Deregulation, Market Structure, and the Demise of Old-School Banking*

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Abstract

We construct a new network-based measure of U.S. state-level bank deregulation intensity that allows us to separately identify the effects of deregulation on competition and investment opportunities. In contrast to existing studies, we find that increased competition leads to higher deposit funding costs and a reduction in banks' net interest margins and profitability. In response, banks increase their risk-taking, shift their business models towards new sources of non-interest income, and become more likely to be acquired by other banks. Our findings resolve conflicting evidence in the literature and support theories in which reductions in bank charter values lead to increased bank risk-taking.

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1 Introduction

Over the past thirty years, the traditional bank business model—taking deposits and making loans—has come under siege. For example, Figure 3 of Gorton, Lewellen, and Metrick (2012) shows that the ratio of deposits to total financial sector liabilities has dramatically declined since the 1980s, while Figure 1 of Stiroh (2004) shows that the ratio of banks' non-interest income to operating income nearly doubled between 1984 and 2000.[1] The days when bankers were members of Michael Lewis's "3–6–3 club" —borrow at 3 percent, lend at 6 percent, and be on the golf course by 3pm—appear to largely be over.[2]

In this paper, we examine whether the deregulation of the U.S. commercial banking sector in the 1980s and 1990s may have contributed to the demise of the old-school model of banking. Banking deregulation marked a watershed event for the industry and has spawned a large academic literature studying the effects of deregulation on a host of economic outcomes. However, the literature has largely struggled to reach a consensus on how banks' performance and risk-taking were affected by deregulation, raising questions about whether deregulation played a contributing role in the longer-term trends observed in the commercial banking sector. Moreover, the effects of deregulation on bank performance and risk-taking are of particular interest because theories of the industrial organization of the banking sector make different predictions concerning these outcomes.

In this paper, we construct novel network-based measures of bank deregulation intensity and use these measures to estimate the effects of deregulation on bank risk-taking and performance. A key shortcoming of existing studies is their inability to separately identify the effects of increased competition and increased investment opportunities on bank outcomes. When two states open their

[1] To date, the literature has largely focused on external forces such as the emergence of shadow banks and the rise in securitization to explain the decline in "old school" banking. See, e.g., Keys, Mukherjee, Seru, and Vig (2010), Purnanandam (2011), and Buchak, Matvos, Piskorski, and Seru (2018a,b).

[2] Michael Lewis, *Liar's Poker*, Norton, 1989.

markets to each other, banks from each state face shocks to both in-state competition (since banks from the other state can enter the "home" state) and shocks to investment opportunities (since banks from the home state can enter the other state). Existing studies primarily use the workhorse Kroszner and Strahan (1999) deregulation measure, which defines deregulation based on the first date that a state implemented a deregulation agreement of any kind. However, this measure cannot be used to disentangle shocks to competition from shocks to investment opportunities and does not capture the effective dates of reciprocal agreements on which changes to local banking markets were realized.

To separate the effects of increased competition from increased investment opportunities, we construct a reciprocity matrix showing, for state A at time t, how many other states have access to state A's banking markets (a metric we call "*States In*"), and how many other states' markets banks in state A have access to (which we refer to as "*States Out*"). The difference between *States In* and *States Out*, which we refer to as *Net States In*, therefore captures a bank's net exposure at a given point in time to either increased in-state competition or increased out-of-state investment opportunities. This measure also mechanically sums to zero across all states at a given point in time, which ensures that there are no aggregate trends in the treatment variable across time (Goodman-Bacon, 2018).[3] Given its parsimonious nature, we use *Net States In* as our primary measure of deregulation intensity throughout most of the paper.

Our network-based approach yields two advantages over other measures of state-level deregulation timing. First, a large number of deregulation agreements are reciprocal, meaning that nothing happens until *both* states implement deregulation agreements with each other. Hence, if state A passes a reciprocal deregulation agreement with state B, banks from state A cannot enter state B until state B passes a similar law. Directly accounting for the reciprocal nature of most agreements

[3] An increase in *Net States In* must also lead to a decrease in *Net States In* in another state at the same point in time.

therefore generates significant additional variation in the timing and scope of deregulation relative to measures such as the one developed by Kroszner and Strahan (1999). Second, some states pass *non*-reciprocal agreements that yield asymmetric changes in either competition or investment opportunities for home-state banks. For example, state A might pass a non-reciprocal deregulation agreement allowing banks from state B to enter state A even though banks from state A cannot enter state B. The existence of such agreements allows us to cleanly identify cases where there is *only* a competition shock or an investment opportunities shock, but not both.

Colorado offers an example of the benefits of our measure. In 1991, Colorado passed a nationwide, non-reciprocal interstate banking law granting banks in all 50 states immediate access to Colorado's banking markets (corresponding to a significant increase in 1991 in our *States In* measure for Colorado). However, due to the non-reciprocal nature of the law, banks in Colorado could not access banking markets in, say, Missouri until 1995, after a federal law was passed (the so-called "Riegle-Neal Act") that removed all restrictions on interstate banking.[4] At the time that Colorado passed its 1991 law, our *States Out* measure for Colorado stood at only five states, meaning that Colorado banks were subject to competition from 49 other states in local markets, but could only expand into five outside states. Hence, the dates in which Missouri banks could access Colorado markets (1991) and Colorado banks could access Missouri markets (1995) are quite different. Traditional measures of interstate banking deregulation such as Kroszner and Strahan (1999) effectively code all Colorado banks as having been deregulated in 1988 (the year in which Colorado passed its first interstate banking law, a reciprocal agreement with nearby states), or focus on the number of states that can access Colorado at any given point in time (e.g. Jiang, Levine, and Lin (2016, 2018)), abstracting from any changes in Colorado banks' investment opportunities.

[4]The formal name for the Riegle-Neal Act is the Interstate Banking and Branching Efficiency Act of 1994.

We find that the removal of interstate banking restrictions leads to a significant increase in local deposit competition and deposit rates, a significant decline in bank net interest margins and performance, and a significant increase in bank risk-taking. First, using novel pre-1993 summary of deposits data, we find that deregulation leads to sizable increases in local *deposit* competition, as measured by county-level deposit HHI.[5] In turn, increased competition significantly erodes banks' net interest margins: we find that a one standard-deviation increase in competition is associated with a 4.1 standard-deviation reduction in NIM. In contrast with previous studies (Jayaratne and Strahan (1998), Dick (2006)), we find that this decrease is almost entirely driven by higher deposit funding costs. Banks respond in at least three ways to this shock. First, they significantly increase risk-taking. For example, ROE and ROA volatility respectively increase by 2.2% and 1.4% for each new state that is given access to a bank's home market.[6] Second, banks reorient their business models towards fee-based income: loan-to-asset ratios fall and the ratios of non-interest income to total income increase as a result of increased competition. Finally, when all else fails, banks put themselves up for sale: a one-state increase in *Net States In* increases the probability of becoming an M&A target by 11 percentage points. Despite these business model changes, increased competition has a negative effect on bank profitability: ROA and ROE fall by approximately 1% for each new state that is able to access a bank's home market. Hence, increased competition appears to be associated with higher funding costs, lower profitability, higher risk-taking, and significantly-altered bank business models.

One potential concern with our findings is that states did not select the timing or scale of deregulation at random. To alleviate such concerns, we confirm that our main results hold when we restrict the sample to changes in *Net States In* caused by the (federal) Riegle-Neal Act. We also find simi-

[5]The data comes from Christa Bouwman's website.

[6]We also examine banks' failure probabilities. However, there are at least two reasons to avoid using failure probabilities as a measure of risk-taking. First, many banks that are near failure are sold before they fail (which is what we find). Second, and more importantly, competition can lead to higher failure probabilities even in the absence of a direct risk-taking channel (see, e.g., Egan, Hortacsu, and Matvos (2017)).

lar results using both distance-weighted and state banking size-weighted versions of *States In* and *Net States In*. Our main results also become stronger in cases where we can isolate the asymmetric effects of deregulation (i.e. "one-way streets" whereby banks in a state gain access to another state's market in a non-reciprocal fashion), while surviving a second robustness check where we examine NIM in states that signed national agreements (reducing the likelihood that economic conditions in specific state couples drove deregulation decisions). In addition, our main results hold (though are weaker) when we perform our tests on bank holding companies rather than on chartered commercial banks. We also confirm that our results disappear when we perform placebo tests that randomly perturb our reciprocity matrix. We perform a number of other robustness tests that are documented in the sections below.

Our results differ from the existing literature precisely because prior measures of deregulation cannot disentangle increased out-of-state investment opportunities and increased competition. In specifications that include our network-based measures of deregulation and the deregulation measure of Kroszner and Strahan (1999), we find that the inclusion of the Kroszner and Strahan (1999) deregulation measure does not affect the loadings on our deregulation measures. Consistent with the existing literature, we also find a positive (though statistically insignificant) relationship between the Kroszner and Strahan (1999) measure and NIM, suggesting that much of the prior work on interstate deregulation may be capturing variation in banks' out-of-state investment opportunities rather than shocks to local competition. Our use of network-based measures of interstate deregulation allows us to reconcile prior evidence arguing that banks earn rents on deposit markets (e.g. Berger and Hannan (1989, 1997), Drechsler, Savov, and Schnabl (2017, 2018)) but that deregulation had little to no effect on bank interest expense and a positive effect on bank profitability (Jayaratne and Strahan (1998), Berger and Mester (2003)). Additionally, we extend these findings to provide charter-level evidence

of bank responses on risk and business model margins.

Our empirical approach also allows us to test two competing classes of theories. Keeley (1990) argues that interstate banking regulations limit entry into local banking markets and allow incumbent banks to extract rents from market power. This market power, in turn, provides a natural check on banks' risk-taking activities: were a bank to become excessively risky, it could lose its charter, and hence lose its ability to extract rents. This logic, expressed more generally in Allen and Gale (2000), suggests that increased competition should drive banks' net interest margin and profitability downward, absent a competitive response. In contrast, Boyd and De Nicolo (2005) argue that increased competition should lead to reduced risk-taking, since monopolist banks would charge higher rates that, all else equal, would increase the probability of borrower defaults and would hence increase the probability of the bank's own failure. Moreover, the removal of interstate banking restrictions should allow banks to improve their diversification by expanding into new markets, thereby also potentially reducing overall risk-taking. Hence, whether risk-taking rises or falls following a shock to competition is largely an empirical question. Our results are consistent with the hypothesis of Keeley (1990), Allen and Gale (2000), and Hellmann, Murdock, and Stiglitz (2000) that higher competition induces lower profitability and increased risk-taking.[7]

Our paper adds to a long empirical literature on competition, risk-taking, and commercial bank performance. Jayaratne and Strahan (1996, 1998), and Stiroh and Strahan (2003) find that interstate banking deregulation leads to a more efficient banking sector, which in turn is associated with lower risk-taking, weakly higher profitability, and higher economic growth in affected lending markets (see, e.g., Berger, Demsetz, and Strahan (1999), Beck, Levine, and Levkov (2010) and Mian, Sufi, and Verner (2018)). At the same time, other studies by Keeley (1990), Dick (2006), and Jiang, Levine, and

[7]Relatedly, a recent paper by Carlson et al. (2018) uses data from the national banking era to show that increased competition in *lending* increases bank risk taking.

Lin (2018) find that interstate banking deregulation is associated with higher risk-taking. Our paper contributes to this literature by separating, for the first time, the effects of increased competition and increased investment opportunities on bank performance and risk-taking. We show that separating competitive pressure from investment opportunities allows us to identify a negative impact of competition on bank net interest margins, profitability, and a positive impact on bank risk-taking.

Our paper also contributes to the literature on market power in banking. A number of studies—both old and recent—have found that banks possess market power in their deposit-taking and lending activities.[8] We contribute to this literature by directly linking the post-deregulation increase in local banking market competitiveness to the significant decline in NIM that started in the 1990s.[9] Our identification strategy, which relies on plausibly-exogenous changes in local market competition derived from interstate bank deregulation, delivers results that support this literature's primary inference that banks have market power at a local level.[10] Finally, the existing literature has focused on external shocks such as securitization and shadow banking to explain the demise of old-school banking. We argue that an internal shock—increased competition in local markets—also appears to explain many of the changing trends we have observed in the commercial banking sector over the past 30 years.

The closest paper to ours is Dick (2006), which uses a single event (the Riegle-Neal Act) to show that deregulation induces higher local competition, lower loan rates, and weakly higher deposit rates and portfolio risk. We complement this study by proposing a new deregulation measure that al-

[8]See, e.g., Berger and Hannan (1989, 1997), Hannan (1991, 1994, 1997, 1998), Hannan and Berger (1991), Neumark and Sharpe (1992), Jackson III (1997), Driscoll and Judson (2013), Scharfstein and Sunderam (2016), and Drechsler, Savov, and Schnabl (2017, 2018).

[9]See, e.g., https://fred.stlouisfed.org/series/USNIM for evidence of the decline in NIM.

[10]The previous studies on market power raise a natural question: how have commercial banks maintained market power in local markets despite facing significant upheaval (including the deregulation of the entire commercial banking sector) over the past thirty years? Our paper provides one potential answer: it appears that market power has in fact gone down in most local markets.

lows us to separate banks' competitive pressure from investment opportunities, and to reconcile previously-conflicting results in the deregulation literature. Another closely-related paper is Jiang, Levine, and Lin (2018), which constructs a variable similar to our *States In* measure and examines within-state variation in the risk-taking and performance of US Bank Holding Companies based on the geographic distance between banks in one state and a partner deregulating state.[11] However, Jiang, Levine, and Lin (2018) do not attempt to separate changes in local market competition from changes in bank investment opportunities. They also use a completely different source of identifying variation—a distance or gravity-weighted measure of treatment *intensity* and include state by time fixed effects to soak up the main treatment effect of deregulation. In contrast, we identify the average treatment effects associated with deregulation and show that these treatment effects often go in the opposite direction relative to most of the existing literature.

2 Institutional Setting and Empirical Design

In this section we describe the institutional setting of the US interstate banking deregulation, and how we exploit the features of the deregulation process to identify the impact of increased competition on bank profitability, risk-taking, and business models.

2.1 Institutional Setting

Banks in the United States historically faced restrictions on branching across states. Before the 1970's, banks were prohibited from opening new branches and from acquiring banks in other states. Starting in the early 1970's, individual states started passing laws lifting these restrictions and allowing interstate banking. The interstate banking deregulation process evolved gradually over a span of

[11] Using a related identification approach, Goetz, Laeven, and Levine (2016) and Jiang, Levine, and Lin (2016) study the effects of interstate bank deregulation on bank geographic allocation and disclosure.

around fifteen years, and culminated in 1994 with the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act. Following the passage of the Riegle-Neal Act, all remaining interstate banking restrictions were removed.

A characteristic feature of the deregulation process was the reciprocal nature of the interstate banking agreements. In practice, any given state *i* had two options to allow interstate banking. The first option was for state *i* to pass a non-reciprocal agreement allowing banks from all other states (or possibly from a specific set of states) to acquire local banks. The second option was for state *i* to sign national or regional reciprocal agreements allowing banks from other states to acquire local banks only if such states also allowed state-*i* banks to acquire banks in these other states.

In practice, the vast majority of the interstate banking deregulation happened through national and regional reciprocal agreements. For example, on December 29, 1982, the State of Massachusetts passed "An Act Relative to Branch Offices and Acquisitions of Financial Institutions" stating that "Any out-of-state banking association or corporation [...] may establish and maintain branch offices or deposits in the commonwealth, or merge with or purchase the assets of any Massachusetts bank [...]; provided that the laws of the state in which such banking association or corporation has its principal place of business expressly authorized [...] Massachusetts banks to establish and maintain branches and deposits in such state or to merge with or purchase the assets of a banking institution in such state," further specifying that "the term out-of-state banking association or corporation shall mean an association or corporation with its principal place of business in one of the states of Connecticut, Maine, New Hampshire, Rhode Island, or Vermont [...]." In other words, the Act allowed banks from Connecticut, Maine, New Hampshire, Rhode Island, and Vermont to enter Massachusetts subject to banks from Massachusetts being allowed to enter these other states.

Since individual states had to wait for other states to sign reciprocal laws, the date of passage of an

interstate banking law almost never coincided with the date at which local banks could acquire or be acquired by banks from other states. For example, the State of New York passed a national-reciprocal law in 1982. By 1987, only five states (AK, AZ, DC, KY, ME) had signed reciprocal agreements with New York, and by 1992 only twenty-one states had signed such agreements.

2.2 Empirical Design

We exploit the reciprocal nature of the interstate banking agreements to construct two measures that we use to capture two distinct aspects of interstate banking deregulation: Increased competition and increased investment opportunities for local banks. Specifically, we use the deregulation details contained in Amel (1993) to construct year-level reciprocity matrices mapping US states to each other based on whether they allow interstate banking between each other. In a given year, the (i, j)-th element of the reciprocity matrix is equal to one if banks based in state i can be acquired by banks based in state j, and it is equal to zero otherwise.

We use our reciprocity matrices to compute two deregulation measures at the state-year level. For a given year t and a given state i, our first deregulation measure is the number of states whose banks can acquire state-i banks—the column-sum of the reciprocity matrix in year t. We call this measure *States In*, and we use this measure to capture changes in state-i competition stemming from deregulation. Similarly, our second deregulation measure is the number of states that state-i banks can enter—the row-sum of the reciprocity matrix in year t. We call this measure *States Out*, and we use this measure to capture changes in state-i banks' investment opportunities stemming from deregulation. Our main empirical measure, called *Net States In*, is simply the difference between *States In* and *States Out*. This measure captures the extent to which a state's banks, on net, have more opportunities to expand outside of the state or face internal competition from new entrants.

Figure 1 provides a visual illustration of how we use the interstate deregulation process to identify shocks to competition (*States In*), shocks to investment opportunities (*States Out*), and net shocks to competition (*Net States In*) taking Colorado as focal state. In the figure, arrows indicate whether banks from a given state are allowed to enter another state through interstate banking. Until the end of the 1980's, Colorado, Nebraska, and Massachusetts share no interstate banking connection (Panel (a)). In 1988, Colorado signs a regional reciprocal agreement with Nebraska (along with six other states), which Nebraska does not reciprocate immediately.[12] In 1991, Nebraska reciprocates the agreement, allowing Colorado banks to enter Nebraska and Nebraska banks to enter Colorado (Panel (b)). We argue that from the perspective of Colorado banks, this corresponds to an increase in both competitive pressure (a one-state increase in *States In*) investment opportunities (a one-state increase in *States Out*), which does not change our *Net States In* measure.[13] In 1991, Colorado also signs a national non-reciprocal agreement allowing banks from all other states to enter Colorado. In Panel (c) of Figure 1, we take the example of Massachusetts and show that following this non-reciprocal agreement Massachusetts banks can now enter Colorado even if Colorado banks cannot enter Massachusetts—a one-state increase in *Net States In*, corresponding to an increase in competitive pressure not matched by a change in Colorado banks' investment opportunities. Finally, the Riegle-Neal Act of 1994 allows Colorado banks to expand in all other US states, including Massachusetts, in 1995 (Panel (d)). From the perspective of Colorado, the Riegle-Neal Act in this example represent a one-state decrease in *Net States In*, corresponding to an increase in investment opportunities not matched by a change in local competitive pressure.

[12]Note that while the earlier deregulation literature usually codes 1988 as Colorado's deregulation year, more recent studies such as Goetz, Laeven, and Levine (2016) and Jiang, Levine, and Lin (2016) take into account the reciprocal nature of the interstate banking deregulation process.

[13]One might argue that Colorado and Nebraska might be characterized by different banking sectors at the time of deregulation, such that increased competition and increased investment opportunities might not have perfectly-offsetting effects on Colorado banks' profitability. In the appendix, we show that our main results are robust when we weigh our main competition measures by the size of each state's banking sector before the start of the deregulation process.

Our deregulation measures offer a few advantages in identifying the effect of new entrants and increased competition on bank profitability, risk-taking, and bank business models. First, our measures allow us to separately identify the effects of deregulation on local banks' profitability and risk-taking. The first effect of deregulation, captured by *States In*, is an increase in the competitive pressure faced by local banks. The second effect, captured by *States Out*, is an increase in local banks' investment opportunities once local banks are allowed to enter other states. Since our annual reciprocity matrices are typically not symmetric—state-*i* banks are allowed to acquire state-*j* banks, even if state-*j* banks are not allowed to acquire state-*i* banks—, *States In* typically differs from *States Out* for a given state and a given year. As such, our *Net States In* measure allows us to disentangle the separate effects of increased competition and increased investment opportunities. Second, our measures also capture changes in deregulation that affect the same state at different points in time and with different intensity, as the result of multiple law changes within that state. Third, *States In* and *States Out* are a function of *other* states' deregulation decisions and legislative timing, and this timing exhibits large variation both across and within states. In this sense, changes in competition and investment opportunities captured by *States In* and *States Out* are arguably quasi-exogenous from the perspective of local banks, and especially from the perspective of banks operating in early-deregulating states.

One final advantage of *Net States In* is that in the cross-section, any given state's *State In* has to be matched by a *State Out* in some other state, which makes *Net States In* equal to zero on average at any given point in time. This feature of *Net States In* is particularly helpful because it allows us to avoid possible contamination from state-level trends when deregulation is staggered over a long period of time (Roberts and Whited (2013)). In other words, our tests rely on the different competitive pressure faced by different states at any given point in time. In the left panel of Figure 2, we provide an illustration of this argument by showing the time-series evolution of average *Net States In*, as

well as the evolution of *Net States In* in the two states with the highest and lowest values for the variable. The figure confirms that our main deregulation variable is zero on average, but it exhibits large cross-sectional variation. The cross-sectional dispersion in *Net States In* ranges from 49 states at the beginning of our sample in 1984 to 28 states right before the passage of the Riegle-Neal Act in 1994. The right panel of 2 provides a cross-sectional snapshot of the cross-section of *Net States In* from the beginning of our sample to 1995. The figure confirms that our main deregulation measure is zero on average but exhibits large cross-sectional variation across states.

In Figure 3, we display the distribution of changes in *Net States In* in the cross-section of US states before the Riegle-Neal Act. The goal of this figure is to study which US states provide the most *Net States In* variation in our sample.[14] In Panel A, we show the number of times that Net States In changes for any given state. In this panel, lighter colors identify states that experienced relatively few changes in *Net States In* before the Riegle-Neal Act. Panel A shows that states that implemented early national non-reciprocal agreements such as Colorado, Idaho, and Texas, experienced a large number of *Net States In* changes during our sample period—mainly driven by *States Out* changes.

In Panel B of Figure 3, we show the number of *Net States In* that are on average added to a given state, conditional on a *Net States In* change. In this panel, lighter colors identify states with negative changes in *Net States In* on average—states that are on average "exporters" of competition, for which the effect of *States Out* dominates. Conversely, darker colors identify states with positive changes in *Net States In* on average—states that are on average "importers" of competition, for which the effect of *States In* dominates. Panel B shows that average "importers" and "exporters" of competition according to our *Net States In* definition are geographically dispersed around the country, suggesting that our main results are unlikely driven by geographic clustering of states with different economic

[14]We would like to thank Christine Dobridge for suggesting the addition of this figure to the paper.

environments.

3 Data

Our data comes from four different sources. Quarterly income statement and balance sheet data comes from the FDIC Call Reports. Due to differences in net interest income reporting before 1984, we drop quarterly observations before the first quarter of 1984. Starting with the first quarter of 1984, we compute NIM as net interest income minus net interest expense, divided by earning assets, where we borrow the definition of earning assets from the Federal Reserve of St. Louis' website.[15] Similarly, we compute Return on Equity (ROE) as net income divided by the book value of bank equity, and Return on Assets (ROA) as net income divided by total bank assets. In our empirical specifications, Loan Loss Provisions and Loan Charge-Offs are normalized by total loans, while Non-Interest Income is normalized by earning assets. Annual data on branch-level deposits comes from Christa Bouwman's website for the years 1984-1993 and from the FDIC Summary of Deposits dataset for all subsequent years.[16] As described in the previous section, we manually collect deregulation data from Amel (1993) and use this data to construct our annual reciprocity matrices and *States In* and *States Out* measures. Table 1 provides summary statistics for the main variables we use in the paper.

4 Results

We argue that the 1980s and 1990s wave of staggered reciprocal interstate banking agreements led to a change in the industrial organization of the U.S. commercial banking sector. Specifically, we

[15] https://fred.stlouisfed.org/series/USNIM.
[16] https://sites.google.com/a/tamu.edu/bouwman/data

provide support for the claim that these deregulation events increased bank competition, reduced banks' local monopoly rents, and changed risk-taking incentives for commercial banks.

4.1 Deregulation and Bank Profitability

We first link local market concentration to state-level deregulation activity and to a traditional measure of bank profitability—Net Interest Margin (NIM)—during the thirty years between 1984 and 2010. Figure 4 plots the time series evolution of local market concentration along with two different measures of deregulation intensity. The first deregulation measure is the average *States In* value across all US states at each point in time. We define *States In* as the count of outside states j with an agreement with state i that allows banks from j to enter state i. The second measure is the cumulative number of US states that pass an interstate banking law for the first time (Kroszner and Strahan (1999)). Figure 4 provides visual evidence of a negative relationship between deregulation and concentration in our sample.

Although the evidence in Figure 4 is visually compelling, it does not account for factors that may impact bank profitability through other channels. For example, demand for banking products may have increased during the period, particularly in states and counties that experienced large increases in active banks. To investigate whether the time series relationship is driven by time-invariant bank or county factors that could affect the entry or exit of banks or by aggregate or state-level economic trends, we introduce a multivariate regression with bank, county, year-quarter, state, and in some cases, state by time fixed effects.

Table 2 presents the results of our regression analysis of the link between NIM and county-level deposit HHI. The sample of 4,558,911 bank-county-quarter level observations spans 1984 to 2000. Column (1) includes bank, time, and state fixed effects, column (2) includes bank, time, and county

fixed effects, and column (3) includes bank, county, and state by time fixed effects. Since our identifying variation (state-level deregulation changes over time) varies at the state by time level, the final column serves as a baseline placebo test: if our identifying assumptions are met, we would expect the inclusion of state by time fixed effects to largely eliminate any relationship that exists between market concentration and banks' net interest margins.

The results in Table 2 suggest that local market concentration is strongly and positively related to bank NIM. Compared to banks operating in disperse counties elsewhere in the country, banks operating in one standard deviation (12.92 HHI units) more concentrated counties earn 0.47 percentage points higher NIM. In column (2), we add county fixed effects, forcing identification to come from changes in NIM, and we find that a one standard deviation increase in concentration is associated with a 1.42 percentage points increase in NIM. Furthermore, the loading on market concentration drops by roughly 10 times in magnitude in column (3) relative to column (2) and becomes statistically insignificant, suggesting that state by time shocks explain a significant fraction of the relationship between market concentration and banks' net interest margins. This result provides support for our main source of identifying variation (state by time deregulation changes). However, this result could also indicate that the relationship between market concentration and bank NIM is driven by changes in time-varying state-level economic conditions. To rule out this possibility, and to disentangle the effects of increased competition and increased investment opportunities on bank NIM, profitability, and risk-taking, we must turn to our *States In* and *States Out* measures of deregulation intensity.

To do so, we regress county-level deposit concentration on our primary network-based measure of deregulation, *Net States In*. We define *Net States In* as *States In* $-$ *States Out*, where *States In* measures the count of outside states j with an agreement with state i that allows banks from j to enter state i, and *States Out* measures the count of outside states j with an agreement with state i that allows

banks from i to enter j with branches or by acquisitions. Table 3 presents the results of our regression analysis. The sample of 4,559,205 bank-county-quarter level observations spans 1984 to 2000. Columns (1)-(3) incrementally include bank, year-quarter, and county fixed effects. We consistently find statistically significant evidence that a higher *Net States In* measure is associated with lower deposit concentration, consistent with our hypothesis. In our most restrictive specification, we find that a one-state increase in *Net States In* leads to a 0.031 percentage point reduction in county-level concentration. In turn, this implies that fifty-state increase in *Net States In* leads to a 1.5 percentage point reduction in county-level HHI, or seven percent of the sample mean.

The evidence in Tables 2 and 3 link interstate deregulation dynamics to the structure of local banking markets and the structure of local banking markets to bank profitability, respectively. However, our main interest is in relating deregulation dynamics directly to bank outcome variables such as profitability and risk-taking, which we do using our *Net States In* measure.

In Table 4, we provide evidence that directly links *Net States In* to bank level NIM. Banks operating in state i that are shocked by an agreement that allows banks from one additional state j to enter i face increased local competition. Similarly, banks operating in state i that are shocked by an agreement that allows banks from state i to enter one additional state j receive an increase in external investment opportunities. We incrementally include *States In* and *States Out* in specifications with bank, state, and year-quarter fixed effects such that our most restrictive specification forces identifying variation to come from banks' time-varying NIM and exposures to deregulation-driven variation in local competition and external investment opportunities.

In column (1), we show that increases in our *States In* measure lead to decreases in banks' net interest margins, consistent with increased competition leading to lower bank profitability. In column (2), we add *States In*, which loads positively, suggesting that increased investment opportunities are

associated with increases in bank NIM. Column (2) suggests that a one state increase in *States In* is associated with a 0.19 basis point decrease in NIM, and a one state increase in *States Out* is associated with a 0.25 basis point increase in NIM. Our preferred specification in column (3) replaces *States In* and *States Out* with our *Net States In* measure, and shows that a one-state increase in *Net States In* (meaning increased *net* in-state competition) is associated with 0.17 basis points decrease in NIM, as hypothesized. A fifty-state increase in *Net States In* is therefore associated with a 8.5 basis point reduction in NIM, around seven percent of the sample mean.

In the final two columns of Table 4, we explore the empirical relationships between our deregulation measures and the measure of interstate deregulation based on the first deregulation date in each state as in Kroszner and Strahan (1999). After adding the Kroszner and Strahan (1999) deregulation measure, which is the standard measure in the literature on bank deregulation, column (4) shows that the coefficients on *States In* and *States Out* are statistically and economically identical to the loadings in column (2). Column (4) also shows that the Kroszner and Strahan (1999) measure loads positively, but is statistically insignificant. Finally, column (5) confirms that these results continue to hold using our preferred *Net States In* measure.[17]

We also run a large number of robustness tests to confirm that our conceptualization of interstate banking deregulation as a series of network shocks makes economic sense. First, we focus on one-way, non-reciprocal agreements that allow banks from other states to enter state *i* without a reciprocal arrangement. These instances represent a "pure" one-way shock to in-state competition. We call such

[17] Appendix Tables A1-A5 and A9-A10 provide a number of robustness tests of this main finding. These include specifications that incorporate additional bank-level control variables, analyze the effect of the Riegle-Neal Act in isolation, introduce alternative measures of *States In* and *States Out* that weight links between states *i* and *j* by both geographic distance and assets, aggregate the sample to the bank-quarter or bank holding company-quarter levels of observation, extend the sample to end in 2010 rather than 2000, and interact *Net States In* with bank characteristics likely to determine deregulation responses. These tests provide supporting evidence that our network-based measures of interstate deregulation are capturing an economically important phenomenon that underlies bank behavior irrespective of various measurement and specification choices.

arrangements *One-Ways In*. Similarly, we examine one-way, non-reciprocal agreements that allow state *i* banks to enter other states, or *One-Ways Out*, which we combine with *One-Ways In* to form a *Net One-Ways In* measure (defined analogously to *Net States In*). Since non-reciprocal agreements are asymmetric, they provide more cleanly signed variation in the competitive environment of banks operating in focal state *i*. In columns (1) and (2) of Table 5, we present regressions of NIM on *One-Ways In* and *Net One-Ways In* with bank, year-quarter, and state fixed effects. As expected, we find evidence that non-reciprocal agreements have larger economic effects on state-*i* banks. A one-state increase in the number of states with non-reciprocal agreements that allow their banks to enter state *i* is associated with a 0.33 basis point decrease in state *i* banks' NIMs. This corresponds to a fifty percent increase from the average marginal effect in our baseline tests.

A natural concern with tests related to deregulation is that states' decisions regarding the timing and scope of deregulation are endogenous. Hence, it could be that states deregulate only with states that have stronger or weaker banking markets, or better or worse economic conditions. To ensure that this concern is not driving our results, we construct a sample of states that chose to implement *national* deregulation agreements (whether reciprocal or non-reciprocal) as opposed to deregulating selectively with individual states or groups of states. For these states, the decision to deregulate is plausibly exogenous to the economic conditions in any of the partner states (and in any event, our tests compare results across states that made similar decisions to sign national agreements). We define *National States In* and *Net National States In* as, respectively, the changes in *States In* and *Net States In* that are specifically a function of states that implemented national deregulation agreements. The results in columns (3) and (4) of Table 5 are of similar sign and significance to the results in columns (1) and (2), suggesting that the specific scope of states' deregulation changes is not a likely driver of our results.

We also construct 1,000 placebo samples that randomize state reciprocation events and re-run our analysis in Table 4 on these placebo samples. In each placebo sample, we take random permutations of the square matrix whose (m, n)-th element is the first year in which banks from state m can enter state n, and we construct our main *States In* and *Net States In* measures using these placebo reciprocation years instead of the actual reciprocation years from Amel (1993). In this way, we preserve the overall distribution of reciprocation years but randomly assign deregulation years to state couples. By construction, these dates have no economic content, and hence, we would expect to see no relationship between "deregulation" and NIM in these placebo samples. Indeed, Figure 5 shows that the t-statistics on our placebo versions of *States In* and *Net States In* are centered symmetrically around zero.

In Table 6, we decompose the change in NIM documented in Table 4 into its components, interest income divided by earning assets (column (1)), and interest expense divided by earning assets (column (2)). The table shows that changes in competition and investment opportunities captured by *Net States In* have no effect on interest income divided by earning assets, and that the changes in NIM documented in Table 4 can be entirely attributed to changes in interest expense. Specifically, Column (2) of Table 6 shows that a one-state increase in *Net States In* increases interest expense to earning assets by 0.074 basis points. The last column of the table show that this change in interest expense can be attributed to changes in interest expense paid on deposits, supporting the theoretical predictions of Allen and Gale (2000), Hellmann et al. (2000), and Keeley (1990), and confirming the empirical findings in Drechsler, Savov, and Schnabl (2018).

We next split the sample based on bank size and banks' concentration within their local markets. All else equal, one might expect the effects of deregulation to be smaller for large banks and banks with significant market power. Large banks have the ability to shift resources to more or less-

affected states, while banks with high pre-deregulation market concentration are better positioned to withstand the effects of increased competition. Indeed, Table 7 shows that larger banks and banks operating in less competitive environments prior to deregulation are less affected by deregulation.

In Table 8, we examine the effects of our *Net States In* measure on bank profitability. We find that an increase in deregulation-induced competition reduces bank profitability, and we argue that positive relationship between deregulation and bank profits is likely due to changes in bank investment opportunities. We use two profitability measures: banks' ROE (columns (1)-(3)) and ROA (columns (4)-(6)). In column (1), we show that a one state increase in *Net States In* is associated with a 2.33 basis point decrease in ROE, or a 0.8% decrease relative to average ROE. In column (2), we decompose the *Net States In* effect into its two components. As hypothesized, the coefficient on *States In* is negative (capturing increased competition), and the coefficient on *States Out* is positive (capturing increased investment opportunities).

In column (3), we confirm a positive correlation between the interstate deregulation measure from Kroszner and Strahan (1999) and bank profitability (see, e.g. Jayaratne and Strahan (1998), Stiroh and Strahan (2003)). In column 4, we augment our specification from column (2) with this indicator, and find that the coefficient associated with *States In* is unchanged relative to the coefficient in column (2). In other words, the interstate deregulation indicator does not capture the same variation in competition that we argue is captured by the *States In* variable. At the same time, the coefficient associated with *States Out* loses its economic magnitude and statistical significance to the interstate deregulation indicator, supporting the hypothesis that the interstate deregulation indicator mainly captures changes in bank investment opportunities. In columns (4)-(8), we confirm these findings by documenting an even stronger marginal effect on ROA.

4.2 Bank Risk and Transformations

The same deregulation-driven competitive pressure that restricted traditional sources of bank profitability may have provided banks with greater risk-taking incentives (Keeley (1990), Allen and Gale (2000), and Hellmann et al. (2000)). To test this corollary, we study the effect of *Net States In* on measures of *ex-post* income volatility and *ex-ante* asset risk. In Table 9, we investigate the effects of deregulation on future variability in ROE and ROA (which we measure using two year rolling standard deviations of ROE and ROA, respectively), loan loss provisioning, charge offs, and banks' asset allocation to residential mortgages.

The results in Table 9 suggest that banks increase risk-taking following an increase in *Net States In*. In column (1), we show that a one-state increase in *Net States In* leads to a 4.98 basis point increase in the standard deviation of bank ROE, or 2.2% of the sample mean. In column (2), we similarly show that a one-state increase in *Net States In* leads to a 0.21 basis point increase in the standard deviation of bank ROA, or 1.4% of the sample mean. In columns (3)-(5), we document similar increases in balance-sheet measures of risk such as Loan Loss Provisions (LLPs), charge-offs, and residential mortgages as a fraction of total assets.[18]

We next investigate whether banks that are subject to increased in-state entry subsequently fail or are acquired by other banks. Our data on bank acquisition and M&A activity comes from the Federal Reserve of Chicago's website.[19] Table 10 shows that a one-state increase in *Net States In* induces a large 0.04% increase in the probability that the bank is acquired next year, which is roughly 27% of the sample mean. In contrast, we do not find evidence that *Net States In* has an effect on bank's likelihood of failure, consistent with inefficient banks being acquired before they fail.

[18]Unreported results show that the majority of the loan charge-offs documented in column (4) of this table come from residential mortgages.

[19]https://www.chicagofed.org/banking/financial-institution-reports/merger-data.

4.3 Bank Business Models

Finally, we provide evidence that deregulation had an important effect on banks' business models. This evidence is presented in Table 11. Specifically, we study the impact of changes in *Net States In* on loans to total assets (column (1)) and on the incidence of gains or losses due to loan sales on the bank's income statement (column (2)). A one-state *Net States In* increase induces a 0.02 percentage points decrease in loans to total assets and a 0.096 percent increase in the incidence of loan sale gains and losses. These results are economically larger and statistically more significant one year after the *Net States In* change, suggesting that banks take time to adjust their business models to changes in their competitive environment.

5 Conclusions

We argue that the deregulation of the U.S. banking sector in the late 1980s played an important role in facilitating the demise of "old-school" banking. Deregulation increased competition and significantly squeezed banks' net interest margins by increasing interest expense. Banks responded rationally by increasing risk-taking, developing new sources of non-interest income, and using acquisitions to increase scale and reduce competition. Using novel network-based measures of state-level deregulation intensity, we verify these patterns in the data and reconcile prior conflicting evidence on the effects of interstate bank deregulation on traditional sources of bank income (e.g., Kroszner and Strahan (1999), Jiang, Levine, and Lin (2018)).

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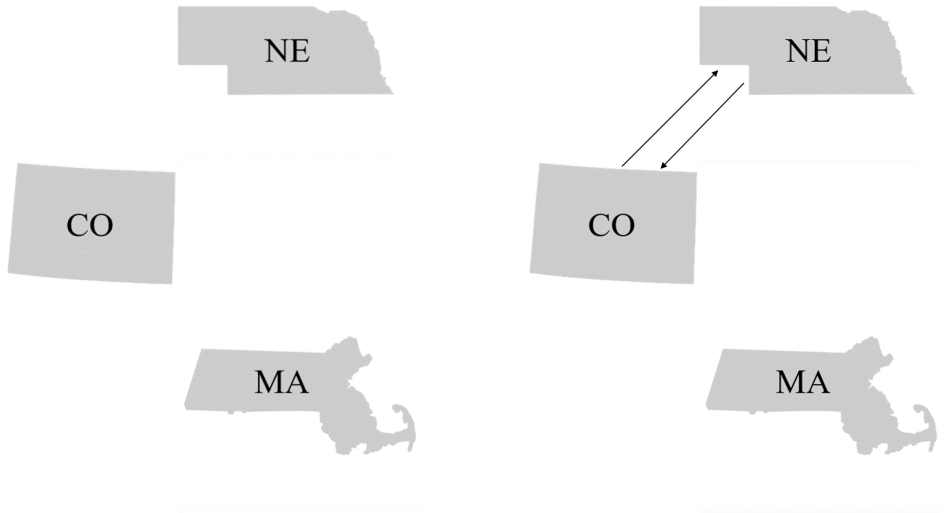
Figure 1

Identification Example: Colorado, Nebraska, and Massachusetts

This figure provides a visual illustration of the deregulation process that we use to identify shocks to competition (*States In*) and shocks to investment opportunities (*States Out*), taking Colorado as focal state. Arrows indicate whether banks from a given state are allowed to enter another state through interstate banking.

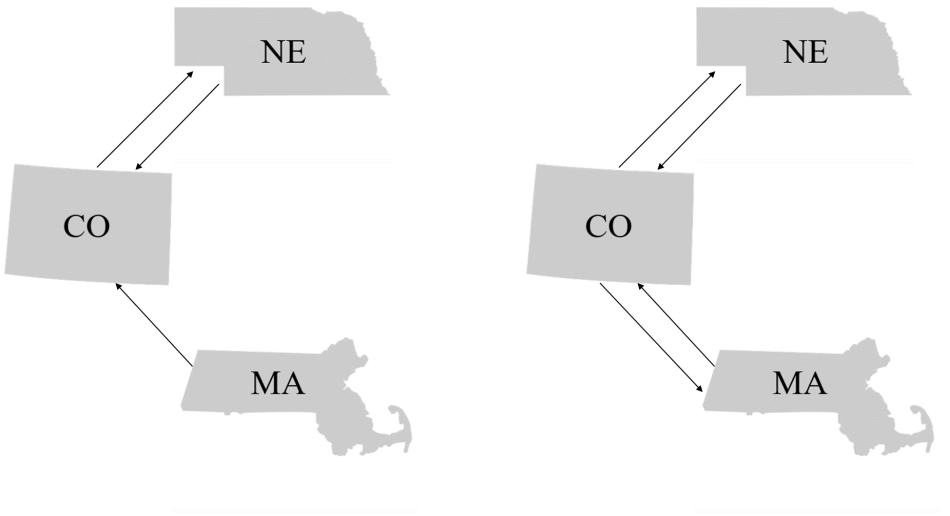


(a)

CO isolated until 1991

(b)

CO-NE reciprocal agreement (1991)



(c)

CO non-reciprocal agreement (1991)

(d)

Riegle-Neal Act (1995)

Figure 2

Net States In: Time Series and Cross-Section

The left panel of this figure shows the time series evolution of the two states with the highest (top net states in) and lowest (bottom net states in) values of net states in every year, as well as average net states in across states (the dashed flat line) during the period 1978-2000. The identity of the top and bottom net states in can vary from year to year as different states sign interstate agreements. The right panel shows the distribution of net states in from the start of our sample (1984) to the year after the passage of the Riegle-Neal Act (1995).

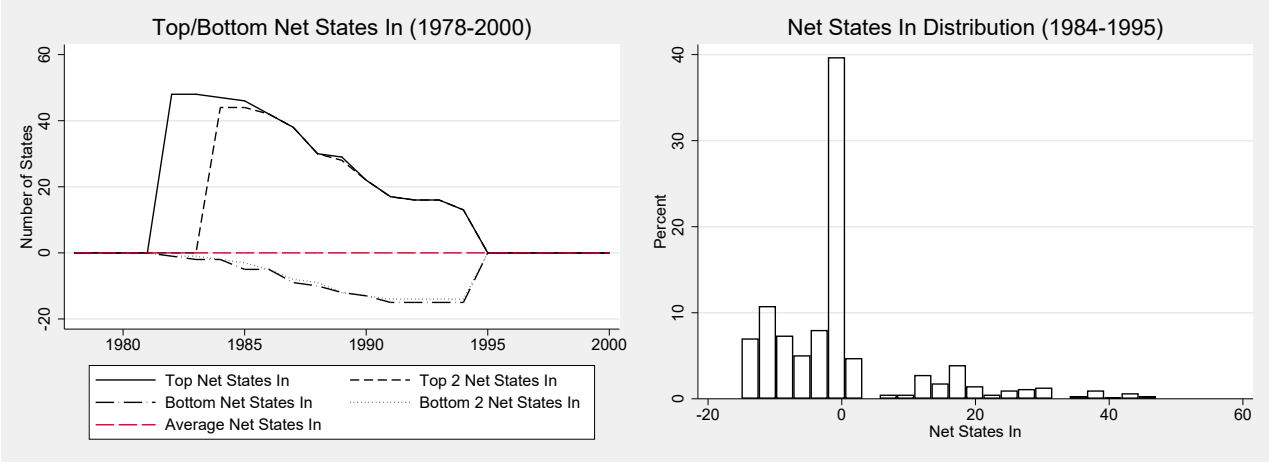


Figure 3

The Cross-Section of Net States In Changes

In this figure, we study the distribution of changes in *Net States In* in the cross-section of US states before the Riegle-Neal Act. In Panel A, we show the number of times that *Net States In* changes for any given state. In this panel, lighter colors identify states that experienced relatively few changes in *Net States In* before the Riegle-Neal Act. In Panel B, we show the number of *Net States In* that are on average added to a given state, conditional on a *Net States In* change. In this panel, lighter colors identify states with negative changes in *Net States In* on average—states that are on average "exporters" of competition, for which the effect of *States Out* dominates. Conversely, darker colors identify states with positive changes in *Net States In* on average—states that are on average "importers" of competition, for which the effect of *States In* dominates.

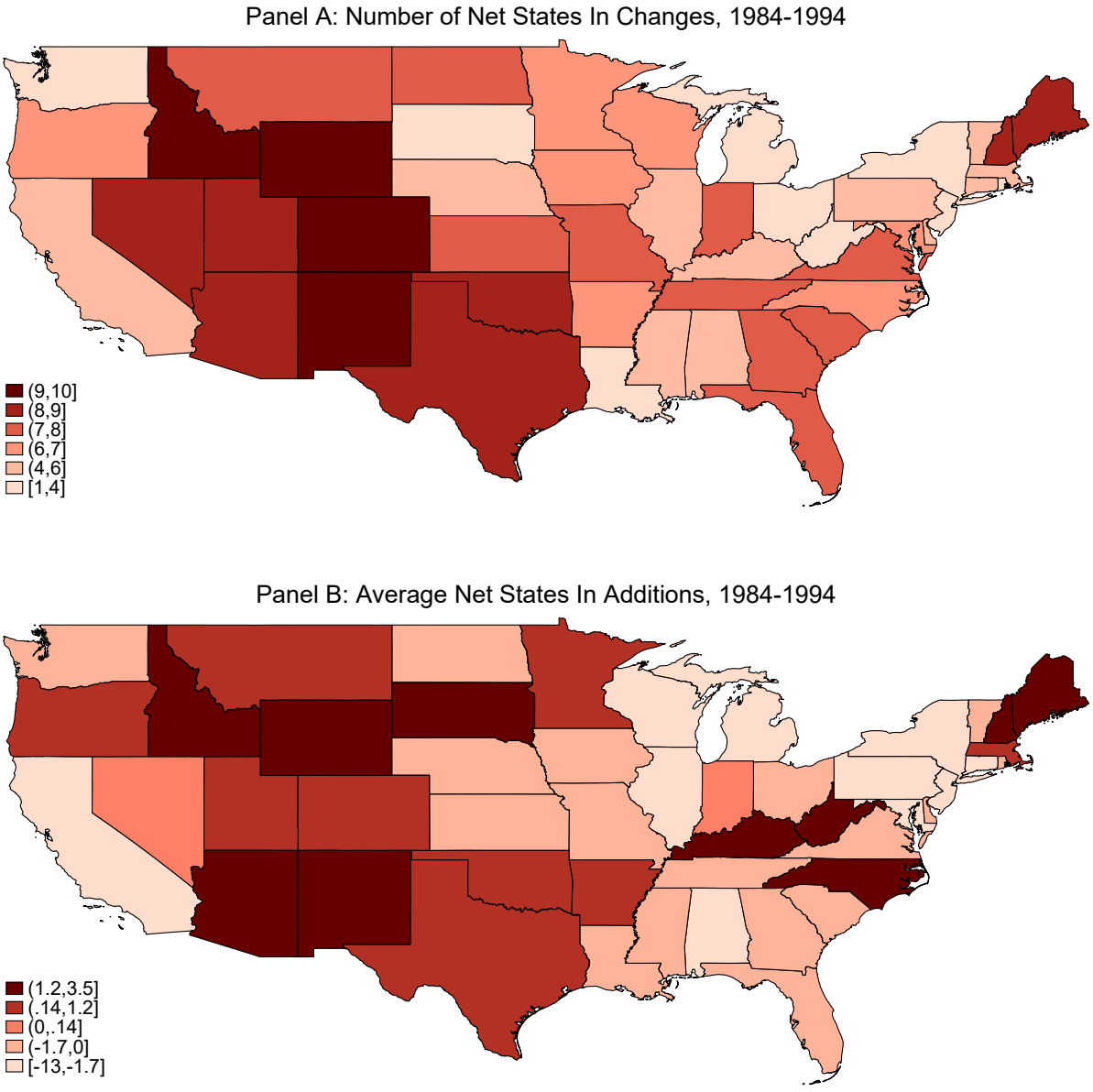


Figure 4

Time Series Aggregate Concentration and Deregulation Measures, 1984-2013

The figure shows average market concentration, which we calculate using average deposit HHI at the county-level, and two different measures of deregulation. The first measure is the average number of states that can enter any other state due to reciprocal interstate banking agreements or unilateral non-reciprocal agreements. The second measure is the cumulative number of states that allow inter-state banking (as in Kroszner and Strahan (1999)). The data for deposit concentration comes from Christa Bouwman's website for the years 1984-1993 and from the FDIC website for all subsequent years. To account for the break in data availability before and after 1993, in the figure we normalize all pre-1994 deposit HHI observations by subtracting the difference between deposit HHI in 1993 and deposit HHI in 1994. The data for the number of states that allow inter-state banking comes from Amel (1993).

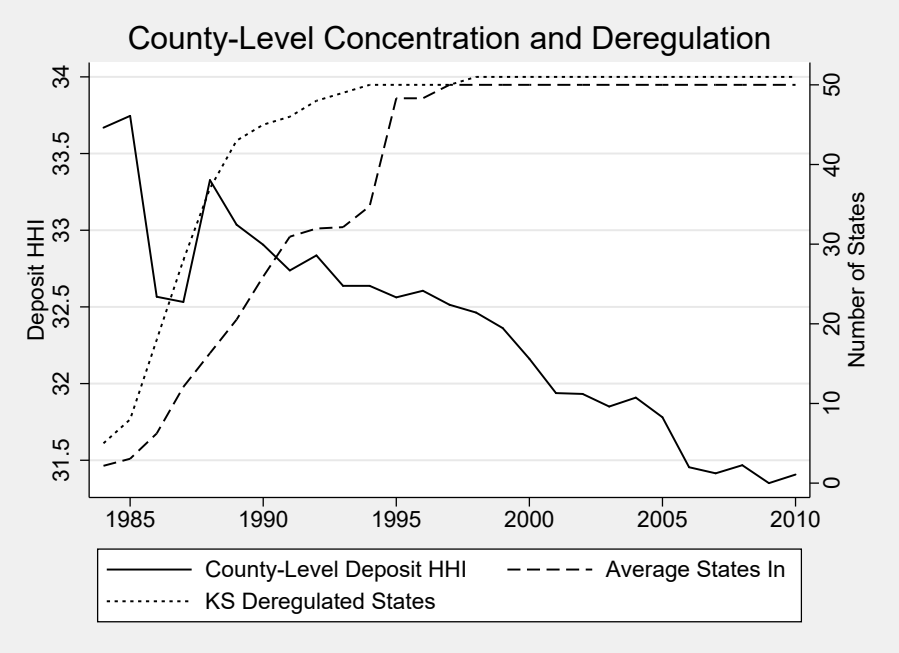


Figure 5

Distribution of Estimated *t*-Statistics across Placebo Samples

The left and right panels of this figure respectively show the distribution of estimated *t*-statistics when we run Specifications (1) and Specification (3) of Table 4 in 1,000 placebo samples that randomize state reciprocation events. In each placebo sample, we take random permutations of the square matrix whose (m, n)-th element is the first year in which banks from state m can enter state n, and we construct our main *States In* and *Net States In* measures using these placebo reciprocation years instead of the actual reciprocation years from Amel (1993). In this way, we preserve the overall distribution of reciprocation years but we randomly assign deregulation years to state couples. The left panel of the figure reports the distribution of estimated *t*-statistics for regression coefficients of NIM on placebo *States In*, while the right panel reports the distribution of estimated *t*-statistics for regression coefficients of NIM on placebo *Net States In*. Both sets of regressions include bank, year-quarter, and state fixed effects. Each panel also reports the average *t*-statistics across all placebo simulations as well as the estimated *t*-statistics from Specifications (1) and (3) of Table 4 using actual reciprocation years. The sample period is 1984-2000.

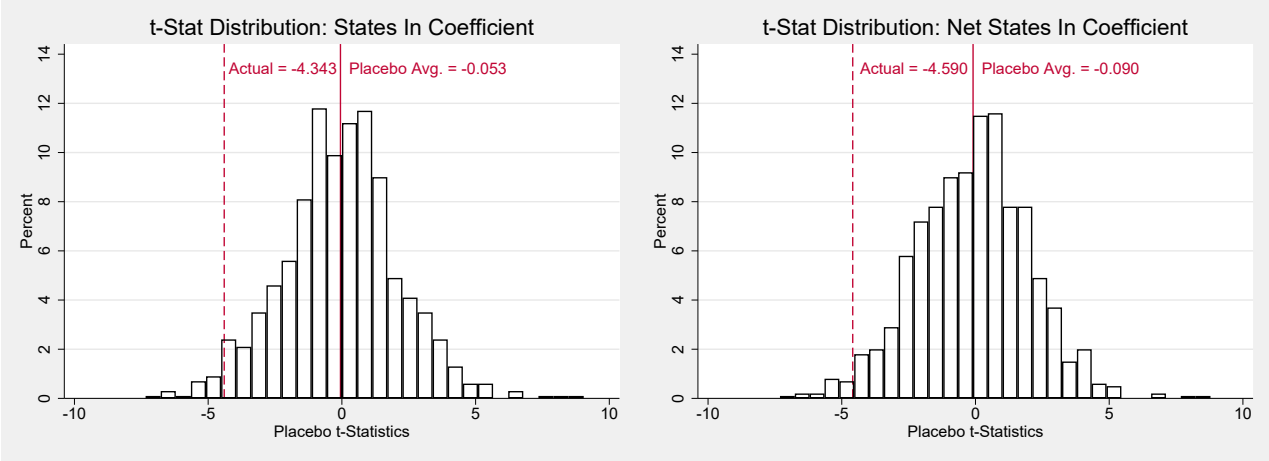


Table 1

Summary Statistics, 1984-2000

This table presents summary statistics for the main variables in the paper over the period 1984-2000. NIM is Net Interest Margin and is computed using the Federal Reserve of St. Louis' website definition as tax-adjusted net interest income divided by average earning assets. Return on Equity (ROE) is net income divided by the book value of bank equity, and Return on Assets (ROA) is net income divided by total bank assets. Loan Loss Provisions and Charge-Offs are normalized by total loans, while Interest Income, Interest Expense, Interest on Deposits and Non-Interest Income are normalized by earning assets. Pr(Acquired) and Pr(Failure) represent unconditional probabilities that a bank in our sample is acquired by another bank or fails. Pr(Loan Sale Gain/Loss) represents the incidence of loan sale gains and losses, as described in Table 11. Bank balance sheet and income statement data comes from the FDIC Call Reports. The data used to compute deposit concentration comes from Christa Bouwman's website for the years 1984-1993 and from the FDIC website for all subsequent years. All variables but Deposit HHI, Pr(Acquired), Pr(Failure), Pr(Loan Sale Gain/Loss), and Loans-to-Assets (expressed in percentage points) are expressed in basis points. All variables are measured at the quarterly level, and are aggregates of branch-year-quarter level measures.

	Mean	SD	p25	p50	p75	Banks	Observations
County Deposit HHI (pp)	22.02	12.92	12.92	18.98	27.71	18,759	4,559,249
NIM (bp)	123.08	32.81	106.96	122.72	140.01	18,757	4,558,956
ROE(bp)	292.94	346.72	232.13	347.81	445.57	18,483	4,541,944
ROA(bp)	23.75	23.71	18.19	27.23	34.96	18,483	4,542,139
Interest Income (bp)	226.32	41.30	194.73	219.23	254.18	18,475	4,531,939
Interest Expense (bp)	115.62	38.14	85.81	108.52	143.84	18,475	4,531,939
Interest on Deposits (bp)	100.83	39.79	69.05	94.22	130.91	18,486	4,512,071
2-Y Rolling Sd(ROE) (bp)	221.10	390.04	54.88	99.26	202.56	18,473	4,535,372
2-Y Rolling Sd(ROA) (bp)	14.59	18.84	4.34	8.01	16.05	18,473	4,535,608
Loan Loss Provisions (bp)	17.95	30.76	3.84	9.65	18.92	18,444	4,549,756
Charge-Offs (bp)	15.02	26.39	1.57	7.25	16.83	18,449	4,553,090
Pr(Acquired)	0.36	5.95	0.00	0.00	0.00	18,759	4,559,249
Pr(Failure)	5.87	23.51	0.00	0.00	0.00	18,759	4,559,249
Loans to Assets (pp)	60.28	12.59	53.32	62.05	68.78	18,498	4,555,524
Pr(Loan Sale Gain/Loss)	16.24	36.88	0.00	0.00	0.00	18,759	4,559,249

Table 2

County-Level Concentration and Net Interest Margin

This table presents the results of our regression analysis of the link between NIM and county-level deposit HHI. Column (1) includes bank and year fixed effects, column (2) includes bank, county, and year fixed effects, and column (3) includes bank, county, and state by year fixed effects. A comparison of coefficients between columns (2) and (3), therefore, is informative about the amount of within versus across state variation in bank NIM and market concentration. NIM (expressed in basis points) and county-level deposit HHI (expressed on a 0-100 scale) are computed as in Table 1, and are measured at the bank-branch level in every quarter. The sample period is 1984-2000.

	Dependent Variable: Net Interest Margin		
	(1)	(2)	(3)
Deposit HHI	0.037***	0.110***	0.017
	(0.01)	(0.02)	(0.01)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	No
State FE	Yes	No	No
County FE	No	Yes	Yes
State × Year-Quarter FE	No	No	Yes
R-Squared	0.500	0.503	0.560
Observations	4,558,911	4,558,911	4,558,911

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 3

Deregulation and County-Level Concentration

In this table we link our main deregulation measure, *Net States In*, to county-level concentration. For a given state i, and a given quarter t, we first define *States In* as the number of states whose banks are allowed to acquire banks based in state i in quarter t. Conversely, we define *States Out* as the number of states where banks from state i can acquire other banks in quarter t. Our main *Net States In* measure is the difference between *States In* and *States Out*. County-level HHI is expressed in percentage terms, and it is measured at the bank-branch level. The sample period is 1984-2000.

	Dependent Variable: Deposit HHI		
	(1)	(2)	(3)
Net States In	-0.142***	-0.040***	-0.031***
	(0.018)	(0.008)	(0.005)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	No	Yes	Yes
County FE	No	No	Yes
R-Squared	0.631	0.676	0.880
Observations	4,559,205	4,559,205	4,559,205

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 4

Deregulation and Net Interest Margin

In this table we link our annual deregulation measures, *States In*, *States Out*, and their difference *Net States In*, to bank-level Net Interest Margin. In columns (4)-(6) we complement our deregulation measures with the deregulation measure from Kroszner and Strahan (1999)—an indicator equal to one after state *i* passes a law allowing interstate banking for the first time, and zero otherwise. NIM (expressed in basis points) is computed as in Table 1, and is measured at the bank-branch level in every quarter. *States In*, *States Out*, and *Net States In* are defined as in Table 3. The sample period is 1984-2000.

	Dependent Variable: NIM				
	(1)	(2)	(3)	(4)	(5)
States In	-0.101***	-0.191***		-0.189***	
	(0.02)	(0.05)		(0.05)	
States Out		0.245**		0.231**	
		(0.10)		(0.11)	
Net States In			-0.172***		-0.174***
			(0.04)		(0.04)
Inter-State Deregulation				1.019	1.119
				(1.20)	(1.10)
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.501	0.501	0.501	0.501	0.501
Observations	4,558,911	4,558,911	4,558,911	4,558,911	4,558,911

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 5

Robustness: Deregulation and Net Interest Margin

This table presents robustness tests on our main results from Table 4. In the first two columns, we focus on one-way, non-reciprocal agreements that allow banks from other states to enter state *i*, without allowing banks from state *i* to enter those other states. We call such arrangements *One-Ways In*, and we call *Net One-Ways In* the difference between *One-Ways In* and non-reciprocal agreements that allow state *i* banks to enter other states without allowing banks from these other states to enter state *i* (*One-Ways Out*). In the third and fourth columns, *National States In* are *States In* that arise from national agreements, and *Net National States In* are *National States In* minus *States Out* that arise from national agreements. NIM (expressed in basis points) is computed as in Table 1, and is measured at the bank-branch level in every quarter. The sample period is 1984-2000.

	Dependent Variable: NIM			
	(1)	(2)	(3)	(4)
One-Ways In	-0.333***			
	(0.058)			
Net One-Ways In		-0.172***		
		(0.037)		
National States In			-0.076***	
			(0.022)	
Net National States In				-0.159***
				(0.033)
Bank FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
R-Squared	0.501	0.501	0.500	0.501
Observations	4,558,911	4,558,911	4,558,911	4,558,911

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 6

Deregulation and NIM Components

In this table we link our main *Net States In* deregulation measure to the components of Net Interest Margin. In the first column of the table, use interest income divided by earnings assets as dependent variable. In the second column, we use interest expense divided by earning assets. In the last column, we use interest expense on deposit (a component of total interest expense) divided by earning assets. All dependent variables are expressed in basis points. *Net States In* is defined as in Table 3. The sample period is 1984-2000.

	$\frac{\text{Interest Income}}{\text{Earning Assets}}$	$\frac{\text{Interest Expense}}{\text{Earning Assets}}$	$\frac{\text{Interest on Deposits}}{\text{Earning Assets}}$
	(1)	(2)	(3)
Net States In	0.001	0.074***	0.082***
	(0.02)	(0.02)	(0.02)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
R-Squared	0.796	0.894	0.873
Observations	4,531,895	4,531,895	4,512,026

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 7

Deregulation and Bank Characteristics

In this table we examine the interaction between *Net States In* and pre-deregulation bank characteristics. In the first column, we interact pre-deregulation *Net States In* with an indicator for high bank market power (an indicator that takes the value of one if the bank's average county-level deposit share before the first year of deregulation in the bank's home state is above or below median). In the second column, we similarly interact *Net States In* with pre-deregulation bank size (an indicator equal to one if pre-deregulation bank total assets are above or below median). In the third column, we interact *Net States In* with contemporaneous bank size, which we measure with the natural logarithm of the bank's total assets. The sample period is 1984-2000.

	Dependent Variable: NIM		
	(1)	(2)	(3)
Net States In	-0.449***	-0.230***	-1.023***
	(0.04)	(0.02)	(0.27)
Net States In × High Mkt. Power	0.415***		
	(0.06)		
Net States In × Large		0.099*	
		(0.05)	
log(Assets)			-4.089***
			(1.22)
Net States In × log(Assets)			0.068***
			(0.02)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
R-Squared	0.492	0.492	0.503
Observations	4,274,480	4,322,686	4,558,911

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 8

Deregulation and Profitability

In this table we repeat the same exercise of Table 4 using Return on Equity and Return on Assets as dependent variables. All dependent variables (expressed in basis points) are defined as in Table 1, and the deregulation variables are defined as in Table 4. The sample period is 1984-2000.

	Return on Equity (ROE)				Return on Assets (ROA)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net States In	-2.326***				-0.171***			
	(0.42)				(0.03)			
States In		-2.504***		-2.320***		-0.184***		-0.174***
		(0.60)		(0.61)		(0.03)		(0.03)
States Out		2.764*		1.547		0.217***		0.149*
		(1.54)		(1.67)		(0.08)		(0.08)
Inter-State Dereg.			79.096***	84.953***			4.523***	4.805***
			(16.44)	(18.31)			(0.96)	(1.04)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	No	Yes	No	Yes	No	Yes	No
R-Squared	0.244	0.243	0.245	0.246	0.313	0.313	0.313	0.314
Observations	4,541,900	4,541,900	4,541,900	4,541,900	4,542,095	4,542,095	4,542,095	4,542,095

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 9

Deregulation and Bank Risk

In this table, we study the effect of *Net States In* on bank income volatility, loan loss provisions, charge-offs, and loan portfolio composition. ROE and ROA volatility are measured as two year rolling standard deviations of ROE and ROA, respectively. Residential mortgages are open-end loans secured by 1-4 family residential properties (call item RCON1797, available from 1990 onward). All dependent variables are expressed in basis points. The sample period is 1984-2000.

	Roll. Sd(ROE)	Roll. Sd(ROA)	$\frac{\text{LLP}}{\text{Net Loans}}$	$\frac{\text{Charge Offs}}{\text{Net Loans}}$	$\frac{\text{Res. Mortgages}}{\text{Earning Assets}}$
	(1)	(2)	(3)	(4)	(5)
Net States In	4.977***	0.209***	0.238***	0.256***	0.761***
	(0.60)	(0.02)	(0.03)	(0.03)	(0.25)
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.387	0.418	0.235	0.249	0.825
Observations	4,535,276	4,535,512	4,549,710	4,553,046	3,560,799

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 10

Bank M&A and Failure

In this table, we study the effect of *Net States In* on the likelihood that a bank is going to be acquired or fail in the future. Lag-1 *Net States In* is the one-year lagged value of *Net States In*, defined in Table 4. The data on bank acquisitions and failures comes from the Federal Reserve of Chicago's website. The dependent variable in the first column is an indicator equal to 100 if a bank is acquired (Merger Code 1) next year and zero otherwise. The dependent variable in the second column is an indicator equal to 100 if the bank fails (Merger Code 50) next year, and zero otherwise. The sample period is 1984-2000.

	Bank Acquired Next Year	Bank Fails Next Year
	(1)	(2)
Net States In	0.041***	-0.004
	(0.01)	(0.03)
Bank FE	Yes	Yes
Year-Quarter FE	Yes	Yes
State FE	Yes	Yes
R-Squared	0.256	0.187
Observations	4,559,205	4,559,205

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 11

Deregulation and Bank Business Models

In the first two columns of this table we study the effect of deregulation on loans to total assets (expressed in percentage terms). In columns (3) and (4), we study the effect of deregulation on the incidence of loan sale gains/losses on bank income statements. The dependent variable in the second column is a bank-year-quarter indicator equal to 100 if the bank reports non-missing or non-zero gains/losses from loan sales on its income statement (call item RIAD5416), and equal to zero otherwise. The sample period is 1984-2000.

	Loans to Total Assets		Loan Sale Gain/Loss	
	(1)	(2)	(3)	(4)
Net States In	-0.020*		0.096**	
	(0.01)		(0.04)	
Lag-1 Net States In		-0.052***		0.155***
		(0.01)		(0.04)
Bank FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
R-Squared	0.696	0.696	0.419	0.419
Observations	4,555,480	4,555,480	4,559,205	4,559,205

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

A Additional Tables

Table A1

Deregulation and NIM: Additional Specifications

In this table, we augment our main specifications from Table 4 with additional control variables, namely the natural logarithm of total assets, leverage (total liabilities divided by total assets), net charge-offs to earning assets, deposits to total liabilities, and non-interest income to earning assets. The sample period is 1984-2000.

	Dependent Variable: NIM		
	(1)	(2)	(3)
States In	-0.045**	-0.067*	
	(0.02)	(0.04)	
States Out		0.062	
		(0.11)	
Net States In			-0.069***
			(0.03)
log(Assets)	0.308	0.321	0.323
	(0.96)	(0.97)	(0.97)
Leverage	-3.501***	-3.498***	-3.498***
	(0.24)	(0.24)	(0.24)
$\frac{\text{Net Charge-Offs}}{\text{Earning Assets}}$	-39.500***	-39.475***	-39.474***
	(1.51)	(1.50)	(1.50)
$\frac{\text{Deposits}}{\text{Total Liabilities}}$	0.565***	0.564***	0.564***
	(0.06)	(0.06)	(0.06)
$\frac{\text{Non-Interest Income}}{\text{Earning Assets}}$	37.151***	37.168***	37.170***
	(2.93)	(2.94)	(2.93)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
R-Squared	0.587	0.587	0.587
Observations	4,531,895	4,531,895	4,531,895

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A2

Deregulation and NIM: Bank and BHC Panels

In this table, we repeat the main exercise from Table 4 using a bank-state-quarter panel (Panel A) and a BHC-state-quarter panel (Panel B) instead of a bank-branch-quarter panel. The sample period is 1984-2000.

Panel A: Bank-Level Panel

	Dependent Variable: NIM	
	(1)	(2)
States In	-0.167**	
	(0.08)	
Net States In		-0.281***
		(0.10)
Bank FE	Yes	Yes
Year-Quarter FE	Yes	Yes
State FE	Yes	Yes
R-Squared	0.478	0.479
Observations	818,655	818,655

Panel B: BHC-Level Panel

	Dependent Variable: NIM	
	(1)	(2)
States In	-0.072*	
	(0.04)	
Net States In		-0.124***
		(0.05)
BHC FE	Yes	Yes
Year-Quarter FE	Yes	Yes
State FE	Yes	Yes
R-Squared	0.704	0.704
Observations	87,103	87,103

Note: Standard errors (in parentheses) are clustered at the state level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A3

Riegle-Neal Deregulation and NIM (1993-1997)

In this table we examine the impact of the Riegle-Neal (RN) Act on bank Net Interest Margins. Similar to our main Table 4, we define *RN States In* as the number of residual states whose banks can access the focal state following the 1994 Riegle-Neal Act, and we compute the value of this variable as 50 minus *States In* in 1994 (right before the passage of the Act). Similarly, we define *RN States Out* as the number of residual states that the focal state's banks can access following the Riegle-Neal Act—50 minus *States Out* in 1994. Therefore, *RN Net States In* represents the number of states whose banks can access the focal state following the Riegle-Neal Act, net of the number of states that focal state's banks can access following the Act. In the table, we interact our measures of residual deregulation induced by the Riegle-Neal Act with three indicators for whether the year in which we measure NIM is greater or equal than 1994, 1995, 1996, or 1997. The coefficients on these interaction terms represent estimates of treatment intensity following Riegle-Neal deregulation. NIM is measured in basis points, and the sample period is 1993-1997.

	Dependent Variable: NIM	
	(1)	(2)
RN States In $\times$ Year $\geq$ 1994	0.008	
	(0.03)	
RN States In $\times$ Year $\geq$ 1995	-0.060*	
	(0.03)	
RN States In $\times$ Year $\geq$ 1996	-0.030	
	(0.04)	
RN States In $\times$ Year $\geq$ 1997	-0.045	
	(0.05)	
RN Net States In $\times$ Year $\geq$ 1994		-0.009
		(0.05)
RN Net States In $\times$ Year $\geq$ 1995		-0.125**
		(0.05)
RN Net States In $\times$ Year $\geq$ 1996		-0.021
		(0.07)
RN Net States In $\times$ Year $\geq$ 1997		-0.067
		(0.09)
Bank FE	Yes	Yes
Year-Quarter FE	Yes	Yes
State FE	Yes	Yes
R-Squared	0.643	0.643
Observations	1,350,006	1,350,006

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A4

Distance-Weighted States In and States Out

In this table, we modify our main specification from Table 4 to account for the geographic distance between different states, as well as for the (pre-deregulation) size of the other states' banking markets. In each year, we weigh our state network nodes by the inverse of the distance between the two most populous cities of each state. *Distance-Weighted States In* is then the distance-weighted sum of the states whose banks can access the home state, and *Distance-Weighted Net States In* is equal to *Distance-Weighted States In*, minus the distance-weighted sum of the states that home state's banks can access. Similarly, we compute the pre-deregulation relative size of each state's banking market as total bank assets in that state in 1980, divided by the total US bank assets in 1980. *Asset-Weighted States In* is then the sum of the states whose banks can access the home state weigthed by these other states' relative banking market size. *Asset-Weighted Net States In* is equal to *Asset-Weighted States In*, minus the sum of the states that the home state can access, weighted by these other states' relative banking market size.The sample period is 1984-2000.

	Dependent Variable: NIM			
	(1)	(2)	(3)	(4)
Distance-Weighted States In	-0.010			
	(0.01)			
Distance-Weighted Net States In		-0.180***		
		(0.03)		
Asset-Weighted States In			-3.515***	
			(1.02)	
Asset-Weighted Net States				-6.083***
				(1.50)
Bank FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
R-Squared	0.500	0.501	0.500	0.501
Observations	4,541,911	4,541,911	4,558,911	4,558,911

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A5

Alternative NIM Construction

This table repeats the same exercise performed in Table 4 using a slightly different variation on the definition of Net Interest Margin, namely net interest income (interest income minus interest expense) divided by earning assets. The sample period is 1984-2000.

	Dependent Variable: Net Interest Income to Earning Assets				
	(1)	(2)	(3)	(4)	(5)
States In	-0.029*	-0.074**		-0.069**	
	(0.02)	(0.03)		(0.03)	
States Out		0.122		0.090	
		(0.08)		(0.08)	
Net States In			-0.058**		-0.062***
			(0.02)		(0.02)
Inter-State Deregulation				2.200***	2.251***
				(0.63)	(0.58)
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.614	0.614	0.614	0.614	0.614
Observations	4,531,895	4,531,895	4,531,895	4,531,895	4,531,895

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A6

Deregulation and Risk: Bank and BHC Panels

In this table, we repeat the exercise from Table 9 using a bank-state-quarter panel (Panel A) and a BHC-state-quarter panel (Panel B) instead of a bank-branch-quarter panel. The sample period is 1984-2000.

Panel A: Bank-Level Panel

	Roll. Sd(ROE)	Roll. Sd(ROA)	$\frac{\text{LLP}}{\text{Net Loans}}$	$\frac{\text{Charge Offs}}{\text{Net Loans}}$	$\frac{\text{Res. Mortgages}}{\text{Earning Assets}}$
	(1)	(2)	(3)	(4)	(5)
Net States In	7.844***	0.268***	0.395***	0.414***	0.009**
	(1.790)	(0.062)	(0.139)	(0.132)	(0.003)
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.423	0.491	0.220	0.209	0.750
Observations	811,690	811,694	812,530	813,648	595,921

Panel B: BHC-Level Panel

	Roll. Sd(ROE)	Roll. Sd(ROA)	$\frac{\text{LLP}}{\text{Net Loans}}$	$\frac{\text{Charge Offs}}{\text{Net Loans}}$	$\frac{\text{Res. Mortgages}}{\text{Earning Assets}}$
	(1)	(2)	(3)	(4)	(5)
Net States In	3.823***	0.155***	0.249***	0.284***	0.014*
	(1.055)	(0.043)	(0.079)	(0.090)	(0.008)
BHC FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.587	0.551	0.355	0.363	0.717
Observations	95,534	95,534	98,564	101,210	6,335

Standard errors (in parentheses) are clustered at the state level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A7

Mergers and Focal State Characteristics

In this table we investigate whether states characterized by different levels of pre-deregulation banking sector size and competitiveness are differently exposed to M&A during the deregulation period. In the first three columns of the table, we interact *Net States In* with state-level indicators for whether state-level bank assets, number of branches, and deposits are above median before the first year of the deregulation process (where the first year of the deregulation process is defined as in Kroszner and Strahan (1999)). In the last column, we interact *Net States In* with state-level indicators for whether average state-level county HHI is below median before the first year of the deregulation process. The sample period is 1984-2000.

	Dependent Variable: Bank Acquired Next Year			
	(1)	(2)	(3)	(4)
Net States In	0.006	0.015**	0.012*	0.009**
	(0.01)	(0.01)	(0.01)	(0.00)
Net States In × Large (Bank Assets)	0.060***			
	(0.01)			
Net States In × Large (Number of Branches)		0.055***		
		(0.01)		
Net States In × Large (Total Deposits)			0.054***	
			(0.01)	
Net States In × Competitive				0.060***
				(0.01)
Bank FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
R-Squared	0.257	0.259	0.259	0.259
Observations	4,559,205	4,526,113	4,526,113	4,526,113

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A8

County-Level Concentration and Net Interest Margin: Extended Sample

This table presents the results of our regression analysis of the link between NIM and county-level deposit HHI. This table is identical to Table 2 but utilizes a longer sample period (1984-2010 rather than 1984-2000).

	Dependent Variable: NIM		
	(1)	(2)	(3)
Deposit HHI	0.032***	0.087***	0.019*
	(0.01)	(0.02)	(0.01)
Bank FE	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	No
County FE	No	Yes	Yes
State × Year-Quarter FE	No	No	Yes
R-Squared	0.511	0.514	0.565
Observations	7,809,910	7,809,910	7,809,910

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A9

Deregulation and Net Interest Margin: Extended Sample

In this table we link our deregulation measures to bank-level Net Interest Margin. This table is identical to Table 4 but utilizes a longer sample period (1984-2010 rather than 1984-2000).

	Dependent Variable: NIM				
	(1)	(2)	(3)	(4)	(5)
States In	-0.111***	-0.237***		-0.233***	
	(0.02)	(0.05)		(0.05)	
States Out		0.344***		0.312***	
		(0.11)		(0.11)	
Net States In			-0.200***		-0.206***
			(0.04)		(0.04)
Inter-State Deregulation				2.035*	2.257**
				(1.12)	(1.02)
Bank FE	Yes	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
R-Squared	0.512	0.513	0.513	0.513	0.513
Observations	7,809,910	7,809,910	7,809,910	7,809,910	7,809,910

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A10

Robustness on Deregulation and Net Interest Margin: Extended Sample

This table presents robustness tests on our main results from Table 4 using a longer sample period than the robustness tests reported in Table 5 (1984-2010 rather than 1984-2000).

	Dependent Variable: NIM			
	(1)	(2)	(3)	(4)
One-Ways In	-0.393***			
	(0.057)			
Net One-Ways In		-0.200***		
		(0.037)		
National States In			-0.094***	
			(0.022)	
Net National States In				-0.186***
				(0.032)
Bank FE	Yes	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
R-Squared	0.513	0.513	0.512	0.513
Observations	7,809,910	7,809,910	7,809,910	7,809,910

Note: Standard errors (in parentheses) are clustered at the bank level. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.