How Does Credit Supply Expansion Affect the Real Economy? The Productive Capacity and Household Demand Channels

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Abstract

Credit supply expansion can affect an economy by increasing productive capacity or by boosting household demand. This study develops an empirical test to determine whether the household demand channel of credit supply expansion is present, and it implements the test using both a natural experiment in the United States in the 1980s based on banking deregulation and an international panel of 56 countries over the last several decades. Consistent with the importance of the household demand channel, credit supply expansion boosts non-tradable sector employment and the price of non-tradable goods, with limited effects on tradable sector employment. Such credit expansions amplify the business cycle, leading to more severe recessions.

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There is increasing recognition that credit supply expansions and business cycles are closely connected.[1] However, less is known about the exact channel through which credit supply expansion affects the business cycle. This study outlines two potential channels. First, credit expansion may allow constrained firms to borrow and grow, increasing the economy's *productive capacity*. Second, credit expansion may allow households to borrow and consume more, increasing overall *household demand*. The distinction between the two channels is important because the macroeconomic implications may be different based on whether credit expansion increases household demand or productive capacity. For example, researchers have highlighted that a rise in household debt is associated with a heightened risk of financial crisis and a slow-down in growth (Jordà et al. (2016), Mian et al. (2017)).

This paper develops and empirically implements a test of whether the household demand channel is operative during a credit supply expansion. The basic insight comes from Bahadir and Gumus (2016), who show that credit expansion operating through the household demand channel is inflationary in nature and expands employment in the non-tradable sector relative to tradable sector. In contrast, credit expansion operating through the productive capacity channel has a negligible effect on the ratio of employment in the non-tradable to tradable sectors, and a more ambiguous effect on the relative price of non-tradable goods. As a result, empirical evaluation of employment and nominal price patterns across the non-tradable and tradable sectors can be used to highlight the importance of the household demand channel. This study implements the test using both a natural experiment in the United States in the 1980s and a broader international panel of 56 countries with data going back to the 1960s.

The cleanest natural experiment to test the presence of the household demand channel requires an exogenous shock to credit supply that could, in theory, boost either household demand or productive capacity. The United States in the 1980s provides such an environment: there was an aggregate expansion in credit supply, and the strength of this expansion varied across states based on the extent of deregulation of the state's banking sector.

The top panel in Figure 1 shows that credit to GDP expanded by 21.8 percentage points between

[1]See for example, Reinhart and Rogoff (2009), Jordà et al. (2013), Krishnamurthy and Muir (2017), Mian et al. (2017), Baron and Xiong (2017), and López-Salido et al. (2017). Credit supply expansion refers to a greater willingness to lend, all else equal. It may be driven by factors such as deregulation, liberalization, a global savings glut, or behavioral factors (as examples, see Gennaioli et al. (2012), Favilukis et al. (2015), Justiniano et al. (2015), Landvoigt (2016), Greenwood et al. (2016), Bordalo et al. (2018)).

1982 and 1988, the highest growth in credit during an expansionary cycle prior to the 2000s. As the bottom panel of Figure 1 shows, measures of the credit risk premium fell as the quantity of credit increased; for example, the spread between corporate bonds rated BAA and AAA fell by over a hundred basis points. Furthermore, the share of high-yield corporate debt issuance increased from 14.6% to 56.1%. Taken together, a fall in the credit spread and a rise in the high yield share during an era of rapid overall credit growth is a telltale sign of credit supply expansion (see, e.g., Greenwood and Hanson (2013), López-Salido et al. (2017), and Krishnamurthy and Muir (2017)).

The aggregate credit supply expansion affected states differentially based on the extent of deregulation of geographic restrictions on banking activity. Figure 2 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 in 1983 or earlier compared to states that did not deregulate until after 1983. Credit growth in early deregulation states was broad-based, including a large relative rise in the household debt to income ratio, consumer credit, and mortgage applications.

Using this variation across states, the results of this study show that the household demand channel was an important channel through which credit supply expansion driven by banking deregulation affected the real economy during the 1980s. In particular, early deregulation states that experienced a large increase in credit also experienced strong relative expansion in non-tradable employment, while seeing no relative change in tradable sector employment. Even among small tradable sector firms, which Chen et al. (2017) find are likely to be sensitive to expansions in local bank credit supply, there was no differential employment growth in early deregulation states. Furthermore, early deregulation states witnessed inflationary pressure in the non-tradable sector as measured by a relative increase in the price of non-tradable goods compared to late deregulation states. In contrast, there was no relative change in the price of tradable goods in early deregulation states.

The simultaneous increase in the relative price of non-tradable goods, growth in non-tradable sector employment, and stability of tradable sector employment is robust evidence of the importance of an increase in household demand driven by credit supply expansion. A credit supply expansion that boosts productive capacity alone is unlikely to produce these patterns in the data.

Recent theoretical research suggests that the household demand channel of credit expansion may amplify business cycles by generating short term gain at the expense of an eventual bust

(see, e.g., Schmitt-Grohé and Uribe (2016), Korinek and Simsek (2016), and Farhi and Werning (2015)). The results from the 1980s are consistent with this view. In particular, states more exposed to the stronger credit supply expansion experienced a more amplified business cycle. Growth in employment, GDP, house prices, and construction was larger in early deregulation states from 1982 to 1989, and the downturn of 1989 to 1992 was significantly worse in these same states.

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

In addition to downward nominal rigidity, banking sector problems and household debt overhang help explain the worse recession in early deregulation states. 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 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 2012 (Mian et al. (2017)).

One concern with the results is that omitted variables unrelated to credit supply expansion are responsible for the differential patterns found in early banking deregulation states. However, this concern is mitigated by the fact that the methodology follows a long literature in finance starting with Jayaratne and Strahan (1996)'s seminal work using 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

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

cycle conditions.

Furthermore, omitted factors must explain why both the boom and bust were more pronounced in early deregulation states, and why the differential patterns were concentrated in the non-tradable sector. To mitigate such concerns, we show that the results described above are robust to the inclusion of control variables for oil shocks, regulatory forbearance, industry trends, and exposure to import penetration by China. Finally, early deregulation states did not display higher cyclicality in previous business cycles, which suggests that deregulation efforts in the late 1970s and 1980s were critical to the amplification found in the 1980s.

While a focus on the 1980s allows for more precise identification of a credit supply expansion, there is a question of external validity. To broaden the scope of the findings, we construct a novel country-year data set covering 56 economies going back to the 1960s. Results using this data set show that an increase in the household debt to GDP ratio is statistically significantly positively associated with a rise in the non-tradable employment to tradable employment ratio, a rise in the ratio of non-tradable output to tradable output ratio, and a rise in the ratio of non-tradable prices to tradable prices. In contrast, a rise in the firm debt to GDP ratio has almost no significant relationship with any of these variables. Further, consistent with Mian et al. (2017) and IMF (2017), the rise in the household debt to GDP ratio predicts lower subsequent growth whereas a rise in the firm debt to GDP ratio is uncorrelated with subsequent growth.

Cross-sectional variation across states in the rise of the household debt to income ratio from 2000 to 2007 in the United States reveals a similar pattern: states with a larger rise in the household debt to income ratio experienced a sharp rise in employment in the non-tradable sector with no statistically significant change in employment in the tradable sector. These same states witnessed a rise in the relative price of non-tradable goods and a more severe recession from 2007 to 2009. The international evidence and the evidence from the 2000s suggest that the banking deregulation findings from the 1980s hold more broadly: credit supply expansion has affected the real economy through the household demand channel in several episodes over the past 50 years.

This study is most closely related to the literature, initiated by Jayaratne and Strahan (1996), using banking deregulation as an instrument for credit expansion. This is a large body of research; as a result, we delay discussion of its relationship to this study until Section 6, after we have presented the main results. In summary, the approach and results of this study are distinct relative to much

of this literature. For example, this study is the first to our knowledge to use variation across states driven by deregulation to isolate the household demand channel of credit supply expansion, and it is the first to show that early deregulation states witnessed a large relative increase in household debt from 1982 to 1989 and a more severe downturn from 1989 to 1992.[3]

This study is also related to the open economy macroeconomics literature studying 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. This study addresses this challenge by using the staggered timing of deregulation across states and analyzing its macroeconomic implications.[4]

The next section describes the data and summary statistics. Section 2 develops the methodology, and Section 3 describes the 1980s natural experiment of banking deregulation in the United States. Sections 4 and 5 present the results for the 1980s, and Section 6 compares the results for the 1980s natural experiment with the previous literature. Section 7 presents results from the international panel data set and the 2000s boom in the United States, and Section 8 concludes.

1 Data and Summary Statistics

1.1 1980s U.S. state level dataset

The primary data set used in this study is a 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, household debt is constructed using a random sample of individual tax return data at the NBER. The capitalization methodology of Saez and Zucman (2016) is used 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. The second source of household debt is HMDA data which reports data at the loan application level. These data are aggregated to the state level to compute the total number and amount of loan applications.

[3]Please see Section 6 for more details on the contribution of this study relative to the previous literature.

[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, and construction in particular.

Unlike HMDA data from 1991 onward, the earlier sample does not reveal whether a loan is actually originated.

Third, credit to households is measured using bank-level Call Report data at the state level.[5] Two different measures of loans to the household sector are 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 1980s. 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.

Three sources of data are used to measure state-level 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, a *household leverage index* is constructed 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 at the state level.

The most accurate disaggregated measures of household debt come from credit bureau data. Unfortunately, such data are not available for the 1980s. However, we are able to test the quality of the measures constructed for the 1980s by constructing the same measures for the 2000s, and then comparing them with credit bureau data for the 2000s. This exercise is conducted in Figure A1 in the Online Appendix, which shows that the state-level correlation between our measures and credit-bureau measures of the rise in household debt from 2000 to 2007 match closely. This gives us confidence that state-level measures of household debt using the IRS, HMDA, and Call Report

[5]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).

data for the 1980s correspond closely with the actual rise in household debt.[6]

In terms of real variables, the data set includes total employment from the County Business Patterns data set published by the U.S. Census Bureau. Employment is classified into non-tradable, construction, tradable, and other industries using the classification scheme in Mian and Sufi (2014b).[7] The 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. The measure of residential construction is based on new building permits collected by the Census and is available at the state-year level for the full sample starting in 1980.

State-level inflation data comes 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 began in 1984. More specifically, to proxy for the price of non-tradable goods in an MSA, the BLS price index for services is used, and to proxy for the price of tradable goods in a given state, the BLS price index for commodities is used. The state-level index is obtained by averaging across all MSAs in a state. Inflation for subcategories of goods is only available for 26 states in the sample.

State level wages come from the Current Population Survey Outgoing Rotation Group using the CEPR extracts, which are cleaned and adjusted for top-coding.[8] Both raw and residualized state average hourly wages are constructed 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. Average wages are constructed for all workers, separately for males and females, and by industry.

Panel A of Table 1 reports state-level summary statistics of the key variables for the 1980s analysis. 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 by 63%, while consumer loans (which exclude mortgages through 1987 but include home equity loans after 1987) grew 70%. Commercial and industrial loans increased

[6] For state-level household debt in the 2000s, see https://www.newyorkfed.org/microeconomics/databank.html. The numerator comes from the Federal Reserve Bank of New York and income in the denominator comes from IRS filings from the Statistics of Income.

[7] "Other" industries refer to remaining industries that cannot be clearly identified as either tradable or non-tradable. For example, the financial sector provides both tradable and non-tradable services. See Mian and Sufi (2014b) for more details.

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

by 42%. House prices grew by 37% 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, consumer prices rose by 24% from 1982 to 1989.

1.2 International panel dataset

We also construct a panel dataset of 56 economies going back to the 1960s with information on private debt measures, non-tradable and tradable employment and output, and prices. Details on the countries in the sample and date ranges are provided in Table A1 of the Online Appendix. The expansion in household and non-financial firm credit at the country level is constructed using the BIS Long Series on Credit to the Private Sector Database, supplemented with the IMF's new Global Debt Database (Mbaye et al. (2018)).

Employment, prices, and value added by industry are from the EU KLEMS, Groningen Growth and Development Center, and the OECD. We follow Kalantzis (2015) in classifying industries as tradable and non-tradable at the country level. Tradable industries include: Agriculture, Forestry, and Fishing; Manufacturing; and Mining and Quarrying. Non-tradable industries comprise: Utilities; Construction; Wholesale and Retail Trade; Transportation and Storage; Accommodation and Food Service; Information and Communication; Finance and Insurance; Real Estate; and Professional Services. The results are similar when using narrower classifications, such as classifying tradable as Manufacturing and non-tradable as Construction and Wholesale and Retail Trade. Real GDP growth comes from the World Bank's World Development Indicators.

Table 1 panel B presents summary statistics for the key country-level variables. The average three-year change in debt to GDP is 5 percentage points for household debt and 4 percentage points for non-financial corporate debt, consistent with a stronger growth in household debt in recent years. Sectoral activity has been shifting toward non-tradables, with non-tradable employment increasing 10% faster than tradable employment over three-year windows.

2 Empirical Framework

Existing research suggests that credit supply expansions may pose greater downside risks to the real economy if they boost household demand (see, e.g., Schmitt-Grohé and Uribe (2016), Korinek and Simsek (2016), and Farhi and Werning (2015)). This section presents a framework that can be taken to data to discern whether an identified credit supply expansion is operating through the household demand channel.

2.1 Environment

Consider a small open economy inhabited by a representative household, a tradable production sector, and a non-tradable production sector. The household allocates α fraction of expenditures to non-tradable goods, c_N, and $(1-\alpha)$ share of expenditures to tradable goods, c_T. The price of tradables is normalized to one, and the price of non-tradables is denoted by p_N. The household supplies labor to the tradable and non-tradable sector, with total labor supply fixed at $\overline{n}$.[9]

We focus on a single time period and suppress time subscripts to reduce notational clutter. The household finances consumption through wages, w, firm profits, Π, and by borrowing from abroad through debt, d. Assuming the household enters the period with zero debt, the household's period budget constraint is

$$c_T + p_N c_N = \frac{d}{1+r} + w\overline{n} + \Pi.$$

We assume that household borrowing is subject to a borrowing constraint, which can depend on tradable and non-tradable income

$$d \leq \theta_H(y_T, p_N y_N).$$

In the main analysis, we assume that the household can borrow up to a fixed fraction of tradable income, $d \leq \theta_H y_T$, but, as we discuss below, our key results are robust to assuming that household borrowing is constrained by total income, labor income, or by a fixed amount. We assume that the

[9] We generalize the model in several dimensions including allowing for elastic labor supply in Section 2 of the Online Appendix. Robustness to these extensions is discussed in section 2.4.

household borrowing constraint is binding so that $d = \theta_H y_T$. A household credit supply expansion, captured by an increase in θ_H, boosts household borrowing and spending.

Firms in the tradable and non-tradable sectors produce output with labor, n, and capital, k, using a constant returns to scale production function, $y_i = (z_i k_i)^{\phi} n_i^{1-\phi}$, $i \in \{T, N\}$. Firms rent capital at a rate $r + \delta$, subject to a collateral constraint

$$k_i \leq \theta_i, \quad i \in \{T, N\}.$$

In each period, sector i firms solve

$$\max_{k_i, n_i} \; p_i (z_i k_i)^{\phi} n_i^{1-\phi} - w_i n_i - (r + \delta) k_i \quad \text{s.t. } k_i \leq \theta_i.$$

We assume that the collateral constraint is binding in each period, so that $k_i = \theta_i$.[10] If the collateral constraint is not binding, then a relaxation of the constraint will have no impact on the real economy. When the constraint is binding, labor demand by sector i is

$$n_i = \left(\frac{p_i (1 - \phi)}{w} \right)^{\frac{1}{\phi}} \tilde{\theta}_i \tag{1}$$

where, to simplify notation, we have defined $\tilde{\theta}_i := z_i \theta_i$. A relaxation in the collateral constraint, θ_i, leads to a rise in labor demand for a given wage.

2.2 Equilibrium

The ratio of non-tradable to tradable labor demand will be a useful object and is given by

$$\frac{n_N}{n_T} = \frac{\tilde{\theta}_N}{\tilde{\theta}_T} p_N^{\frac{1}{\phi}}. \tag{2}$$

This equation represents the combinations of the non-tradable to tradable employment ratio and non-tradable price consistent with firm optimization. We can think of this relation as the economy's supply curve in $\left(\frac{n_N}{n_T}, p_N \right)$ space, as is depicted by the solid upward sloping "SS" curve in Figure 3(a).

[10] This holds as long as $z_i \phi p_i^{\frac{1}{\phi}} \left(\frac{1-\phi}{w} \right)^{\frac{1-\phi}{\phi}} > r + \delta$, for example, when firm productivity z_i is high, all else being equal.

In equilibrium, the supply of non-tradable output equals demand for non-tradables, $y_N = c_N$. Demand for non-tradables is $c_N = \frac{1-\alpha}{p_N}[\frac{d}{1+r} + p_N y_N + y_T]$. Defining $\tilde{\theta}_H = \frac{\theta_H}{1+r}$, and using that $d = \tilde{\theta}_H y_T$, the non-tradable market clearing condition is

$$y_N = \frac{1-\alpha}{\alpha}\frac{1}{p_N}[\tilde{\theta}_H + 1]y_T,$$

or, substituting in the production functions,

$$\frac{p_N \tilde{\theta}_N^{\phi} n_N^{1-\phi}}{\tilde{\theta}_T^{\phi} n_T^{1-\phi}} = \frac{1-\alpha}{\alpha}[\tilde{\theta}_H + 1]. \tag{3}$$

Equation (3) represents a negative relation between $\frac{n_N}{n_T}$ and p_N that is consistent with non-tradable goods market equilibrium. This can be thought of as the economy's demand curve, and Figure 3(a) plots this relation as the solid downward sloping "DD" curve.[11]

The intersection of the solid supply and demand curves at point A in Figure 3(a) represents the equilibrium values $\frac{n_N}{n_T}$ and p_N. We can solve for equilibrium non-tradable to tradable employment by combining (2) and (3) to obtain

$$\frac{n_N}{n_T} = \frac{1-\alpha}{\alpha}(\tilde{\theta}_H + 1). \tag{4}$$

Substituting (4) back into equation (2) yields the equilibrium price of non-tradables:

$$p_N = \left(\frac{1-\alpha}{\alpha}(\tilde{\theta}_H + 1)\right)^{\phi} \left(\frac{\tilde{\theta}_T}{\tilde{\theta}_N}\right)^{\phi}. \tag{5}$$

2.3 Real effects of credit supply shocks

The model is useful for examining a credit supply expansion for which it is difficult for the econometrician to directly measure whether θ_H, θ_N, and θ_T have changed. Such a credit supply expansion could be driven by factors such as financial deregulation, an inflow of foreign capital, or a change in the financial intermediation technology.

The central result of the model is that one can infer whether the credit supply expansion works

[11] Technically, the "demand" curve is perhaps more accurately described as the curve that corresponds to the non-tradable goods market equilibrium. The curve is shifted by a change in household borrowing constraints, but it can also be shifted by changes in the productivity of firms producing the non-tradable good.

through the household sector (θ_H) by looking at the response of the ratio of employment in the non-tradable to tradable sector. In particular, from equation (4), we have:

Result 1 (Non-tradable to tradable employment ratio). The non-tradable to tradable employment ratio is increasing in θ_H and independent of θ_N and θ_T.

Result 1 implies that *only* a household credit supply expansion boosts the non-tradable relative to tradable employment ratio.

The price of non-tradables is also informative about the nature of a credit supply shock, which is summarized in the second main result that follows directly from (5):

Result 2 (Non-tradable price). The price of non-tradables is increasing in θ_H and θ_T, but decreasing in θ_N. If θ_T is always proportional to θ_N, then a credit supply shock can only affect the price of non-tradables by shifting θ_H.

To better understand Results 1 and 2, consider the impacts of shocks to θ_H, θ_T, and θ_N in a simplified graph of the model (Figure 3). First, consider the impact of a credit supply shock that only operates through the household channel, captured by an increase in θ_H. As depicted in Figure 3(a), this shifts the demand curve outward, but does not affect the supply curve. The equilibrium moves from A to B, with an increase in both $\frac{n_N}{n_T}$ and p_N. Household credit shocks lead to real appreciation and reallocation toward non-tradables. Increased household borrowing boosts demand, raising imports of tradables and production of non-tradables. The price of non-tradables rises to reflect the scarcity of non-tradable output.

Next, consider a credit supply shock that affects both production sectors equally so that the ratio $\frac{\theta_N}{\theta_T}$ remains unchanged. This affects the economy by increasing output of tradables and non-tradables, but has no effect on the non-tradable to tradable employment ratio or the price of non-tradables. Therefore, a broad-based credit supply expansion to firms has no impact on $\frac{n_N}{n_T}$ or p_N.

Suppose instead that the credit supply expansion only affects the tradable sector, so that only θ_T rises. Figure 3(b) shows that this leads to an inward shift in the $\frac{n_N}{n_T}$ supply schedule, reflecting an increase in labor productivity in the tradable sector. All else equal, this lowers $\frac{n_N}{n_T}$ and increases p_N, as non-tradable goods become relatively scarce. The increase in tradable output also raises income and therefore the demand for non-tradables, which shifts the demand schedule outward. In the new equilibrium, the price of non-tradables is higher, but the non-tradable to tradable

employment ratio is unchanged.

Finally, Figure 3(c) presents the impact of an increase in θ_N. The increase in labor productivity in the non-tradable sector leads to a rightward shift in the supply curve, which pushes toward reallocation toward non-tradables and a decline in the price of non-tradables. At the same time, the increase in non-tradable output also shifts the demand curve inward by increasing the supply of non-tradable output. In the new equilibrium $\frac{n_N}{n_T}$ is unchanged, and the price of non-tradables is lower.

In summary, observing a shift in the non-tradable to tradable employment ratio following an identified credit supply expansion implies that the credit expansion is operating through the household sector. This is the key response that we will use to discern whether the household demand channel plays an important role in a credit supply expansion. The impact of a credit supply shock on the price of non-tradables also provides additional information about the nature of the shock. The price of non-tradables rises if credit supply operates through household demand or through the tradable production capacity.

2.4 Robustness of comparative statics

The model is stylized and abstracts from several features that might change how a credit supply shock affects real outcomes. The Online Appendix generalizes the model and illustrates the robustness of Results 1 and 2. First, the appendix shows that Results 1 and 2 are robust to assuming elastic labor supply. Furthermore, the results are robust to allowing for the production technologies in the tradable and non-tradable sectors to differ in the degree of decreasing returns and in their labor intensity. In practice, the non-tradable sector likely exhibits greater decreasing returns and higher labor intensity. Result 1 continues to hold analytically with different production technologies, and Result 2 holds for reasonable numerical values.

The baseline model assumes that household borrowing is constrained by tradable output. The Online Appendix shows that Results 1 and 2 both hold analytically if it is instead assumed that household borrowing is constrained by total output, i.e. $d \leq \theta_H(y_T + p_N y_N)$. We cannot solve the model analytically assuming a fixed household borrowing constraint, $d \leq \theta_H$, but for reasonable numerical values, Results 1 and 2 are robust when solving the model numerically.

Another assumption in the baseline model is that all income from production accrues to house-

holds and this income can be leveraged for consumption. An alternative assumption is that households only receive labor income from production, for example, if technology and capital are owned by households outside of the economy. The Online Appendix shows that Results 1 and 2 continue to hold analytically when households only receive labor income and can only leverage labor income ($d \leq \theta_H wn$).

A firm credit supply expansion can also affect firms by lowering the cost of credit and relaxing working capital constraints. The Online Appendix shows that Results 1 and 2 hold analytically in a model without capital, but where the firm is subject to a working capital constraint on labor, such as in Neumeyer and Perri (2005). In such a model, a credit supply expansion to firms increases firms' ability to finance working capital. This is similar to an increase in labor productivity, which boosts labor demand, as in equation (1) of the baseline model.

Finally, the Online Appendix also allows for more general preferences over non-tradable and tradable consumption. The baseline model assumes a unit elasticity of substitution between non-tradable and tradable consumption. Unit elasticity of substitution is the key result that generates the sharp prediction that only a household credit expansion affects that non-tradable to tradable employment ratio. If non-tradable and tradable goods are complements in consumption, so that the elasticity of substitution is less than one, a tradable sector credit expansion also boosts the non-tradable to tradable employment ratio. However, for empirically plausible values of the elasticity of substitution, the effect of a shock to θ_T on the non-tradable to tradable ratio is substantially smaller than a household credit shock. Therefore, an increase in the non-tradable to tradable employment ratio following a credit supply expansion remains a robust sign that household demand is an important channel of credit supply expansion.

3 The 1980s Banking Deregulation Natural Experiment

Was an increase in household demand an important channel through which banking deregulation in the 1980s affected the real economy? This section presents the natural experiment exploiting the timing of deregulation to answer this question.

3.1 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, intra-state branching restrictions were removed to allow banks to expand their branch network within a state.[12] Second, out-of-state banks were gradually allowed to operate in various states.

Table 2 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, the methodology excludes South Dakota and Delaware, two states that took advantage of the elimination of usury laws to attract credit card businesses.[13]

Table 2 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 2 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 enter a state by purchasing existing banks. The decision to allow out-of-state banks to enter was based on bilateral arrangements between states, until the Riegle-Neal Act of 1994 opened inter-state 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.[14]

To take into account the continuous process and varying pace of bank deregulation across states, our methodology uses 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. Given the focus on the aggregate credit supply expansion during the 1980s, this value is

[12] These changes only applied to commercial banks.

[13] 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.

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

capped at 10, treating states that deregulated before 1979 equally. For each state, the average of these two deregulation variables is the "deregulation measure" that captures the combined effect of the two types of deregulation.[15] 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 2 shows the deregulation measure by state.[16]

The deregulation measure is fixed for each state, which is distinct to the methodology in Jayaratne and Strahan (1996) which uses within-state variation and the exact year of intra-state deregulation as the key right hand side variable. Section 6 explains the reason for the difference and contrasts the methodologies.

The starting point of the empirical analysis is the expansion in credit supply at the aggregate level in the United States that began in 1983. States with a more deregulated banking sector were more exposed to this aggregate expansion in credit supply, a fact shown in Figure 2.[17] The "instrument" for state level credit supply expansion should be seen as the interaction of the aggregate credit supply expansion with state-level deregulation status.

What caused the aggregate increase in credit supply in the United States during the 1980s? We are agnostic on the fundamental source of this underlying process. Global capital flows, behavioral biases, or a change in monetary policy may be posited as potential explanations (e.g. Walsh (1993) and Feldstein (1993)). However, the exact source is not critical for the methodology. What matters is that states with different levels of deregulation "load" differentially on the aggregate credit supply expansion.

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

[16] In Table A2 in the Online 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.

[17] Figure 2 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 the main measure described above with an an R^2 of 0.84. Tables A3-A5 in the appendix show that all of the main results are robust to using this alternative deregulation measure.

3.2 First stage

States that deregulated their banking sector earlier experienced stronger growth in credit during the expansion phase of the business cycle. According to the NBER, the turning point of the economic cycle was July 1990 when the recession began. We mark the turning point of the cycle as of the end of 1989, but show results for the full time series for transparency. Figure 2 shown above shows that total credit growth was stronger in states that started deregulating in 1983 or earlier relative to those that started deregulation afterwards. Table 3 shows further evidence by estimating the following specification:

$$\Delta_{82,89} Y_s = \alpha^{boom} + \pi^{boom} \cdot DEREG_s + \Gamma^{boom} \cdot Z_s + \epsilon_s^{boom} \tag{6}$$

where $\Delta_{82,89} Y_s$ reflects the growth in credit 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.

Panel A presents the estimates of π^{boom} without control variables. All measures of household credit increased relatively more in states that deregulated their banking sector earlier. In terms of magnitudes, a one standard deviation increase in the deregulation measure (1.00) was associated with a 0.04 increase in the household debt to income ratio, which is almost one-half a standard deviation. Growth in mortgage loan applications was also larger in early deregulation states. As columns 4 through 7 show, all measures of credit from the Call Report data grew more from 1982 to 1989 in early deregulation states. Household loan and consumer loan growth were stronger, as was commercial and industrial loan growth.

The final column of Table 3 examines 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 was associated with a 0.74 increase in the household leverage index, 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.

In order to examine the exact timing of the relative growth in credit in early deregulation states, Figure 4 presents coefficient estimates of β_q from the following equation:

$$Y_{st} = \alpha_s + \gamma_t + \sum_{q \neq 1982} \mathbb{1}_{t=q} \cdot DEREG_s \cdot \beta_q + \epsilon_{st} \tag{7}$$

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

Figure 4 shows estimates of β_q 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.[18] After 1989, measures of credit growth in early deregulation states decline relative to the peak. Figure 4, as in Figure 2, shows no strong pre-trend for the credit variables.

Table 3 and Figure 4 show a broad-based increase in household and firm credit in early deregulation states, consistent with a relative expansion in credit supply. However, an evaluation of debt patterns alone is not informative of whether the household or productive capacity of credit supply expansion is operative. For example, in the model above, either an increase in θ_H or an increase in θ_T would increase household debt. The model above demonstrates that the key outcome variables to be evaluated to assess whether the household demand channel is operative are the ratio of employment in the non-tradable to tradable sector, and the relative price of non-tradable goods. Such an evaluation is in Section 4 below.

3.3 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 from 1982 to 1989 may be due to better income prospects as opposed to more credit supply from a more liberalized banking sector.

[18] Household debt-to-income in the top-left panel of Figure 4 only rises in 1987 because household debt and income grow at a similar rate before then.

The source of variation in banking deregulation has 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 1980s, but technological innovations such as 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.[19]

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."[20]

The Kroszner and Strahan (2014) view is further corroborated by the finding of no differential pre-trend in early versus late deregulating states in most of the outcomes explored in this study. Moreover, Panel C of Table 3 presents a placebo test using the previous economic expansion to show that states that deregulated their banking sectors earlier in the 1980s did not see differentially large credit growth during the previous economic expansion. More specifically, Panel C presents specifications similar to equation 6, but using credit growth from 1975 to 1979 instead of 1982 to 1989. We can conduct this test for credit growth from the Call Reports, and we find substantially smaller and statistically insignificant estimates in this placebo period.[21] To further support the exclusion restriction assumption, we show below that, before the 1980s, there is no evidence that early deregulation states had an amplified economic cycle relative to late deregulation states.

An alternative test of the exclusion restriction is the inclusion of control variables. Table 4 presents estimates of equation 6 using growth in the household leverage index from 1982 to 1989

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

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

[21] Recall that the Call Report data start in 1975, whereas the IRS debt to income and the HMDA data only start in 1979 and 1981, respectively.

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, state demographics, unemployment levels prior to the credit boom, and contemporaneous measures of GDP growth and C&I loan growth.[22]

4 Evidence of the Household Demand Channel

4.1 Employment and prices during credit expansion

The discussion in Section 2 highlights how the behavior of non-tradable versus tradable employment and consumer prices can be used to analyze whether a credit supply expansion affects the economy through its impact on household demand. This section explores this idea in the context of the 1980s, where early deregulation states experienced a significantly stronger expansion in credit.

Figure 5 presents state-level scatter plots of employment growth by sector from 1982 to 1989 against the deregulation measure. As the upper left panel shows, employment growth was stronger in early deregulation states. Consistent with the hypothesis that credit supply expansion works through household demand, the higher employment growth in early deregulation states was driven by employment in the non-tradable and construction sector. There was no relative rise in employment in the tradable sector in early deregulation states.

These results are confirmed in a regression context in Table 5. Columns 1 through 4 estimate equation 6 using measures of employment as the outcome variable. They confirm that there was a statistically significant and economically meaningful relative rise in employment in the non-tradable and construction sectors in early deregulation states. In contrast, there was 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 led to a 6% and 16% larger increase in employment in the non-tradable and construction industries, respectively. For both industries, this was one-half a standard deviation of the outcome variable.[23]

The regressions reported in columns 5 through 8 use a dataset covering employment growth

[22] Table A6 of the Online Appendix performs a test of the degree of selection on unobservables based on Oster (2016). The test is based on coefficient stability and the change in R^2 when moving from an uncontrolled to controlled regression. Even with the most comprehensive set of controls (column 6), the identified set excludes zero.

[23] In Table A7 of the Online 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.

from 1982 to 1989 at the state by 2 digit industry level. This data set allows for inclusion of 2-digit industry fixed effects and state fixed effects.[24] Column 7 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 in column 7 ensures that the coefficient estimate on the deregulation variable is independent of any secular trends related to a state's industrial composition. Column 8 adds state fixed effects, which controls for any shock to overall state employment growth that is correlated with the deregulation measure. Even in the specification with state fixed effects, there was a similar differential increase in non-tradable and construction employment relative to tradable employment.

One potential explanation for the limited effect on tradable employment growth is that large firms accounted for the majority of tradable employment, and these large tradable firms did not rely on financing from local banks. Table A8 of the Online Appendix 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, tradable employment growth was not significantly different from 1982 to 1989 in early deregulating states. This finding is important given evidence in Chen et al. (2017) that small tradable firms are on average more reliant on local bank credit than small non-tradable firms.

Figure 6 explores predictions from the model on consumer price inflation. As the top left panel shows, early deregulation states experienced higher inflation rates during the credit expansion phase from 1982 to 1989. A separate examination of prices of consumer goods in the non-tradable (services) and tradable (commodities) categories reveals that the positive correlation is significantly stronger for the price of non-tradable goods.[25]

[24] The inclusion of 2-digit industry fixed effects in columns 7 and 8 helps rule out spurious shocks to employment in certain industries located in certain states. As an extreme example, suppose that a given non-tradable 2-digit industry was located primarily in states that deregulated early, and suppose this 2-digit industry experienced some major demand shock unrelated to banking deregulation that led to a large increase in employment. In the absence of the state and industry fixed effects, the coefficient on the interaction term (Dereg. Measure × non-tradables) would be biased upward. The inclusion of state fixed effects in column 8 controls for shocks to overall employment that may be correlated with Dereg. Measure. This saturated specification allows us to identify the relative effect on non-tradable and construction industries.

[25] In Figure 6 and Table 6, Alaska is excluded when using the smaller sample of 26 states for which the breakdown of tradable and non-tradable goods inflation is available. This is because Alaska is a major outlier for the inflation of non-tradable goods, as shown in Figure A2 in the Online Appendix. As Figure A2 shows, inclusion of Alaska affects inference but not the overall pattern in the cross-section. When the specifications are estimated using overall inflation in the larger sample, Alaska remains an outlier but is included in the estimation because it does not have a major effect on inference in the larger sample. Table A9 in the Online Appendix shows inflation results with the inclusion of Alaska but weights by state population in 1980. The coefficients in the weighted regressions are similar

Table 6 presents similar results in a regression context. There was a larger rise in consumer prices in early deregulation states from 1982 to 1989 which was driven in particular by consumer prices of non-tradable goods. In terms of magnitudes, a one standard deviation increase in deregulation led to a 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 from 1984 to 1989. Column 5 of Table 6 shows that the relative rise in consumer prices of non-tradable goods was statistically significantly larger compared to prices of tradable goods.

Overall, the results on the growth in sectoral employment and prices imply that the stronger credit expansion in early deregulation states affected the real economy through the household demand channel.

4.2 Placebo tests from earlier expansions

One explanation of the results above is that they are spuriously related to banking deregulation in the 1980s because early deregulation states always experience a larger expansion in consumer prices and employment in the non-tradable sector during economic expansions. To test this hypothesis, Table 7 presents specifications similar to equation 6, but using the dates of previous economic expansions instead of 1982 to 1989. The specifications are limited by the availability of data for outcomes going back in time. Economic expansions are dated using NBER recession dates, where expansion is measured from the trough of the last recession to the peak before the next recession. For the 1960s, Table 7 also presents an alternative definition of the expansion from 1960 to 1967 given some evidence that the credit cycle peaked in 1967 instead of 1969.

Across the 14 specifications for which outcome variables are available, there is 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 a larger boost in demand for non-tradable goods during economic expansions.

to the unweighted regression excluding Alaska from the sample.

5 Credit Expansion and Business Cycle Amplification

5.1 Business cycle amplification

The previous section presents evidence that credit supply expansion during the 1980s affected the real economy primarily through boosting household demand. This section is motivated by the idea that such a boost to household demand may ultimately prove short-lived, and in fact may predict a subsequent downturn when credit supply contracts (see, e.g., Schmitt-Grohé and Uribe (2016), Korinek and Simsek (2016), and Farhi and Werning (2015)). Such theories suggest that credit supply expansion may lead to a more amplified business cycle.

The evidence from the 1980s is consistent with this idea. Figure 7 presents estimates of β_q from equation 7 using five measures of economic activity: the unemployment rate, total employment, real GDP per capita, new construction of residential units, and house prices. For all five outcomes, states that deregulated their banking sector earlier experienced an amplified cycle. 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 per capita as for the other outcomes.

The patterns were most pronounced in the housing market. House prices and residential construction displayed 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 four of the five outcomes, there is no differential pre-trend, and the differences began during the heart of the aggregate credit expansion from 1982 onward.

Table 8 presents estimates of equation 6 and a similar equation for the bust:

$$\Delta_{89,92} Y_s = \alpha^{bust} + \pi^{bust} \cdot DEREG_s + \Gamma^{bust} \cdot Z_s + \epsilon_s^{bust}, \tag{8}$$

These specifications allow for the inclusion of control variables for potentially confounding factors. 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. Table 8 shows further evidence of an amplified cycle in the real economy and housing market in early deregulation

states.[26]

The boom-bust pattern is robust to control variables for exposure to oil prices, demographics, and regulatory forbearance during the S&L crisis.[27] Table A10 in the Online Appendix shows that the t-statistics are similar when using standard errors that allow for spatial correlation in the residuals that varies proportionally with the inverse of the distance between states.

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 of 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.

Table A11 in the Online Appendix tests the hypothesis that early deregulation states are inherently more cyclical. In particular, Table A11 reports first difference regressions for previous boom-bust cycles for which data are available. There is no evidence to support the hypothesis that early deregulation states are more cyclical. In fact, there is some evidence that early deregulation states experienced a more modest boom during the 1970 to 1973 period of aggregate expansion.

5.2 Why a worse downturn?

This subsection investigates the factors that led early deregulation states to experience a worse recession. In particular, we investigate three factors that have been emphasized in the literature: high household leverage, nominal rigidities, and banking sector losses. All three factors contributed to the more severe downturn in early deregulation states.

The focus on 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)). There was an aggregate rise in household debt that occurred during the 1980s. From 1984 to 1989, the household

[26] Figure A3 in the Online Appendix presents scatterplots of the regressions in Table 8 to confirm that the results are not driven by outliers.

[27] 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.

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 Figure A4 in the Online Appendix). As shown above in Figure 4, early deregulation states saw a substantially larger rise in household debt from 1984 to 1989.

How was the boom in household leverage related to the bust? All of the results are estimated in reduced form, which makes it impossible to estimate with certainty the underlying structural relationships between measures of the boom in a state and the severity of the subsequent recession. Nonetheless, the correlations suggest an important role of household debt.

Figure 8 shows the scatter plot of the increase in the household leverage index from 1982 to 1989 against the severity of the recession from 1989 to 1992. The rise in household debt prior to 1989 is a statistically powerful predictor of recession severity. The rise in household leverage predicts the rise in the unemployment rate, the fall in retail sales and GDP, and the collapse in house prices and new housing construction.[28]

Panel A of Table A12 of the Online Appendix reports estimates of the regression version of Figure 8. The rise in household leverage has strong predictive power, with an R^2 of 0.35 or above for five of the six measures used. Panel B of Table A12 in the Online Appendix reports estimates of "horse-race" specifications where the effect of an increase in household leverage on downturn severity is compared with the effect of other variables such as the rise in construction from 1982 to 1989. 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.

Another important factor proposed by the literature as an explanation for downturns is nominal rigidities, especially on the downside (e.g. Schmitt-Grohé and Uribe (2016)). Figure 9 explores the full dynamics of consumer prices and wages in early relative to late deregulation states. Specifically, the figure presents estimates of β_q from equation 7 for the overall CPI and for nominal wages. In early deregulation states, consumer prices and average wages increased during the expansionary phase of the cycle, as unemployment was declining. By 1989, price and wage growth stalled,

[28] The retail sales variable at the state-year level is constructed from MSA-level data available from the Census from 1986 to 1996 for 44 MSAs.

but prices and wages remained persistently higher than in late deregulation states, even as the unemployment rate rose sharply. 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 and wages faced some downward rigidity that exacerbated the decline in employment.[29]

Banking sector distress is another factor that can contribute to a worse recession by leading to a contraction in credit supply. As discussed above, Figure 4 shows a sharp reversal of loans, especially household loans, in early deregulation states. Table A14 and Figure A5 in the Online Appendix explore the role of a bigger disruption in the banking sector in early deregulation states during the contraction. As the results in the Online Appendix show, early deregulation states experienced a significantly higher NPL ratio in 1990 for both total loans and household loans. Furthermore, more severe losses by banks on household loans in particular in early deregulation states are correlated with a larger decline in employment.

Downward wage rigidity and banking sector disruption can potentially explain why employment losses in early deregulation states were present in all sectors during the recession (see, for example, Table A7 in the Online Appendix). Both of these factors would affect the tradable sector of the economy, even if employment gains during the boom were primarily concentrated in the non-tradable sector. For example, if banks cut lending to all firms in response to losses stemming from household loans, then even firms in the tradable sector may have reduced employment.

6 Comparison to Literature on Banking Deregulation

The methodology employed in this study is distinct from most of the existing empirical work on banking deregulation. In this study, a state is assigned a single deregulation score based on how early banking deregulation took place, and the methodology is designed to capture how a state with earlier deregulation differentially loads on the aggregate credit supply cycle of 1982 to 1992.

[29] 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)). Table A13 of the Online Appendix explores 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 A13 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. We also explored whether the lack of a decline in wages among early deregulation states was stronger in high union density states, but we did not find a significant interaction effect between the deregulation measure and unionization.

In contrast, the existing literature typically adopts a 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.[30] More specifically, the specification used in Jayaratne and Strahan (1996) is:

$$Y_{st} = \alpha_s + \gamma_t + \beta * DEREG_{st} + \epsilon_{st} \tag{9}$$

where $DEREG_{st}$ takes on the value zero before a state deregulates and one afterward. This specification also includes state and year fixed effects. The estimated β from this specification reflects the immediate effect of deregulation on Y by comparing states that deregulate in year t with states that have not yet deregulated.[31]

The specifications in this study are not designed to capture the short-term effect of deregulation, but instead they are designed to capture the higher loading on the longer economic cycle that comes from having a more deregulated banking sector. For example, consider two states, one that deregulated in 1980 and the other in 1984. Equation 9 estimates the effect of deregulation by comparing differences between the two states from 1980 to 1984, but treats both states equally after 1984 when the aggregate credit supply expansion accelerated to its peak. In contrast, the specifications shown in Section 3.2 give a higher deregulation score to the state that deregulated in 1980 with the presumption that a state that deregulated in 1980 versus 1984 will have a stronger loading on the aggregate credit supply expansion that accelerated from 1984 to 1989.

The contrast between the two specifications is even starker for examination of the bust from 1989 to 1992. For the bust, equation 9 treats two states equally that deregulated in 1981 and 1989. In contrast, the specifications shown in Section 3.2 acknowledge that the state that deregulated in 1981 witnessed a substantially larger credit boom from 1981 to 1989, which will likely lead to a more severe bust. Further, given that most states deregulated prior to 1990, the specification in equation 9 is not well-suited for an examination of the effect of deregulation on subsequent recession severity.

[30] 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.

[31] Tables A15 through A17 of the Online Appendix replicate this specification from Jayaratne and Strahan (1996) in our data set and finds similar results for economic growth, employment growth, and bank loan growth.

The key findings of this study with regard to employment patterns are robust to either methodology. More specifically, the employment results shown in Table 5 are similar if we adopt the specification in equation 9, as shown in Table A18 in the Online Appendix. There was an increase in total employment after a state deregulated, and this increase was driven by an increase in employment in the non-tradable and construction sectors. There was no statistically significant increase in employment in the tradable sector after deregulation.

There are several novel results in this study relative to the extensive body of research on U.S. banking deregulation in the 1980s. To the best of our knowledge, this is the first study to examine the effect of deregulation on employment growth across sectors and on nominal prices and wages. It is also the first to examine the effect of deregulation on household debt; in fact, the state-year level household debt data set constructed in this study is new to the literature.[32] Furthermore, this is the first study to our knowledge to examine the medium-run consequences of deregulation on downturn severity from 1989 to 1992. While banking deregulation may have boosted economic growth in the short-term, the findings presented here suggest that early deregulation may have led to a more severe recession in 1990 and 1991.

The results shown in this study do not imply a normative stance on deregulation. 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 the empirical setting used here. Table A19 in the Online Appendix presents estimates of "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.

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

[32] Favara and Imbs (2015) and Landier et al. (2017) examine the effect of deregulation on house price growth and co-movement in house prices, respectively.

show that these residuals decline in a given state as the banking system becomes more integrated due to deregulation. In Table A20 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.

Another key difference in this study is the focus on more aggregated analysis at the state level as opposed to firm or household level analysis. Focusing on firm or household level data may miss across-industry spillovers created by credit supply expansions. For example, if credit expansion temporarily boosts household demand, wages in all sectors may rise, resulting in tradable firms becoming less competitive with tradable sector firms in other locations. Or alternatively, there may be reallocation of labor away from tradable sector firms toward less productive firms producing non-tradable goods (Borio et al. (2016)).

While credit expansion may relax borrowing constraints at the firm level within a given industry thereby shifting employment to more productive firms, the across-industry spillovers could offset some of the partial equilibrium gains estimated at the microeconomic level. As an example, Bai et al. (2016) use establishment-level data to find compelling evidence that banking deregulation increased employment for more productive firms within the manufacturing industry in a state. However, the results presented here suggest that early deregulation states witnessed a substantial relative increase in employment in the retail and construction sectors while employment in the manufacturing sector remained unchanged. Even though deregulation improved productivity within the manufacturing sector, the shift of jobs to the retail and construction sector prevented overall growth in employment in the manufacturing sector.

Finally, while this study emphasizes the importance of household demand in explaining how credit supply expansion fueled by banking deregulation affected the real economy, it does not dispute the potential importance of the productive capacity channel. As the model shows, an expansion of credit that loosens constraints for both firms producing non-tradable and tradable goods does not have an effect on either the ratio of employment in the non-tradable to tradable sector or the relative price of non-tradable goods. In other words, even if there was no relative

change in these two variables, the productive capacity channel may still have been operative. While the test developed here helps illuminate the importance of the household demand channel, it is not well-suited for detecting the existence or strength of the productive capacity channel.[33]

Furthermore, the focus of the analysis on variation across states based on banking deregulation misses any national-level effects of credit supply expansion that may have operated through the productive capacity channel, such as the expansion of the high-yield bond market in the mid to late 1980s.

7 The Household Demand Channel in Broader Settings

The staggered banking deregulation that occurred in the United States during the 1980s provides an appealing setting to study the real consequences of credit supply expansion. However, it represents only one cycle in one country. This section presents evidence that the household demand channel of credit supply expansion is prevalent in broader settings.

The analysis in Table 9 uses the international panel dataset of 56 countries going back to the 1960s described in Section 1.2. Columns 1 and 2 of Panel A present results from estimating the following specification at the country level:

$$\Delta_3 \ln(Emp_{NT}/Emp_T)_{it} = \alpha_i + \beta^P \Delta_3 d^P_{it} + \epsilon_{it}, \tag{10}$$

where $\Delta_3 \ln(Emp_{NT}/Emp_T)_{it}$ is the three-year change in the log non-tradable to tradable employment ratio, α_i is a country-fixed effect, and $\Delta_3 d^P_{it}$ is the three-year changes in the private debt to GDP ratio. We examine three-year changes based on the result in Mian et al. (2017) that credit shocks typically lead to an expansion in credit of three to four years.[34] Standard errors are dually clustered on country and year. This accounts for within-country correlation induced by overlapping observations, as well as common shocks in a given year.

The drawback of this setting is the lack of exogenous variation in the measure of credit expansion, $\Delta_3 d^P_{it}$. However, recent evidence suggests that sudden three to four year increases in private

[33] Examples of studies that support the role of the productive capacity channel following banking deregulation and other credit supply expansions include Jayaratne and Strahan (1996), Bai et al. (2016), Bertrand et al. (2007), and Larrain and Stumpner (2017).

[34] The results are robust to the length of differencing.

debt to GDP ratios are driven by credit supply (see, e.g., Mian et al. (2017) and Krishnamurthy and Muir (2017)). For example, Mian et al. (2017) show that expansions in household debt to GDP ratios are typically associated with low interest rate spread environments.

Column 1 of Panel A of Table 9 shows that an increase in the private debt to GDP ratio is associated with an increase in the non-tradable to tradable employment ratio. Column 2 shows that this relation is not affected by controlling for GDP growth over the same three-year window, the level of GDP per capita, and year fixed effects. Columns 3 and 4 replace the dependent variable with the relative growth in non-tradable to tradable output from $t-3$ to t, $\Delta_3 \ln(Y_{NT}/Y_T)$. Credit expansions are associated with a rise in non-tradable output relative to tradable output. Columns 5 and 6 examine the relationship between credit expansion and the price of non-tradables relative to tradables, defined as the non-tradable and tradable output deflators. Here, the relationship is weaker.

Panel B reports estimates from a specification similar to equation 10 in which changes in the private debt to GDP ratio are decomposed into changes in the household debt to GDP ratio and changes in the firm debt to GDP ratio. As the results in Panel B show, a rise in the household debt to GDP ratio is driving the overall positive relationship between credit expansions and the rise in the non-tradable to tradable employment and output ratios (columns 1 through 4). A rise in firm debt to GDP ratios have a significantly smaller effect on these variables. Further, a rise in the household debt to GDP ratio is positively associated with the relative rise in the price of non-tradable goods (columns 5 and 6). Overall, the results from the broader sample support the idea that credit supply expansions affect the real economy primarily through boosting household demand.

The international evidence also confirms the relationship between credit expansion and subsequent growth found in the United States in the 1980s. The specifications reported in columns 7 and 8 of Panel A replace the left-hand-side variable with GDP growth from $t+1$ to $t+4$. Consistent with the evidence in Mian et al. (2017), in this broader panel, credit expansions are associated with lower subsequent growth. Furthermore, as shown in Panel B, the predictive power comes primarily from the growth in household debt.

As a final exercise to explore the methodology, we examine the 2000s boom in the United States. There is a large body of evidence supporting the view that credit supply expansion to households in

the United States fueled household demand (see, e.g., Mian and Sufi (2018) and citations therein). For example, from 2000 to 2007, the aggregate household debt to income ratio experienced a large increase. In contrast, the aggregate corporate debt to income ratio actually fell (Mian and Sufi (2011)). Given these patterns, we should expect to find evidence in favor of the household demand channel of credit supply expansion during these years.

Table 10 provides such evidence. The analysis is conducted at the state-level using the rise in the household debt to income ratio in a state as the right hand side variable. As the table shows, there was a positive relationship between the household debt to income change and growth in non-tradable and construction employment, and the magnitude was large. For example, a one-standard deviation increase in the rise in mortgage debt to income (13.9 percentage points) was associated with a 3.1% percent increase in non-tradable employment, or half a standard deviation. In contrast, there was no statistically significant relationship between the rise in the household debt to GDP ratio and employment growth in the tradables sector. Further, Table 10 shows that a rise in the household debt to income ratio was associated with a statistically significant increase in the price of non-tradables, and a statistically significant but smaller increase in the price of tradables. Finally, as shown in column 7, the increase in the household debt to income ratio from 2000 to 2007 predicts a decline in employment growth from 2007 to 2009, with an R^2 of 39%.

As with the international panel evidence, there is no instrument for the change in the household debt to income ratio. As a result, these results should be interpreted with caution. Nonetheless, this exercise is useful because it shows that implementation of the methodology outlined in Section 2 reveals the importance of the household demand channel in an environment in which it is already well established that credit supply expansion primarily affected the household sector.

8 Conclusion

The effect of credit supply expansion on the real economy depends on whether it boosts household demand or productive capacity. This study develops a simple empirical test based on movements in employment and prices to detect the importance of the household demand channel. The methodology is implemented in the context of bank deregulation across the United States in the 1980s. This is a particularly interesting environment given that the existing literature emphasizes how bank

deregulation improved the allocation of resources across firms, but is largely silent on the household demand channel.

The analysis here shows that the household demand was an important channel through which banking deregulation affected the real economy. 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. Early deregulation states also witnessed substantial relative increase in the price of non-tradable goods during the expansion.

Consistent with demand-based models of credit supply cycles, the evidence shows 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.

The hope is that the methodology can prove useful in broader settings. For example, analysis of international panel data along with the experience of the United States during the 2000s supports the importance of the household demand channel of credit supply expansion. Credit supply expansions are common, and the methodology here offers a simple test to detect the importance of such expansions in boosting household demand.

Table 1: Summary Statistics

	N	Mean	Median	SD
Panel A: U.S. 1980s state-level dataset				
Dereg. measure	49	0.00	-0.32	1.00
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(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	0.63	0.61	0.36
Δ_{82-89} ln(Consumer loans)	49	0.70	0.71	0.46
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(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_{82-89} ln(Non-tradable employment)	49	0.23	0.24	0.11
Δ_{82-89} ln(Construction employment)	49	0.20	0.30	0.31
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
Panel B: International panel dataset				
Δ_3 HH debt to GDP	843	0.05	0.04	0.06
Δ_3 Firm debt to GDP	843	0.04	0.03	0.12
Δ_3 ln(Non-trad./tradable empl.)	843	0.10	0.09	0.07
Δ_3 ln(Non-trad./tradable output)	843	0.03	0.03	0.10
Δ_3 ln(Non-trad./tradable prices)	843	0.02	0.03	0.11
Δ_3 ln(Real GDP)	843	0.09	0.08	0.08

Notes: Dereg. measure is defined in Table 2. 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 2: Year of State Level Deregulation

State	Inter-state deregulation	Intra-state deregulation	Dereg. measure
Alaska	1982	1970	1.62
Alabama	1987	1981	0.38
Arkansas	1989	1994	-1.39
Arizona	1986	1970	0.91
California	1987	1970	0.74
Colorado	1988	1991	-1.21
Connecticut	1983	1980	1.27
Washington, DC	1985	1970	1.09
Florida	1985	1988	-0.50
Georgia	1985	1983	0.38
Hawaii	1995	1986	-0.86
Iowa	1991	1994	-1.39
Idaho	1985	1970	1.09
Illinois	1986	1988	-0.68
Indiana	1986	1989	-0.86
Kansas	1992	1987	-1.03
Kentucky	1984	1990	-0.50
Louisiana	1987	1988	-0.86
Massachusetts	1983	1984	0.56
Maryland	1985	1970	1.09
Maine	1978	1975	2.15
Michigan	1986	1987	-0.50
Minnesota	1986	1993	-0.86
Missouri	1986	1990	-0.86
Mississippi	1988	1986	-0.68
Montana	1993	1990	-1.39
North Carolina	1985	1970	1.09
North Dakota	1991	1987	-1.03
Nebraska	1990	1985	-0.68
New Hampshire	1987	1987	-0.68
New Jersey	1986	1977	0.91
New Mexico	1989	1991	-1.39
Nevada	1985	1970	1.09
New York	1982	1976	1.62
Ohio	1985	1979	1.09
Oklahoma	1987	1988	-0.86
Oregon	1986	1985	-0.15
Pennsylvania	1986	1982	0.38
Rhode Island	1984	1970	1.27
South Carolina	1986	1970	0.91
Tennessee	1985	1985	0.03
Texas	1987	1988	-0.86
Utah	1984	1981	0.91
Virginia	1985	1978	1.09
Vermont	1988	1970	0.56
Washington	1987	1985	-0.32
Wisconsin	1987	1990	-1.03
West Virginia	1988	1987	-0.86
Wyoming	1987	1988	-0.86

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 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: Baseline								
Dereg. measure	0.0410**	0.422*	0.196*	0.193**	0.239**	0.136*	0.237**	0.752**
	(0.0117)	(0.162)	(0.0889)	(0.0587)	(0.0628)	(0.0536)	(0.0608)	(0.149)
R^2	0.210	0.182	0.128	0.217	0.250	0.144	0.269	0.398
Panel B: Lagged Dependent Variable Controls								
Dereg. measure	0.0301**			0.190**	0.170*	0.125+	0.222**	
	(0.0103)			(0.0492)	(0.0633)	(0.0627)	(0.0584)	
R^2	0.477			0.439	0.425	0.197	0.375	
Panel C: Placebo Test on 1975-79 Expansion								
Dereg. measure				-0.0169	0.0174	-0.0246	0.0220	
				(0.0110)	(0.0267)	(0.0171)	(0.0208)	
R^2				0.035	0.012	0.036	0.031	
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: $\Delta_{82,89}Y_s = \alpha^{boom} + \pi^{boom} \cdot DEREG_s + \Gamma^{boom} \cdot Z_s + \epsilon_s^{boom}$. The $\Delta_{84,89}$ Loan application number and $\Delta_{84,89}$ 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 "Mortgages Secured by 1-4 Family Residential Properties" 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 $\Delta_{82,89}$ HH leverage index represents the first principal component of $\Delta_{82,89}$ Debt-to-income, $\Delta_{84,89}$ Loan appl. volume, and $\Delta_{82,89}$ Consumer loans. Panel B controls for the one-year changes in the dependent variable between 1978 and 1982. Panel C presents placebo tests on the previous expansion from 1975 to 1979 for variables available during that period. 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	0.710**	0.690**	0.531**	0.788**	0.709**	0.354*	0.533**
	(0.153)	(0.169)	(0.156)	(0.139)	(0.176)	(0.172)	(0.190)
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)	
Real GDP per Capita$_{1982}$				-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 $\Delta_{82,89}$ HH leverage index on the deregulation measure and various controls. $\Delta_{82,89}$ HH leverage index represents the first principal component of $\Delta_{82,89}$ Debt-to-income, $\Delta_{84,89}$ Loan appl. volume, and $\Delta_{82,89}$ 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 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	0.0539**	0.00240	0.0572**	0.163**	0.0384*	-0.0209	-0.0184	-
	(0.0149)	(0.0176)	(0.0136)	(0.0410)	(0.0157)	(0.0218)	(0.0215)	-
Dereg. measure x other						0.0726**	0.0686**	0.0697**
						(0.0234)	(0.0233)	(0.0229)
x non-tradables						0.0903**	0.0878**	0.0887**
						(0.0241)	(0.0238)	(0.0235)
x construction						0.187**	0.184**	0.185**
						(0.0400)	(0.0405)	(0.0402)
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; and others are the remaining industries. 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. In column 6, an indicator variable for each group if industries is included, but the coefficients on these variables are not reported. 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 6: 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	1.805**	2.367**	4.074**	0.307	0.307
	(0.489)	(0.520)	(0.788)	(0.465)	(0.470)
Dereg. measure × NT					3.767**
					(0.832)
Dummy Non-tradables					11.86**
					(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. Table A9 in the online appendix reports estimates with Alaska included. 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 7: Placebo Regressions of CPI and Employment Growth on Deregulation in Previous Expansions

	(1) Δ CPI (Del Negro)	(2) Δ Empl. tradables	(3) Δ Empl. non-tradables	(4) Δ Empl. construction
Panel A: Boom Period 1975-1979				
Dereg. measure	-0.00828**	-0.00844	-0.0130	-0.0754*
	(0.00275)	(0.0141)	(0.0120)	(0.0318)
R^2	0.179	0.008	0.026	0.125
Observations	48	49	49	49
Panel B: Boom Period 1970-1973				
Dereg. measure	0.00339*	-0.0275+	-0.0103	-0.0153
	(0.00150)	(0.0146)	(0.00997)	(0.0205)
R^2	0.126	0.083	0.026	0.011
Observations	48	49	49	49
Panel C: Boom Period 1962-1969				
Dereg. measure		0.00332	0.0452	0.0283
		(0.0322)	(0.0313)	(0.0442)
R^2		0.000	0.067	0.010
Observations		48	48	48
Panel D: Boom Period 1962-1967				
Dereg. measure		0.0192	0.0398	0.0215
		(0.0349)	(0.0333)	(0.0550)
R^2		0.010	0.055	0.004
Observations		47	47	47

Notes: The table reports regressions of inflation and employment growth in previous expansions on the deregulation measure. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 8: Deregulation and Amplification: First-Difference Specifications

	Boom: Change from 82 to 89				Bust: Change from 89 to 92			
	(1)	(2) Lagged	(3)	(4) Demographics	(5)	(6) Lagged	(7)	(8) Demographics
Controls	None	Dep. Var.	Oilshock	& Forbearance	None	Dep. Var.	Oilshock	& Forbearance
				Panel A: Unemployment				
Dereg. measure	-0.606*	-0.845**	-0.217	-0.431*	0.889**	0.832**	0.792**	0.776**
	(0.228)	(0.164)	(0.219)	(0.208)	(0.138)	(0.140)	(0.159)	(0.107)
R^2	0.104	0.678	0.419	0.422	0.405	0.440	0.473	0.582
				Panel B: Total Employment				
Dereg. measure	0.0539**	0.0639**	0.0172	0.0487**	-0.0282**	-0.0305**	-0.0296**	-0.0220+
	(0.0149)	(0.0160)	(0.0112)	(0.0170)	(0.00984)	(0.00870)	(0.00914)	(0.0113)
R^2	0.193	0.332	0.723	0.214	0.181	0.240	0.358	0.452
				Panel C: Real GDP				
Dereg. measure	0.0908**	0.0607**	0.0592**	0.0708*	-0.0185*	-0.0126	-0.0185*	-0.0155
	(0.0285)	(0.0189)	(0.0147)	(0.0320)	(0.00822)	(0.00884)	(0.00720)	(0.0108)
R^2	0.217	0.773	0.802	0.353	0.121	0.429	0.326	0.209
				Panel D: Real GDP per capita				
Dereg. measure	0.0624*	0.0381**	0.0431**	0.0423	-0.0228**	-0.0200**	-0.0202**	-0.0214*
	(0.0294)	(0.0114)	(0.0102)	(0.0318)	(0.00776)	(0.00676)	(0.00509)	(0.00860)
R^2	0.134	0.871	0.861	0.380	0.218	0.472	0.524	0.383
				Panel E: House prices				
Dereg. measure	0.189**	0.189**	0.151**	0.193**	-0.0430**	-0.0327*	-0.0461**	-0.0444*
	(0.0403)	(0.0376)	(0.0475)	(0.0499)	(0.0134)	(0.0127)	(0.0163)	(0.0176)
R^2	0.325	0.506	0.384	0.468	0.150	0.433	0.153	0.313
				Panel F: Housing unit permits				
Dereg. measure	0.277**	0.283**	0.0280	0.216*	-0.228**	-0.230**	-0.156*	-0.144*
	(0.0861)	(0.102)	(0.0612)	(0.0878)	(0.0585)	(0.0638)	(0.0598)	(0.0629)
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 E columns 2 and 6 use two lagged dependent variables due to data availability. Alaska is dropped from Panel E 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 9: Broader Evidence from International Panel Data

	$\Delta_3 \ln\left(\frac{Emp_{NT}}{Emp_T}\right)_{it}$		$\Delta_3 \ln\left(\frac{Y_{NT}}{Y_T}\right)_{it}$		$\Delta_3 \ln\left(\frac{P_{NT}}{P_T}\right)_{it}$		$\Delta_3 y_{it+4}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Private Credit Expansion								
$\Delta_3 d_{it}^P$	0.16**	0.15**	0.23**	0.17**	0.066+	0.043	-0.15**	-0.12**
	(0.040)	(0.039)	(0.031)	(0.029)	(0.038)	(0.040)	(0.032)	(0.025)
R^2	0.13	0.25	0.14	0.27	0.0099	0.12	0.100	0.53
Panel B: Household and Firm Credit Expansion								
$\Delta_3 d_{it}^{HH}$	0.39**	0.37**	0.47**	0.45**	0.31*	0.34*	-0.45**	-0.32**
	(0.069)	(0.060)	(0.080)	(0.079)	(0.13)	(0.15)	(0.11)	(0.075)
$\Delta_3 d_{it}^F$	0.059	0.055	0.12*	0.051	-0.041	-0.082	-0.019	-0.038
	(0.055)	(0.056)	(0.059)	(0.056)	(0.071)	(0.071)	(0.045)	(0.031)
R^2	0.16	0.28	0.16	0.29	0.030	0.14	0.16	0.55
Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Controls and year FE		✓		✓		✓		✓
Observations	843	843	843	843	843	843	843	843

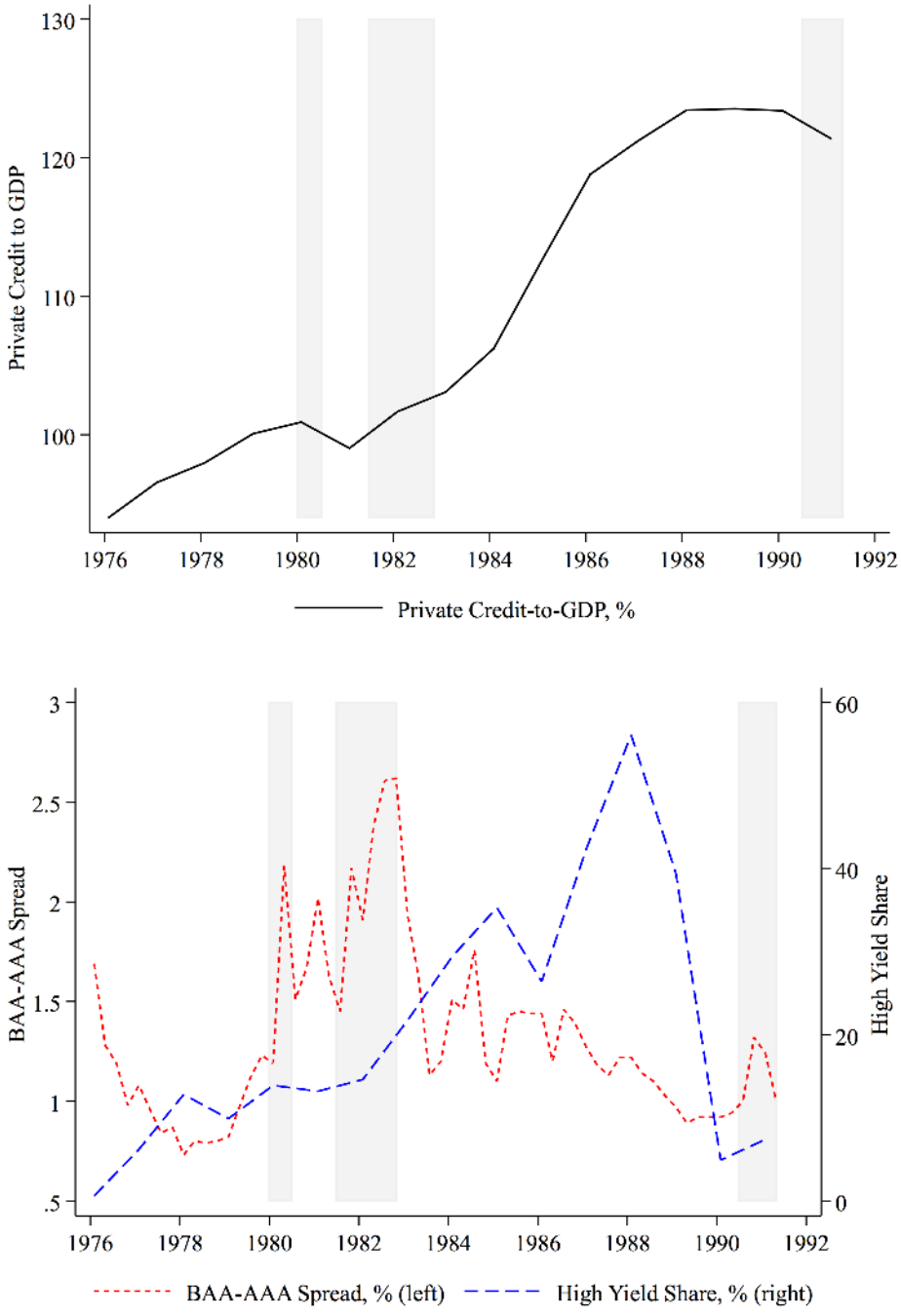
Notes: This table analyzes the relation between private, household, and non-financial firm credit expansions on various outcomes at the country-level. Panel A uses the overall private non-financial credit-to-GDP expansion between $t-3$ and t as the right hand side variable. Panel B breaks the private credit expansion into the expansion in household and non-financial firm debt to GDP. The dependent variables are the relative growth in non-tradable to tradable employment (columns 1-2), relative growth in non-tradable to tradable output (columns 3-4), relative growth in non-tradable to tradable prices (columns 5-6), and future GDP growth from year $t+1$ to $t+4$ (columns 7-8). Controls include real GDP growth from $t-3$ to t and the level of real GDP per capita. Standard errors are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table 10: Broader Evidence: The 2000s Boom

	(1) Δ_{00-07} Empl. Non-tradables	(2) Δ_{00-07} Empl. Tradables	(3) Δ_{00-07} Empl. Construction	(4) Δ_{00-07} CPI	(5) Δ_{00-07} CPI Non-tradables	(6) Δ_{00-07} CPI Tradables	(7) Δ_{07-09} Total Employment
Δ_{00-07} HH DTI	0.22**	-0.16	0.27*	0.069**	0.079*	0.036*	-0.11**
	(0.073)	(0.16)	(0.11)	(0.021)	(0.031)	(0.013)	(0.026)
R^2	0.28	0.037	0.14	0.21	0.16	0.13	0.39
Observations	50	50	50	29	29	29	50

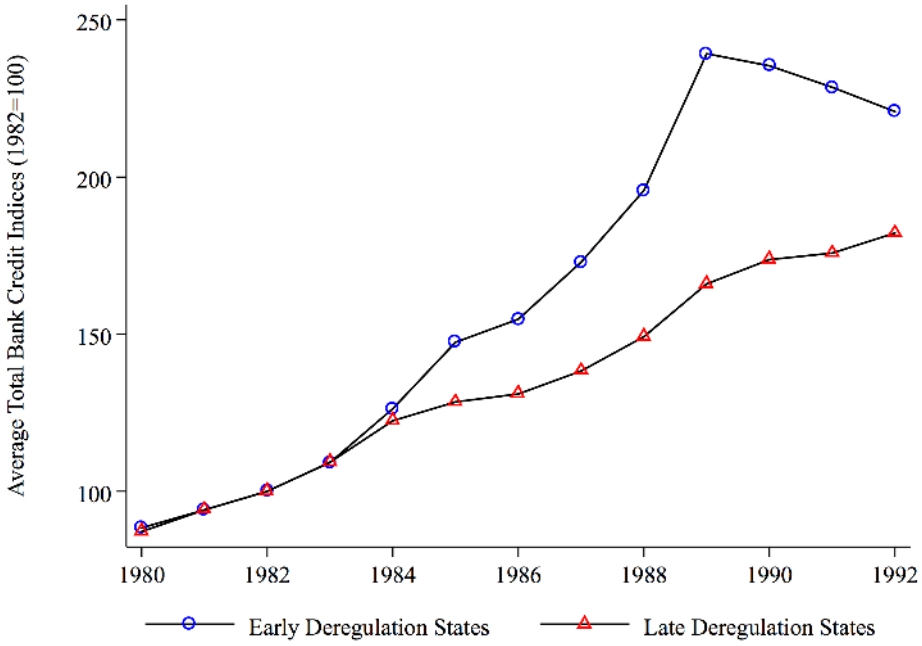
Notes: This table explores the consequences of household credit expansions at the state level during the 2000s boom in the United States. The right-hand-side variable is the change in state household debt to income between 2000 and 2007 from the Federal Reserve Bank of New York. Heteroskedasticity robust standard errors in parentheses. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

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



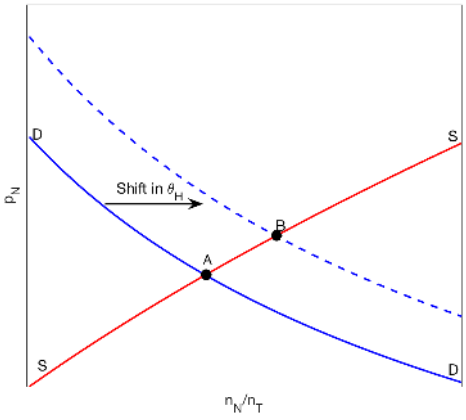
Notes: The top panel shows time series plot of the private credit to GDP ratio. The bottom panel shows the time series plot of the Baa-Aaa spread (left axis), and the high yield share (HYS) of corporate debt issuance from Greenwood and Hanson (2013) (right axis). Shaded bars represent NBER recession dates.

Figure 2: Credit Expansion in Early and Late Deregulation States

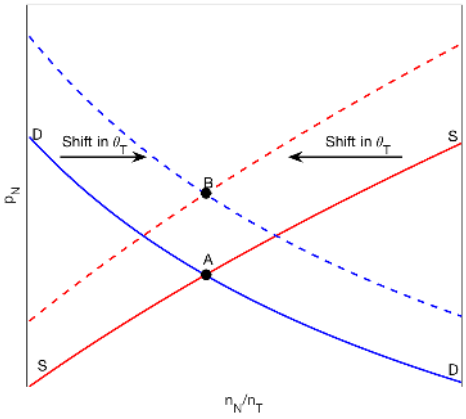


Notes: This figure shows average of total bank credit indices (normalized to 100 for each state in 1982) across early and late deregulation states. Total bank credit is the sum of household loans and commercial and industrial loans in the Call Reports. Early deregulation states are defined as states that deregulated intra- or inter-state restrictions in 1983 or earlier, and late deregulation states are states that began the deregulation process after 1983.

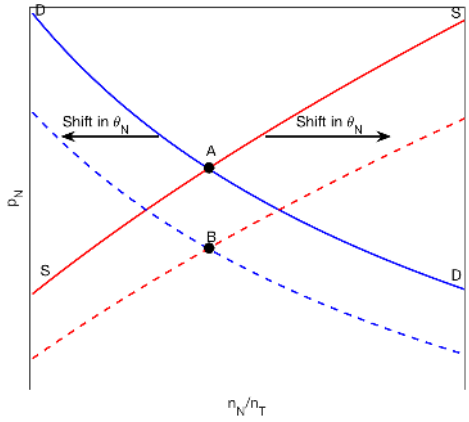
Figure 3: Household and Firm Credit Shocks in the Model



(a) Household credit shock, θ_H



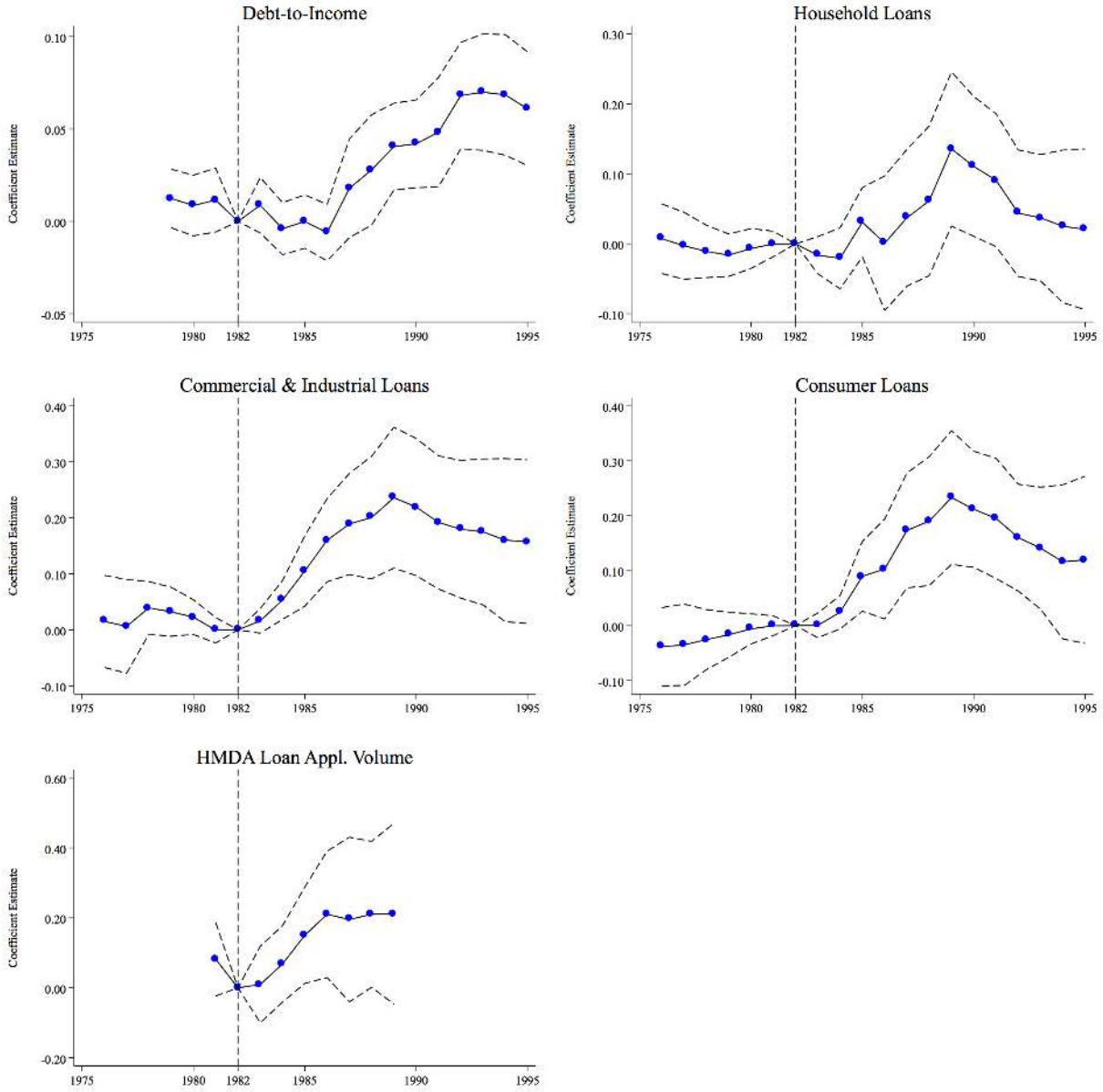
(b) Tradable firm credit shock, θ_T



(c) Non-tradable firm credit shock, θ_N

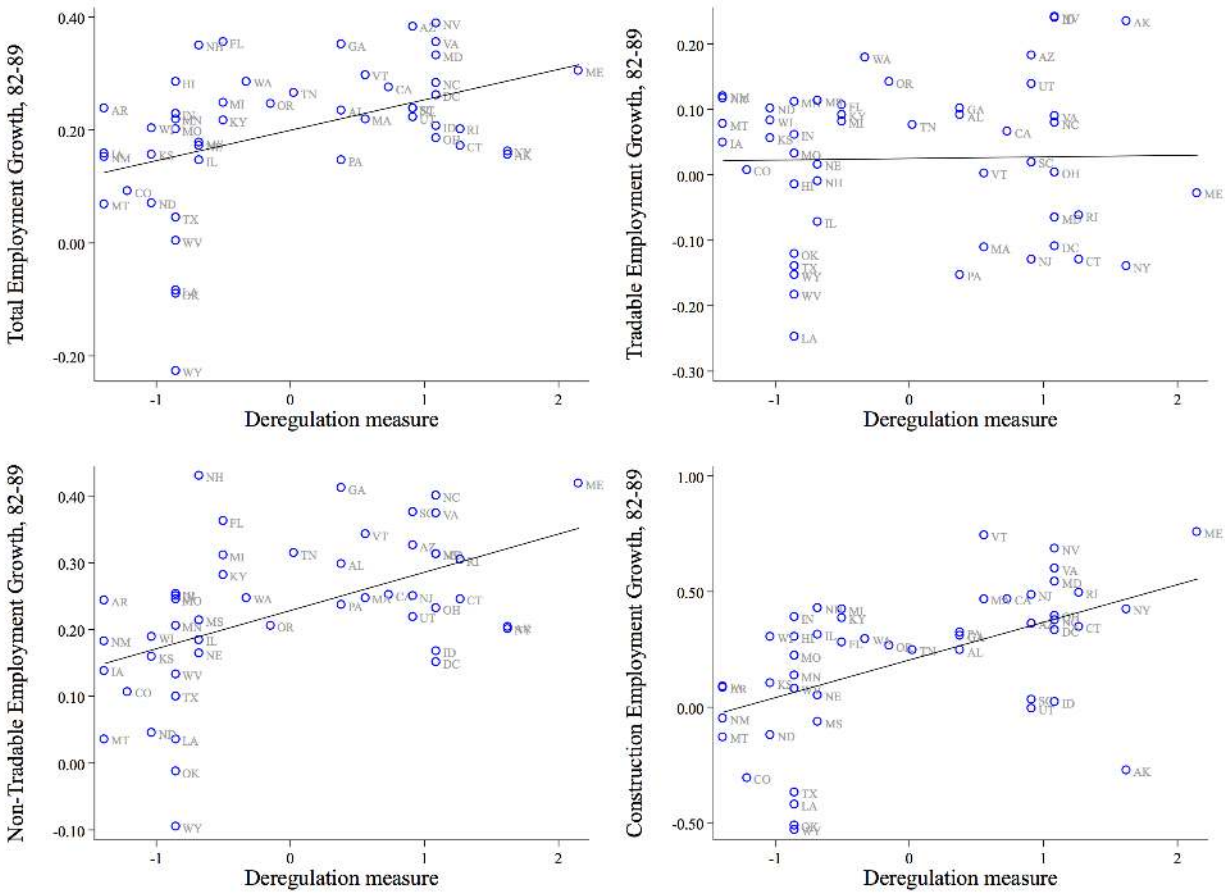
Notes: This figure presents comparative statics to a household credit shock, θ_H, tradable firm credit shock θ_T, and non-tradable firm credit shock θ_N. In each panel, the credit shock shifts the equilibrium from A to B.

Figure 4: Credit Growth and Deregulation



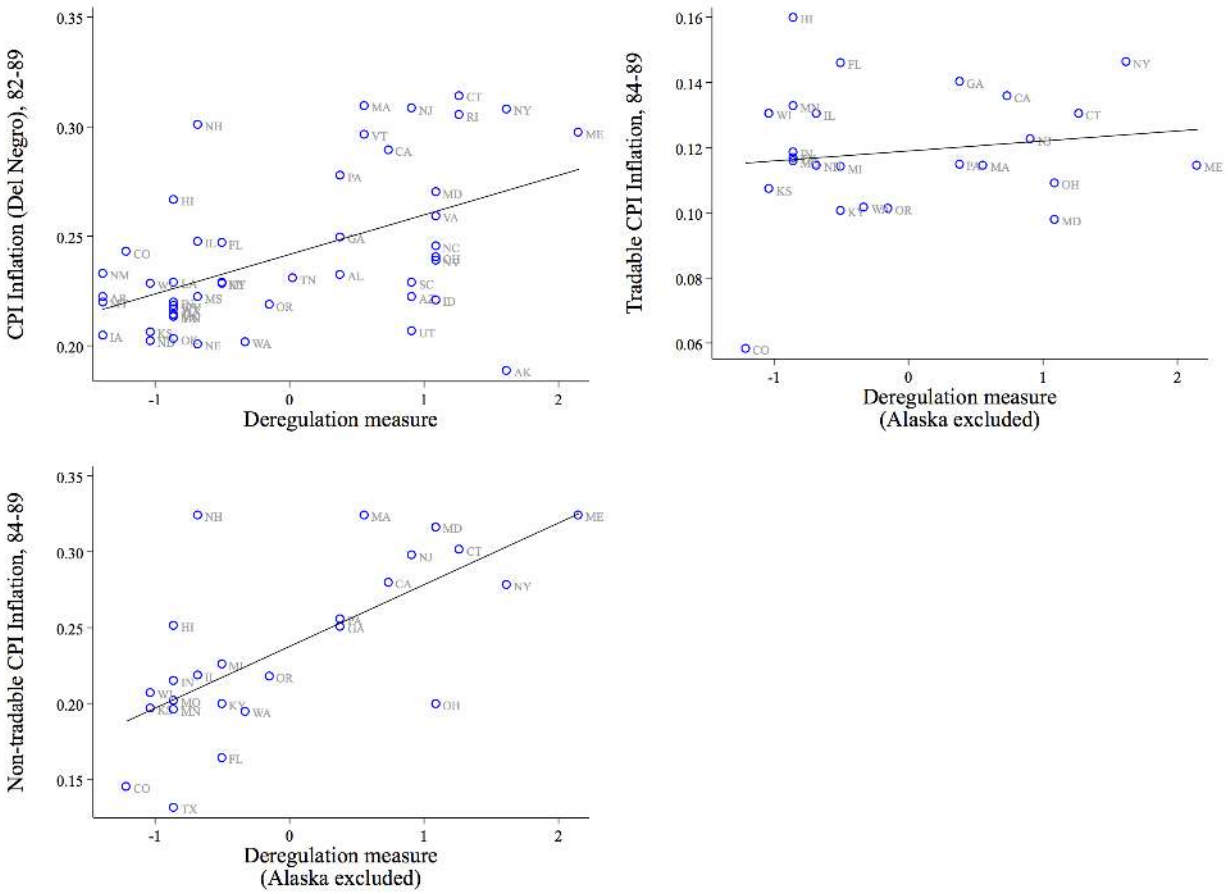
Notes: This figure presents estimates of $\{\beta_y\}$ from $y_{st} = \alpha_s + \alpha_t + \sum_{y \neq 1982} \mathbb{1}_{t=y} d_s \beta_y + \epsilon_{st}$, where d_s is the deregulation measure. Dashed lines represent 95% confidence intervals from standard errors clustered at the state level. Household loans are 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 5: Deregulation and Employment Growth, 1982-1989



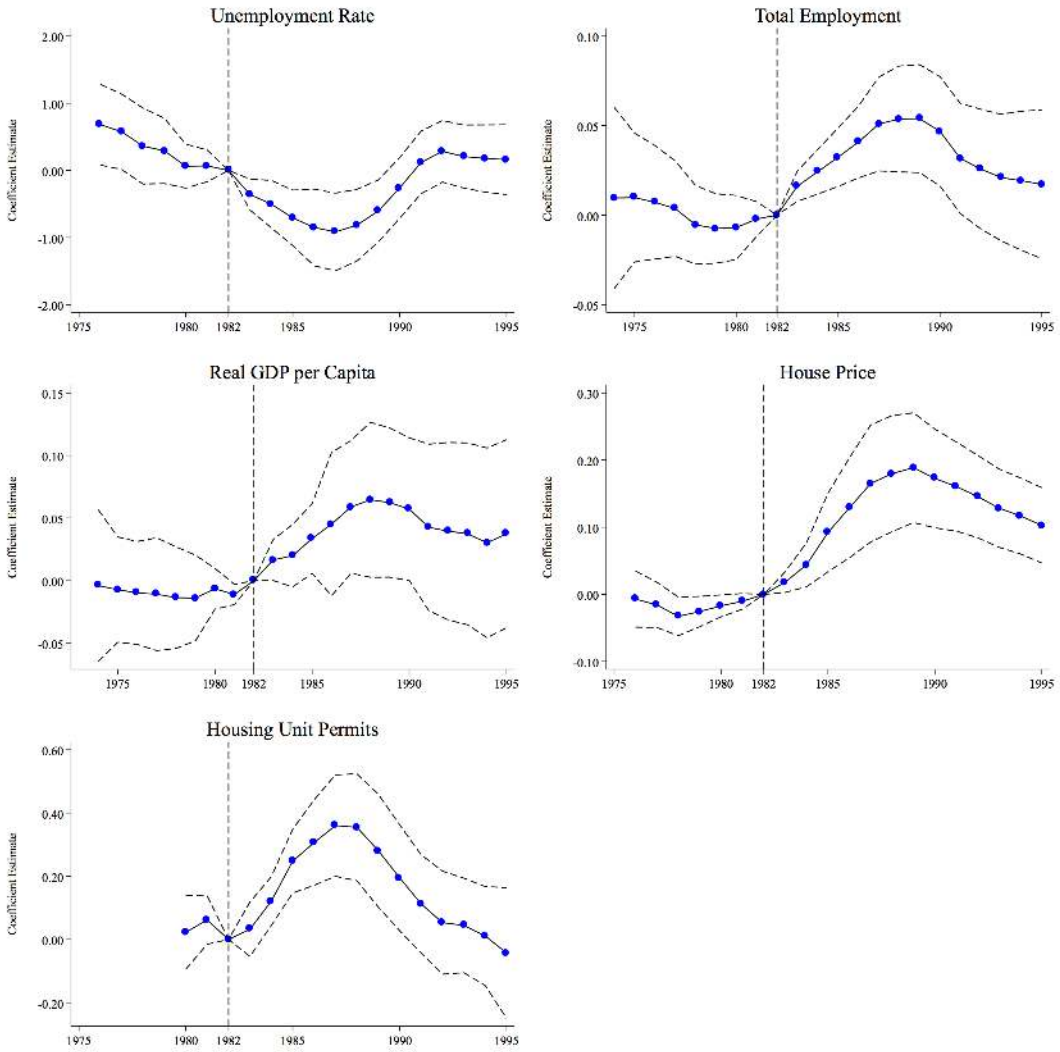
Notes: This figure presents scatterplots of the deregulation measure on employment growth by industry from 1982 to 1989.

Figure 6: Inflation and Deregulation



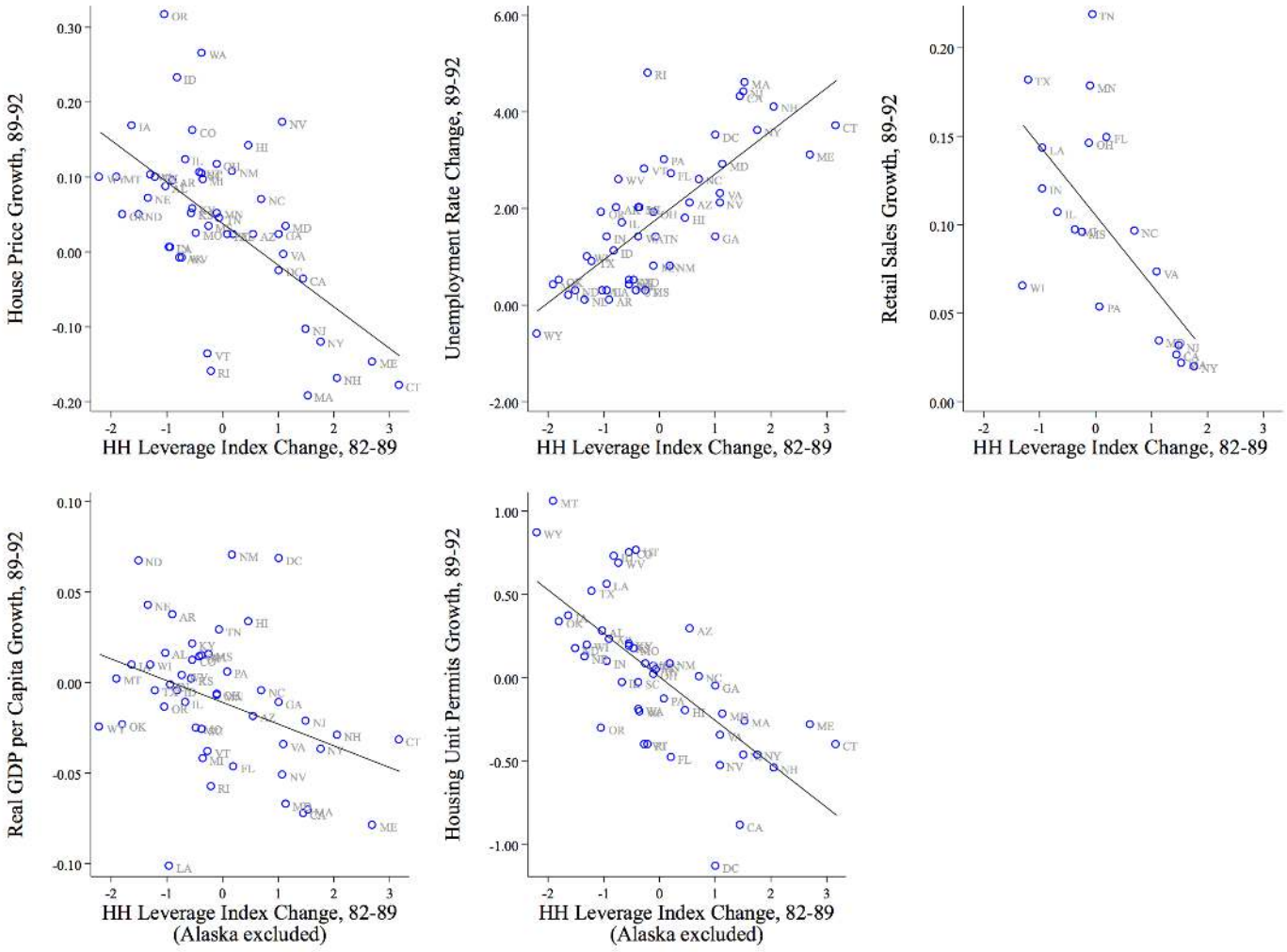
Notes: This figure presents scatter plots of the CPI inflation from 1982 (1984) to 1989 on the deregulation measure. The top-right and bottom-left panels show inflation for tradables ("Commodities") and non-tradables ("Services") for 25 states for which this measure is available (excluding Alaska).

Figure 7: Deregulation and Unemployment, Real GDP per Capita, House Prices, and Housing Units



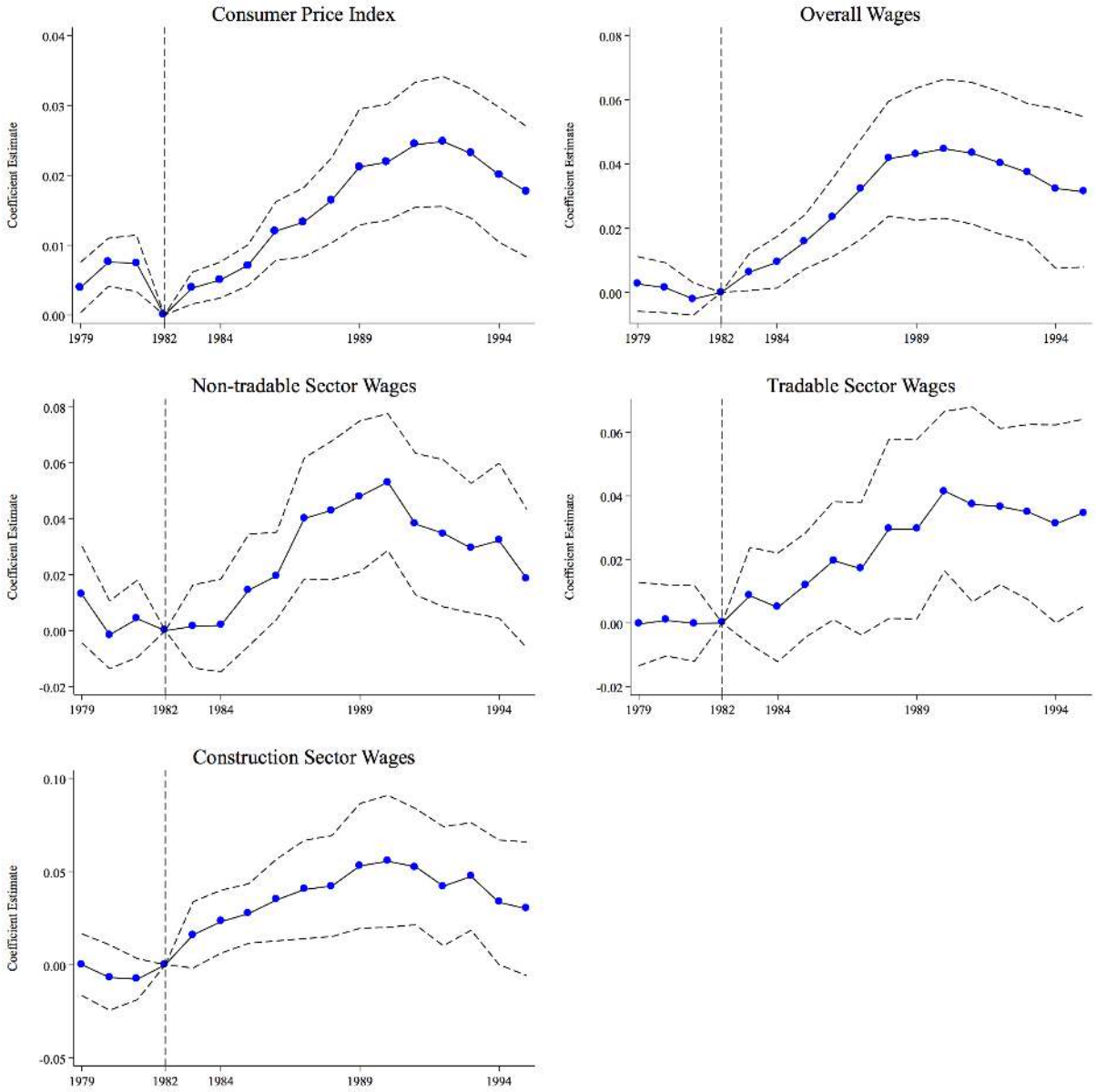
Notes: This figure presents estimates of $\{\beta_q\}$ from $Y_{st} = \alpha_s + \gamma_t + \sum_{q \neq 1982} \mathbb{1}_{t=q} \cdot DEREG_s \cdot \beta_q + \epsilon_{st}$, where $DEREG_s$ is the deregulation measure and Y_{st} is the state unemployment rate, log total employment, log real GDP per capita,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

Figure 8: 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.

Figure 9: Consumer Prices and Wages over the Full Cycle



Notes: This figure presents estimates of $\{\beta_q\}$ from $Y_{st} = \alpha_s + \gamma_t + \sum_{q \neq 1982} \mathbb{1}_{t=q} \cdot DEREG_s \cdot \beta_q + \epsilon_{st}$, where $DEREG_s$ is the deregulation measure. The dependent variable is the log of the state CPI for all items or a measure of residualized state wages from the CPS.

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