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ABSTRACT

We study the business cycle consequences of credit supply expansion in the U.S. The 1980's credit boom resulted in stronger credit expansion in more deregulated states, and these states experience a more amplified business cycle. A new test shows that amplification is primarily driven by the local demand rather than the production capacity channel. States with greater exposure to credit expansion experience larger increases in household debt, the relative price of non-tradable goods, nominal wages, and non-tradable employment. Yet there is no change in tradable sector employment. Eventually states with greater exposure to credit expansion experience a significantly deeper recession.

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1 Introduction

There is increasing recognition that credit supply expansions and business cycles are closely connected.[1] While establishing a causal connection between credit and business cycles is typically difficult, even less is known about *how* credit affects the business cycle. There are two ways through which credit can influence the macroeconomy. First, credit expansion may allow constrained firms to borrow and invest more, increasing the economy's *production capacity*. Second, credit expansion may allow households to borrow and consume more, increasing overall *local demand*. The two channels are fundamentally different since the *production capacity* channel shifts out aggregate supply while the *local demand* channel shifts out aggregate demand.

The two channels are not mutually exclusive. However, understanding which one dominates in practice is important since they have different implications for prices and real allocations. Bahadir and Gumus (2016) show that credit expansion operating through the *local demand* channel is inflationary in nature, expands the non-tradable sector relative to tradable sector and leads to real exchange rate appreciation. In contrast, credit expansion operating through the *production capacity* channel is deflationary in nature and increases labor productivity and employment in sectors that were financially constrained.

Separating these two channels is also important since they have different implications for business cycle amplification and macroprudential policy. A number of recent theoretical papers, e.g. Schmitt-Grohé and Uribe (2016), Korinek and Simsek (2016) and Farhi and Werning (2015), show that the local demand channel of credit expansion amplifies business cycles by generating short term gain at the expense of an eventual bust. A natural macroprudential implication is that household leverage growth may need to be regulated.

This paper studies the business cycle consequences of credit supply expansion with a particular emphasis on understanding whether credit expansion works through the local demand channel or the production capacity channel. We focus on state level business cycle in the United States during the 1980s, which provides an appealing natural experiment for two reasons. First, there was rapid

[1] For example, Jordà et al. (2013), Krishnamurthy and Muir (2016), Reinhart and Rogoff (2009), Mian et al. (2017), Baron and Xiong (2016) and López-Salido et al. (2016). Credit supply expansion refers to a greater willingness to lend, all else equal. It may be driven by factors such as deregulation, liberalization, global savings glut, or behavioral factors (as examples, see Favilukis et al. (2015), Justiniano et al. (2015), Gennaioli et al. (2012), Bordalo et al. (2015), Landvoigt (2016), and Greenwood et al. (2016))

expansion in credit supply during this period. Second, the strength of this expansion varied across states depending on how deregulated a state's banking sector was.

The top panel in Figure 1 shows that credit to GDP expanded by 21.8 percentage points between 1982 and 1988, the highest growth in credit during an expansionary cycle until 2001. Moreover, as credit quantity expanded, credit spread, i.e. the price of risk, fell by over a hundred basis points. At the same time, the share of high-yield corporate debt issuance increased from 14.6% to 56.1%. The fall in credit spread and the rise in the high yield share during an era of rapid overall credit growth are considered tell-tale signs of credit supply expansion (see Greenwood and Hanson (2013)).

Equally important from an identification perspective, the expansion in credit supply in a given state depended critically on the extent of banking deregulation in that state. The bottom panel in Figure 1 shows that growth in total bank credit between 1982 and 1988 was on average 42 percentage points stronger in states that had started deregulating their banking sector before 1983 compared to states that did not deregulate until after 1983. Credit growth in early deregulating states was broad-based as well, including a sharp rise in household debt to income, consumer credit and mortgage applications.

We use the natural experiment described in Figure 1 to estimate the effect of credit supply expansion on the local business cycle. We also develop a new test to understand whether the effect of credit expansion on the business cycle is primarily driven by the local demand channel or through production capacity. The basic idea is that credit operating through the local demand channel should be inflationary in nature, with real expansion concentrated in the non-tradable sector. On the other hand, credit operating through increased production capacity should be deflationary in nature for the sectors that experience real expansion (Section 2 provides full details).

We find that states exposed to stronger credit supply expansion experience a much more amplified business cycle. The amplification is driven by higher loading on aggregate factors, and not higher state-level idiosyncratic volatility. A one standard deviation increase in our banking deregulation measure leads to 21.3 percentage points stronger credit growth and a much more amplified overall business cycle. In particular, a one s.d. increase in banking deregulation leads to a 72.6% larger "beta" or loading for GDP, 61.0% for employment and 111.1% for house prices.

What is the mechanism through which credit supply expansion amplifies the business cycle? We find that *local demand channel* is the primary mechanism responsible for the amplification on

the upside of the cycle. In particular, early deregulation states that experience a large increase in credit also experience strong relative expansion in non-tradable employment, while seeing *no* relative change in tradable sector employment. These results are extremely robust and hold within the same 4-digit industry across states. Moreover, even among small tradable sector firms, which Chen et al. (2017) find are likely to be sensitive to expansions in local bank credit supply, we find no differential employment growth in early deregulation states. We further find strong evidence of inflationary pressure in the non-tradable sector as early deregulation states see a relative increase in the price of non-tradable goods compared to late deregulation states. At the same time there is no relative change in the price of tradable goods.

The expansion in state level employment in early deregulating states, driven by the non-tradable sector, is also accompanied by relative increase in nominal wages. Interestingly the increase in nominal wage occurs throughout the economy, including non-tradable as well as tradable sector, but is stronger in the non-tradable sector. The simultaneous real exchange rate appreciation, growth in non-tradable employment, and stability of tradable employment is consistent with a model in which credit supply shocks boost local local demand. However, these patterns are inconsistent with the view that deregulation operated primarily by boosting firms' production capacity.

Why is the recession worse in early deregulation states? Downward nominal wage rigidity, as in Schmitt-Grohé and Uribe (2016), could be one reason. We find that the significant relative increase in nominal wages in early deregulation states from 1982 to 1989 does not subsequently reverse from 1989 to 1992. While there is some evidence of a small relative decline by 1993 and 1994, wages remain significantly higher even as of 1995 relative to their 1982 level. Moreover, wages in the tradable sector do not decline from 1989 to 1995, despite the large relative increase during the 1983 to 1989 period. These results suggest that credit supply expansion may have reduced the long-term competitiveness of labor in the tradable sector in early deregulation states.[2]

In addition to downward nominal rigidity, we also show evidence that banking sector problems and household debt overhang played a role in explaining the worse recession in early deregulation states. We find that in the cross-section of states, of all the outcomes we measure during the boom phase, the rise in household debt from 1982 to 1989 is the strongest predictor of recession

[2]Rodrik and Subramanian (2009) argue foreign finance can inhibit long-run growth because capital inflows appreciate the real exchange rate and reduce the returns to tradable sector investment.

severity from 1989 to 1992. These results for the early 1990s recession confirm the pattern found by other researchers across U.S. counties during the Great Recession (Mian and Sufi (2014a)), across countries during the Great Recession (Glick and Lansing (2010), IMF (2012)), across countries during the 1990 to 1991 recession (King (1994)), and in a large panel of countries from the 1960s through 2010 (Mian et al. (2017)).

One concern with our results may be that early banking deregulation states are spuriously correlated with factors that independently lead to a more amplfied cycle. However, this concern is mitigated by the fact that our paper follows a long literature in finance starting with Jayaratne and Strahan (1996)'s seminal work that uses the timing of deregulation as an instrument for credit expansion. Kroszner and Strahan (2014) review the extensive evidence suggesting that the timing of banking deregulation was plausibly exogenous to current and anticipated business cycle conditions. We also provide additonal evidence for the plausibility of exclusion restriction through placebo tests in earlier business cycles.

Our paper connects with work in finance and open economy macro. We follow existing finance literature in using deregulation as an instrument for credit expansion, but our motivation and approach are different. Existing work typically examines short run effects of banking deregulation on growth, market structure and prices[3], whereas we analyze the full cyclical implications of credit expansion. Our motivation comes from Kindleberger (1978), Minsky and others who emphasize that positive short-run effects of credit expansions may be reversed due to endogenous consequences of credit boom.

As we explain in section 4.5, the desire to focus on full business cycle consequences changes our methodology relative to the literature. Our methodology shows that credit supply shocks lead to a more amplified business cycle due to higher loading on aggregate factors, even though state-level idiosyncratic volatility goes down as Morgan et al. (2003) document.

Our paper is closely related to the long-standing interest in open economy macro about the impact of large credit flows on business cycles (see e.g. Calvo et al. (1996)). Empirical progress on the question has been hampered by the difficulty in generating plausibly exogenous variation in credit flows at the level of a small open economy. We address this critical challenge by using the

[3]See Kroszner and Strahan (2014) for review. Favara and Imbs (2015) and Landier et al. (2017) examine the effect of deregulation on house price growth and correlation, respectively.

staggered deregulation timing and analyzing its macroeconomic implications[4].

Since our focus is on macroeconomic implications, we deliberately keep our analysis at the aggregate state level. Focusing on firm or household level data may miss spill-overs created by credit supply shocks. For example, if credit expansion temporarily boosts local demand, wages may rise, resulting in tradable firms becoming less competitive. There may also be a reallocation of labor toward less productive firms producing non-tradable goods. While credit expansion may relax borrowing constraints at the firm level within a narrowly defined industry, the afore-mentioned spillovers could offset some of the partial equilibrium gains estimated at micro level[5].

The rest of this study proceeds as follows. In the next section, we describe our methodology for testing whether credit supply shocks operate through demand or supply. Section 3 presents the data and summary statistics. In Section 4 we discuss banking deregulation in the 1980s, our empirical framework, and the relation of our study with existing research on banking deregulation. Sections 5 through 7 present results, and Section 8 concludes.

2 Theoretical Framework

We outline a simple two-sector small open economy model that yields two conclusions about the real consequences of credit supply expansions. First, as in Bahadir and Gumus (2016), a credit supply shock that boosts *local demand* raises non-tradable employment relative to tradable sector employment, and also raises non-tradable goods prices relative to tradable goods prices. On the other hand, a credit supply shock that expands either tradable or non-tradable firms' *production capacity* does not make this joint prediction. Second, as in Schmitt-Grohé and Uribe (2016), presence of frictions such as downward nominal wage rigidity leads to a subsequent reversal of economic expansion. This results in a more amplified business cycle relative to a counterfactual without the initial credit supply shock.

[4]Di Maggio and Kermani (2017) is another related example. Borio et al. (2016) show that periods of rapid growth in credit are associated with labor reallocation to lower productivity growth sectors, construction in particular.
[5]See Bai et al. (2016) for evidence on labor reallocation for small manufacturing firms after banking deregulation.

2.1 Environment

States exist in a currency union with each state having a tradable (T) and non-tradable (N) production sector. Time $t = -1, 0, 1, \ldots$ represents half a cycle - e.g., an expansion of 5 years - with $t = 0$ refering to the boom phase, and $t = 1$ the bust phase of a business cycle. We omit the state subscript to minimize notational clutter, and write preferences for the representative household as,

$$\sum_{t=-1}^{\infty} \beta^{t+1} u(C_t - v(L_t)),$$

with $u(C_t - v(L_t)) = \log(C_t - \frac{1}{2}L^2)$. Consumption, C_t, is a Cobb-Douglas aggregate over tradable and non-tradable consumption, $C_t = A(C_{T,t}, C_{N,t}) = C_{T,t}^{\alpha} C_{N,t}^{1-\alpha}$. We assume that a fraction θ_H of the household's members can borrow at the risk free rate i_t plus a spread s_t, while the remaining fraction $1 - \theta_H$ borrow at the risk free rate i_t. The interest rate faced by the household as a whole is thus $i_t + \theta_H s_t$. The value of θ_H captures the household sector's exposure to the state's credit supply shock s_t. The household is subject to the sequence of budget constraints

$$C_{T,t} + P_{N,t} C_{N,t} + B_t = W_t L_t + \frac{B_{t+1}}{1 + \theta_H s_t + i_t} + \Phi_t,$$

where $P_{N,t}$ is the price of the non-tradable good relative to the tradable numeraire, W_t is the nominal wage, B_t is one-period bond brought into period t, and Φ_t are profits from ownership of firms in the tradable and non-tradable sectors. The risk-free rate is set at the union-wide level, and we assume that $i_t = i = \frac{1}{\beta} - 1$, so that debt is constant in a steady state with $s_t = 0$. Households starts off with zero debt, $B_{-1} = 0$.

The household's first order conditions are

$$\frac{A_{C_{N,t}}}{A_{C_{T,t}}} = P_{N,t}$$

$$\frac{v'(L_t)}{A_{C_{N,t}}} = \frac{W_t}{P_{N,t}}$$

$$u'(C_t - v(L_t)) A_{C_{T,t}} = \beta(1 + \theta_H s_t + i_t) u'(C_{t+1} - v(L_{t+1})) A_{C_{T,t+1}}$$

Firms in the tradable and non-tradable sectors produce output with labor as the only input using a decreasing returns production function, $Y_{j,t} = A_j L_j^{1-\eta}$, where $j \in \{T, N\}$. As in Neumeyer and Perri (2005), firms face an intra-period working capital constraint and need to borrow $\theta_j \in [0, 1]$ fraction of the wage bill, $W_t L_{j,t}$, between the start and end of each period at a cost $r_t = i_t + s_t$. The sector j firm's first order condition for labor is

$$W_t = (1 - \eta) P_{j,t} \frac{A_{j,t}}{1 + \theta_j r_t} L_{j,t}^{-\eta}, \qquad j \in \{T, N\}.$$

When the working capital constraint is positive $\theta_j > 0$, a reduction in the cost of working capital r_t leads to a rise in labor demand for a given wage. A reduction in r_t is thus similar to an increase in the firm's productivity.

Labor market and non-tradable goods market clear each period

$$L_{N,t} + L_{T,t} = L_t$$
$$C_{N,t} = A_{N,t} L_{N,t}^{1-\eta},$$

and the state's budget constraint satisfies

$$C_{T,t} + B_t = A_{T,t} L_{T,t}^{1-\eta} - \omega_t + \frac{B_{t+1}}{1 + \theta_H s_t + i_t},$$

where $\omega_t = \theta_T r_t W_t L_{T,t} + \theta_N r_t W_t L_{N,t}$ is the working capital expense.

2.2 Credit shock and nominal rigidity

We model credit shock as a one-time decline in credit spread s_0. States differ in the strength of this shock with some states experiencing a stronger positive credit supply shock ("strong shock") than others ("weak shock"). The shock hits unexpectedly at the beginning of period 0, and everyone understands that its lasts for only one period. "Strong shock" states correspond to states that deregulated their banking system earlier and "weak shock" states correspond to those that deregulated later in our empirical setting. In the beginning of period 0, a strong shock state experiences the sequence of interest rates $(i, i + s_0^{strong}, i, i, ...)$, whereas a weak shock state faces interest rates

$(i, i + s_0^{weak}, i, i, ...)$, with $s_0^{strong} < s_0^{weak} < 0$.[6]

Business cycles result from the interaction of credit shock with downward wage rigidity as in Schmitt-Grohé and Uribe (2016). We assume that the nominal wage cannot adjust downward between period $t = 0$ and $t = 1$, i.e. $W_1 \geq W_0$, and wage are fully flexible from period $t = 2$ onwards when economy is in steady state. [7]

2.3 How does the business cycle respond to credit supply shock?

We feed in the credit supply shock into our model under three different assumption. First, we shut down the *production capacity* channel by assuming that $\theta_T = \theta_N = 0$ and only allow the *local demand* channel to operate via $\theta_H > 0$. Panel (a) in Figure 2 plots the response of various macroeconomic outcomes for this case.

The top left panel shows the path of $(i + s_t)$ for strong and weak shock states respectively. Since households in the strong shock state experience a larger decline in the interest rate at $t = 0$, debt rises more to fuel a boost in consumption. The boost to local demand in $t = 0$ raises non-tradable employment and the price on the non-traded good, as the non-tradable good becomes relatively scarce. This *real appreciation* leads to a reallocation of labor from the tradable to the non-tradable sector.

Local demand expansion in period $t = 0$ boosts the nominal wage W_0. However, as local demand contracts in period $t = 1$ due to increase in interest rate, wage cannot automatically adjust downwards due to wage rigidity. Consequently households are off their labor supply condition $(\frac{v'(L_1)}{A_{C_{N,1}}} \neq \frac{W_1}{P_{N,1}})$, and there is an excess supply of labor at the elevated wage $W_1 = W_0$. The economy experiences a bust in non-tradable and total employment in $t = 1$. As in Schmitt-Grohé and Uribe (2016), the bust is caused by the fact that during the boom agents do not internalize that an increase in the wage will generate unemployment if the boom subsides.

Panel (a) shows that the *local demand* channel of credit expansion leads to a more amplified business cycle with *both* non-tradable employment and non-tradable price rising faster than the economy during the expansion phase.

[6] The credit supply expansion here is modeled simply as a reduction in the interest rate. One could instead assume that credit supply expansion relaxes borrowing constraints for households and firms, and the qualitative results would be unchanged. See Bahadir and Gumus (2016) for an example of such a model.

[7] More generally, we could assume that the wage could only adjust partially downward in each period so that convergence to the steady state takes several periods.

Panels (b) and (c) shut down the *local demand* channel with $\theta_H = 0$ and sequentially turn on the *production capacity* channel first in the non-tradable sector with $\theta_N > 0$ (panel b), and then in the tradable sector with $\theta_T > 0$ (panel c). Since credit expansion is assumed not to affect households, household debt does not rise more in the strong shock state at $t = 0$.

When *production capacity* channel operates through the non-tradable sector, labor in that sector become more productive. Consequently employment in the non-tradable sector expands while price of non-tradable goods falls (panel b). On the other hand, when *production capacity* channel operates through the tradable sector, it is employment in the tradable sector that expands, and price in the non-tradable sector rises due to higher demand for local goods given homothetic preferences (panel c).

Figure 2 only turned on one channel at a time for expositional simplicity. In reality, local demand and production capacity channels are likely to operate contemporaneously, but with different intensities. Our objective is to understand which channel is the most dominant. The analysis above shows that an increase in the size of the non-tradable sector accompanied by an increase in the price of this sector during expansion is unique to the *local demand* channel. We will use this insight in the analysis that follows.

Our model is stylized and abstracts from several potentially important effects of credit shocks. An obvious omission is that the model does not include capital. In Bahadir and Gumus (2016) firms produce with capital and labor, and capital is produced from tradable output. They find similar effects of credit shocks on employment and prices. If, however, producing the investment good requires a non-tradable input, then a tradable credit shock also expands demand for non-tradable goods, boosting non-tradable employment. An example is a tradable credit shock that increases firms' investment in commercial real estate. Similarly, a tradable credit shock would also boost non-tradable employment if preferences over tradable and non-tradable consumption are complements (elasticity of substitution less than one). Nevertheless, even if a tradable credit shock increases non-tradable employment, as in both of these examples, we would still expect a rise in tradable employment.[8] As we discuss in section 6, we find no evidence that credit supply expansion

[8]In the extreme case where preferences are Leontief over tradable and non-tradable consumption, a rise in tradable labor productivity would actually reduce tradable employment as workers are reallocated to the non-tradable sector. An implicit assumption for the predictions of the sectoral effects of credit shocks is therefore that complementarities between the tradable and non-tradable sector are not too strong.

boosts tradable employment.

3 Data and Summary Statistics

We construct state-year level data set for the 1980s and 1990s with information on bank credit, household debt, house prices, retail sales, employment by industry, wages, unemployment, residential construction, inflation, and GDP. The state-year level data on household debt and retail sales are new to the literature. Information on household debt comes from three sources. First, we calculate household debt using a random sample of individual tax return data at the NBER. We follow the capitalization methodology used by Saez and Zucman (2016) to impute total household debt and income at the state level. This calculation excludes the top 2 to 3% of filers for whom state identifiers are missing for confidentiality reasons. Our second source of household debt is HMDA data which reports data at the loan application level. We aggregate this data at the state level to compute total number and amount of loan applications. Unlike HMDA data from 1991 onwards, the earlier sample does not tell us whether a loan is actually originated.

Third, we measure credit to households using bank-level Call Report data at the state level.[9] We use two different measures of loans to the household sector derived from Call Report data. Household loans include real estate loans and loans to individuals. Consumer loans are loans to individuals, and "loans secured by 1-4 family residential properties, revolving open end loan." The first measure includes all mortgage debt, whereas the second measure is the cleanest measure of consumer loans other than mortgages used to purchase a new home. The second measure includes home equity loans, but not primary mortgages. Consumer loans are a sub-set of household loans.

One potential problem with using Call Report data to measure household debt is that a significant fraction of household mortgages are ultimately securitized and held by the GSEs. Moreover, as Kroszner and Strahan (2014) report using data from Frame and White (2005), the share of mortgages held by GSEs expanded by more than 20 percentage points during the 1980's. The corresponding share fell for banks and saving institutions. While banks were actively involved in originating mortgages during this period, they increasingly sold these mortgages to the GSEs. We

[9]Call Report data come from the Commercial Bank Database from the Federal Reserve Bank of Chicago, which contains data of all banks filing the Report of Condition and Income that are regulated by the Federal Reserve System, Federal Deposit Insurance Corporation (FDIC), and the Comptroller of the Currency. We do not have data from savings institutions (e.g., S&L associations) that file with the Office of Thrift Supervision (OTS).

have three sources from which we measure the growth in household debt from 1982 to 1989: the IRS, HMDA, and Call Report data. As mentioned above, each has certain drawbacks. As a result, we construct a variable *household leverage index* which is the first principal component of the change in the household debt to income ratio, growth in mortgage loan applications, and growth in consumer loans.

In terms of real variables, our data set includes total employment from the County Business Patterns data set published by the U.S. Census Bureau. We classify employment into non-tradable, construction, and tradable industries using the classification scheme in Mian and Sufi (2014b). Our data set also includes state-level retail sales data from 1986 to 1996 for 19 states from the Census, which were obtained from the Census website. Our measure of residential construction is based on new building permits collected by the Census, and is available at the state-year level for our full sample starting in 1980.

We utilize state-level inflation series from Del Negro (1998), which is also utilized in Nakamura and Steinsson (2014). In addition, to construct state-level CPI inflation for subcategories of goods, we use the Bureau of Labor Statistics MSA level CPI series, which begin in 1984. More specifically, to proxy for the price of non-tradable goods in an MSA, we use the BLS price index for services, and to proxy for the price of tradable goods in a given state, we use the BLS price index for commodities. We average across all MSAs in a state to obtain the state-level index. This is available for only 26 states in our sample.

We also estimate state level wages from the CPS Outgoing Rotation Group using the CEPR extracts, which are cleaned and adjusted for top-coding.[10] We construct both raw and residualized state average hourly wages for workers age 21-55. Residual wages are constructed by estimating log hourly wages on age dummies, education dummies, and race dummies for each year. We estimate the wage equations separately for males and females and construct average wages for all workers, separately for males and females, and by industry.

Table 2 reports state-level summary statistics of the key variables used in this study. We break the sample period of 1982 to 1992 into two sub-periods: the expansion phase from 1982 to 1989 and the contraction phase from 1989 to 1992. The household debt to income ratio increased by an average of 0.21 during the expansion phase. Loans to households (which include mortgages) grew

[10]The data are available from the CEPR's webpage.

by 72%, while consumer loans (which exclude mortgages through 1987 but include home equity loans after 1987) grew 70%. Commercial and industrial loans increased by only 42%. House prices grew by 27% on average during the boom phase, but then grew by only 4% during the contraction phase. The unemployment rate fell from 1982 to 1989 on average by 4 percentage points, but then increased from 1989 to 1991 by 1.8 percentage points. The boom and bust in employment in the non-tradable and construction sectors was especially pronounced. On average across states, prices rose by 24% from 1982 to 1989.

4 Empirical Setting and Methodology

4.1 Banking deregulation

The United States experienced a period of significant deregulation of the banking sector in the late 1970s and 1980s, with the pace of deregulation differing across states. Deregulation consolidated the fragmented banking system in multiple ways. First, out-of-state banks were gradually allowed to operate in various states. Second, intra-state branching restrictions were removed to allow banks to expand their branch network within a state.[11]

Table 1 lists each state and the year in which it removed restrictions on inter-state bank branching and intra-state bank branching. The two types of deregulation are positively correlated with a correlation coefficient of 0.46. Following the existing literature on deregulation, our methodology excludes South Dakota and Delaware, two states that took advantage of elimination of usury laws to attract credit card businesses.[12]

Table 1 shows that there is no single date when a state's banking system was deregulated. Instead, deregulation was a continuous process that occurred across states at different times. Moreover, the years shown in Table 1 reflect the start of a deregulation process that expanded over time. For example, the year of inter-state banking deregulation is the first year that a state allowed *some* out-of-state banks to open a branch. The decision to allow out-of-state banks to open branches was based on bilateral arrangements between states, until the Riegle-Neal Act of 1994 opened inter-state

[11] These changes only applied to commercial banks.

[12] Arkansas did not fully deregulate the intra-state restrictions until 1996. Although Maine permitted out-of-state bank holding companies (BHC) to operate in 1978, the statute only permitted this if the home state of the acquiring BHC reciprocated by permitting Maine-based BHCs to operate in their state. This only happened in 1982, when Alaska, Massachusetts, and New York permitted out-of-state BHCs to enter.

banking everywhere. Once states allowed some out-of-state banks to operate within their state, the state typically expanded the list of states over time.[13]

To take into account the continuous process and varying pace of bank deregulation across states, we utilize a measure of state-level banking deregulation that is based on the number of years since deregulation began in the state as of 1989. A higher measure indicates more deregulation as of 1989, as the state began deregulating further into the past. More specifically, we use 1989 minus the initial year of inter-state and intra-state branching deregulation as the two variables of interest. Since we focus on the aggregate credit supply expansion during the 1980s, we cap this value at 10, treating states that deregulated before 1979 equally. For each state we then take the average of these two deregulation variables to obtain a single "deregulation measure" that captures the combined effect of the two types of deregulation.[14] For Connecticut, for example, the first measure takes on the value (1989-1983=) 6 and the second measure takes on the value (1989-1980=) 9, which gives it a high deregulation score relative to the mean. The last column of Table 1 shows the deregulation measure by state.[15]

4.2 Empirical Methodology

As we described in the introduction and top panel of figure 1, our starting point is the expansion in credit supply at the aggregate level in the U.S. starting in 1983. The key role played by banking deregulation in our natural experiment is that states with more deregulated banking system experience a stronger credit supply expansion from 1983 onwards (lower panel of figure 1)[16]. Thus our "instrument" for state level credit supply expansion should be seen as the *interaction* of aggregate credit supply shock with state-level deregulation status.

What caused the aggregate increase in credit supply in the United States during the 1980s? We

[13] Michalski and Ors (2012) report in detail how these bilateral arrangements expanded over time in each state until the Riegle-Neal Act.

[14] Specifically, our deregulation score for a state s is defined as the standardized value of $.5 \sum_{j \in \{inter, intra\}} \min\{\max\{1989 - DeregYear_{j,s}, 0\}, 10\}$.

[15] In Table A1 in the appendix, we show regressions relating credit expansion in a state during the 1980s to the year of removal of inter-state branching restrictions and intra-state branching restrictions separately. For both intra- and inter-state branching restriction removal, states with earlier deregulation years see larger growth in credit during the 1980s.

[16] Figure 1 uses an alternative measure of deregulation, an indicator variable that is one if a state implemented either intra- or inter-state deregulation as of 1983 or earlier, and zero otherwise. Twenty-two states are early deregulators according to this measure, and this measure is highly correlated with our main measure described above with an an R^2 of 0.84. Appendix Tables A11-A14 show that all of our main results are robust to using this alternative deregulation measure.

are agnostic on the fundamental source of this underlying process. Global capital flows, behavioral biases and change in monetary policy regime may be posited as potential explanations (e.g. Walsh (1993) and Feldstein (1993)). However, the exact source is not important for our methodology. What matters is that the aggregate shock "loads" differentially on states with different levels of deregulation. The exclusion restriction needed is that these cross-state differences are not spuriously related to business cycle expectations.

In what follows, we use NBER dating convention to define expansion or boom phase as 1982 to 1989 period, and the contraction or bust phase as 1989 to 1992 period. But we also present results for the each year in graphical from to show the full timing transparently.

Our goal is to understand how the aggregate credit cycle differentially affects early versus late deregulation states. We begin by exploring the differential increase in lending, employment, consumer prices, and wages during the expansion phase from 1982 to 1989. More specifically, we estimate equations of the following form:

$$\Delta_{82,89} Y_s = \alpha^{boom} + \pi^{boom} \cdot DEREG_s + \Gamma^{boom} \cdot Z_s + \epsilon_s^{boom} \tag{1}$$

where $\Delta_{82,89} Y_s$ reflects the growth in a given outcome variable from 1982 to 1989, $DEREG_s$ is the deregulation measure capturing the extent of deregulation in the 1980s (described above), and Z_s is a set of control variables. The key coefficient is π^{boom} which measures whether early deregulation states witness lower or higher growth in outcome Y from 1982 to 1989.

We then turn toward empirical tests to assess whether states with a more deregulated banking sector see an amplified business cycle from 1982 to 1992. We use three different techniques. First, we run first-difference regressions separately for the boom and bust, showing that outcomes Y such as GDP or residential construction increase by more in early deregulation states from 1982 to 1989 and fall by more in early deregulation states from 1989 to 1992. The boom equation is already shown above in equation 1, and the bust equation takes the following form:

$$\Delta_{89,92} Y_s = \alpha^{bust} + \pi^{bust} \cdot DEREG_s + \Gamma^{bust} \cdot Z_s + \epsilon_s^{bust} \tag{2}$$

We also exploit the full state-year panel by estimating equations of the following sort:

$$Y_{st} = \alpha_s + \gamma_t + \sum_{q \neq 1982} \mathbb{1}_{t=q} \cdot DEREG_s \cdot \beta_q + \epsilon_{st} \tag{3}$$

This specification yields a series of estimates of β_q in order to show the full dynamics for outcome Y, and how they differ for early versus late deregulation states.

Finally, we also use a specification motivated by asset pricing tests where one wants to understand the "loading" of a specific asset return on aggregate factors such as the overall market return. As mentioned above, we believe there are two aggregate states during our time period: expansion from 1982 to 1989, and contraction from 1989 to 1992. And we want to understand how a state's loading on the aggregate state differs based on the extent of banking deregulation in the 1980s. The specification takes the following form:

$$\Delta Y_{sb} = \alpha + \beta \cdot \Delta S_b \cdot DEREG_s + \gamma \cdot \Delta S_b + \delta \cdot DEREG_s + \epsilon_{sb} \tag{4}$$

The equation is estimated in changes using two periods, the boom from 1982 to 1989 and the bust from 1989 to 1992 (i.e., $b = \{boom, bust\}$). The key coefficient of interest is β, which measures the differential loading of early deregulation states for outcome Y on the aggregate cycle S_b. We use log aggregate GDP as our aggregate S_b measure. For example, one of the outcomes we examine is state level GDP. In this case, ΔY_{sb} is the log change in state level GDP during the boom and bust, and β measures whether log state GDP in early deregulation states changes more for a given change in log aggregate GDP.

4.3 Was credit growth stronger in early deregulation states?

Figure 1, lower panel, showed that total credit growth was much stronger in states that started deregulating before 1983 relative to those that started deregulation afterwards. Table 3 estimates equation (1) and shows that credit growth was significantly stronger in early deregulation states. Panel A presents the baseline estimates without control variables. All measures of household credit increase relatively more in states that deregulated their banking sector earlier. In terms of magnitudes, a one standard deviation increase in the deregulation measure (1.01) leads to a

0.04 increase in the household debt to income ratio, which is almost one-half a standard deviation. Growth in mortgage loan applications is also larger in early deregulation states.

All measures of credit from the Call Report data show stronger growth from 1982 to 1989 in early deregulation states. Household loan and consumer loan growth is stronger, as is commercial and industrial loan growth. This latter results suggests that the larger increase in credit in early deregulation states was not isolated to household loans. However, some caution is warranted in evaluating this result. C&I loans include loans to construction companies and local businesses, which are likely influenced by local demand effects coming from the rise in credit to the household sector. As illustrated in Section 2, a joint examination of consumer prices and employment patterns is needed to understand whether credit expansion operates primarily through local demand or production capacity expansion.

The final column reports the estimate for growth in the household leverage index from 1982 to 1989, which as mentioned above is the first principal component of the three measures of household debt growth shown in columns 1, 2, and 7. A one standard deviation increase in the deregulation measure leads to a 0.74 increase in household leverage, which is more than half a standard deviation. The specifications reported in Panel B add control variables for pre-1982 growth in the outcome variables where available. The estimates on the deregulation measure are similar.

Figure 3 presents coefficient estimates of β_q from equation 3 from section 4.2 for five measures of credit growth: the household debt to income ratio, household loans, commercial and industrial loans, consumer loans, and mortgage application volume. For all five measures, we see similar results. Prior to 1982, there is no differential increase in credit in early deregulation states. From 1982 to 1989, credit grows more in early deregulation states.[17] After 1989, measures of credit growth in early deregulation states decline relative to the peak. Figure 3, as in Figure 1, shows no strong pre-trend for the credit variables.

Table 4 tests for robustness by estimating equation 1 using growth in the household leverage index from 1982 to 1989 as the outcome variable and including extensive control variables. The coefficient estimate remains significantly positive even when including measures of exposure to the oil industry, regional indicator variables, unemployment levels prior to the credit boom, and

[17] Household debt-to-income in the top-left panel of Figure 3 only rises in 1987 because household debt and income grow at a similar rate before then.

contemporaneous measures of GDP growth and C&I loan growth.

4.4 Exclusion restriction

One concern with using deregulation timing to generate credit supply shocks is that the timing of deregulation is spuriously correlated with other sources of business cycle variation. For example, if deregulation occurred earlier in states that had better income prospects, then the more rapid expansion in credit or residential construction from 1982 to 1989 may be due to better income prospects as opposed to more credit supply from a more liberalized banking sector.

Fortunately, the source of variation in banking deregulation has already been researched extensively. Kroszner and Strahan (2014) provide an excellent review of the banking deregulation literature. States initially restricted bank entry and geographical expansion in order to generate revenue through granting state charters, owning bank shares and taxes. Kroszner and Strahan (1999) argue that a combination of public and private interest kept these banking restrictions in place until the 1980's, but technological innovations, e.g. the advent of money market funds, the ATM and credit scoring models, eroded the competitive edge of small local banks. Such developments reduced opposition to deregulation, and states started to deregulate with Republican controlled states typically deregulating earlier.[18]

While a number of political and technological factors contributed to the varied timing of deregulation across U.S. states, Kroszner and Strahan (2014) argue that "there is no correlation between rates of bank failures or the state-level business cycle conditions and the *timing* of branching reform." They further argue based on results from earlier work that "states did *not* deregulate their economies in *anticipation* of future good growth prospects."[19]

The Kroszner and Strahan (2014) view is further corroborated by our finding of no differential pre-trend in early versus late deregulating states. We also conduct additional placebo tests using prior economic cycles to show that states that deregulated their banking sectors earlier in the 1980s did not see differentially large credit growth during the economic expansions of the 1960s and 1970s. Likewise, before the 1980s, we find no evidence that early deregulation states had an

[18] Kane (1996) further argues that failure of geographically concentrated banks that imposed costs on local population also lowered the appetite of restrictive regulation among the public. For example, exemptions were specifically granted for out of state banks to acquire failing banks and savings institutions.

[19] These results are based on the work of Jayaratne and Strahan (1996), Kroszner and Strahan (1999), and Morgan et al. (2003).

amplified economic cycle relative to late deregulation states.

4.5 Comparison to literature

The existing empirical work on deregulation typically adopts the difference-in-differences specification first used by Jayaratne and Strahan (1996). This specification estimates the coefficient on a deregulation indicator variable that turns on when a state adopts a specific deregulation policy[20]:

$$Y_{st} = \alpha_s + \gamma_t + \beta * DEREG_{st} + \epsilon_{st} \tag{5}$$

(5) estimates the immediate effect of deregulation on Y by comparing states the deregulate in t with states that have not yet deregulated[21].

However, equation (5) is not appropriate for the question in our paper for two reasons. First, (5) is designed to estimate the immediate causal impact of deregulation per se. On the other hand the premise of our paper is that a more deregulated banking system will pass-through an aggregate credit supply shock more strongly even it it has been deregulated for a while. Thus the appropriate first-stage for our natural experiment is the one shown in bottom panel of figure 1, or equation (3), and not equation (5).

A second limitation of equation 5 for our purpose is that it focuses on the short-term impact of deregulation by construction, and is not designed to analyze the full business cycle implications of credit expansion. For example, consider two states that deregulate three years apart. Equation 5 estimates the effect of deregulation by comparing differences between the two states when one state has started the deregulation process but the other has not. However, once both states have deregulated, differences between these states are not attributed to deregulation. Our methodology in (3) on the other hand is meant to capture both the short- and medium-run effects of credit expansion.

Another related difference is that our specification captures the higher loading on aggregate

[20] Strahan (2003) shows that interstate deregulation as opposed to intra-state branching deregulation led to significantly increased banking acquisitions. Kroszner and Strahan (2014) and Black and Strahan (2001) find that the share of small banks falls significantly, and bank efficiency as measured by noninterest costs, wages, and loan losses increases when states deregulate.

[21] In Tables A4 through A6 of the appendix, we replicate this specification from Jayaratne and Strahan (1996) in our data and find similar results for economic growth, and also find a significant effect of deregulation on bank loan growth.

credit supply shocks that comes from a longer cumulative period of deregulation. In contrast, the methodology in equation 5 treats two states equally once they are both deregulated even if one deregulated much earlier than the other. For example, let us compare a state that deregulates its banking sector in 1982 versus a state that deregulates in 1988, and let us assume that deregulation boosts lending gradually over the subsequent five years after deregulation. As of 1989, we would expect for the state that deregulated in 1982 to have a larger cumulative increase in lending from deregulation than the state that deregulated in 1988, and hence be more vulnerable to a credit supply contraction in 1989. Our methodology is designed to capture exactly this heightened vulnerability, whereas the methodology in equation 5 would miss it by treating both states as the same as of 1989.

A related study by Morgan et al. (2003) finds that state-level idiosyncratic volatility in economic growth declined with banking integration after deregulation. More specifically, Morgan et al. (2003) first estimate the idiosyncratic component of economic growth in a state-year by obtaining the residual from regressing growth in a state-year on year and state indicator variables. They then show that these residuals decline in a given state as the banking system becomes more integrated due to deregulation. In Table A7 of the online appendix we replicate this result for employment growth. The finding of lower idiosyncratic volatility in economic growth after deregulation in Morgan et al. (2003) is distinct from our finding of a higher loading, or "beta," on aggregate GDP growth. A more integrated banking sector can stabilize a state's economy after a negative idiosyncratic shock such as a shock to a specific industry, but it could also increase exposure to national-level credit supply expansions and contractions.

5 Does credit expansion lead to business cycle amplification?

5.1 Main results

Figure 4 examines the effect of credit expansion on the state level business cycle by estimating equation 3 using five measures of economic activity: the unemployment rate, total employment, real GDP, new construction of residential units, and house prices. More specifically, Figure 4 presents coefficient estimates of β_q from estimation of equation 3 using these five outcome measures. For all five outcomes, we see an amplified cycle in states that deregulated their banking system earlier.

The unemployment rate fell more in early deregulation states from 1982 to 1989, before rising sharply during the recession. Employment and real GDP expanded significantly more in early deregulation states during the expansion, and then fell more in the recession, although the fall is not as large for real GDP as for the other outcomes.

The patterns are most pronounced in the housing market. House prices and residential construction see a significantly stronger boom-bust pattern in early deregulation versus late deregulation states, suggesting that banking deregulation had strong effects on the housing market during this time period. For three of the four outcomes, there is no differential pre-trend, and the differences begin during the heart of the aggregate credit expansion from 1982 onwards.

Table 5 separately tests for amplification over the boom and bust phases of the cycle by estimating equations 1 and 2.[22] The first four columns present results for the expansion phase from 1982 to 1989, and the fifth through eighth column presents results for the contraction phase from 1989 to 1992. The boom-bust pattern in these four outcomes is robust to control variables for exposure to oil prices, demographics, and regulatory forbearance during the S&L crisis.[23] In terms of magnitudes, a one standard deviation increase in the deregulation measure leads to a 0.6 percentage point decline in the unemployment rate from 1982 to 1989, and a 0.9 percentage point increase from 1989 to 1992. The former is almost a third of a standard deviation and the latter is two-thirds a standard deviation. Overall, the correlation between the deregulation measure and the decline in economic outcomes during the contraction is larger in magnitude and more statistically robust than the correlation between the deregulation measure and the increase in economic outcomes during the expansion period.

Panel A of Table 6 presents estimates from equation (4) described in section 4.2. The data set is a state-level panel where the two time periods for the outcome variables are 1982 to 1989, and 1989 to 1992. Contemporaneous aggregate GDP growth is the aggregate measure we employ. For any given state, we calculate GDP growth excluding the state in question to avoid mechanical correlation. As the coefficient on the interaction term shows, early deregulation states see a stronger loading on aggregate GDP growth for all five measures. For example, a state with a deregulation measure of zero has a β of its own GDP growth on aggregate GDP growth of 0.7 to 0.9. A state with

[22] Figure A3 in the online appendix presents scatterplots of the regressions in Table 5.

[23] The results are also robust to controlling for other state institutional characteristics such as state union density in the 1980s, which we estimate from the CPS.

a deregulation measure of one (which is one standard deviation relative to the mean) has a β that is 1.2 to 1.3, and the difference is statistically significant at the one percent level. In general, one standard deviation increase in our banking deregulation measure leads to a much more amplified business cycle with a 72.6% larger β for GDP, 61.0% for employment and 111.1% for house prices.

5.2 Placebo tests for amplification

In Panels B and C of Table 6, we conduct placebo tests for prior economic cycles that are similar to the analysis presented in Panel A of Table 6. For the previous cycles, we use the NBER dates for expansions and recessions to define the dates of the cycle. Panel B presents results for the 1975 to 1982 cycle, where we define the end of the expansion in 1979. In contrast to the 1982 to 1992 period, there is no evidence of a differential loading on the aggregate GDP growth in the earlier cycle. If anything, there is some evidence of a smaller loading for house price growth. In Panel C, we examine the 1970 to 1975 cycle, where we define the end of the expansion in 1973. Once again, for the three outcome variables for which we have data available, we see no evidence of a differential loading on aggregate GDP growth. Taken together, the results in Table 6 Panels B and C are inconsistent with the hypothesis that states deregulating their banking sectors in the late 1970s or early 1980s are inherently more cyclical.

6 Is amplification driven by demand or production capacity?

6.1 Employment, prices, and wages during credit expansion

The discussion in section 2 highlights how the behavior of tradable versus non-tradable employment and prices can be used to analyze whether credit supply shocks impact the economy primarily through their impact on local demand or labor productivity. Figure 5 presents state-level scatter plots of employment growth by sector from 1982 to 1989 against the deregulation measure. As we saw in the previous section, employment growth is stronger in early deregulation states. However, the higher employment growth in early deregulation states is driven by employment in the non-tradable and construction sector. There is no relative rise in employment in the tradable sector in early deregulation states. This is consistent with the hypothesis that credit supply shocks work through local demand.

We confirm these results in a regression context in Table 7. Columns 1 through 4 estimate equation 1 using measures of employment as the outcome variable. They confirm that there is a statistically significant and economically meaningful relative rise in employment in the non-tradable and construction sectors in early deregulation states. In contrast, there is no differential increase in employment in the tradable sectors in early deregulation states. In terms of magnitudes, a one standard deviation increase in the deregulation measure leads to a 6% and 16% larger increase in employment in the non-tradable and construction industries, respectively. For both industries, this is one-half a standard deviation of the outcome variable.[24]

In columns 5 through 8, we utilize a data set covering employment growth from 1982 to 1989 at the state by 2 digit industry level. This data set allows us to fully control for 2-digit industry fixed effects and state fixed effects. We do so in the specification reported in column 8, which shows a relative increase in employment in the non-tradable and construction sectors from 1982 to 1989 in early deregulation states. The inclusion of 2-digit industry fixed effects ensures that the coefficient estimate on the deregulation variable is independent of any secular trends related to a state's industrial composition.

One potential explanation for the limited effect on tradable employment growth is that large firms account for the majority of tradable employment, and these large tradable firms do not rely on financing from local banks. Table 8 presents estimates for tradable, non-tradable, and construction employment growth separately by establishment size categories. Even for small tradable establishments, those with between 1 and 9 or 10 and 50 employees, we do not find stronger tradable employment growth in early deregulating states. This argues against a local credit supply channel operating through tradable firms, especially since Chen et al. (2017) find that small tradable firms are on average more reliant on local bank credit than small non-tradable firms.

In Figure 6, we explore predictions from the model on consumer price inflation. As the top left panel shows, early deregulation states see higher inflation rates during the credit expansion phase from 1982 to 1989. When we split the prices of consumer goods into non-tradable (services) and tradable (commodities) categories, we see that the positive correlation is significantly stronger for

[24] In Table A2 of the appendix, we include a control variable for the exposure of the labor force in a state to Chinese import competition from Autor et al. (2013). The results are similar with inclusion of this control variable. In Table A8 we show that the results are similar when using a within-state specification for employment growth as in equation (5) which is closer to the specification estimated in Jayaratne and Strahan (1996). The results in Table A8 are consistent with deregulation spurring non-tradable and construction employment in the short-run.

the price of non-tradable goods. Table 9 presents similar results in a regression context. There is a larger rise in consumer prices in early deregulation states from 1982 to 1989 which is driven in particular by consumer prices of non-tradable goods. In terms of magnitudes, a one standard deviation increase in deregulation leads to 2 percentage point larger increase in prices of all goods from 1982 to 1989 and a 4 percentage point larger increase in prices of non-tradable goods. In column 5 of Table 9, we show that the relative rise in consumer prices of non-tradable goods is statistically significantly larger compared to prices of tradable goods.

Overall, the results on the growth in employment and prices are consistent with a model in which credit supply expansion boosts local demand in early deregulation states. The results are inconsistent with the view that the dominant impact of credit supply expansion is to boost labor productivity among either tradable or non-tradable firms.

As shown in Section 2, all three types of credit shocks result in higher wage growth. We confirm this pattern in Figure 7 and Table 10. Wage growth is significantly stronger in early deregulation states from 1982 to 1989. This is true for both males and females, and across all industries. The magnitude is large. A one standard deviation increase in the deregulation measure leads to more than a half standard deviation increase in average wages. The relative growth of wages in early deregulation states is especially strong for construction and non-tradable firms.

Figure 8 presents estimates of β_q from equation 3 for employment in the non-tradable, tradable, and construction industries. These estimates show the dynamic pattern in employment for early versus late deregulation states from 1975 to 1995. The results for the non-tradable and construction industries are similar to the results for other measures of real economic activity shown in Figure 4. In particular, early deregulation states see a sharp relative rise in employment in the non-tradable and construction sectors from 1982 to 1989. Subsequently, early deregulation states witness a sharp relative drop which brings employment in these industries close to its initial level. This same pattern can be seen in total employment as well.

6.2 Placebo tests from earlier expansions

One explanation of the results above is that early deregulation states always experience a larger expansion in credit, consumer prices, wages, and employment in the non-tradable sector during economic expansions. We test this hypothesis in Table 11, and we find no evidence supporting

it. More specifically, we measure economic expansions using the NBER recession dates, where an expansion is measured from the trough of the last recession to the peak before the next recession. For the 1960s, we present also an alternative definition of the expansion from 1960 to 1967 given some evidence that the credit cycle peaked in 1967 instead of 1969. We then present specifications similar to equation 1, but using the dates of previous economic expansions instead of 1982 to 1989. We estimate specifications for whichever outcomes we can measure going back in time.

Across the 15 specifications for which we have outcome variables available, we find only one positive and statistically significant coefficient for previous expansions (consumer price growth from 1970 to 1973). Overall, the evidence is difficult to reconcile with the view that states that deregulated their banking sectors early in the late 1970s and 1980s always witnessed larger credit growth or a larger boost in demand for non-tradable goods during economic expansions.[25]

7 Why a worse recession: nominal rigidity, banking losses and household leverage

Why did early deregulation states experience a worse recession? We present evidence on three factors which have been emphasized in the literature as amplifying forces on the downside of a cycle: nominal rigidity, banking sector losses and high household leverage. As we show below, all three of these factors were significantly more powerful in early deregulating states.

7.1 Evidence on nominal rigidity

In our theoretical framework in Section 2, employment declines during the recession because wages cannot adjust downward. We see evidence of downward wage rigidity in Figure 9, which presents estimates of β_q from equation 3 for wages. As the top left panel shows, average wages in early deregulation states are almost constant in relative terms from 1989 to 1992, despite the previous large relative rise in wages from 1982 to 1989 and the significant relative rise in unemployment during the recession. When we examine wages by sector, we see evidence of some decline in wages for jobs in the non-tradable sector, but wages are still slow to adjust. In the tradable sector, there is almost no relative decline even through 1995 despite the much larger rise in wages from

[25] We do not have data on wages prior to 1979.

1982 to 1989.[26] This latter result suggests that the credit boom in early deregulation states may have led to long-run higher relative wages in the tradable sector, thereby reducing competitiveness. The tradable employment dynamics in Figure 8 show suggestive evidence consistent with a loss of competitiveness. Tradable employment in early deregulation states begins to gradually decline starting in 1988, prior to the recession, although the change is not statistically significant.

Figure 10 presents estimates of β_q for the overall CPI and the tradable and non-tradable price indexes. In early deregulation states, the overall CPI and non-tradable price index stop increasing in 1990. But, similar to wages, there is limited downward price adjustment during the recession. By 1994 there is some evidence of a modest reversal in prices for early relative to late deregulation states. These results suggest that consumer prices also face some downward rigidity, which leads to longer run real exchange rate appreciation in early deregulation states.[27]

7.2 Disruption in the banking sector

One result that is inconsistent with our theoretical framework is the relative decline in employment for early deregulation states in the tradable sector during and after the recession. This is shown in the top right panel of Figure 8. Consistent the results above, during the 1982 to 1989 period of rapid credit growth, employment in the tradable industry does not grow disproportionately in early deregulation states. But employment in the tradable sector does show a sharper decline in growth during the contraction phase after 1989. What explains this asymmetry? One reason could be the downward rigidity in wages already analyzed since higher wages make the tradable sector less competitive.

Table 13 and Figure 11 explore another explanation based on bigger disruption in the banking sector in early deregulation states during the contraction. We use Call Report data to construct the non-performing loans to total loans ratio ("NPL ratio") for the banking sector in a state in

[26] We also explored whether the lack of decline in wages among early deregulators was stronger in high union density states, but we did not find a significant interaction effect between the deregulation measure and unionization.

[27] These results on downward wage and price rigidity in the bust implicitly assume that changes in wages and prices are related to changes in employment (see also Beraja et al. (2016)). In appendix Table A10 we explore Phillips curve regressions of wage and price inflation on the level of the unemployment rate, using the deregulation measure as an instrument for the level of the unemployment rate separately in the expansion and contraction. Table A10 shows that the deregulation measure predicts a lower (higher) level of unemployment in the expansion (contraction). Using the predicted level of the unemployment rate in a second stage regression yields a larger Phillips curve slope estimate in the expansion (1982 to 1989) than in the contraction (1989 to 1994), consistent with downward wage and price rigidity in the bust.

1990. We construct the NPL ratio for both total and household loans. In columns 1 and 2 of Table 13, we report estimates from specifications relating the NPL ratio in a state to the deregulation measure, and it shows that early deregulation states experienced a significantly higher NPL ratio in 1990 for both total loans and household loans.

Figure 11 shows that the larger NPL ratio in early deregulation states is concentrated in the contraction phase of 1989 to 1992. More specifically, we estimate equation 3 using the NPL ratio for total and household loans as the outcome variable, and we plot in Figure 11 the coefficient estimates of β_q. As the estimates show, the higher NPL ratio in early deregulation states is only present in the 1989 to 1992 period. Outside of this contraction period, early deregulation states do not see more non-performing loans in their banking sector.[28]

These results suggest that more severe losses by banks during the recession in early deregulation states may have had spillover effects on employment even in the tradable industry. The estimates reported in columns 3 and 4 of Table 13 are consistent with this view. If we regress total employment growth in a state from 1989 to 1992 on NPL ratio of the banking sector in 1990, we find a large negative coefficient that is statistically distinct from zero. The estimates in column 4 show that the power of the NPL ratio in predicting employment comes from the NPL ratio on household loans.

One interpretation is that expansion in credit in early deregulation states led to larger losses for banks, which then led to a negative effect on employment during the recession. Column 5 reports an instrumental variables specification where we instrument for the NPL ratio of the banking sector with the deregulation instrument. The interpretation of such a specification is that deregulation is responsible for the larger losses in the banking sector in the state, which in turn exacerbated the decline in employment during the recession.

7.3 Household debt and the recession of 1990 to 1991

How is the boom related to the bust? All of our results are estimated in reduced form, which makes it impossible to say with certainty the underlying structural relationships between measures of the boom in a state and the severity of the subsequent recession.

We explore the role of the expansion of household debt from 1982 to 1989. Our focus on

[28] The estimation in Figure 11 includes control variables. We show the results without control variables in Figure A4 in the appendix.

household debt is motivated by the extensive body of research showing a robust correlation between a rise in household debt and subsequently lower growth (e.g., Glick and Lansing (2010), IMF (2012), King (1994), Mian and Sufi (2014a), Mian et al. (2017)). We are also motivated by the aggregate rise in household debt that occurred during the 1980s. From 1984 to 1989, the household debt to disposable personal income ratio of the United States rose from 0.58 to 0.72 after staying roughly constant from 1963 to 1984 (see Figures A1 and A2 in the appendix). We already know from Figure 3 that early deregulation states saw a substantially larger rise in household debt from 1984 to 1989.

In Table 14, we estimate "horse-race" specifications where we examine how measures of expansion in a state correlate with recession severity during the bust. As Panel A of Table 14 shows, the rise in household debt from 1982 to 1989 in a state, as measured by the state's household leverage index, predicts recession severity for all measures except for real GDP per capita. The explanatory power is strong: The R^2 is 0.35 or above for five of the six measures we have. Figure 12 shows the scatter plot of these regressions for all outcome variables. The rise in household debt prior to 1989 is a statistically powerful predictor of recession severity.

In Panel B of Table 14, we include five other measures of the economic expansion in the state. The coefficient estimates on the household leverage index are similar, and none of the other measures has the same predictive power as the rise in household debt. Early deregulation states saw an increase in several measures of credit and economic activity from 1982 to 1989, but the rise in household debt is statistically most powerful in predicting recession severity.

8 Conclusion

The implications of positive credit supply shocks are substantially different depending on whether they primarily boost demand or improve labor productivity. In this paper we develop a simple empirical test based on movements in employment and prices to disentangle whether credit supply shocks primarily boost demand or firms' production capacity.

We implement this methodology in the context of bank deregulation across the United States in the 1980s. This is a particularly interesting environment given that many argue bank deregulation improves the allocation of resources across firms, thereby increasing labor productivity. Our results suggest that banking deregulation during the 1980s primarily affected the real economy by boosting

demand as opposed to improving labor productivity. In particular, early deregulation states experienced a relative rise in household debt, and a relative increase in employment in the non-tradable sector. In contrast, employment in the tradable sector was similar in early and late deregulation states. This is true even for small firms producing tradable goods, which we know rely on bank credit. Early deregulation states also witnessed substantial real exchange rate appreciation during the expansion.

Consistent with demand-based models of credit supply cycles, we find that early deregulation states witnessed an amplified business cycle from 1982 to 1992 relative to late deregulation states. The recession of 1990 to 1991 was significantly worse in states that deregulated their banking systems earlier. This is explained in part due to downward nominal wage rigidity, banking sector losses, and elevated household debt.

While we focus on the United States in the 1980s, we believe this methodology can be used in other contexts to help uncover the nature of credit expansions. An example is the introduction of the euro during the late 1990s. The introduction of the euro led to a positive credit supply shock in many European countries such as Portugal and Spain, and this positive credit supply shock can be seen in the substantial decline in sovereign debt interest rate spreads relative to the United States (e.g., Schmitt-Grohé and Uribe (2016), Mian et al. (2017), Gopinath et al. (2017)). In Table 15, we split the 11 euro countries in the Mian et al. (2017) sample into two groups based on the decline in in the sovereign debt interest spread relative to the United States from 1996 to 1999. On average, Denmark, Finland, Greece, the Netherlands, Spain, and Portugal saw a decline in the sovereign debt interest spread of 1.7 percentage points, compared to a decline of only 0.1 percentage points for Austria, Belgium, Germany, France, and Italy.

As Table 15 shows, European countries experiencing the largest decline in sovereign interest spreads due to introduction of the euro witnessed substantially stronger employment growth from 2002 to 2007 in the non-tradable and construction sector but almost no difference in employment growth in the tradable sector. Further, countries seeing the largest positive credit supply shock also witnessed stronger nominal price and wage growth. These same countries experienced a more severe recession from 2007 to 2010. This suggests that the stronger positive credit supply shock due to the introduction of the euro in countries such as Spain and Portugal primarily worked through

boosting demand as opposed to improving labor productivity.[29]

As a final caveat, it is important to note that we avoid normative claims in regards to banking deregulation in the 1980s: states that deregulated their banking systems earlier may end up better in the long run, and we do not claim that the regulations in place prior to deregulation were optimal or better than a deregulated system. The long run effects of deregulation are difficult to estimate precisely in our empirical setting. In Table A3 of the appendix, we estimate "long-horizon" regressions of outcomes from 1982 to 1995 on the deregulation measure. The estimates are inconclusive, based largely on the fact that standard errors are large in such long-horizon specifications. The only correlation that appears robust is a positive relation between house price growth from 1982 to 1995 and deregulation. We look forward to future research that focuses on the long-term implications of deregulation for economic growth.

[29] Gopinath et al. (2017) examine data on manufacturing firms in Spain to show that capital inflows actually reduced total factor productivity because they were misallocated toward higher net worth firms.

Table 1: Year of State Level Deregulation

State	Inter-state deregulation	Intra-state deregulation	Dereg. measure
Alaska	1982	1970	1.62
Alabama	1987	1981	0.37
Arkansas	1989	1994	-1.43
Arizona	1986	1970	0.90
California	1987	1970	0.72
Colorado	1988	1991	-1.25
Connecticut	1983	1980	1.26
Washington, DC	1985	1970	1.08
Florida	1985	1988	-0.53
Georgia	1985	1983	0.37
Hawaii	1995	1986	-0.89
Iowa	1991	1994	-1.43
Idaho	1985	1970	1.08
Illinois	1986	1988	-0.71
Indiana	1986	1989	-0.89
Kansas	1992	1987	-1.07
Kentucky	1984	1990	-0.53
Louisiana	1987	1988	-0.89
Massachusetts	1983	1984	0.55
Maryland	1985	1970	1.08
Maine	1978	1975	2.16
Michigan	1986	1987	-0.53
Minnesota	1986	1993	-0.89
Missouri	1986	1990	-0.89
Mississippi	1988	1986	-0.71
Montana	1993	1990	-1.43
North Carolina	1985	1970	1.08
North Dakota	1991	1987	-1.07
Nebraska	1990	1985	-0.71
New Hampshire	1987	1987	-0.71
New Jersey	1986	1977	0.90
New Mexico	1989	1991	-1.43
Nevada	1985	1970	1.08
New York	1982	1976	1.62
Ohio	1985	1979	1.08
Oklahoma	1987	1988	-0.89
Oregon	1986	1985	-0.17
Pennsylvania	1986	1982	0.37
Rhode Island	1984	1970	1.26
South Carolina	1986	1970	0.90
Tennessee	1985	1985	0.01
Texas	1987	1988	-0.89
Utah	1984	1981	0.90
Virginia	1985	1978	1.08
Vermont	1988	1970	0.55
Washington	1987	1985	-0.35
Wisconsin	1987	1990	-1.07
West Virginia	1988	1987	-0.89
Wyoming	1987	1988	-0.89

Notes: The intra-state and inter-state deregulation years have a correlation of 0.46. Deregulation measure is the average of the number of years during which a state is in the process of deregulating between 1979 and 1989, according to inter-state deregulation and intra-state deregulation definitions. That is, Dereg. measure is defined as the standardized value of $.5 \sum_{j \in \{inter, intra\}} \min(\max(1989 - DeregYear_j, 0), 10)$. Intra-state deregulation dates for states that deregulated intra-state branching before 1970 are truncated at 1970.

Table 2: Summary Statistics

	N	Mean	Median	SD
Years deregulation	49	2.82	3.00	1.94
Years dereg. intra	49	4.92	4.00	4.19
Dereg. measure	49	-0.02	-0.35	1.01
Dereg. measure (1983 dummy)	49	0.45	0.00	0.50
Δ_{82-89} HH Debt to income	49	0.21	0.20	0.09
Δ_{82-89} HH leverage index	49	-0.06	-0.35	1.19
Δ_{82-89} ln(House prices)	49	0.37	0.30	0.33
Δ_{89-92} ln(House prices)	49	0.04	0.05	0.11
Δ_{82-89} Unemployment	49	-4.09	-3.80	1.88
Δ_{89-92} Unemployment	49	1.77	1.70	1.40
Δ_{82-89} ln(Real GDP per capita)	49	0.17	0.22	0.17
Δ_{89-92} ln(Real GDP per capita)	49	-0.01	-0.01	0.05
Δ_{82-89} ln(Housing unit permits)	49	0.14	0.35	0.81
Δ_{89-92} ln(Housing unit permits)	49	0.03	0.04	0.46
Δ_{82-89} ln(Total employment)	49	0.20	0.22	0.12
Δ_{89-92} ln(Total employment)	49	0.03	0.04	0.07
Δ_{82-89} ln(Tradable employment)	49	0.02	0.06	0.12
Δ_{89-92} ln(Tradable employment)	49	-0.04	-0.04	0.09
Δ_{82-89} ln(Non-tradable employment)	49	0.23	0.24	0.11
Δ_{89-92} ln(Non-tradable employment)	49	0.03	0.04	0.08
Δ_{82-89} ln(Construction employment)	49	0.20	0.30	0.31
Δ_{89-92} ln(Construction employment)	49	-0.05	-0.01	0.25
Δ_{89-92} ln(Retail sales)	19	0.10	0.10	0.06
Δ_{84-89} ln(Loan appl. volume)	49	2.39	2.24	0.99
Δ_{84-89} ln(Loan appl. number)	49	1.78	1.75	0.55
Δ_{82-89} ln(Total loans)	49	0.58	0.56	0.41
Δ_{82-89} ln(Commercial and industrial loans)	49	0.42	0.42	0.48
Δ_{82-89} ln(Household loans)	49	0.72	0.69	0.36
Δ_{82-89} ln(Consumer loans)	49	0.70	0.71	0.46
Δ_{82-89} ln(CPI) (Del Negro)	48	0.24	0.23	0.04
Δ_{82-89} ln(CPI Tradables)	25	0.12	0.12	0.02
Δ_{82-89} ln(CPI Non-Tradables)	25	0.24	0.22	0.06
Δ_{82-89} ln(Average wages)	49	1.24	-0.75	7.57
Δ_{82-89} ln(Resid. wages)	49	-0.52	-1.07	7.99
Δ_{82-89} ln(Tradable resid. wages)	49	-1.44	-2.04	9.05
Δ_{82-89} ln(Non-tradable resid. wages)	49	0.32	1.87	10.23
Δ_{82-89} ln(Construction resid. wages)	49	-4.02	-7.40	12.25

Notes: Dereg. measure is defined in Table 1. Household loans subsume the call report item Loans to Individuals and Real Estate Loans. Commercial and industrial loans are based on the call report item Commercial and Industrial Loan. Consumer loans are based on the call report item Loans to Individuals and subsume home-equity loans starting in 1987. Δ_{82-89} HH leverage index represents the first principal component of Δ_{82-89} Debt-to-income, Δ_{84-89} ln(Loan appl. volume), and Δ_{82-89} ln(Consumer loans).

Table 3: Deregulation and the Rise in Leverage from 1982 to 1989

	(1) Δ_{82-89} Debt to income	(2) Δ_{84-89} Loan appl. volume	(3) Δ_{84-89} Loan appl. number	(4) Δ_{82-89} Total loans	(5) Δ_{82-89} C&I loans	(6) Δ_{82-89} HH loans	(7) Δ_{82-89} Con. loans	(8) Δ_{82-89} HH leverage index
Panel A: Base Line								
Dereg. measure	0.0405**	0.416*	0.193*	0.190**	0.236**	0.136*	0.233**	0.742**
	(0.0115)	(0.159)	(0.0876)	(0.0579)	(0.0619)	(0.0543)	(0.0600)	(0.147)
R^2	0.210	0.182	0.128	0.217	0.250	0.147	0.269	0.398
Panel B: Lagged Dependent Variable Controls								
Dereg. measure	0.0296**	0.187**			0.167*	0.137*	0.219**	
	(0.0101)	(0.0485)			(0.0624)	(0.0558)	(0.0576)	
R^2	0.477	0.439			0.425	0.314	0.375	
Observations	49	49	49	49	49	49	49	49

Notes: This table presents state-level regressions of growth in leverage from 1982 to 1989 on the deregulation measure: $\Delta_{82-89} y_s = \alpha + \beta d_s + \epsilon_s$. The Δ_{84-89} Loan application number and Δ_{84-89} Loan application volume variables are computed using HMDA flows. The growth rate is calculated based on the mean flow between 1981-1983 and the mean flow between 1984-1988. Household loans (HH loans) comprise the call report items "Real Estate Loans" and "Loans to Individuals". Consumer loans (Con. loans) are based on the call report item "Loans to Individuals" and subsume home-equity loans starting in 1987. Commercial and industrial loans (C&I loans) and total loans follow their corresponding definitions in the call report. The Δ_{82-89} HH leverage index represents the first principal component of Δ_{82-89} Debt-to-income, Δ_{84-89} Loan appl. volume, and Δ_{82-89} Consumer loans. Specification in panel B control for the one-year changes in the dependent variable between 1978 and 1982. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 4: Deregulation and the Household Leverage Index from 1982 to 1989

	Δ_{82-89} HH leverage index						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dereg. measure	0.700**	0.680**	0.524**	0.777**	0.699**	0.349*	0.525**
	(0.151)	(0.166)	(0.154)	(0.137)	(0.174)	(0.170)	(0.188)
Oil Exposure '85	-0.137*					-0.428**	
	(0.0521)					(0.148)	
Oil Empl. '82	-8.573*					-29.04**	
	(3.725)					(5.999)	
Forbearance		0.201				-0.0635	
		(0.150)				(0.157)	
Northeast region			1.332*			1.412*	
			(0.516)			(0.554)	
South region			0.284			0.677	
			(0.233)			(0.414)	
West region			0.0985			0.224	
			(0.336)			(0.499)	
Debt to income$_{1982}$				-0.905		-2.319	
				(1.508)		(2.050)	
Δ_{82-89} Real GDP per Capita				-0.560		3.617**	
				(0.582)		(1.185)	
Unemployment$_{1982}$				-0.0920		-0.0110	
				(0.0633)		(0.0606)	
Δ_{82-89} C&I loans							0.918*
							(0.400)
R^2	0.503	0.416	0.524	0.439	0.483	0.766	0.500
Demographic controls					✓	✓	
Observations	49	48	49	49	49	48	49

Notes: This table presents regressions of the Δ_{82-89} HH leverage index on the deregulation measure and various controls. Δ_{82-89} HH leverage index represents the first principal component of Δ_{82-89} Debt-to-income, Δ_{84-89} Loan appl. volume, and Δ_{82-89} Consumer loans. Oil exposure 1985 represents the share of the state's oil production after excluding federal production. This share is further normalized by the state's population in 1985. Oil employment 1982 is the state's share of employment in the oil industry. Commercial and industrial loans (C&I loans) follows its corresponding definition in the call report. Demographic controls are the fraction of people in urban neighborhood, fraction black, fraction hispanic, fraction with a high school degree, and fraction with college degree, based on the 1980 census. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 5: Deregulation and Amplification in Boom and Bust

	Boom: Change from 82 to 89				Bust: Change from 89 to 92			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Controls	None	Lagged Dep. Var.	Oilshock	Demographics & Forbearance	None	Lagged Dep. Var.	Oilshock	Demographics & Forbearance
				Panel A: Unemployment				
Dereg. measure	-0.597*	-0.833**	-0.214	-0.425*	0.877**	0.820**	0.781**	0.765**
	(0.225)	(0.162)	(0.216)	(0.205)	(0.137)	(0.138)	(0.157)	(0.106)
R^2	0.104	0.678	0.419	0.422	0.405	0.440	0.473	0.582
				Panel B: Total Employment				
Dereg. measure	0.0531**	0.0630**	0.0170	0.0480**	-0.0278**	-0.0301**	-0.0292**	-0.0217+
	(0.0147)	(0.0158)	(0.0110)	(0.0168)	(0.00970)	(0.00858)	(0.00902)	(0.0111)
R^2	0.193	0.332	0.723	0.214	0.181	0.240	0.358	0.452
				Panel C: Real GDP per capita				
Dereg. measure	0.0615*	0.0375**	0.0425**	0.0417	-0.0225**	-0.0197**	-0.0199**	-0.0211*
	(0.0290)	(0.0112)	(0.0101)	(0.0313)	(0.00765)	(0.00666)	(0.00502)	(0.00848)
R^2	0.134	0.871	0.861	0.380	0.218	0.472	0.524	0.383
				Panel D: House prices				
Dereg. measure	0.186**	0.186**	0.149**	0.191**	-0.0424**	-0.0323*	-0.0455**	-0.0438*
	(0.0397)	(0.0370)	(0.0469)	(0.0492)	(0.0133)	(0.0125)	(0.0161)	(0.0173)
R^2	0.325	0.506	0.384	0.468	0.150	0.433	0.153	0.313
				Panel E: Housing unit permits				
Dereg. measure	0.277**	0.283**	0.0280	0.216*	-0.225**	-0.226**	-0.154*	-0.142*
	(0.0861)	(0.102)	(0.0612)	(0.0878)	(0.0577)	(0.0629)	(0.0589)	(0.0620)
R^2	0.148	0.330	0.671	0.305	0.246	0.308	0.360	0.351
Observations	49	49	49	48	49	49	49	48

Notes: This table presents regressions of changes in real outcomes from 1982 to 1989 (column 1-4) and 1989 to 1992 (columns 5-8) on the deregulation measure. The column labeled "Oilshock" controls for a state's oil production share after excluding federal production normalized by population and the oil industry's 1982 employment share. Column 4 and 8 uses only 48 observations as there is no information available for forbearance in D.C. Demographic controls include the fraction urban, fraction black, fraction hispanic, fraction with high school, and fraction with college, based on the 1980 census. Panel D columns 2 and 6 use two lagged dependent variables due to data availability. Alaska is dropped from Panel D as it is a large outlier. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 6: Deregulation and Amplification: Estimating Beta

	(1) Real GDP growth	(2) Real GDP p.c. growth	(3) Unemployment Change	(4) Total Empl. Growth	(5) House price growth	(6) Housing unit permit growth
Panel A: Boom-Bust Cycle 1982-89 & 1989-92						
GDP growth	0.734**	0.875**	-1.735**	0.769**	1.171**	-1.552
	(0.103)	(0.0845)	(0.100)	(0.121)	(0.312)	(1.035)
Dereg. measure	-0.00858**	-0.00955**	0.0113**	-0.0114**	-0.0201**	-0.0747**
	(0.00284)	(0.00253)	(0.00174)	(0.00385)	(0.00585)	(0.0272)
Dereg. measure x GDP growth	0.539**	0.453**	-0.463**	0.466**	1.304**	2.526*
	(0.102)	(0.0870)	(0.0908)	(0.133)	(0.303)	(1.133)
R^2	0.369	0.481	0.802	0.409	0.379	0.154
Panel B: Boom-Bust Cycle 1975-79 & 1979-82						
GDP growth	1.030**	0.981**	-1.355**	1.302**	2.327**	
	(0.110)	(0.0938)	(0.0771)	(0.0792)	(0.173)	
Dereg. measure	0.00315	0.00328	-0.00312+	0.000828	0.00485	
	(0.00600)	(0.00478)	(0.00174)	(0.00292)	(0.00352)	
Dereg. measure x GDP growth	-0.164	-0.140	0.0117	-0.149+	-0.377*	
	(0.133)	(0.114)	(0.0870)	(0.0797)	(0.171)	
R^2	0.378	0.489	0.795	0.645	0.630	
Panel B: Boom-Bust Cycle 1970-73 & 1973-75						
GDP growth	0.969**	0.919**	-0.420**	0.379**		
	(0.134)	(0.120)	(0.0511)	(0.0974)		
Dereg. measure	-0.00110	-0.00154	0.00293	-0.00101		
	(0.00896)	(0.00720)	(0.00248)	(0.00809)		
Dereg. measure x GDP growth	-0.188	-0.186	-0.00976	-0.106		
	(0.179)	(0.158)	(0.0605)	(0.130)		
R^2	0.401	0.462	0.501	0.131		
Observations	98	98	98	98	98	

Notes: This table presents regressions of the form: $\Delta y_{sb} = \alpha + \beta X_b \cdot d_s + \gamma \Delta X_b + \delta d_s + \epsilon_{sb}$. The equation is estimated in changes using two periods, the boom and the bust (i.e. $b = \{boom, bust\}$). The dependent variables in Panel A are defined as the growth rate from 1983 to 1989 (boom) and 1989 to 1992 (bust), with the exception of unemployment, which is measured as the change from 1982 to 1989 and 1989 to 1992. Panels B and C present placebo regressions for earlier cycles. The variable ΔX_b is the change in aggregate GDP growth excluding state i. The coefficient on the interaction between the deregulation measure and the aggregate cycle variable, β, measures how a state's cyclicality varies with the deregulation measure. House price growth (column 4) and housing unit permit growth (column 5) are missing in some periods due to data availability. Standard errors are clustered at the state level. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 7: Deregulation and Change in Employment by Industry from 1982 to 1989

	Δ_{82-89} Total employment	Δ_{82-89} Empl. tradables	Δ_{82-89} Empl. non-tradables	Δ_{82-89} Empl. construction	Δ_{82-89} Industry-level employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dereg. measure	0.0531**	0.00237	0.0564**	0.161**	0.0378*	-0.0206	-0.0181	-
	(0.0147)	(0.0174)	(0.0134)	(0.0404)	(0.0155)	(0.0215)	(0.0212)	-
Dereg. measure x other						0.0715**	0.0676**	0.0687**
						(0.0231)	(0.0229)	(0.0226)
x non-tradables						0.0890**	0.0866**	0.0874**
						(0.0238)	(0.0235)	(0.0232)
x construction						0.184**	0.182**	0.183**
						(0.0395)	(0.0400)	(0.0396)
Unit of Obs.	State	State	State	State	State x 2 digit Ind.	State x 2 digit Ind.	State x 2 digit Ind.	State x 2 digit Ind.
2 Digit Ind. FE							✓	✓
State FE								✓
R^2	0.193	0.000	0.256	0.276	0.004	0.023	0.446	0.478
Observations	49	49	49	49	3,762	3,762	3,762	3,762

Notes: This table reports regressions of employment growth from 1982 to 1989 by industry on the deregulation measure. The employment industry categorization is based on the SIC industries, where tradables: $2000 \leq$ sic ≤ 3900, sic $= 20001$, and sic $= 30001$; non-tradables: $5200 \leq$ sic ≤ 5900; construction: $1500 \leq$ sic ≤ 1700. Columns 1-4 report regressions at the state level for each industry categorization separately. Columns 5-8 report regressions of employment growth at the state by two digit industry level. In columns 6-8 the deregulation measure is interacted with industry category, with tradable employment being the omitted category. Standard errors are heteroskedasticity robust (columns 1-4) or clustered at the state level (columns 5-8). +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 8: Deregulation and Employment Growth from 1982 to 1989 by Establishment Size

	(1) 1 to 9	(2) 10 to 49	(3) 50 to 99	(4) 100+
Panel A: Tradable Employment Growth, 1982-89				
Dereg. measure	0.0118	0.0284	-0.0181	-0.00385
	(0.0539)	(0.0353)	(0.0302)	(0.0268)
R^2	0.001	0.017	0.007	0.001
Observations	48	49	49	49
Panel B: Non-tradable Employment Growth, 1982-89				
Dereg. measure	0.0434**	0.0637**	0.0522^{+}	0.0253
	(0.00830)	(0.0131)	(0.0281)	(0.0302)
R^2	0.324	0.314	0.087	0.015
Observations	49	49	49	49
Panel C: Construction Employment Growth, 1982-89				
Dereg. measure	0.0992**	0.189**	0.182**	0.125^{+}
	(0.0318)	(0.0463)	(0.0625)	(0.0667)
R^2	0.189	0.293	0.183	0.064
Observations	49	49	49	49

Notes: This table reports regressions of employment growth from 1982 to 1989 by industry and establishment size on the deregulation measure. Panels A, B, and C show separate regressions for tradable, non-tradable, and construction industries. Columns 1-4 present estimates separately by establishment size in terms of number of employees (1 to 9 employees, 10 to 49, 50 to 99, and 100 or greater). Standard errors are heteroskedasticity robust. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 9: Deregulation and Consumer Price Inflation from 1982 to 1989

			Special Aggregates		
	(1) Δ_{82-89} All items (Del Negro)	(2) Δ_{84-89} All items	(3) Δ_{84-89} Non-tradables	(4) Δ_{84-89} Tradables	(5) Δ_{84-89} Non-tradables or Tradables
Dereg. measure	1.780**	2.334**	4.017**	0.303	0.303
	(0.482)	(0.513)	(0.777)	(0.459)	(0.463)
Dereg. measure × NT					3.714**
					(0.821)
Dummy Non-tradables					11.94**
					(0.878)
R^2	0.261	0.434	0.476	0.021	0.807
Unit of obs.	State	State	State	State	State × NT-T
Observations	48	25	25	25	50

Notes: This table presents regressions of CPI inflation on the deregulation measure. Inflation measures in columns 2-5 are state-level aggregates computed using the BLS's MSA-level indexes and are thus only available for 26 states. Columns 2-5 exclude Alaska, which is a large outlier in the sample. Tradable and non-tradable CPI inflation are defined at the BLS "Commodities" and "Services" Special Aggregates, respectively. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 10: Deregulation and Wage Growth from 1982 to 1989

	Aggregate Wage Growth		By Gender		By Industry		
	(1) Average Wages	(2) Residualized Wages	(3) Male Resid. Wages	(4) Female Resid. Wages	(5) Tradable Resid. Wages	(6) Non-Tradable Resid. Wages	(7) Construction Resid. Wages
Dereg. measure	4.007**	4.249**	4.364**	3.638**	2.911*	4.735**	5.232**
	(0.888)	(0.994)	(1.013)	(0.878)	(1.366)	(1.304)	(1.618)
R^2	0.288	0.291	0.299	0.255	0.106	0.221	0.188
Observations	49	49	49	49	49	49	49

Notes: This table presents regressions of state level wage growth on the deregulation measure. State level wages are estimated from the CPS Outgoing Rotation Group. The dependent variable in column 1 is the change in log average hourly wages. Column 2 uses the change in log residualized hourly wages, where residual wages are estimate by regressing log wages on age, education, and race dummies separately for males and females. Columns 3 and 4 present separate regressions for residualized wages of male and female workers. Columns 5-7 report wage growth separately for workers in the tradable, non-tradable, and construction sectors, where sectors are defined using the same definition as employment. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 11: Placebo Regressions of Credit, CPI, and Employment Growth on Deregulation in Previous Expansions

	(1) Δ Total loans	(2) Δ C&I loans	(3) Δ HH loans	(4) Δ Con. loans	(5) Δ CPI (Del Negro)	(6) Δ Empl. tradables	(7) Δ Empl. non-tradables	(8) Δ Empl. construction
Panel A: Boom Period 1975-1979								
Dereg. measure	-0.00109	0.000888	-0.00172	0.00138	-0.00817**	-0.00832	-0.0128	-0.0743*
	(0.000724)	(0.00143)	(0.00109)	(0.00130)	(0.00271)	(0.0139)	(0.0118)	(0.0314)
R^2	0.034	0.010	0.040	0.027	0.179	0.008	0.026	0.125
Observations	49	49	49	49	48	49	49	49
Panel B: Boom Period 1970-1973								
Dereg. measure					0.00334*	-0.0271+	-0.0102	-0.0150
					(0.00148)	(0.0144)	(0.00983)	(0.0203)
R^2					0.126	0.083	0.026	0.011
Observations					48	49	49	49
Panel C: Boom Period 1962-1969								
Dereg. measure						0.00327	0.0445	0.0279
						(0.0318)	(0.0309)	(0.0436)
R^2						0.000	0.067	0.010
Observations						48	48	48
Panel D: Boom Period 1962-1967								
Dereg. measure						0.0190	0.0393	0.0212
						(0.0344)	(0.0329)	(0.0543)
R^2						0.010	0.055	0.004
Observations						47	47	47

Notes: The table reports regressions of credit growth, inflation, and employment growth in previous expansions on the deregulation measure. Panel A columns 1-4 use the change from 1976 to 1979 due to data availability. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 12: Deregulation and Change in Employment by Industry from 1989 to 1992

	Δ_{89-92} Total employment	Δ_{89-92} Empl. tradables	Δ_{89-92} Empl. non-tradables	Δ_{89-92} Empl. construction	Δ_{89-92} Industry-level employment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dereg. measure	-0.0278**	-0.0322*	-0.0313*	-0.128**	-0.0435*	-0.0438*	-0.0422*	-
	(0.00970)	(0.0140)	(0.0116)	(0.0329)	(0.0162)	(0.0188)	(0.0184)	-
Dereg. measure								
x other						0.00386	0.00135	0.000297
						(0.0192)	(0.0190)	(0.0187)
x non-tradables						0.00814	0.00654	0.00612
						(0.0140)	(0.0136)	(0.0134)
x construction						-0.0742**	-0.0758**	-0.0762**
						(0.0253)	(0.0250)	(0.0244)
Unit of Obs.	State	State	State	State	State x 2 digit Ind.	State x 2 digit Ind.	State x 2 digit Ind.	State x 2 digit Ind.
2 Digit Ind. FE							✓	✓
State FE								✓
R^2	0.181	0.140	0.166	0.264	0.005	0.009	0.468	0.500
Observations	49	49	49	49	3,816	3,816	3,816	3,816

Notes: This table reports regressions of employment growth from 1989 to 1992 by industry on the deregulation measure. The employment industry categorization is based on the SIC industries, where tradables: $2000 \leq$ sic ≤ 3900, sic $= 20001$, and sic $= 30001$; non-tradables: $5200 \leq$ sic ≤ 5900; construction: $1500 \leq$ sic ≤ 1700. Columns 1-4 report regressions at the state level for each industry categorization separately. Columns 5-8 report regressions of employment growth at the state by two digit industry level. In columns 6-8 the deregulation measure is interacted with industry category, with tradable employment being the omitted category. Standard errors in parentheses are heteroskedasticity robust (columns 1-4) or clustered at the state level (columns 5-8). +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 13: Deregulation, Non-Performing Loans and Employment from 1989 to 1992

	NPL ratio total loans 1990	NPL ratio HH loans 1990	Δ_{89-92} Total Employment		
	(1)	(2)	(3)	(4)	(5)
Dereg. measure	0.00866**	0.0111**			
	(0.00245)	(0.00248)			
NPL ratio total loans 1990			-2.610**		-3.206**
			(0.332)		(0.882)
NPL ratio HH loans 1990				-1.982*	
				(0.784)	
NPL ratio C&I loans 1990				-0.382	
				(0.595)	
R^2	0.225	0.320	0.532	0.504	0.504
Specification	OLS	OLS	OLS	OLS	IV
Observations	49	49	49	49	49

Notes: This table shows the relation between banking deregulation, non-performing loans in 1990, and employment growth from 1989 to 1992. The NPL ratio of total loans in 1990 is defined as total non-performing loans relative to total loans in 1990, based on the corresponding call report items. The NPL ratio of HH loans in 1990 is the non-performing loans ratio for the aggregate of real estate and individual loans in 1990. The 1990 NPL ratio of total loans in column 5 is instrumented with the deregulation measure. Standard errors in parentheses are heteroskedasticity robust. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 14: Household Leverage and the Bust from 1989 to 1992

	Δ_{89-92} Unemployment	Δ_{89-92} Total employment	Δ_{89-92} Real GDP per capita	Δ_{89-92} House prices	Δ_{89-92} Retail sales	Δ_{89-92} Housing unit permits
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Base Case						
Δ_{82-89} HH leverage index	0.889**	-0.0380**	-0.00970	-0.0556**	-0.0393**	-0.265**
	(0.111)	(0.00592)	(0.00580)	(0.0109)	(0.0111)	(0.0402)
R^2	0.575	0.467	0.056	0.357	0.424	0.482
Panel B: Controls						
Δ_{82-89} HH leverage index	0.861**	-0.0289**	-0.0198*	-0.0582**	-0.0329+	-0.201**
	(0.152)	(0.00693)	(0.00748)	(0.0136)	(0.0183)	(0.0516)
Δ_{82-89} C&I loans	0.0627	-0.0113	-0.0218	-0.0644+	-0.0484	0.0881
	(0.427)	(0.0194)	(0.0209)	(0.0381)	(0.0381)	(0.144)
Δ_{82-89} Housing unit permits	-0.397	0.0121	0.0209	0.0588*	-0.0874+	-0.205+
	(0.318)	(0.0145)	(0.0156)	(0.0284)	(0.0424)	(0.108)
Δ_{82-89} Real GDP per capita	1.673	-0.273**	0.160*	-0.221	0.0192	-0.0918
	(1.600)	(0.0727)	(0.0785)	(0.143)	(0.231)	(0.541)
Δ_{82-89} Unemployment	-0.242*	0.00219	0.00738	-0.00298	-0.0157	0.00165
	(0.0990)	(0.00450)	(0.00486)	(0.00884)	(0.0122)	(0.0335)
Δ_{82-89} Total employment	-1.607	0.247**	-0.0349	0.340*	0.444+	-0.366
	(1.645)	(0.0747)	(0.0807)	(0.147)	(0.211)	(0.556)
R^2	0.655	0.683	0.319	0.564	0.624	0.629
Observations	49	49	49	49	19	49

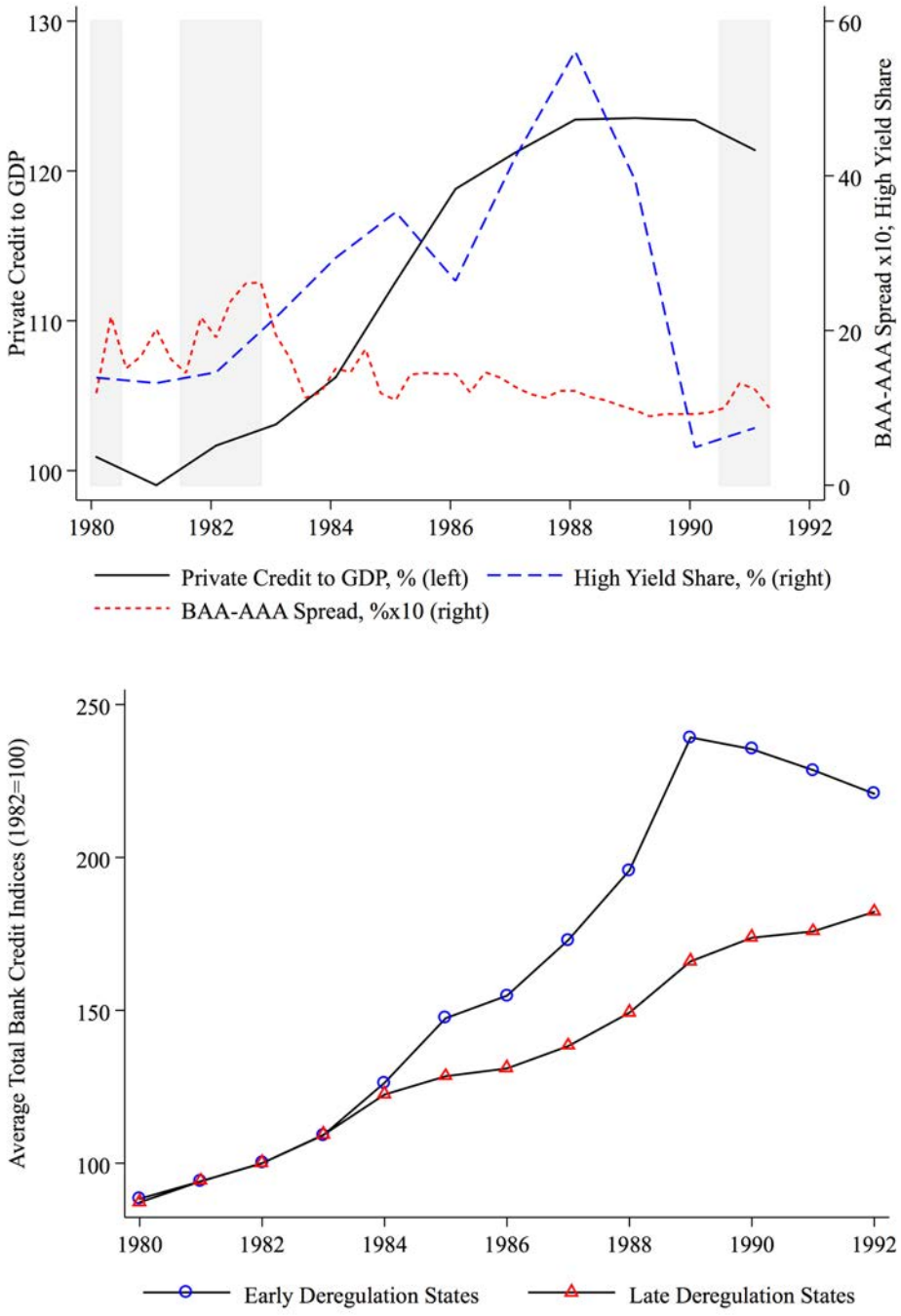
Notes: The table presents regressions of economic outcomes from 1989 to 1992 on the rise in household leverage and several other predictors from 1982 to 1989. Δ_{82-89} HH leverage index represents the first principal component of Δ_{82-89} Debt-to-income, Δ_{84-89} Loan appl. volume, and Δ_{82-89} Consumer loans. Standard errors in parentheses are heteroskedasticity robust. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 15: Credit Supply Shocks, Employment, and Prices: The Eurozone Experience

	Small Decline in Spread (N=5)	Large Decline in Spread (N=6)
Sovereign spread change, 1996-99	-0.14	-1.71
Employment growth, 2002-07	4.41	7.80
Tradable empl. growth, 2002-07	-4.62	-6.79
Non-tradable empl. growth, 2002-07	5.47	12.20
Construction empl. growth, 2002-07	5.04	13.38
Inflation, 2002-07	9.86	11.88
Nominal wage growth, 2002-07	12.79	16.84
Employment growth, 2007-10	0.73	-2.63

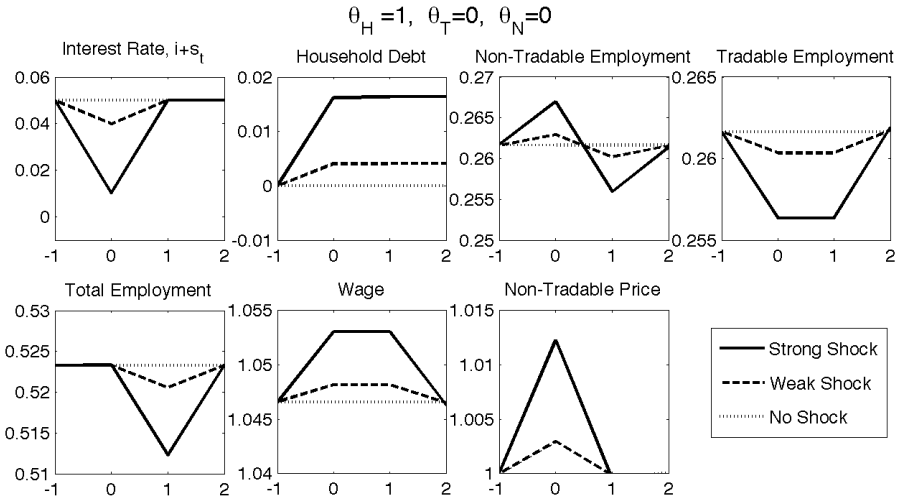
Notes: This table displays average growth in employment, prices, and wages separately for Eurozone countries with small and large declines in the sovereign spread leading up to the introduction of the euro. The small decline category (first column) includes Austria, Belgium, Germany, France, and Italy, and the large decline group is Denmark (ERM II), Finland, Greece, Netherlands, Spain, and Portugal. Data on employment by industry from the OECD is not available for Ireland.

Figure 1: Aggregate Credit Supply: Private Credit to GDP, Baa-Aaa Spread, and High Yield Share of Corporate Debt Issuance

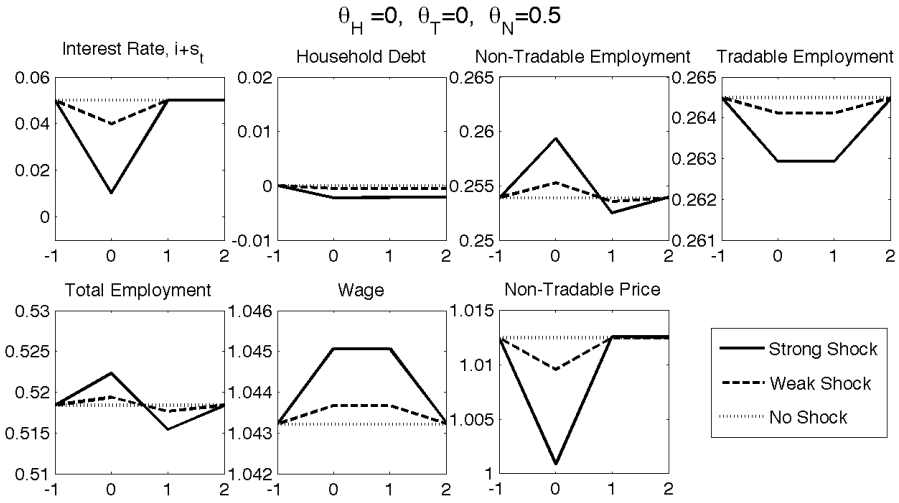


Notes: The top panel shows time series plots of the private credit to GDP ratio (left axis), Baa-Aaa spread (right axis), and the high year share (HYS) of corporate debt issuance from Greenwood and Hanson (2013) (right axis). The Baa-Aaa spread is multiplied by ten to have a similar range as the HYS. Shaded bars represent NBER recession dates. The bottom panel shows average of total bank credit indices (normalized to 100 for each state in 1982) across early and late deregulation states. Total bank credit is the sum of household loans and commercial and industrial loans in the Call Reports. Early deregulation states are defined as states that deregulated intra- or inter-state restrictions in 1983 or earlier, and late deregulation states are states that began the deregulation process after 1983.

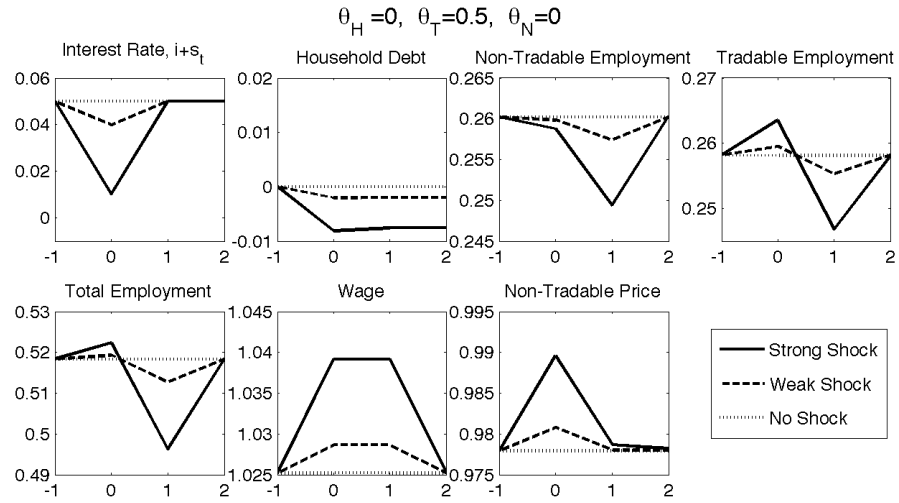
Figure 2: Model Predictions



(a) Credit Supply Shock through Local Demand, $\theta_H > 0$, $\theta_T = \theta_N = 0$

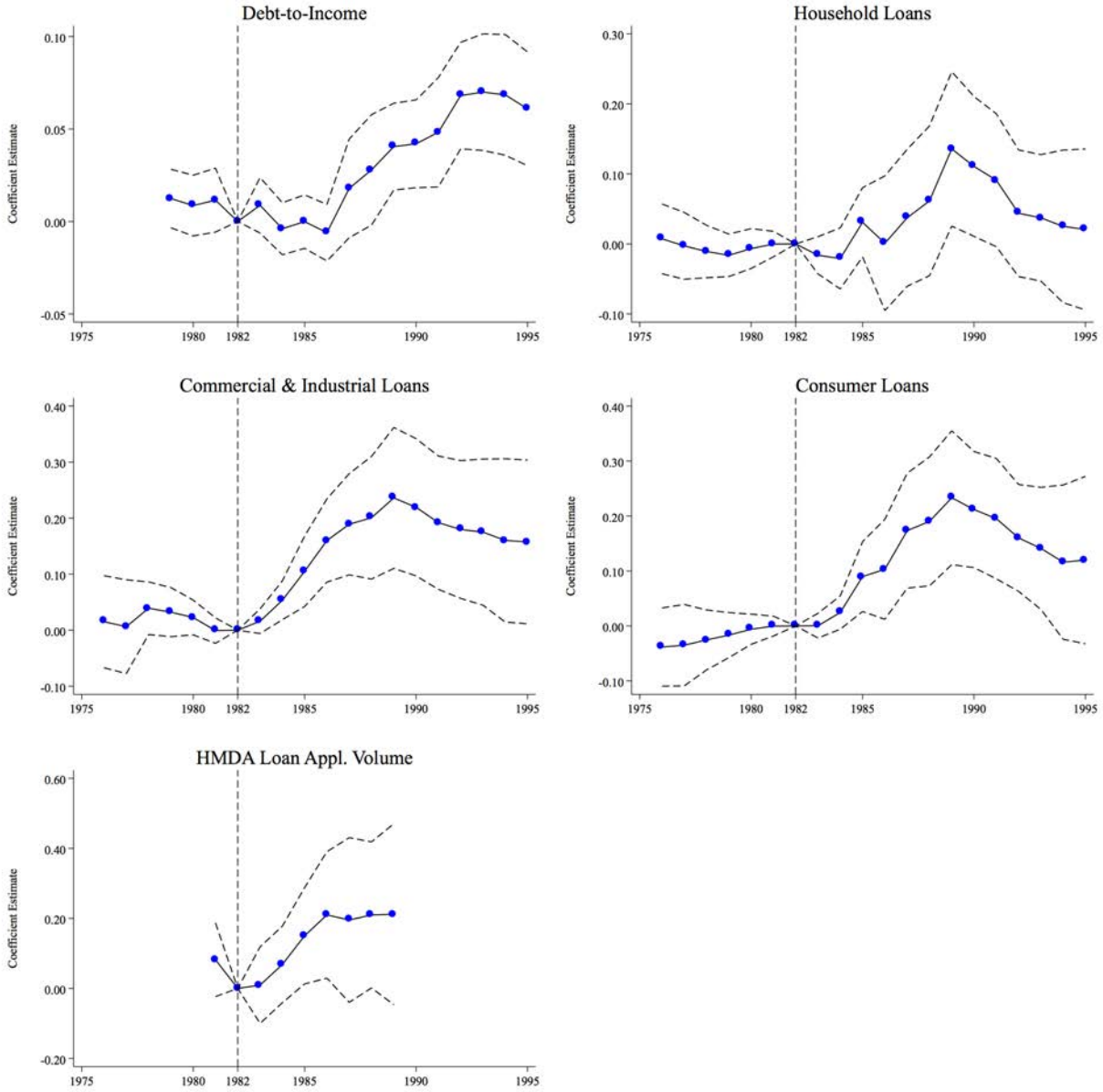


(b) Credit Supply Shock through Non-Tradable Supply, $\theta_N > 0$, $\theta_H = \theta_T = 0$



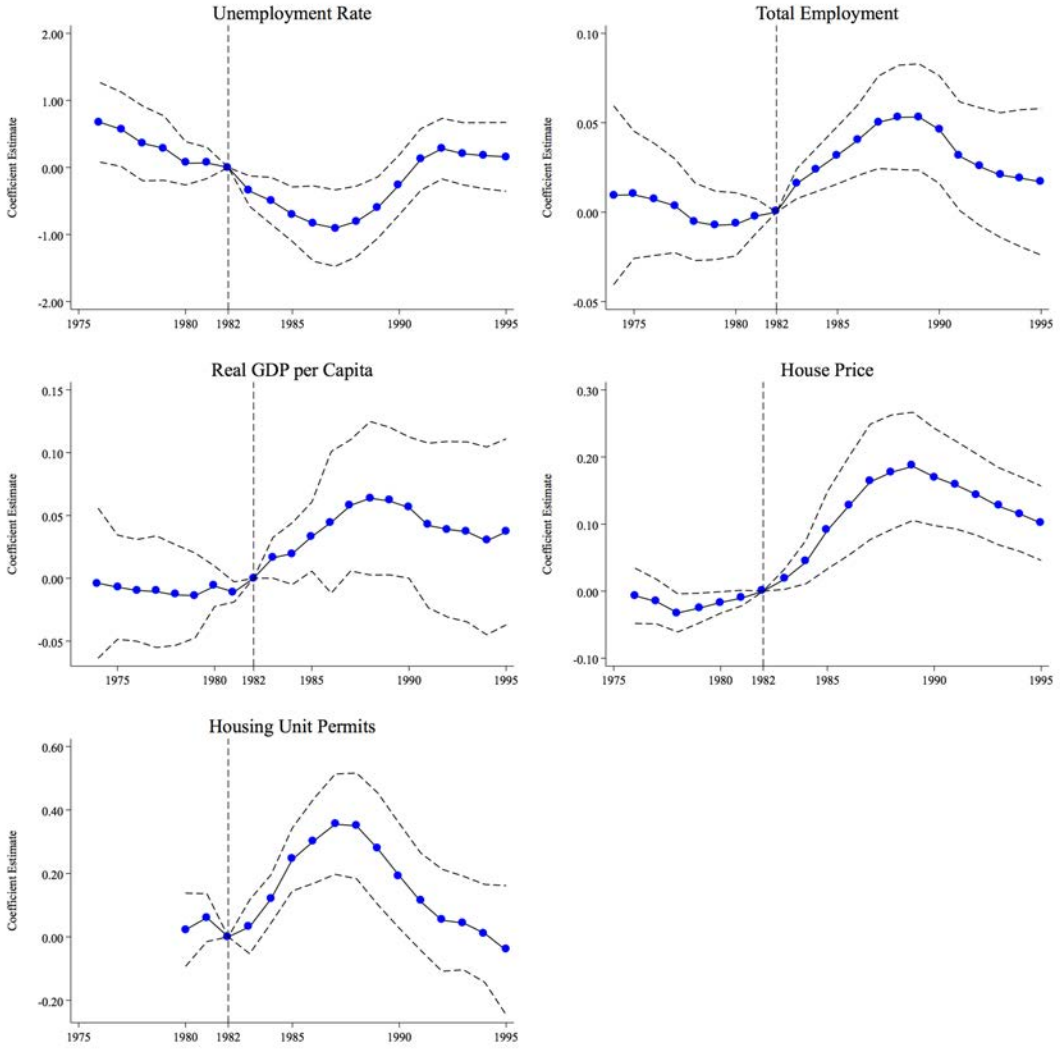
(c) Credit Supply Shock through Tradable Supply, $\theta_T > 0$, $\theta_H = \theta_N = 0$

Figure 3: Credit Growth and Deregulation



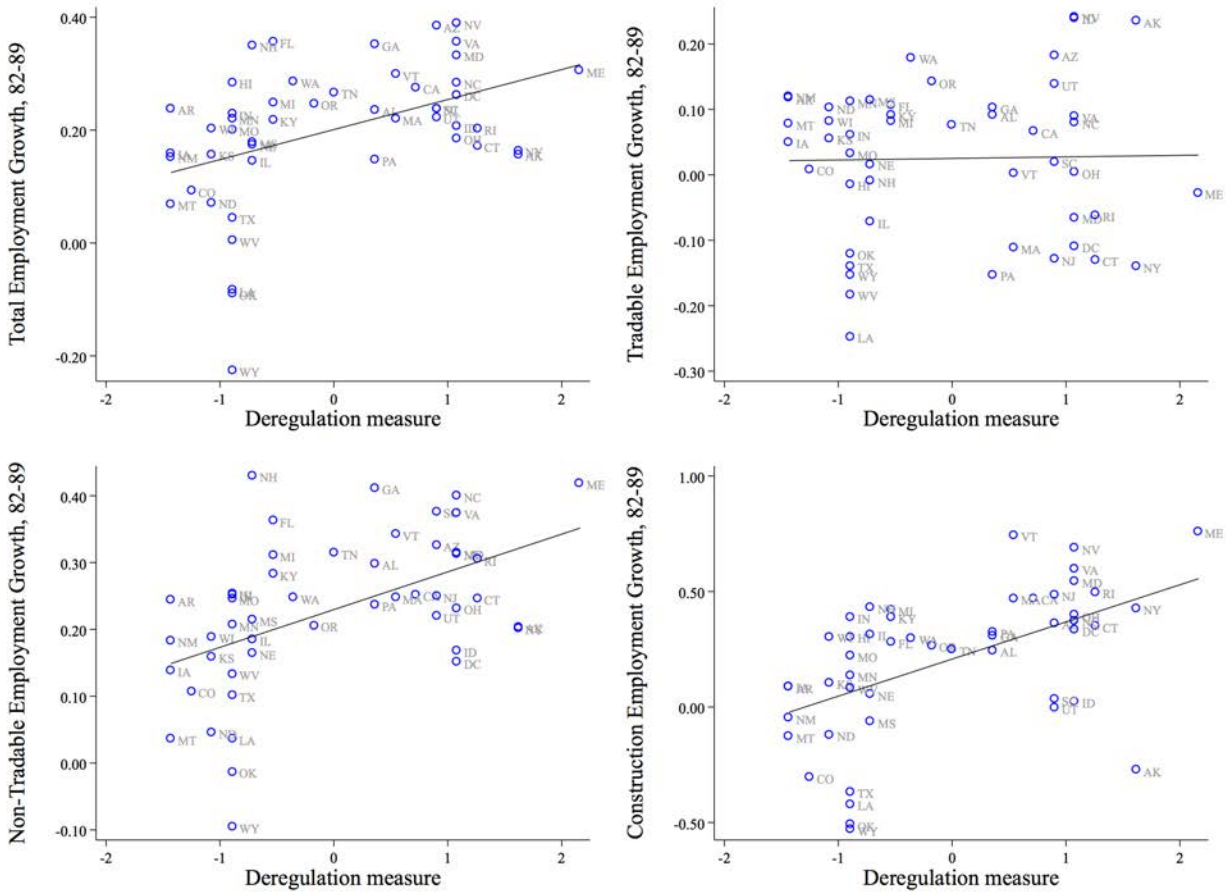
Notes: This figure presents estimates of $\{\beta_y\}$ from $y_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1982} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure. Dashed lines represent 95% confidence intervals from standard errors clustered at the state level. Household loans is based on the call report item "Loans to Individuals" and "Real Estate Loans". Commercial and industrial loans are based on the call report item "Commercial and Industrial Loan". Consumer loans are based on the call report item "Loans to Individuals" and subsume home-equity loans starting in 1987.

Figure 4: Deregulation and Unemployment, Real GDP per Capita, House Prices, and Housing Units



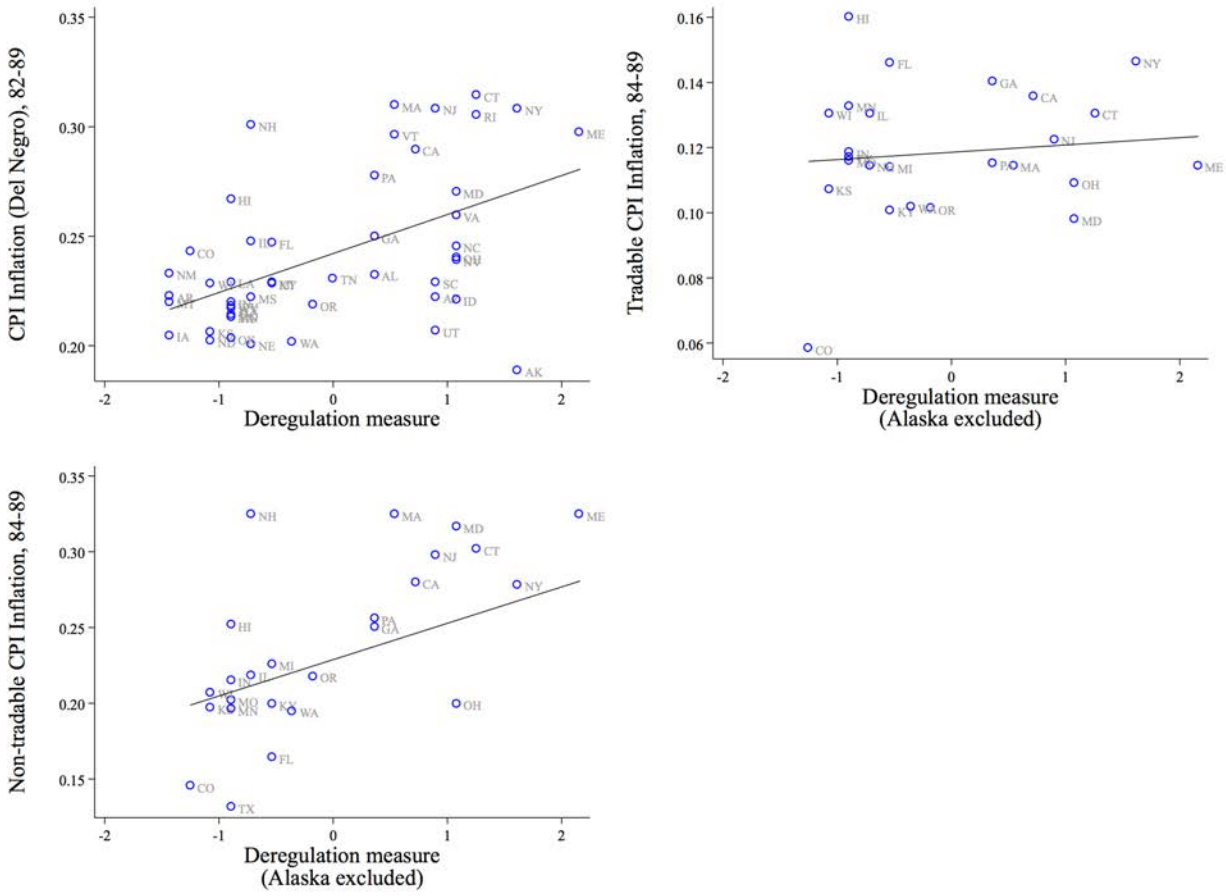
Notes: This figure presents estimates of $\{\beta_y\}$ from $y_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1982} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure and y_{st} is the state unemployment rate, log total employment, log real GDP per capita, log house prices, or log housing units. Dashed lines represent 95% confidence intervals from standard errors clustered at the state level.

Figure 5: Deregulation and Employment Growth, 1982-1989



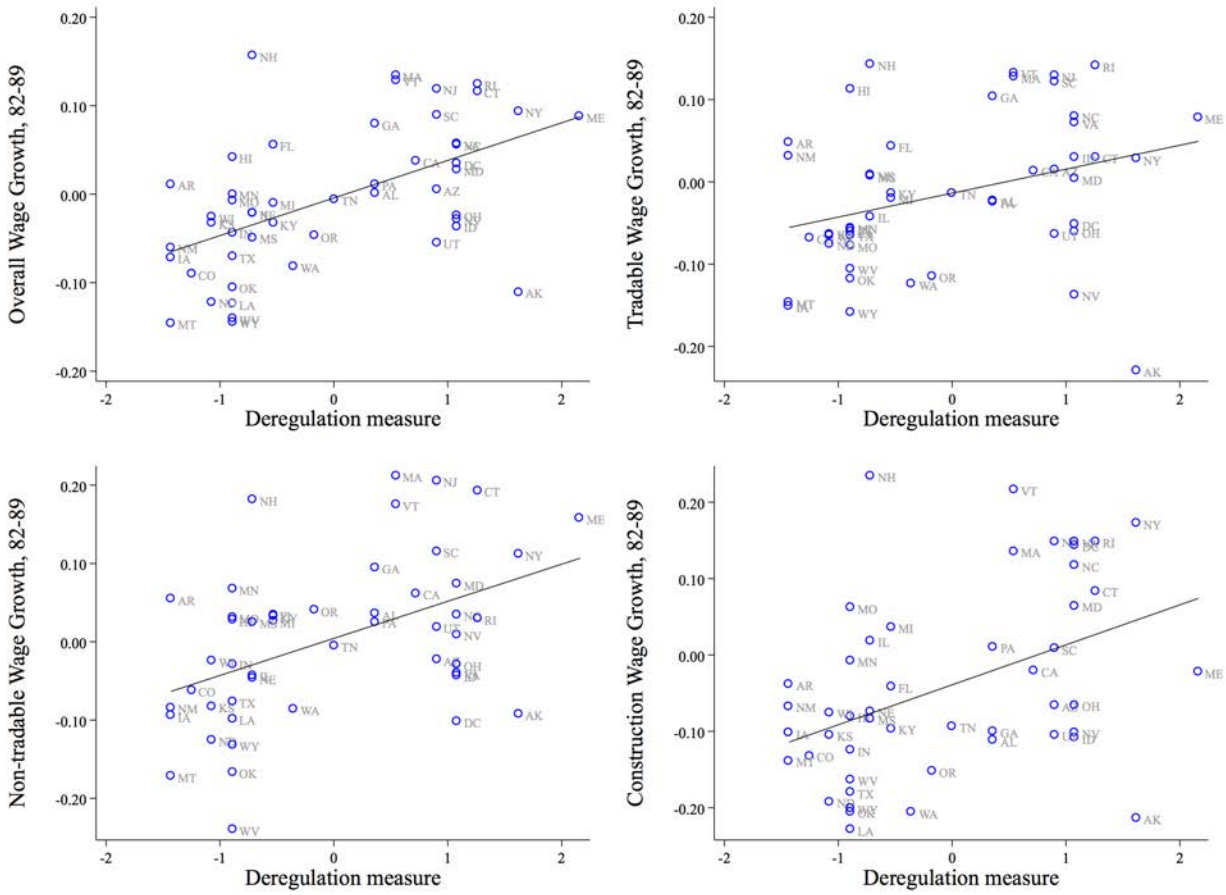
Notes: This figure presents scatterplots of the deregulation measure on employment growth by industry from 1982 to 1989.

Figure 6: Inflation and Deregulation



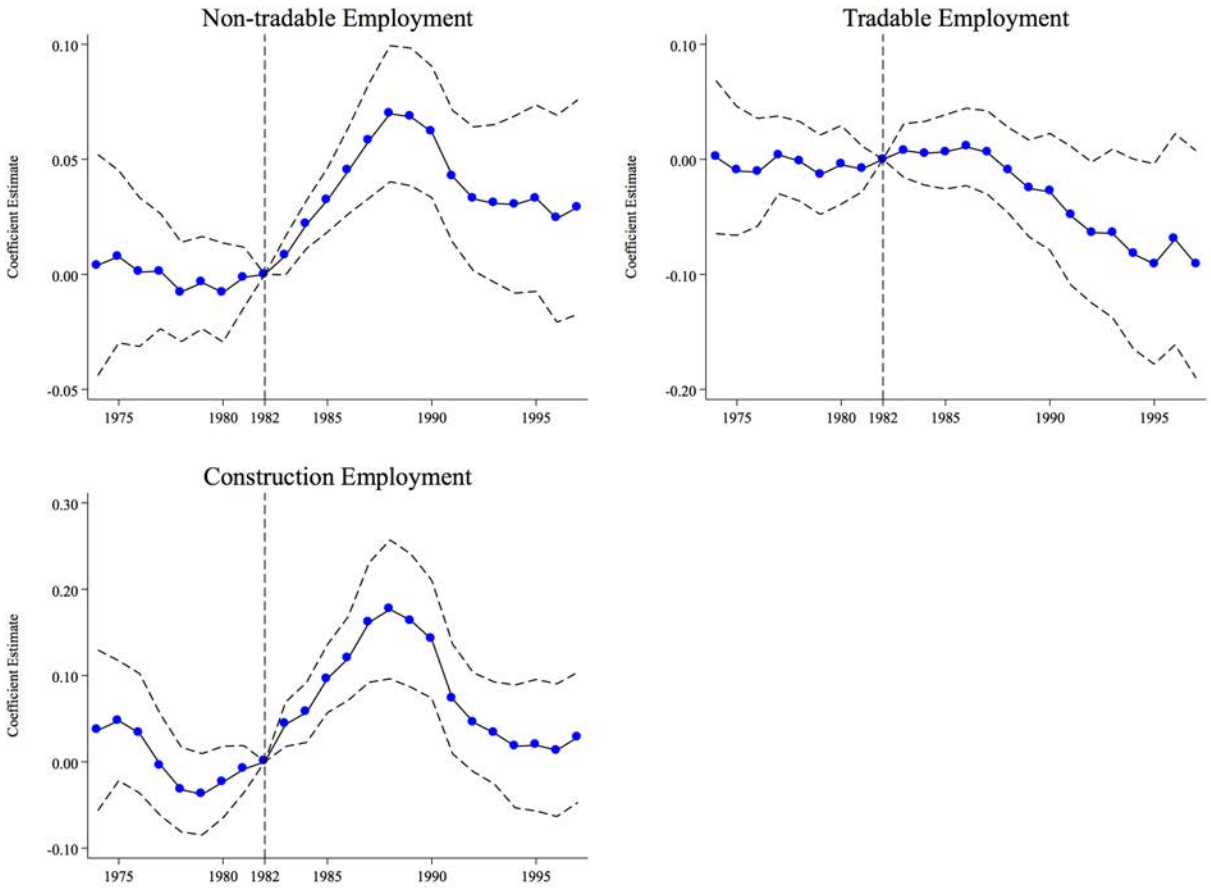
Notes: This figure presents scatter plots of the CPI inflation from 1982 (1984) to 1989 on the deregulation measure. The top-right and bottom-left panels show inflation for tradables ("Commodities") and non-tradables ("Services") for 25 states for which this measure is available (excluding Alaska).

Figure 7: Wage Growth and Deregulation



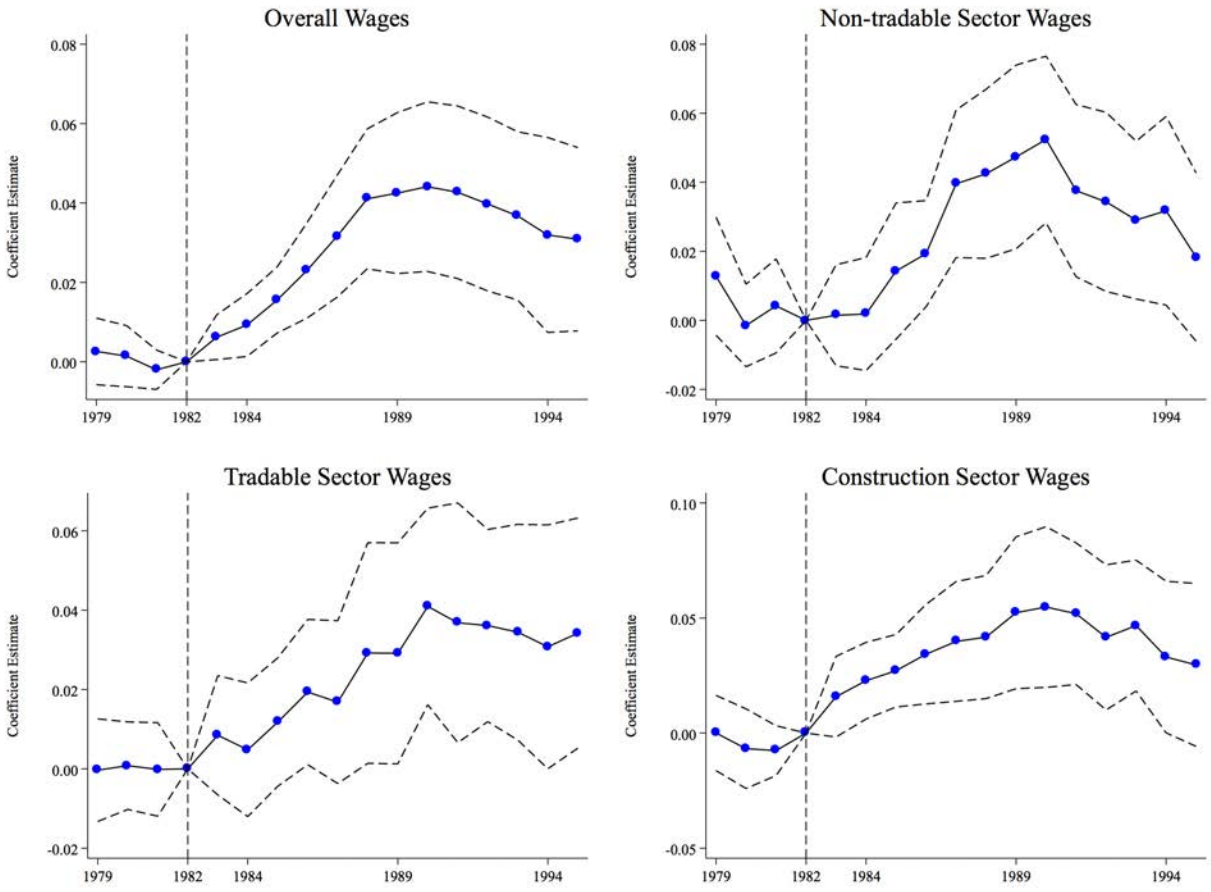
Notes: This figure presents scatter plots of wage growth from 1982 to 1989 against the deregulation measure. Wages are deflated by the aggregate CPI-U-RS (but not by state price indexes).

Figure 8: Deregulation and Employment by Industry over the Full Cycle



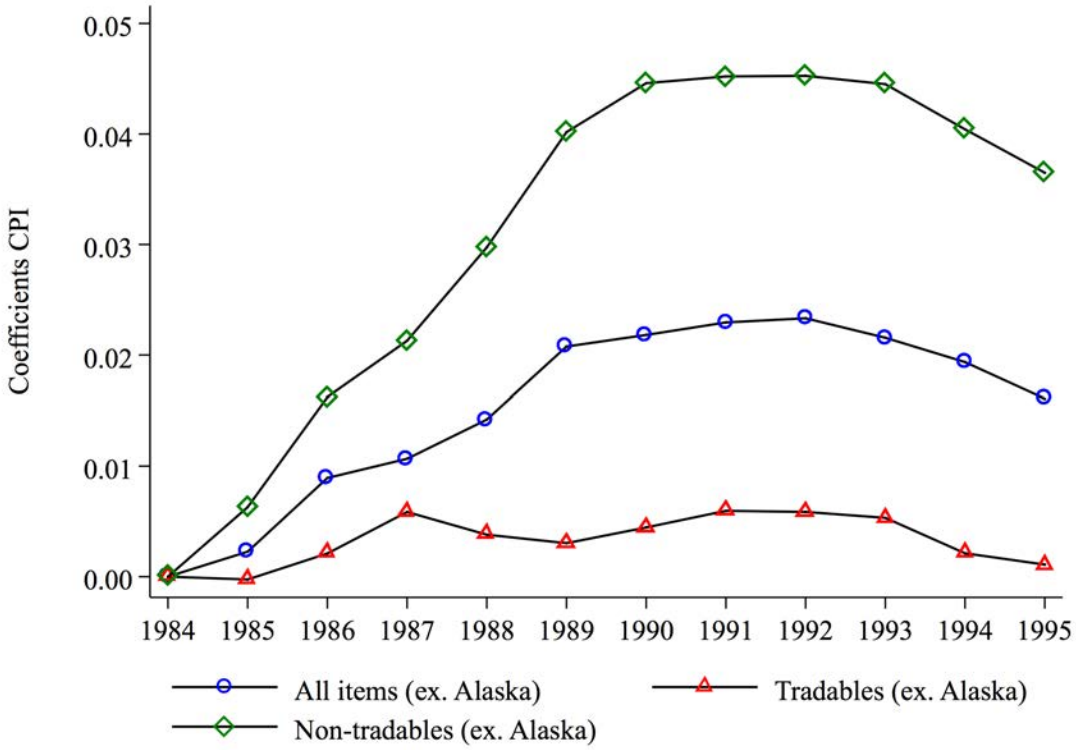
Notes: This figure presents estimates of $\{\beta_y\}$ from $e_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1982} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure and e_{st} is log non-tradable, tradable, or construction employment. Dashed lines represent 95% confidence intervals from standard errors clustered at the state level.

Figure 9: Deregulation and Wages by Industry over the Full Cycle



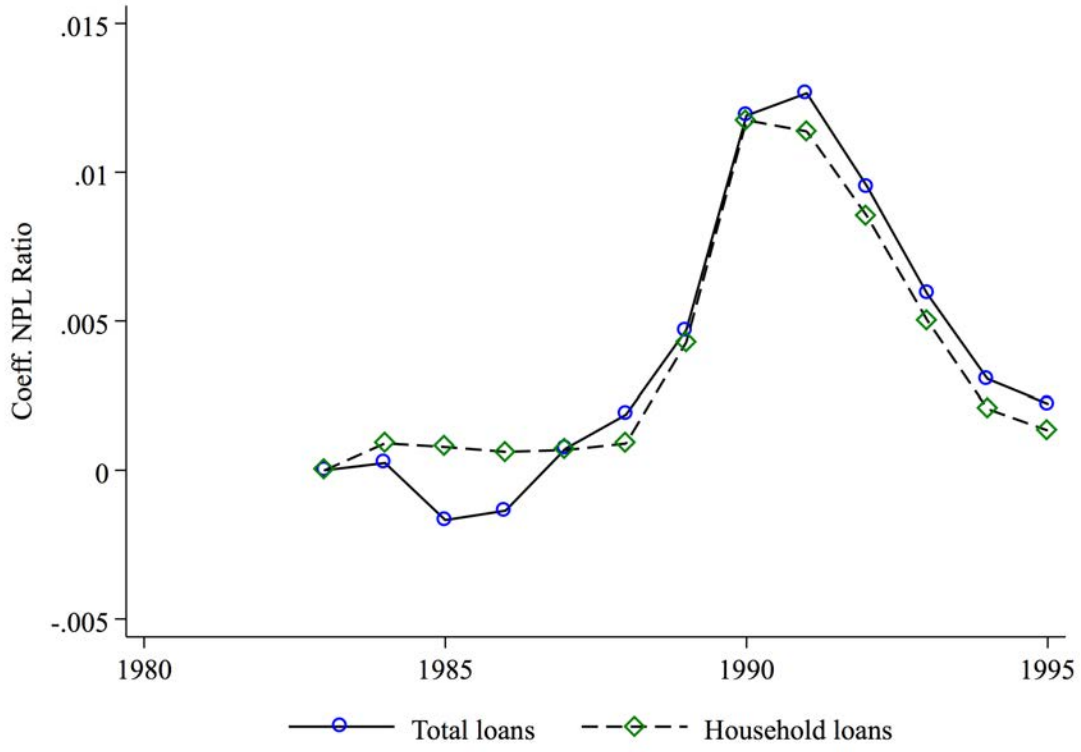
Notes: This figure presents estimates of $\{\beta_y\}$ from $w_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1982} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure and w_{st} is log residualized state wages. Dashed lines represent 95% confidence intervals from standard errors clustered at the state level.

Figure 10: Tradable and Non-Tradable Prices over the Full Cycle



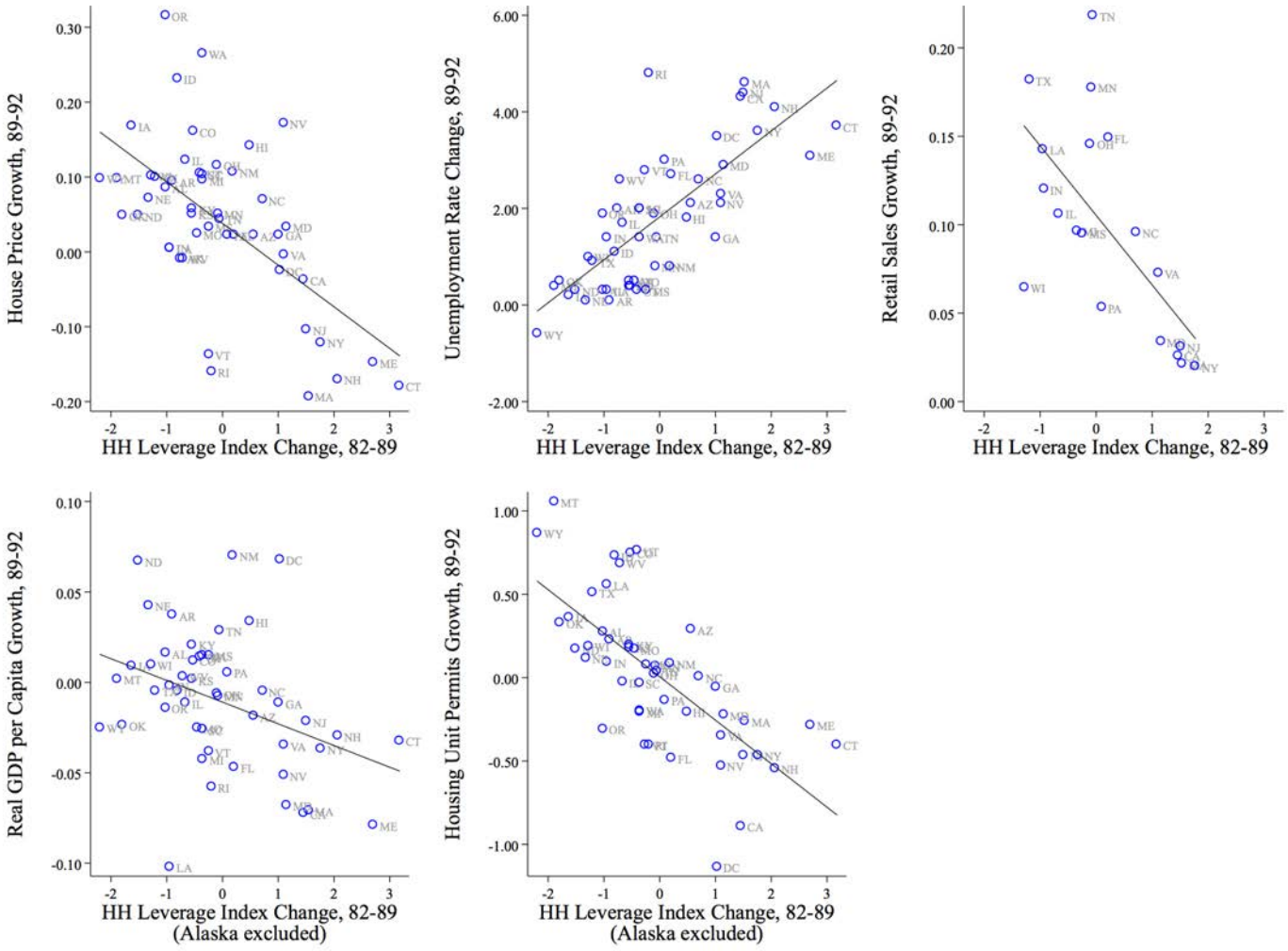
Notes: This figure presents estimates of $\{\beta_y\}$ from $\ln CPI_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1983} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure and $\ln CPI$ is the the log of the state CPI for all items, tradables ("Commodities"), or non-tradables ("Services").

Figure 11: NPL Ratios



Notes: This figure presents estimates of $\{\beta_y\}$ from $NPL_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1983}[\mathbb{1}_{t=y} d_s \beta_y + \mathbb{1}_{t=y} op_s \gamma_y + \mathbb{1}_{t=y} oe_s \delta_y] + \epsilon_{st}$, where d_s is the deregulation measure, op_s is the oil production of state s as of total oil production adjusted for federal production and population size in 1985, oe_s the employment in the oil sector as a share of total employment in 1982, and NPL_{st} is the non-performing loan ratio for household or total loans.

Figure 12: Household Credit Boom and the Subsequent Recession



Notes: This figure presents scatter plots of the change in various outcomes from 1989 to 1992 against the Δ_{82-89} HH leverage index.

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