggesting that deposit services might be the most labor-intensive.

Overall, these findings support our theoretical prediction that retail depositors bear the burden of corporate income tax in markets where savings are large relative to lending opportunities. In contrast, retail borrowers bear the tax burden in markets where retail lending opportunities exceed retail savings.

4.3 Controlling for Spatial Heterogeneity

We next consider more explicitly the issue of selection of states that implement tax reforms and potential heterogeneity in local economic and labor market conditions. There are at least two sources of spatial heterogeneity. First, states may differ in their long-run growth rates or paths of bank rates and employment. Second, there could be spatial heterogeneity in regional economic shocks during our sample period. Accordingly, we extend our baseline model in two ways. First, we add state fixed effects to the first-difference estimation, which is equivalent to including state specific trend in a fixed effect estimation using levels. Second, we control for region-specific time effects by adding (nine) Census division by year fixed effects. While some advocate these controls to account for regional effects when using state level shocks (e.g., Allegretto et al. (2011)), others have argued that states in the same Census divisions may not necessarily be better controls and useful identifying information could be discarded by including region by time effects (Neumark et al. (2014)).

Panel C of Table 4 reports the results. Tax rate increases continue to lead to a drop in deposit rates in deposit-rich areas, and an increase in loan rates in loan-rich areas. The point estimates become larger, while the statistical power declines somewhat due to the more saturated specifications. The evidence here supports our argument above that potential state level confounding factors are not expected to have effects on bank rates that vary with local deposit/loan market conditions.

When compared to banks in the same Census division, however, local income taxes no longer have a significantly negative effect on bank employment.

4.4 Dynamic Effects and Pre-treatment Trends

The first-difference estimation above assumes that banks respond quickly to new tax rates and banks do not change their deposit or loan rates ahead of tax rate changes. This is a reasonable assumption given that banks typically consider adjustments of their interest rates on a weekly basis, and there appear to be relatively low direct costs of adjusting rates. In this section, we explore the timing of the response more formally by including two leads and lags of tax changes in the estimation. This exercise will also shed light on the pre-treatment parallel trend assumption in the DID estimation. The model estimated here is

$$\Delta Y_{i,t} = \alpha + \sum_{k=-2}^{2} \beta_k \Delta TaxRate_{i,t-k} + \gamma \Delta X_{i,t-1} + \mu_t + \epsilon_{i,t} \tag{21}$$

Table 5 reports the results. The effects of tax change on deposit rates in year t are largely the same as those in Table 4. Overall there is little evidence of delayed response of banks rates to tax changes. The only lagged tax rate change that is statistically significant is year $t-1$ for MM25k rates in deposit-rich counties. Several lead tax changes are statistically significant (year $t+1$ for MM25K rates in deposit-poor areas, and year $t+2$ for 12-month CD is deposit-rich areas), suggesting that treated and control branches sometimes adjust deposits rates differently ahead of tax rate changes. Although this raises some concerns about omitted pre-treatment controls, there is no strong evidence to suggest that the effects in Table 4 are due to differential trends of deposits rates in deposit-rich and deposit-poor areas.

The point estimate of $\Delta TaxRate$ on the rate of home equity loan in loan-rich areas is also essentially the same as our baseline model. However, it becomes marginally insignificant because of an increase in standard errors when the lead and lag tax rate changes are included. The effect of $\Delta TaxRate$ on employment becomes a bit smaller compared to the baseline estimate but remains statistically significant. None of the lead or lag tax rate changes is statistically significant in loan and employment estimation.

The last column shows that wage growth is significantly affected by tax changes two years ago. The slow adjustment of wages is consistent with wage rigidity well documented in the literature. For example, in a recent study Fuest et al. (2018) find that wages adjust gradually in response to corporate tax changes.

4.5 Tax Increases versus Decreases

Our last test examines potential asymmetric effects of tax rate changes. Banks might respond differently to an increase in corporate income tax rates than to a decrease due to behavior or adjustment costs that are not captured by our model.[18] Empirically, Hannan and Berger (1991) and Neumark and Sharpe (1992) find that banks are quicker to adjust deposit rates downward when market interest rates decline than to increase deposit rates when market interest rates rise. They find that this slow and asymmetric adjustment is more apparent in higher concentrated banking markets. Using more recent data over the 2000 to 2005 period, Driscoll and Judson (2013) continue to find that deposit rates are downwards-flexible and upwards-sticky. The asymmetry appears to reverse for retail loan rates. Kahn et al. (2005) find that banks are quicker to increase retail loan rates as market rates rise than they are to decrease retail loan rates when market interest rates fall.

We first create two indicator variables *Increase* (*Decrease*) equal to one if the tax rate goes up (down) by at least 50 basis points, and zero otherwise. This 50 basis point cutoff is chosen so that only sufficiently meaningful tax changes are used while still having enough instances of increases and decreases for our tests. We also include the one year lags of these two variables to allow for possibly gradual responses.

Panel A of Table 6 reports the results of this exercise. In the year of the tax change, it appears that the effects on deposit rates are significant only for tax increases: a tax rate rise leads to a same-year reduction in the 12-month CD rate in deposit rich markets. Tax rate increases also lead to statistically significant reductions in employment during

[18]The model in Kahn et al. (1999) predicts that sticky, asymmetric adjustments in deposit rates may be the result of limited recall by some retail depositors. Driscoll and Judson (2013) show that asymmetric deposit rates adjustments can be generated by a model with menu costs.

the same year. A tax rate decrease leads to a significant decline in the 12-month CD rate in deposit rich counties, but only in the year following the reduction in the tax rate. This is consistent with banks being slower to raise deposit rates than to lower them.

In Panel B, we replace the *Increase* and *Decrease* indicator variables with the continuous changes in tax rates interacted with these indicator variables for tax increases and decreases. This specification permits the coefficients on tax rate changes to differ based on the sign of the tax change. We further control for state and Census division by year effects as in Panel C of Table 4. The results show that most of the significant effects are in tax increases — an increase in taxes leads to a significant drop in deposit rates in deposit rich markets and a significant increase in loan rates in loan rich markets. As shown earlier, employment shows little response to tax changes after controlling for region specific time effects. Overall, we see statistically insignificant effects from tax rate decreases. The one exception may be for wages, where $\Delta TaxRate_{t-1}||_{<0}$ is negative and significant at the 10% level, suggesting that a decline in the corporate tax rate leads to an increase in average wages one year later.

5 Conclusion

The theory of our paper emphasizes that the burden of banks' corporate taxes depends on the structure of the market where a bank operates. When a local financial services market is characterized by high retail loan demand and relatively little retail savings, the incidence of banks' corporate taxes falls on retail borrowers. Instead, when a market has abundant retail savings but relatively little lending opportunities, the burden of banks' corporate incomes taxes is felt by retail depositors. Further, when a bank employs labor to reduce loan losses or provide deposit services, and it also faces competition from tax-exempt lenders and savings providers, corporate taxes will also affect banks' hiring decisions.

These theoretical insights are important when testing for bank tax incidence. Empirical work that does not condition on these different market structures can lead to inconsistent results regarding whether higher taxes raise loan rates or lower deposit rates. By classifying "loan rich and deposit poor" U.S. counties as those with a relatively young population, our empirical work confirms that banks operating in these areas pass through taxes via higher retail loan rates. Similarly, by classifying "loan poor and deposit rich" counties as those with a relatively old population, we find that the corporate income taxes of local banks are reflected in lower retail deposit rates. Our empirical tests also provide some evidence that higher corporate taxes are associated with lower bank employment. That we find only mild evidence of taxes affect wages may be a consequence of wage stickiness.

Table 1: Retail Interest Rate Summary Statistics

This table reports the number of branches and banks with deposit rates data from RateWatch by year. The sample includes only single-state banks. The number of branches with available rates and the average rates are reported for 12-month CD of $10,000, money market account of $25,000, home equity line of credit up to 80% of LTV. The last column reports the average annual federal fund rate.

	12MCD		MM25k		Home equity		Fed fund
	Mean	No.	Mean	No.	Mean	No.	Mean
1998	5.14	1584	3.48	1501			5.35
1999	4.69	3331	3.15	3159			4.97
2000	5.60	3291	3.28	3141			6.24
2001	4.14	3171	2.73	3043			3.89
2002	2.46	3222	1.60	3101	6.51	490	1.67
2003	1.65	3194	1.02	3086	6.08	697	1.13
2004	1.65	2975	0.87	2866	6.44	775	1.35
2005	2.79	2859	1.19	2748	6.89	745	3.21
2006	3.93	2577	1.74	2485	7.58	697	4.96
2007	4.16	2526	1.94	2443	7.60	703	5.02
2008	2.74	2486	1.35	2408	6.82	690	1.93
2009	1.72	2458	0.81	2377	6.65	595	0.16
2010	1.15	2493	0.60	2403	6.43	578	0.17
2011	0.75	2404	0.41	2313	6.11	571	0.10
2012	0.51	2325	0.27	2234	5.69	529	0.14
2013	0.39	2204	0.20	2100	5.30	473	0.11
Total	2.78	43100	1.58	41408	6.57	7543	2.60

Table 2: Numbers of Bank-year and Branch-year Observations by State

This table reports the number of single-state bank-year observations from call reports and single-state branch-year observations from RateWatch by state in our sample. The sample period is from 1997 to 2013.

State	No. banks	No. branches	State	No. banks	No. branches
AK	83	28	NH	298	77
AL	1542	681	NJ	1185	378
AR	1647	1206	NM	292	218
AZ	224	96	NV	201	76
CA	3125	846	NY	1877	828
CO	1101	789	OH	1214	1141
DC	50	32	OK	1681	984
DE	172	40	OR	375	191
FL	2355	1112	PA	2020	1575
GA	2820	1875	RI	76	49
HI	82	9	SC	927	600
IA	2724	2031	SD	593	422
ID	187	104	TN	2168	1460
IL	6288	4566	TX	2970	2220
IN	1497	1193	UT	653	124
KS	2735	1755	VA	1232	649
KY	1948	1836	VT	192	51
LA	855	517	WA	878	289
MA	2650	1605	WI	3089	2602
MD	657	437	WV	758	632
ME	364	277	WY	213	142
MI	257	149			
MN	2158	1489			
MO	3128	2313			
MS	968	553			
MT	708	503			
NC	1072	658			
ND	573	467			
NE	1955	1225	Total	66817	43100

Table 3: Loan-rich versus Deposit-rich Market Summary Statistics

Rate_mm25k, *Rate_12mcd*, *Rate_HE* is the annual average of weekly branch level rates of 12-month CD of $10,000, money market account of $25,000, home equity line of credit up to 80% of LTV, respectively. *Income tax rate* is the rate of state income tax on financial institutions. *Assets* is bank level total assets (RCON2170) from the call reports, in millons. *Income* is total income (RIAD4340) scaled by total assets. *Equity ratio* is bank equity capital (RCON3210), scaled by total assets. *State income growth* is the growth of state level total personal income from the BEA. *Loan (Deposit) rich* indicates branches located in counties whose proportion of population aged 65 and above is below (above) the median during our sample period.

	Loan-rich			Deposit-rich		
	Mean	Median	Std	Mean	Median	Std
Rate_mm25k	1.62	1.25	1.19	1.52	1.17	1.18
Rate_12mcd	2.86	2.63	1.65	2.69	2.44	1.69
Rate_HE	6.60	6.75	1.63	6.53	6.63	1.46
Income tax rate	5.76	6.00	2.87	5.21	5.00	2.70
Assets	391.8	174.0	791.7	256.8	106.8	600.3
Income	0.01	0.01	0.01	0.01	0.01	0.01
Equity ratio	0.10	0.09	0.03	0.11	0.10	0.03
State income growth	0.04	0.05	0.03	0.04	0.05	0.03
State unemployment rate	5.58	5.20	1.93	5.50	5.00	2.03
Observations	23182			19918		

Table 4: Main Results

The dependent variable is the change in the rate of the money market account of \$25,000, 12-month CD of \$10,000, and rate of home equity line of credit up to 80% of LTV, log employment, and log wages. L-rich and D-rich in the table header indicates whether branches are located in counties with seniors (65 or above) below or above the median in a given year. Controls include lagged changes in bank size, income-to-asset ratio, equity-to-asset ratio, lagged state total income growth and lagged change in state unemployment rate. Standard errors are clustered by state.

Panel A: Full sample

	MM25k	12MCD	HE	Emp	Wage
$\Delta TaxRate_t$	-0.018	-0.018	0.084***	-0.011***	0.000
	(0.011)	(0.013)	(0.031)	(0.004)	(0.002)
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.515	0.884	0.161	0.079	0.009
N	41221	43100	5801	66010	63297

Panel B: Loan rich/deposits poor vs deposits rich/loan poor

	MM25k		12MCD		HE		Emp		Wage	
	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich
$\Delta TaxRate_t$	-0.007	-0.028***	-0.008	-0.029**	0.103***	0.054	-0.007	-0.013***	0.008	-0.007
	(0.016)	(0.010)	(0.017)	(0.013)	(0.035)	(0.075)	(0.006)	(0.003)	(0.005)	(0.005)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.531	0.495	0.885	0.885	0.161	0.174	0.084	0.057	0.012	0.009
N	22481	18740	23182	19918	3323	2478	35268	30742	34372	28925

Panel C: Controlling for state specific trend and region specific time effects

	MM25k		12MCD		HE		Emp	Wage
	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich		
$\Delta TaxRate_t$	0.014	-0.036*	-0.004	-0.033**	0.175*	0.096	-0.003	-0.001
	(0.030)	(0.019)	(0.015)	(0.015)	(0.097)	(0.106)	(0.005)	(0.005)
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Division×Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.550	0.505	0.890	0.890	0.216	0.253	0.087	0.014
N	22480	18740	23181	19918	3321	2475	66010	63297

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Dynamic Effects

The dependent variable is the change in the rate of the money market account of $25,000, 12-month CD of $10,000, and rate of home equity line of credit up to 80% of LTV, log employment, and log wages. L-rich and D-rich in the table header indicates whether branches are located in counties with seniors (65 or above) below or above the median in a given year. Controls include lagged changes in bank size, income-to-asset ratio, equity-to-asset ratio, lagged state total income growth and lagged change in state unemployment rate. Standard errors are clustered by state.

	MM25k		12MCD		HE		Emp	Wage
	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich		
$\Delta TaxRate_t$	-0.002	-0.028***	-0.005	-0.029**	0.102	0.067	-0.007**	0.000
	(0.015)	(0.010)	(0.016)	(0.012)	(0.077)	(0.093)	(0.003)	(0.002)
$\Delta TaxRate_{t-1}$	0.002	-0.015*	0.013	-0.016	0.017	-0.061	-0.002	-0.002
	(0.013)	(0.008)	(0.016)	(0.012)	(0.084)	(0.095)	(0.003)	(0.003)
$\Delta TaxRate_{t-2}$	-0.026	-0.000	-0.019	0.015	0.011	0.125	-0.006	-0.009**
	(0.045)	(0.010)	(0.026)	(0.015)	(0.109)	(0.094)	(0.004)	(0.004)
$\Delta TaxRate_{t+1}$	-0.021*	0.002	-0.022	-0.007	-0.022	-0.081	0.000	0.003
	(0.011)	(0.010)	(0.018)	(0.011)	(0.072)	(0.088)	(0.003)	(0.003)
$\Delta TaxRate_{t+2}$	-0.032	0.013	-0.010	0.042***	-0.009	0.032	-0.001	-0.004
	(0.040)	(0.012)	(0.017)	(0.011)	(0.063)	(0.076)	(0.005)	(0.005)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.535	0.498	0.886	0.886	0.161	0.174	0.086	0.011
N	21698	18035	22361	19155	3323	2478	57640	54932

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Tax Increases versus Decreases

The dependent variable is the change in the rate of the money market account of $25,000, 12-month CD of $10,000, and rate of home equity line of credit up to 80% of LTV, log employment, and log wages. In Panel A, *Increase* (*Decrease*) are indicator variables equal to one if the tax rate goes up (down) by at least 50 basis points, and zero otherwise. In Panel B, $\Delta TaxRate\|_{>0}$ and $\Delta TaxRate\|_{<0}$ are changes in tax rates interacted with an indicator for tax increase and tax decrease, respectively. L-rich and D-rich in the table header indicates whether branches are located in counties with seniors (65 or above) below or above the median in a given year. Controls include lagged changes in bank size, income-to-asset ratio, equity-to-asset ratio, lagged state total income growth and lagged change in state unemployment rate. Standard errors are clustered by state.

Panel A

	MM25k		12MCD		HE		Emp	Wage
	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich		
$Increase_t$	-0.014	-0.045	0.019	-0.068***	0.235	0.253	-0.012***	0.003
	(0.051)	(0.041)	(0.024)	(0.024)	(0.166)	(0.225)	(0.004)	(0.002)
$Decrease_t$	0.003	0.004	-0.007	-0.063	0.047	0.112	0.011	0.002
	(0.047)	(0.036)	(0.030)	(0.060)	(0.130)	(0.156)	(0.011)	(0.009)
$Increase_{t-1}$	0.041*	-0.014	0.048	0.027	0.078	0.098	0.001	0.005
	(0.021)	(0.020)	(0.031)	(0.035)	(0.153)	(0.200)	(0.007)	(0.006)
$Decrease_{t-1}$	0.021	0.017	0.042	0.104***	-0.121	-0.117	-0.003	0.010
	(0.019)	(0.018)	(0.037)	(0.035)	(0.127)	(0.171)	(0.009)	(0.010)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.531	0.495	0.885	0.885	0.161	0.174	0.079	0.009
N	22481	18740	23182	19918	3323	2478	66010	63297

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B								
	MM25k		12MCD		HE		Emp	Wage
	L-rich	D-rich	L-rich	D-rich	L-rich	D-rich		
$\Delta TaxRate_t\|_{>0}$	0.006	-0.056***	-0.007	-0.045***	0.190*	0.113	-0.002	0.000
	(0.022)	(0.021)	(0.015)	(0.012)	(0.104)	(0.121)	(0.003)	(0.001)
$\Delta TaxRate_t\|_{<0}$	0.061	0.050	-0.001	0.018	0.078	0.169	-0.000	-0.001
	(0.058)	(0.046)	(0.037)	(0.047)	(0.278)	(0.244)	(0.016)	(0.013)
$\Delta TaxRate_{t-1}\|_{>0}$	0.021	-0.027	0.004	0.004	-0.011	0.052	-0.001	0.000
	(0.025)	(0.022)	(0.022)	(0.009)	(0.114)	(0.123)	(0.003)	(0.003)
$\Delta TaxRate_{t-1}\|_{<0}$	0.041	-0.039	0.066	-0.003	-0.068	-0.336	-0.005	-0.032*
	(0.072)	(0.063)	(0.057)	(0.041)	(0.400)	(0.274)	(0.011)	(0.018)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Division×Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.550	0.505	0.891	0.890	0.216	0.254	0.093	0.015
N	22480	18740	23181	19918	3321	2475	61677	58966

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Appendix

This Appendix outlines the derivation of the model. It first considers an equilibria where only banks compete for retail savings and loans and, second, analyzes equilibria where nonbanks also compete. The Appendix also considers sufficient parametric conditions required for each type of equilibrium.

6.1 Loan and Deposit Competition with Only Banks

Substitute the balance sheet condition $E_i = L_i - D_i - W_i$ into bank i's objective function (5) and divide by $(1-\tau)$ to obtain

$$\underset{r_{L,i},\, r_{D,i},\, h_{i,D},\, h_{i,L},\, W_i}{\text{Max}} L_i \left(r_{L,i} - c\left(h_{i,L}\right) - \frac{r_E}{1-\tau} \right) - D_i \left(r_{D,i} - \frac{r_E}{1-\tau} \right) - W_i \left(r_M - \frac{r_E}{1-\tau} \right) - H_i w_i. \tag{A.1}$$

Making the same substitution into the equity capital constraint (4), we have

$$L_i - \left(\frac{D_i}{1-\kappa} + W_i + \frac{\kappa}{1-\kappa} \max\left(W_i, 0\right) \right) \geq 0 \tag{A.2}$$

Next, we derive the values of L_i, D_i, and H_i given the interest and wage rates of bank i and its neighboring competitors. Let $r_{L,i}$ be the retail loan rate offered by bank i, so that $r_{L,i-1}$ and $r_{L,i+1}$ are the loan rates offered by its two neighboring banks. Suppose that a borrower is located between banks i and $i-1$ and is a distance $x_- \in [0, 1/n]$ from bank i and, therefore, a distance $(1/n - x_-)$ from bank $i-1$. This borrower is indifferent between obtaining a loan from these banks when

$$r_{L,i} + t_L x_- = r_{L,i-1} + t_L \left(\frac{1}{n} - x_- \right). \tag{A.3}$$

Another borrower between banks i and $i+1$ who is a distance x_+ from bank i is indifferent between obtaining a loan from these two banks when

$$r_{L,i} + t_L x_+ = r_{L,i+1} + t_L \left(\frac{1}{n} - x_+ \right). \tag{A.4}$$

Then for the distances satisfying equations (A.3) and (A.4), bank i's total loans are

$$L_i = \left(x_- + x_+\right) L = \left(\frac{r_{L,i-1} + r_{L,i+1}}{2} - r_{L,i} \right) \frac{L}{t_L} + \frac{L}{n}. \tag{A.5}$$

Similarly, if a depositor is located between banks i and $i-1$ at a distance $y_- \in [0, 1/n]$

from bank i, then the depositor is indifferent between the two banks when

$$r_{D,i} + s\left(h_{i,D}\right) - t_D y_- = r_{D,i-1} + s\left(h_{i-1,D}\right) - t_D\left(\frac{1}{n} - y_-\right). \tag{A.6}$$

Another depositor located a distance y_+ from bank i but between bank i and bank $i+1$ is indifferent between these two banks when

$$r_{D,i} + s\left(h_{i,D}\right) - t_D y_+ = r_{D,i+1} + s\left(h_{i+1,D}\right) - t_D\left(\frac{1}{n} - y_+\right). \tag{A.7}$$

This comparison implies that bank i's total deposits are

$$D_i = \left(y_- + y_+\right) D = \left(r_{D,i} + s\left(h_{i,D}\right) - \frac{r_{D,i-1} + s\left(h_{i-1,D}\right) + r_{D,i+1} + s\left(h_{i+1,D}\right)}{2}\right)\frac{D}{t_D} + \frac{D}{n}. \tag{A.8}$$

Unlike deposit and loan markets, banks always compete with nonbanks for employees. Suppose an employee is located between banks i and $i-1$ at a distance $z_- \in [0, \frac{1}{2}n]$ from bank i. Since the nonbank employer is always a distance δ_H away and offers a wage of $\widehat{w}$, the employee is indifferent between working for bank i and the nonbank when

$$w_i - t_H z_- = \widehat{w} - t_H \delta_H. \tag{A.9}$$

Another employee that is located between banks i and $i+1$ at a distance $z_+ \in [0, \frac{1}{2}n]$ from bank i is indifferent between working for bank i and the nonbank when

$$w_i - t_H z_+ = \widehat{w} - t_H \delta_H. \tag{A.10}$$

Therefore, bank i's total hours of employment equal

$$H_i = \left(z_- + z_+\right) H = \frac{2H}{t_H}\left(w_i - \widehat{w} + t_H \delta_H\right). \tag{A.11}$$

Written in terms of the wage, equation (A.11) is

$$w_i = \widehat{w} - t_H \delta_H + \frac{1}{2}\frac{t_H}{H} H_i\ . \tag{A.12}$$

Now in (A.1) substitute for L_i, D_i, and w_i using equations (A.5), (A.8), and (A.12) and $H_i = h_{i,D} + h_{i,L}$. Also let λ be the Lagrange multiplier for the equity capital constraint (A.2). Then the first order conditions for $r_{L,i}$, $r_{D,i}$, $h_{i,D}$, and $h_{i,L}$ are[19]

$$\frac{r_{L,i-1} + r_{L,i+1}}{2} - 2r_{L,i} + c\left(h_{i,L}\right) + \frac{r_E}{1-\tau} + \frac{t_L}{n} - \lambda = 0 \tag{A.13}$$

[19]We use the notation $s'\left(h_{i,D}\right) \equiv \partial s\left(h_{i,D}\right)/\partial h_{i,D}$ and $c'\left(h_{i,L}\right) \equiv \partial c\left(h_{i,L}\right)/\partial h_{i,L}$.

$$2r_{D,i}+s\left(h_{i,D}\right)-\frac{r_{D,i-1}+s\left(h_{i-1,D}\right)+r_{D,i+1}+s\left(h_{i+1,D}\right)}{2}-\frac{r_E}{1-\tau}+\frac{t_D}{n}+\frac{\lambda}{1-\kappa}=0 \quad (A.14)$$

$$\begin{aligned}
-\frac{D}{t_D}s'\left(h_{i,D}\right)\left(r_{D,i}-\frac{r_E}{1-\tau}+\frac{\lambda}{1-\kappa}\right)-w_i-H_i\frac{1}{2}\frac{t_H}{H} &= 0 \\
-\frac{D}{t_D}s'\left(h_{i,D}\right)\left(r_{D,i}+\frac{\lambda}{1-\kappa}-\frac{r_E}{1-\tau}\right)-\widehat{w}+t_H\delta_H-\frac{t_H}{H}\left(h_{i,D}+h_{i,L}\right) &= 0 \quad (A.15)
\end{aligned}$$

$$\begin{aligned}
-L_i c'\left(h_{i,L}\right)-w_i-H_i\frac{1}{2}\frac{t_H}{H} &= 0 \\
-L_i c'\left(h_{i,L}\right)-\widehat{w}+t_H\delta_H-\frac{t_H}{H}\left(h_{i,D}+h_{i,L}\right) &= 0\ . \quad (A.16)
\end{aligned}$$

Note that conditions (A.15) and (A.16) imply that labor choices equate the marginal revenue from labor employed in loan loss reduction to the marginal revenue from deposit services to the marginal cost of labor:

$$-L_i c'\left(h_{i,L}\right)=s'\left(h_{i,D}\right)\frac{D}{t_D}\left(\frac{r_E}{1-\tau}-r_{D,i}-\frac{\lambda}{1-\kappa}\right)=\widehat{w}-t_H\delta_H+\frac{t_H}{H}\left(h_{i,D}+h_{i,L}\right). \quad (A.17)$$

Finally, for W_i

$$-\left(r_M-\frac{r_E}{1-\tau}\right)-\lambda\left(1+\frac{\kappa}{1-\kappa}1_{W_i\geq 0}\right)=0\ , \quad (A.18)$$

which implies

$$\lambda=\left(1-\kappa\times 1_{W_i\geq 0}\right)\left(\frac{r_E}{1-\tau}-r_M\right). \quad (A.19)$$

Substituting (A.19) into (A.13), (A.14), and (A.15) gives

$$r_{L,i}=\frac{1}{2}\left[\frac{r_{L,i-1}+r_{L,i+1}}{2}+r_M+\kappa\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i\geq 0}+c\left(h_{i,L}\right)+\frac{t_L}{n}\right] \quad (A.20)$$

$$\begin{aligned}
r_{D,i} \;=\; & \frac{1}{2}\left[\frac{r_{D,i-1}+s\left(h_{i-1,D}\right)+r_{D,i+1}+s\left(h_{i+1,D}\right)}{2}-s\left(h_{i,D}\right)+r_M\right. \\
& \left.-\frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i<0}-\frac{t_D}{n}\right] \quad (A.21)
\end{aligned}$$

$$-\frac{D}{t_D}s'\left(h_{i,D}\right)\left(r_{D,i}-r_M+\frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i<0}\right)-\widehat{w}+t_H\delta_H-\frac{t_H}{H}\left(h_{i,D}+h_{i,L}\right)=0 \quad (A.22)$$

In a symmetric Bertrand-Nash equilibrium where $r_{L,i}=r_{L,i-1}=r_{L,i+1}$, $r_{D,i}=r_{D,i-1}=r_{D,i+1}$, $W_i=W_{i-1}=W_{i+1}$, $h_{i-1,D}=h_{i,D}=h_{i+1,D}$, $h_{i-1,L}=h_{i,L}=h_{i+1,L}$, $L_i=L/n$, and

$D_i = D/n$, the banks' equilibrium loan and deposit rates, (A.20) and (A.21), and labor devoted to deposits and loans, (A.22) and (A.16), become

$$r_{L,i} = r_M + \kappa \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i \geq 0} + c\left(h_L^{B*}\right) + \frac{t_L}{n} \tag{A.23}$$

$$r_{D,i} = r_M - \frac{\kappa}{1-\kappa} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i < 0} - \frac{t_D}{n} \tag{A.24}$$

$$\frac{D}{n} s'\left(h_D^{B*}\right) - \widehat{w} + t_H \delta_H - \frac{t_H}{H}\left(h_D^{B*} + h_L^{B*}\right) = 0 \tag{A.25}$$

$$-\frac{L}{n} c'\left(h_L^{B*}\right) - \widehat{w} + t_H \delta_H - \frac{t_H}{H}\left(h_D^{B*} + h_L^{B*}\right) = 0\ . \tag{A.26}$$

where h_L^{B*} and h_D^{B*} denote each bank's equilibrium hours of labor devoted to loan loss reduction and deposit services, respectively. Note that in a symmetric equilibrium where all banks have $W_i < 0$, it must be that in aggregate $L(1-\kappa) < D$, whereas in a symmetric equilibrium where all banks have $W_i \geq 0$, it must be that in aggregate $L(1-\kappa) \geq D$. Also, note that the conditions for h_D^{B*} and h_L^{B*}, equations (A.25) and (A.26), imply

$$Ds'\left(h_D^{B*}\right) = -Lc'\left(h_L^{B*}\right) \tag{A.27}$$

and substituting in the function forms in equations (1) and (2) imply

$$h_L^{B*} = h_D^{B*} + \ln\left(\frac{L\left(\overline{c} - \underline{c}\right)}{D\left(\overline{s} - \underline{s}\right)} \right)\ . \tag{A.28}$$

Substituting for h_L^{B*} in equation (A.25) using equation (A.28) implies that h_D^{B*} must satisfy

$$2h_D^{B*} - \frac{H}{t_H}\frac{D}{n}\left(\overline{s} - \underline{s}\right) e^{-h_D^{B*}} = \ln\left(\frac{D\left(\overline{s} - \underline{s}\right)}{L\left(\overline{c} - \underline{c}\right)} \right) + H\delta_H - \frac{H}{t_H}\widehat{w}\ . \tag{A.29}$$

The left-hand-side of (A.29) is strictly increasing in h_D^{B*} since its derivative equals $2 + \frac{H}{t_H}\frac{D}{n}\left(\overline{s} - \underline{s}\right) e^{-h_D^{B*}} > 0$. Thus, there is a unique, strictly positive solution, h_D^{B*}, when

$$-\frac{H}{t_H}\frac{D}{n}\left(\overline{s} - \underline{s}\right) < \ln\left(\frac{D\left(\overline{s} - \underline{s}\right)}{L\left(\overline{c} - \underline{c}\right)} \right) + H\delta_H - \frac{H}{t_H}\widehat{w} \tag{A.30}$$

or

$$\frac{D}{n}\left(\overline{s} - \underline{s}\right) > \widehat{w} - \delta_H t_H + \frac{t_H}{H} \ln\left(\frac{L\left(\overline{c} - \underline{c}\right)}{D\left(\overline{s} - \underline{s}\right)} \right)\ . \tag{A.31}$$

From (A.12), we can substitute for $H_i = h_D^{B*} + h_L^{B*}$ using (A.25) or (A.26) to obtain the equilibrium wage

$$\begin{aligned} w_i &= \widehat{w} - t_H\delta_H + \frac{1}{2}\frac{t_H}{H}H_i \\ &= \frac{1}{2}\widehat{w} - \frac{1}{2}t_H\delta_H + \frac{D}{2n}s'\left(h_D^{B*}\right) \\ &= \frac{1}{2}\left[\widehat{w} - t_H\delta_H + \frac{D}{n}\left(\overline{s} - \underline{s}\right)e^{-h_D^{B*}}\right] \\ &= \frac{1}{2}\left[\widehat{w} - t_H\delta_H + \frac{L}{n}\left(\overline{c} - \underline{c}\right)e^{-h_L^{B*}}\right]. \end{aligned} \tag{A.32}$$

Equations (A.28), (A.29), and (A.32), indicate that when only banks compete, equilibrium employment in either loan loss reduction or deposits services, as well as the equilibrium wage, are independent of a bank's corporate taxes or its required equity capital ratio.

6.2 Deposit and Loan Competition with Nonbanks

This section considers competition for retail loans and savings from both banks and nonbanks, such that nonbanks have positive loan and deposit market shares in equilibrium. Similar to the logic used to derive equation (A.11), L_i and D_i satisfy

$$L_i = \left(x_- + x_+\right)L = \frac{2L}{t_L}\left(r_M + \widehat{c} - r_{L,i} + t_L\delta_L\right) \tag{A.33}$$

$$D_i = \left(y_- + y_+\right)D = \frac{2D}{t_D}\left(r_{D,i} + s\left(h_{i,D}\right) - r_M + t_D\delta_D\right)\ . \tag{A.34}$$

Bank i's maximization problem is the same as before except that equations (A.33) and (A.34) replace equations (A.5) and (A.8). The first order conditions for $r_{L,i}$, $r_{D,i}$, and $h_{i,D}$ now lead to

$$r_{L,i} = \frac{1}{2}\left(r_M + \widehat{c} + t_L\delta_L + c\left(h_{i,L}\right) + \frac{r_E}{1-\tau} - \lambda\right) \tag{A.35}$$

$$r_{D,i} = \frac{1}{2}\left(r_M - s\left(h_{i,D}\right) - t_D\delta_D + \frac{r_E}{1-\tau} - \frac{\lambda}{1-\kappa}\right) \tag{A.36}$$

$$-\frac{2D}{t_D}s'\left(h_{i,D}\right)\left(r_{D,i} + \frac{\lambda}{1-\kappa} - \frac{r_E}{1-\tau}\right) = \widehat{w} - t_H\delta_H + \frac{t_H}{H}\left(h_{i,D} + h_{i,L}\right). \tag{A.37}$$

The first order condition for $h_{i,L}$ is the same as equation (A.16). The first order condition for W_i is similar to (A.19): if $W_i < 0$, then $\lambda = \left(\frac{r_E}{1-\tau} - r_M\right)$, and if $W_i > 0$, then $\lambda = (1-\kappa)\left(\frac{r_E}{1-\tau} - r_M\right)$. However, there is a difference when $W_i = 0$, which we discuss in the next section. For now we exclude the $W_i = 0$ case and consider only $W_i < 0$ or $W_i > 0$.

Substituting (A.19) into (A.35) and (A.36) leads to

$$r_{L,i} = r_M + \frac{1}{2}\left(\widehat{c} + c\left(h_{i,L}\right) + t_L\delta_L + \kappa\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i>0}\right) \tag{A.38}$$

$$r_{D,i} = r_M - \frac{1}{2}\left(s\left(h_{i,D}\right) + t_D\delta_D + \frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0}\right). \tag{A.39}$$

Substituting (A.39) and (A.19) into (A.37) leads to

$$\frac{D}{t_D}s'\left(h_{i,D}\right)\left(s\left(h_{i,D}\right) - \frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0} + t_D\delta_D\right) = \widehat{w} - t_H\delta_H + \frac{t_H}{H}\left(h_{i,D} + h_{i,L}\right), \tag{A.40}$$

and substituting (A.38) into (A.33) and then (A.33) into (A.16) leads to

$$-\frac{L}{t_L}c'\left(h_{i,L}\right)\left(\widehat{c} - c\left(h_{i,L}\right) - \kappa\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i>0} + t_L\delta_L\right) = \widehat{w} - t_H\delta_H + \frac{t_H}{H}\left(h_{i,D} + h_{i,L}\right), \tag{A.41}$$

Define $MR_s\left(h_{i,D}\right)$ as the left-hand side of equation (A.40) and $MR_c\left(h_{i,L}\right)$ as the left-hand side of equation (A.41). Also define $MC\left(h_{i,D} + h_{i,L}\right)$ as the right-hand sides of equations (A.40) and (A.41). Then like in the bank-only case, these equations indicate that bank i employs labor such that the marginal revenue from employing labor in deposit services, $MR_s\left(h_{i,D}\right)$, equals the marginal revenue from employing labor in loan loss reduction, $MR_c\left(h_{i,L}\right)$, which equals the marginal cost of labor, $MC\left(h_{i,D} + h_{i,L}\right)$. However, unlike with the bank-only equilibrium, when $W_i < 0$ we see that $MR_s\left(h_{i,D}\right)$ is decreasing in the bank's corporate tax rate and required capital ratio via the term $-\frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)$. In contrast, when $W_i > 0$, we see that $MR_c\left(h_{i,L}\right)$ is decreasing in the bank's corporate tax rate and required capital ratio via the term $-\kappa\left(\frac{r_E}{1-\tau} - r_M\right)$. Now note the following properties of $MC\left(h_{i,D} + h_{i,L}\right)$, $MR_s\left(h_{i,D}\right)$, and $MR_c\left(h_{i,L}\right)$.

First, $\partial MC\left(H_i\right)/\partial H_i = \frac{t_H}{H} > 0$, so that the marginal cost of labor is increasing in the amount of labor employed. Second, we can derive parametric conditions such that $MR_s\left(h_{i,D}\right)$, and $MR_c\left(h_{i,L}\right)$ are decreasing in labor. Note that the marginal revenue from providing deposit services takes the form

$$MR_s\left(h_{i,D}\right) = \alpha_s s'\left(h_{i,D}\right)\left(s\left(h_{i,D}\right) + \beta_s\right) \tag{A.42}$$

where $\alpha_s \equiv D/t_D$ and $\beta_s \equiv t_D\delta_D - \frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0}$ are constants. $MR_s\left(h_{i,D}\right) > 0$ when $\left(s\left(h_{i,D}\right) + \beta_s\right) > 0$, which we take to be the case. Moreover,

$$\frac{\partial MR_s\left(h_{i,D}\right)}{\partial h_{i,D}} = \alpha_s\left[s''\left(h_{i,D}\right)\left(s\left(h_{i,D}\right) + \beta_s\right) + s'\left(h_{i,D}\right)^2\right] \tag{A.43}$$

Substituting the functional form in equation (1) for $s(h_{i,D})$ in (A.43) leads to

$$\begin{aligned}\frac{\partial MR_s(h_{i,D})}{\partial h_{i,D}} &= \alpha_s\left[-(\overline{s}-\underline{s})e^{-h_{i,D}}\left(\overline{s}-(\overline{s}-\underline{s})e^{-h_{i,D}}+\beta_s\right)+(\overline{s}-\underline{s})^2e^{-2h_{i,D}}\right]\\ &= \alpha_s(\overline{s}-\underline{s})e^{-h_{i,D}}\left[2(\overline{s}-\underline{s})e^{-h_{i,D}}-(\overline{s}+\beta_s)\right] \qquad (A.44)\end{aligned}$$

From (A.44), $\partial MR_s(h_{i,D})/\partial h_{i,D}<0$ when

$$h_{i,D}>\ln\left(\frac{\overline{s}+\beta_s}{2(\overline{s}-\underline{s})}\right) \qquad (A.45)$$

which we take to be the case in equilibrium.[20] Similarly, note that the marginal revenue from reducing loan losses takes the form

$$MR_c(h_{i,L})=-\alpha_c c'(h_{i,L})(\beta_c-c(h_{i,L})) \qquad (A.46)$$

where $\alpha_c\equiv L/t_L$ and $\beta_c\equiv\widehat{c}+t_L\delta_L-\kappa\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i>0}$ are constants. We assume that $\beta_c>c(h_{i,L})$ in equilibrium, so that since $c'(h_{i,L})<0$, $MR_c(h_{i,L})>0$. The derivative of marginal revenue is

$$\frac{\partial MR_c(h_{i,L})}{\partial h_{i,L}}=-\alpha_c\left[c''(h_{i,L})(\beta_c-c(h_{i,L}))-c'(h_{i,D})^2\right] \qquad (A.47)$$

Substituting the function form in equation (2) for $c(h_{i,L})$ in (A.47), we obtain

$$\begin{aligned}\frac{\partial MR_c(h_{i,L})}{\partial h_{i,L}} &= -\alpha_c\left[(\overline{c}-\underline{c})e^{-h_{i,L}}\left(\beta_c-\underline{c}-(\overline{c}-\underline{c})e^{-h_{i,L}}\right)-(\overline{c}-\underline{c})^2e^{-2h_{i,L}}\right]\\ &= -\alpha_c(\overline{c}-\underline{c})e^{-h_{i,L}}\left[\beta_c-\underline{c}-2(\overline{c}-\underline{c})e^{-h_{i,L}}\right] \qquad (A.48)\end{aligned}$$

The right-hand side of (A.48) shows that $\partial MR_c(h_{i,L})/\partial h_{i,L}<0$ when

$$h_{i,L}>\ln\left(\frac{\beta_c-\underline{c}}{2(\overline{c}-\underline{c})}\right) \qquad (A.49)$$

which we take to be the case in equilibrium.[21] Thus, marginal revenues for deposit services and loan loss reduction are declining in labor when labor is sufficiently productive.

Now the actual symmetric equilibrium values $h_{i,L}=h_L^{N*}$ and $h_{i,D}=h_D^{N*}$ are determined by the two equation restrictions $MR_s\left(h_D^{N*}\right)=MR_c\left(h_L^{N*}\right)=MC\left(h_D^{N*}+h_L^{N*}\right)$, which

[20]Note that this will always be the case if $2(\overline{s}-\underline{s})>\overline{s}+\beta_s$, or $\overline{s}>\beta_s+2\underline{s}=t_D\delta_D-\frac{\kappa}{1-\kappa}\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i<0}+2\underline{s}$.

[21]Note that this will always be the case if $2(\overline{c}-\underline{c})>\beta_c-\underline{c}$, or $\overline{c}>\frac{1}{2}\left(\widehat{c}+\underline{c}+t_L\delta_L-\kappa\left(\frac{r_E}{1-\tau}-r_M\right)1_{W_i>0}\right)$.

when written in terms of the assumed functional forms (1) and (2) are

$$\begin{aligned}\alpha_s\left(\overline{s}-\underline{s}\right)e^{-h_D^{N*}}\left[\beta_s+\overline{s}-\left(\overline{s}-\underline{s}\right)e^{-h_D^{N*}}\right] &= \alpha_c\left(\overline{c}-\underline{c}\right)e^{-h_L^{N*}}\left[\beta_c-\underline{c}-\left(\overline{c}-\underline{c}\right)e^{-h_L^{N*}}\right] \\ &= \widehat{w}-t_H\delta_H+\frac{t_H}{H}\left(h_D^{N*}+h_L^{N*}\right) \qquad \text{(A.50)}\end{aligned}$$

While the solutions for h_D^{N*} and h_L^{N*} from (A.50) are not in closed form, an important comparative static can be derived. Given that $\partial MC\left(H_i\right)/\partial H_i > 0$, $\partial MR_s\left(h_{i,D}\right)/\partial h_{i,D} < 0$, and $\partial MR_c\left(h_{i,L}\right)/\partial h_{i,L} < 0$, we now show that an increase in τ or κ must reduce equilibrium H_i.

Consider an initial equilibrium satisfying $MR_s\left(h_D^{N*}\right) = MR_c\left(h_L^{N*}\right) = MC\left(H^{N*}\right)$ where $H^{N*} = h_D^{N*}+h_L^{N*}$; that is, (A.50) is satisfied. Then suppose there is an increase in τ or κ such that the term $\kappa\left(\frac{r_E}{1-\tau}-r_M\right)$ is increased. From (A.42) and (A.46) we see that this increase decreases $MR_s\left(h_D^{N*}\right)$ when $W_i < 0$ and decreases $MR_c\left(h_L^{N*}\right)$ when $W_i > 0$. For concreteness, consider the case of $W_i < 0$. Then after $\kappa\left(\frac{r_E}{1-\tau}-r_M\right)$ increases the initial values h_D^{N*} and h_L^{N*} can no longer be an equilibrium since $MR_s\left(h_D^{N*}\right) < MR_c\left(h_L^{N*}\right) = MC\left(h_D^{N*}+h_L^{N*}\right)$.

We now argue that there can no longer be an equilibrium where total employment is the same or greater than the initial level, H^{N*}. The proof is by contradiction. First suppose H^{N*} stays the same, implying $MC\left(H^{N*}\right)$ is unchanged. Then since $\partial MR_s\left(h_{i,D}\right)/\partial h_{i,D} < 0$, h_D must decline, say to $h_D^* < h_D^{N*}$ to restore $MR_s\left(h_D^*\right) = MC\left(H^{N*}\right)$. Thus, to keep H^{N*} constant, the decline in equilibrium h_D^* must be offset by a rise in equilibrium h_L, say to $h_L^* > h_L^{N*}$. But that cannot be an equilibrium since $\partial MR_c\left(h_{i,L}\right)/\partial h_{i,L} < 0$ implies $MR_c\left(h_L^*\right) < MC\left(H^{N*}\right)$. Thus, no equilibrium with the same total employment exists.

A similar argument can be made for why a rise in total H, say to the level $H^H > H^{N*}$ cannot be an equilibrium: in this case since $\partial MC\left(H_i\right)/\partial H_i > 0$, the new level h_D^* must decline even more to equate $MR_s\left(h_D^*\right) = MC\left(H^H\right) > MC\left(H^{N*}\right)$, implying the new h_L^* must rise to an even greater degree, making $MR_c\left(h_L^*\right) < MC\left(H^{N*}\right) < MC\left(H^H\right)$. Thus, there is no equilibrium where total employment rises.

Consequently, the only new equilibrium is where $H = H^L < H^{N*}$. Here, $h_D^* < h_D^{N*}$ and $h_L^* > h_L^{N*}$ but where $H^L = h_D^* + h_L^* < H^{N*}$ so that $MR_s\left(h_D^*\right) = MR_c\left(h_L^*\right) = MC\left(H^L\right)$.

Similar logic implies that when $W_i > 0$, an increase in $\kappa\left(\frac{r_E}{1-\tau}-r_M\right)$ leads to a new equilibrium where $h_D^* > h_D^{N*}$ and $h_L^* < h_L^{N*}$ but where $H^L = h_D^* + h_L^* < H^{N*}$. Note that in either case of $W_i < 0$ or $W_i > 0$, $H^L < H^*$, which from equation (A.12) implies that the equilibrium wage decreases.

6.3 Conditions for Bank Only and Nonbank Equilibria

This section considers minimum and maximum distances for nonbanks, δ_L and δ_D, that would be sufficient to have a bank only equilibrium or a nonbank equilibrium. We first consider the minimum distances for δ_L^B and δ_D^B that ensure a bank only equilibrium. Suppose a borrower was at the maximum distance, $1/(2n)$, from a bank. Based on (A.23), this borrower would continue to prefer borrowing at a bank when

$$\begin{aligned} r_M + \widehat{c} + t_L \delta_L^B &> r_{L,i} + t_L \frac{1}{2n} \\ &= r_M + \kappa \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i \geq 0} + c\left(h_L^{B*}\right) + \frac{3t_L}{2n} \end{aligned} \tag{A.51}$$

or

$$\delta_L^B > \frac{3}{2n} - \frac{\widehat{c} - c\left(h_L^{B*}\right)}{t_L} + \frac{\kappa}{t_L} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i \geq 0} \tag{A.52}$$

Similar logic shows that the minimum distance for a nonbank savings provider that would ensure a bank-only deposit equilibrium is

$$\begin{aligned} r_M - t_D \delta_D^B &< r_{D,i} + s\left(h_D^{B*}\right) - t_D \frac{1}{2n} \\ &= r_M + s\left(h_D^{B*}\right) - \frac{\kappa}{1-\kappa} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i < 0} - \frac{3t_D}{2n} \end{aligned} \tag{A.53}$$

or

$$\delta_D^B > \frac{3}{2n} - \frac{s\left(h_D^{B*}\right)}{t_D} + \frac{\kappa}{t_D(1-\kappa)} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i < 0} \tag{A.54}$$

Second, consider the maximum distances for nonbanks, δ_L^N and δ_D^N, that would ensure that nonbanks have positive market shares in a nonbank equilibrium. From (A.33) and (A.38), a bank's share of total loans under a nonbank equilibrium is

$$\begin{aligned} (x_- + x_+) &= \frac{2}{t_L} \left(r_M + \widehat{c} - r_{L,i} + t_L \delta_L \right) \\ &= \frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} - \frac{\kappa}{t_L} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i > 0} + \delta_L \end{aligned} \tag{A.55}$$

For a loan market equilibrium with positive market shares for nonbanks to exist, $(x_- + x_+) < 1/n$. Using (A.55), this implies[22]

$$\delta_L^N < \frac{1}{n} - \frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} + \frac{\kappa}{t_L} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i > 0} \tag{A.56}$$

[22]Note that this requirement for a positive nonbank market share appears to be stronger than the requirement for the equilibrium bank loan rate under nonbank competition to be lower than the equilibrium bank loan rate under bank-only competition, which is $\delta_L < \frac{2}{n} - \frac{\widehat{c} + c\left(h_L^{N*}\right) - 2c\left(h_L^{B*}\right)}{t_L} + \frac{\kappa}{t_L} \left(\frac{r_E}{1-\tau} - r_M \right) 1_{W_i > 0}$.

Similar arguments lead to

$$
\begin{aligned}
(y_- + y_+) &= \frac{2}{t_D}\left(r_{D,i} + s\left(h_D^{N*}\right) - r_M + t_D\delta_D\right) \\
&= \frac{s\left(h_D^{N*}\right)}{t_D} - \frac{\kappa}{t_D(1-\kappa)}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0} + \delta_D
\end{aligned} \tag{A.57}
$$

Thus, the maximum nonbank distance that gives positive market shares for nonbank savings providers is

$$
\delta_D < \frac{1}{n} - \frac{s\left(h_D^{N*}\right)}{t_D} + \frac{\kappa}{t_D(1-\kappa)}\left(\frac{r_E}{1-\tau} - r_M\right)1_{W_i<0} \tag{A.58}
$$

Therefore, when nonbanks have positive market shares, banks' total lending equals $n \times (x_- + x_+) \times L$ and their total retail deposits equals $n \times (y_- + y_+) \times D$. Given positive nonbank market shares in both lending and savings, banks will have $W_i < 0$ when $n \times (x_- + x_+) \times L(1-\kappa) < n \times (y_- + y_+) \times D$ or

$$
L(1-\kappa) < D\frac{(y_- + y_+)|_{W_i<0}}{(x_- + x_+)|_{W_i<0}} = D\frac{\frac{s\left(h_D^{N*}\right)}{t_D} - \frac{\kappa}{t_D(1-\kappa)}\left(\frac{r_E}{1-\tau} - r_M\right) + \delta_D}{\frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} + \delta_L} \tag{A.59}
$$

Similarly, banks will have $W_i > 0$ when

$$
L(1-\kappa) > D\frac{(y_- + y_+)|_{W_i>0}}{(x_- + x_+)|_{W_i>0}} = D\frac{\frac{s\left(h_D^{N*}\right)}{t_D} + \delta_D}{\frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} - \frac{\kappa}{t_L}\left(\frac{r_E}{1-\tau} - r_M\right) + \delta_L} \tag{A.60}
$$

The intermediate range where

$$
D\frac{\frac{s\left(h_D^{N*}\right)}{t_D} - \frac{\kappa}{t_D(1-\kappa)}\left(\frac{r_E}{1-\tau} - r_M\right) + \delta_D}{\frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} + \delta_L} < L(1-\kappa) < D\frac{\frac{s\left(h_D^{N*}\right)}{t_D} + \delta_D}{\frac{\widehat{c} - c\left(h_L^{N*}\right)}{t_L} - \frac{\kappa}{t_L}\left(\frac{r_E}{1-\tau} - r_M\right) + \delta_L} \tag{A.61}
$$

corresponds to the case of $W_i = 0$. In this situation, retail loans are funded exclusively with retail deposits and equity. Banks' retail loan rates are between $r_{L,i}|_{W_i<0}$ and $r_{L,i}|_{W_i>0}$, where $r_{L,i}$ is given by equation (A.38), and banks' retail deposit rates are between $r_{D,i}|_{W_i<0}$ and $r_{D,i}|_{W_i>0}$, where $r_{D,i}$ is given by equation (A.39). This case corresponds to each bank's loan market share being intermediate between $(x_- + x_+)|_{W_i>0}$ and $(x_- + x_+)|_{W_i<0}$ and its deposit market share being intermediate between $(y_- + y_+)|_{W_i<0}$ and $(y_- + y_+)|_{W_i>0}$.

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Table A1: List of Changes in State Income Tax Rates on Financial Institutions

The table lists changes in state income tax rates on financial institutions and the number of single-state banks, and Ratewatch branches affected. State of Connecticut is not included in our sample because of its highly frequent tax rate changes during this period.

Year	State	Tax rate changes	No. of banks	No. of RW branches
1998	Arizona	Cut rate from 9% to 8%	12	1
	Massachusetts	Cut rate from 11.32% to 10.91%	197	0
	North Carolina	Cut rate from 7.5% to 7.25%	66	27
1999	Colorado	Cut rate from 5% to 4.75%	88	52
	Massachusetts	Cut rate from 10.91% to 10.5%	195	98
	New Hampshire	Increase rate from 7% to 8%	20	0
	North Carolina	Cut rate from 7.25% to 7%	62	33
2000	Arizona	Cut rate from 8% to 7.968%	9	3
	Colorado	Cut rate from 4.75% to 4.63%	80	53
	North Carolina	Cut rate from 7% to 6.9%	65	32
2001	Alabama	Increase rate from 6% to 6.5%	95	42
	Arizona	Cut rate from 7.968% to 6.968%	8	4
	Idaho	Cut rate from 8% to 7.6%	12	4
	New Hampshire	Increase rate from 8% to 8.5%	22	0
	New York	Cut rate from 9% to 8.5%	119	55
2002	New York	Cut rate from 8.5% to 8%	112	58
	Tennessee	Increase rate from 6% to 6.5%	124	100
2003	New York	Cut rate from 8% to 7.5%	105	56
2004	DC	Increase rate from 9.5% to 9.975%	2	2
2007	New York	Cut rate from 7.5% to 7.1%	99	55
	Vermont	Cut rate from 9.75% to 8.9%	8	7
	West Virginia	Cut rate from 9% to 8.75%	37	37
2008	Maryland	Increase rate from 7% to 8.25%	34	25
	Vermont	Cut rate from 8.9% to 8.5%	8	4
2009	Oregon	Increase rate from 6.6% to 7.9%	20	15
	West Virginia	Cut rate from 8.75% to 8.5%	36	36
2010	Massachusetts	Cut rate from 10.5% to 10%	119	99
2011	Illinois	Increase rate from 4.8% to 7%	248	220
	Massachusetts	Cut rate from 10% to 9.5%	117	96
	North Dakota	Cut rate from 7% to 6.5%	18	17
	Oregon	Cut rate from 7.9% to 7.6%	18	13
2012	Idaho	Cut rate from 7.6% to 7.4%	10	9
	Massachusetts	Cut rate from 9.5% to 9%	113	97
	West Virginia	Cut rate from 8.5% to 7.5%	35	33
	Total		2,313	1,383