DEUTSCHE
BUNDESBANK
EUROSYSTEM

Discussion Paper

Deutsche Bundesbank
No 37/2021

Financial integration and the co-movement of economic activity: Evidence from U.S. states

Martin R. Goetz
(Deutsche Bundesbank)

Juan Carlos Gozzi
(Board of Governors of the Federal Reserve System, Washington, DC)

Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978–3–95729–845–4
ISSN 2749–2958

Non-technical summary

Research Question

Financial integration across different regions affect cross-regional risk sharing ability and the co-movement of economic fluctuations between regions. The effect of financial integration on the synchronization of economic activity between regions is theoretically ambiguous and depends on the nature of the underlying shock that drives local economic fluctuations. In this paper, we focus on financial integration through banks across states of the United States and examine empirically whether and how cross-state banking integration affects the co-movement of business cycles between states.

Contribution

We exploit the staggered removal of interstate banking restrictions to construct instrumental variables (IV) for the integration of a state's banking systems at the state-pair level to pin down the causal effect of financial integration on output co-movement using two-stage least-squares (2SLS) regressions. Our paper contributes to research in international macroeconomics, examining the effect of financial integration on the synchronization of output. Our findings further shed light on the functioning of banks' internal capital markets and the impact of financial institutions on the real economy. Finally, our paper presents insights into the effects of interstate banking deregulation in the U.S. on the real economy.

Results

Using a panel data set on bilateral banking integration at the state-pair level and the synchronization of output over the period 1976 to 1994, we find a strong positive and robust effect of financial integration on the co-movement of economic activity using our instrumental variables in a 2SLS analysis. To shed light on the underlying mechanism, we utilize information on aggregate bank failures and monetary losses due to natural disasters to classify periods when states experience financial or real shocks. We find that the effect of financial integration on output co-movement is stronger when (at least one state in) a state-pair experiences a financial shock, while the effect is not different when states face real shocks. We further use information on an industry's dependence on external finance and show that financial integration has a stronger effect on output co-movement of industries with higher dependence on external finance. This effect is again more pronounced when states experience financial shocks. We also document that

financial integration increases the co-movement of business lending between states. Finally, we find that aggregate bank lending in a state is positively affected by changes in the growth of bank deposits in states with which that state is financially integrated. These findings are consistent with the notion that multi-market banks transmit shocks across U.S. states, making states' business cycles more alike.

Nichttechnische Zusammenfassung

Fragestellung

Die Integration von Finanzsystemen verschiedener Wirtschaftsräume beeinflusst die makroökonomische Risikodiversifizierung und die Ähnlichkeit von Konjunkturschwankungen zwischen Regionen. Der Einfluss finanzieller Integration zwischen Wirtschaftsräumen auf die Ähnlichkeit von Wirtschaftszyklen ist in theoretischen Modellen allerdings nicht eindeutig und hängt maßgeblich von der Art des zugrundeliegenden Schocks, welcher lokale Konjunkturschwankungen beeinflusst, ab. In dieser Arbeit analysieren wir den Effekt der Integration des Bankensystems zwischen Bundesstaaten der Vereinigten Staaten von Amerika im Zeitraum 1976 bis 1994 mittels Instrumentenvariablenschätzungen empirisch.

Beitrag

Basierend auf dem Prozess der Deregulierung von Eintrittsbarrieren für Banken zwischen Bundesstaaten in den Vereinigten Staaten von Amerika erstellen wir Instrumentenvariablen (IVs) um den kausalen Effekt von zwischenstaatlicher Bankenintegration auf die Synchronisation von Konjunkturschwankungen zu identifizieren. Unsere Ergebnisse tragen zu Erkenntnissen aus dem Bereich der Internationalen Makroökonomik bei und erweitern diese um Erkenntnisse zu Effekten der Finanzintegration innerhalb eines Landes. Zudem bieten unsere Ergebnisse Einblick in die Rolle interner Bankenkapitalmärkte und dem Einfluss von Banken auf die Realwirtschaft. Unsere Resultate tragen auch zu Untersuchungen hinsichtlich der Auswirkung von Deregulierung von Markteintrittsbarrieren von Banken auf die Realwirtschaft bei.

Ergebnisse

Unsere IV-Schätzungen belegen, dass die Integration von Bankensystemen zwischen US-Bundesstaaten Wirtschaftszyklen zwischen Staaten ähnlicher gemacht hat. In unserer weiteren Analyse ziehen wir Informationen zu Bankeninsolvenzen und monetären Schäden aufgrund Naturkatastrophen heran, um für das Auftreten von Finanz- oder Realschocks in Staaten zu approximieren. Wir testen dann, ob sich der Einfluss von Bankenintegration auf die Synchronisation von Konjunkturschwankungen ändert, wenn Staaten Finanz- oder Realschocks erfahren und finden, dass Bankenintegration einen stärkeren Einfluss hat, wenn Staaten einen Finanzschock erfahren. Des Weiteren verwenden wir Heterogenität von Industrien hinsichtlich deren Abhängigkeit von

Aussenfinanzierung und finden, dass Bankenintegration insbesondere Wirtschaftszyklen von Industrien mit einer höheren Abhängigkeit von Aussenfinanzierung ähnlicher werden lässt. Dieser industriespezifische Effekt ist wiederum noch stärker ausgeprägt, wenn Finanzschocks auftreten. Wir untersuchen auch den Einfluss von Bankenintegration auf Bankverhalten näher und zeigen, dass Bankenintegration ebenfalls zu einem Angleichen von Kreditzyklen führt. Zudem finden wir, dass Schwankungen im Kreditvolumen in einem Staat sehr stark von Schwankungen von Bankeneinlagen in anderen Staaten, mit denen das Bankensystem integriert ist, bestimmt werden. Unsere Ergebnisse sind konsistent mit Theorien, welche auf die Rolle von Multimarktbanken zur Übertragung von Finanzschocks zwischen Regionen und die dadurch entstehende Angleichung von Wirtschaftszyklen abstellen.

DEUTSCHE BUNDESBANK DISCUSSION PAPER NO 37/2021

Financial Integration and the Co-Movement of Economic Activity: Evidence from U.S. States *

Martin R. Goetz† Juan Carlos Gozzi‡

August 17, 2021

Abstract

We analyze the effect of the geographic expansion of banks across U.S. states on the co-movement of economic activity between states. Exploiting the removal of interstate banking restrictions to construct time-varying instrumental variables at the state-pair level, we find that bilateral banking integration increases output co-movement between states. The effect of financial integration depends on the nature of the idiosyncratic shocks faced by states and is stronger for financially dependent industries. Finally, we show that integration increases the similarity of bank lending fluctuations between states and contributes to the transmission of deposit shocks across states.

JEL Classification: E32; F36; F44; G21
Keywords: banking integration; synchronization; financial deregulation; business cycles

*We are grateful to Ricardo Correa, Jose Fillat, Reint Gropp, John Hart, Luc Laeven, Ross Levine, Stefano Puddu, Philip Strahan, David Thesmar, and seminar participants at the Board of Governors of the Federal Reserve, Federal Reserve Bank of Boston, University of Copenhagen, University of Edinburgh, University of Frankfurt, University of Graz, University of Neuchatel, and University of Warwick for helpful discussions and comments. The views in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Deutsche Bundesbank, Board of Governors of the Federal Reserve System or any other person associated with the Federal Reserve System.

†Deutsche Bundesbank, Research Centre, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main, martin.goetz@bundesbank.de

‡Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue N.W., Washington, DC 20551, juan.c.gozzivaldez@frb.gov

1 Introduction

This paper analyzes the effect of financial integration through banks across U.S. states on the co-movement of economic activity. To identify the causal effect of banking integration on output synchronization, we exploit the removal of restrictions to interstate banking to construct instrumental variables. We also provide new insights on the channels and analyze heterogeneity across states and industries and show how integration affects lending and the transmission of bank funding shocks.

The effect of financial integration on output synchronization between regions is theoretically ambiguous and depends on the nature of the shocks that drive economic fluctuations.[1] A negative real (e.g productivity) shock in a region may lead multi-market banks to shift lending to non-affected regions, causing a further divergence in economic activity, which reduces output synchronization.[2] If multi-market banks, however, face a negative financial (e.g funding) shock in one market they may also cut lending in other markets, affecting economic activity in regions not directly hit by the initial shock negatively, which increases output synchronization.[3]

Identifying the causal effect of financial integration (through banks) on output synchronization is empirically difficult. Unobservable time-varying factors, for instance, may jointly determine financial integration and output co-movement between regions. Banks also choose where and when to expand and this expansion decision might be correlated with the level of or changes in output synchronization between regions.

Empirical evidence on the effect of financial integration on output co-movement is somewhat mixed:[4] Morgan et al. (2004) find that banking integration across U.S. states

[1] Morgan et al. (2004) show this using a multi-state version of the banking model of Holmstrom and Tirole (1997). Kalemli-Ozcan et al. (2013a) draw similar conclusions using a DSGE model.

[2] See, among others, Backus et al. (1992), Obstfeld (1994), and Heathcote and Perri (2004).

[3] See, among others, Calvo and Mendoza (2000), Allen and Gale (2000), Devereux and Yetman (2010), Mendoza and Quadrini (2010), Dedola et al. (2012), and Devereux and Yu (2014).

[4] Cross-country analyses tend to find a positive relationship between financial integration and output synchronization (Kose et al., 2004; Baxter and Kouparitsas, 2005; Imbs, 2006; Rose, 2009).

correlates positively with the co-movement of economic activity. Kalemli-Ozcan et al. (2013b) focus on Europe and find a negative link between integration and synchronization when controlling for unobservable time-invariant factors at the country-pair.[5]

We start our analysis using panel data at the state-pair level from 1976 to 1994 and also find mixed effects regarding the relationship between banking integration and output synchronization in OLS regressions.[6] Some specifications indicate a positive, yet insignificant, association between integration and output synchronization. This finding is not robust and we find a negative relationship between integration and output co-movement when using other variable definitions. As discussed earlier, OLS estimates are likely to be biased and thus do not represent a causal relationship.

We identify the causal effect of banking integration across U.S. states on output synchronization by exploiting the removal of restrictions to interstate banking to construct time-varying instrumental variables (IV) at the state-pair level. Restrictions on interstate banking prohibited entry from out-of-state bank holding companies (BHC) for much of the 20th century in the U.S.[7] Starting in the late 1970s, states gradually removed these restrictions, allowing BHCs to expand across states. The Riegle-Neal Act of 1994 eliminated all remaining barriers to interstate banking at the federal level.[8] The removal of these entry restrictions had a direct effect on financial integration between states as banks could expand across states once these barriers were removed (Goetz

[5]Duval et al. (2016) find similar results for a larger panel of countries. Cesa-Bianchi et al. (2019) find that financial integration is positively correlated with synchronization when countries face idiosyncratic shocks.

[6]Data on assets and ownership become available in 1976. Theories stress the role of banks' internal capital market when examining the effect of financial integration. After 1994 it is impossible to distinguish assets of the same BHC in different states because banks consolidated bank charters across states.

[7]U.S. banking organizations are often organized in a BHC structure where a parent company typically controls several subsidiary banks. Subsidiary banks are legally separate entities and subject to regulation and state-specific supervision (Avraham et al., 2012).

[8]States still restricted the entry of out-of-state banks via branches after 1994. These interstate branching restrictions were also gradually removed after 1994 (Rice and Strahan, 2010). We exploit the removal of interstate banking restrictions, which occurred prior and presented a first shock to bank expansion as it allowed banks to expand across state borders for the first time (Goetz et al., 2013).

et al., 2013; Landier et al., 2017).[9] Earlier work suggests that there are good economic reasons for treating the process of interstate banking deregulation as exogenous to state economic conditions (Kroszner and Strahan, 1999). We also find no evidence that the level of and changes in output co-movement are correlated with the timing of interstate banking deregulation.

Using our IV strategy, we find a strong and positive effect of banking integration on output synchronization. This finding is robust to different specifications, other measures of synchronization and economically significant: a one-standard deviation increase in the share of assets and deposits held by BHCs with operations in both states increases output co-movement, measured by the negative absolute difference in residual real GDP growth between states, of about 20 percent of its standard deviation.

To better understand why financial integration increases output synchronization we provide three novel analyses. First, we show that the effect of financial integration depends on the underlying (real or financial) shock. Second, we utilize data on industry output within states and find that output co-movement of industries with a high dependence on external finance responds stronger to financial integration. Third, we further document that the effect of integration on output synchronization of industries with high financial dependence differs when states face real or financial shocks.

To estimate the effect of financial integration when states experience different shocks we first identify (a) states that face financial shocks, proxied by the extent of bank failures in a state and year, and (b) states that face real shocks, proxied by the monetary losses due to natural disasters.[10] Consistent with the idea that banks transmit shocks across regions, we find that banking integration has a larger effect on output synchro-

[9] In addition to interstate banking restrictions states also limited the ability of banks to expand freely within a state by opening up further branches. The removal of these intrastate branching restrictions did not affect financial integration between states, but had effects on a state's banking development (Jayaratne and Strahan, 1996). Thus, we also control for it in our analysis.

[10] Several papers analyze the response of financial institutions to natural disasters, finding that they tend to ameliorate the negative impact of disasters on households (Morse, 2011; Chavaz, 2016).

nization when at least one of the states in the pair faces significant bank failures.

We also examine differences in output co-movement within a state and explore if the synchronization of certain industries' output responds more when states become financially integrated. We find that banking integration has a stronger effect on output synchronization for industries that depend on external finance. This holds if we analyze differential changes in synchronization within a state-pair and year by including state-pair specific time fixed effects. Finally, we test if this stronger effect of integration for financially dependent industries differs when states face real or financial shocks. If multi-market banks transmit financial shocks across states then we expect that integration within a state-pair has a stronger effect on synchronization of financially dependent industries when states experience financial shocks. Our findings confirm this.

To our knowledge, we are the first (1) to assess how the effect of financial integration on output synchronization differs depending on whether regions face financial or real shocks,[11] (2) to analyze whether the effect of financial integration on output co-movement differs across industries and (3) to document that this industry-specific effect varies within a state-pair when states experience financial shocks.

Our findings are consistent with the idea that multi-state banks transmit shocks through internal capital markets, creating a commonality in lending among states which then increases output synchronization.[12] To examine this mechanism, we analyze whether banking integration increases the similarity of bank lending fluctuations between states. Indeed, we find that banking integration increases the co-movement of business lending between states.

Finally, we analyze whether banking integration contributes to the transmission of funding shocks and examine whether fluctuations in deposit funding in one state affect

[11] Kalemli-Ozcan et al. (2013a) study the role of financial shocks, but do not analyze real shocks.

[12] See Houston et al. (1997), Houston and James (1998), Ashcraft (2006), and Holod and Peek (2010), among others, for evidence that U.S. BHCs operate internal capital markets.

lending in (other) financially integrated states. If multi-state banks transmit funding shocks through internal capital markets, then we would expect aggregate bank lending in a state to respond to changes in aggregate deposits in other states with which that state is financially integrated. Analyzing this empirically is difficult, as states that are financially integrated may face common shocks, affecting both deposits and loans. We build on Goetz et al. (2013, 2016) and exploit the process of interstate banking deregulation to construct IVs to recover the exogenous component of deposit growth in financially integrated states. We find that lending in a state responds positively to deposit changes in other states with which it is integrated.

Our paper contributes to a large literature, described above, that analyzes the effect of financial integration on the synchronization of economic activity by (1) identifying the causal effect of banking integration on output co-movement using an IV strategy, (2) showing that the effect of integration varies across industries, and (3) depends on the idiosyncratic shock faced by regions. Furthermore, we present additional novel evidence on aggregate bank behavior and show that integration (1) fosters the co-movement of bank lending between states and (2) contributes to the transmission of funding shocks across states.

This paper is also related to a large literature that studies the effects of banking deregulation in the U.S. Earlier research shows that intrastate and interstate banking deregulation is associated with higher economic growth, improved financing for small firms, and an acceleration in business formation.[13] One mechanism that could account for some of these findings is increased capital mobility across states following deregulation as suggested by our findings. Our paper is also related to a growing literature, analyzing how multi-market banks in the U.S. transmit local shocks to funding and

[13]See, among others, Jayaratne and Strahan (1996), Black and Strahan (2002), Cetorelli and Strahan (2006), Kerr and Nanda (2009), Rice and Strahan (2010).

to credit demand across markets.[14] We do not focus on the transmission of particular shocks through banks' pre-existing geographic networks here, but rather look at the aggregate effect of banking integration between states, while accounting for the endogeneity of banking integration.

This paper is organized as follows. Section 2 describes the data, variable definitions and sample. Section 3 presents findings from OLS and 2SLS estimation, where we use the state-pair specific timing in the removal of interstate banking restrictions as an excluded instrument for banking integration. Section 4 presents analyses exploiting heterogeneity across states and industries. Section 5 focuses on the effect of banking integration on the co-movement of bank lending and the transmission of bank funding shocks across states. Section 6 concludes.

2 Data

2.1 Banking Integration across U.S. States

We measure interstate banking integration based on bank affiliations through bank holding companies (BHCs).[15] We link each bank to its ultimate parent BHC and construct a continuous measure of banking integration by computing the share of jointly-owned assets and deposits, defined as the bank assets and deposits in a state pair held by BHCs with operations in both states divided by the sum of the total bank assets and deposits of both states (*Share of jointly-owned assets and deposits*).[16]

Data on bank assets and ownership structure are obtained from the Report of Condition and Income (*"Call Reports"*).[17] Information on deposits come from the

[14] See, among others, Gilje et al. (2016), Ben-David et al. (2017); Cortes and Strahan (2017), Chakraborty et al. (2018).

[15] We assign a bank to the parent BHC that owns at least 50 percent of the bank's equity.

[16] We consider both assets and deposits for our measures of banking integration to capture different dimensions of integration. This also makes our measures comparable to those used in previous research on international financial integration, which usually considers both assets and liabilities.

[17] All banking institutions in the United States regulated by the Federal Deposit Insurance Corporation

FDIC's Summary of Deposits, which provides branch-level data on deposits, location, and ownership for all branches of insured banks.[18]

We focus on the 48 contiguous U.S. states. Moreover, we omit Delaware and South Dakota since changes to their usury laws were followed by a relocation of BHC headquarters, affecting the measurement of integration with these two states (Jayaratne and Strahan, 1996). Our sample consists of 1,035 (46 * 45 /2) unique state pairs over the period 1976-1994.

2.2 Synchronization of Economic Activity

We measure the synchronization of economic activity between two states using three different variables based on state GDP. First, we measure output synchronization between states i and j as the negative of the absolute difference of residual real GDP growth rates (Morgan et al., 2004; Kalemli-Ozcan et al., 2013b):

$$Synch_{i,j,t} = - \mid \varepsilon_{i,t} - \varepsilon_{j,t} \mid \tag{1}$$

where $\varepsilon_{i,t}$ is the residual from a regression of a state's real GDP growth rate on year and state fixed effects. The residuals $\varepsilon_{i,t}$ thus capture the deviation of a state's real GDP growth in a given year from its sample mean and from the mean of all the states in our sample in that year.[19]

Our second measure of output synchronization is the instantaneous quasi-correlation

(FDIC), the Federal Reserve, or the Office of the Comptroller of the Currency, must file these reports on a regular basis. These reports hold balance sheet, income, and ownership information.

[18] Summary of Deposits data are reported as of June 30 of each year and we also take the data on bank assets and ownership structure from the Call Reports as of June 30 of each year.

[19] This synchronization measure has some advantages relative to the Pearson correlation coefficient as this measure can be calculated at every point in time and is invariant to the volatility of the underlying shock (Forbes and Rigobon, 2002; Corsetti et al., 2005).

of real GDP growth rates between states (Abiad et al., 2013; Duval et al., 2016):

$$QCorrel_{i,j,t} = \frac{(Y_{i,t} - \bar{Y_i}) * (Y_{j,t} - \bar{Y_j})}{\sigma_i \sigma_j} \tag{2}$$

where $\bar{Y_i}$ and σ_i are the average and the standard deviation of real GDP growth of state i over our sample period, respectively.

Finally, to make our results comparable to the earlier cross-country literature, we also measure the synchronization of economic activity between two states using the five-year correlation of real GDP growth. In particular, for each state pair we calculate the correlation of real GDP growth between the two states in year t in a forward-looking manner, using information for years t to $t + 4$.[20]

We construct our measures of output synchronization using state real GDP growth. Data on nominal GDP for each state and year come from the Bureau of Economic Analysis (BEA). We deflate these data using the national U.S. consumer price index from the Bureau of Labor Statistics (BLS) and calculate the annual growth rate of real GDP in each state and year as the change in the natural logarithm of this variable.

We control for several state-pair time-varying variables in our regressions.[21] First, we control for (lagged) differences in industrial structure between states, as this might affect their output synchronization (Obstfeld, 1994; Kalemli-Ozcan et al., 2001).[22] Second, to account for time-varying gravity factors, we control for the (lagged) product of the logarithm of the two states' real GDP. Finally, we include a dummy variable equal to one after (at least) one of the states in a pair eliminates restrictions to intrastate branching.[23] We winsorize all variables at the 1st and 99th percentiles to limit the

[20] We calculate this measure for non-overlapping five-year periods to avoid introducing autocorrelation.

[21] We obtain similar results if we exclude these controls.

[22] For each state pair and year we first calculate the difference between states in the share of total employment accounted for by each one-digit SIC sector in each state. We then add the square of these differences across sectors and take the square root of this sum.

[23] States prohibited banks from expanding their branch network freely within a state and imposed intrastate branching restrictions. States also liberalized these regulatory impediments to expansion

influence of outliers; we obtain similar results if we do not winsorize.

2.3 Descriptive Statistics

Panel A of Table 1 shows summary statistics for our main variables. In terms of banking integration, we find that the average share of jointly-owned assets and deposits amounts to 2.5 percent of total assets and deposits in a state pair. Regarding output synchronization, the negative absolute difference in residual real GDP growth between states averages 3 percent. Panel B of Table 1 presents pairwise correlation coefficients and p-values. We find a positive and statistically significant link between the share of jointly owned assets and deposits and the negative absolute difference in residual real GDP growth between states. Considering other measures of synchronization (instantenous quasi-correlation of real GDP growth rates and the five-year correlation of real GDP growth between states), we do not find that these variables correlate significantly with banking integration. Regarding our control variables, we find that financial integration is significantly larger if states (1) differ in their industry structure, (2) are larger and (3) have liberalized intrastate branching restrictions.

Banking integration between U.S. states increased significantly over our sample period. Figure 1 illustrates the evolution of integration from 1976 to 1994. The top panel shows the fraction of all state pairs in our sample that are financially integrated (i.e., have any jointly-owned bank assets or deposits) in each year. While only nine percent of all state pairs were financially integrated in 1976, more than a third of all state pairs were integrated by 1994.[24] The bottom panel of Figure 1 illustrates the evolution of banking integration at the state-pair level, using the example of California. It shows the

within a state gradually. We control for the removal of these restrictions as their removal was followed by an increase in a state's financial development and growth (Jayaratne and Strahan, 1996).

[24]Some state pairs were financially integrated before the process of interstate banking deregulation started in the early 1980s because some states allowed out-of-state bank entry before the Douglas Amendment to the 1956 Bank Holding Company Act effectively restricted interstate banking. Existing multi-state BHCs at the time were grandfathered by the Bank Holding Company Act.

evolution of the share of jointly-owned assets and deposits between California and three other states (Florida, Texas, and Washington). As Figure 1 illustrates, the banking integration of a given state with other states can exhibit significant variation.

Figure 2 illustrates the evolution of output co-movement between states. The top panel shows the average of the negative absolute difference of residual real GDP growth across state pairs from 1976 to 1994. The average level of output synchronization between states showed some volatility during the 1980s, but was fairly stable after 1988. The bottom panel of Figure 2 illustrates the co-movement of economic activity at the state-pair level, showing the evolution of our main synchronization measure between California and three other states (Florida, Texas, and Washington). As these graphs illustrate, the output co-movement of a given state with other states can show significant variation, both across states and over time.

3 Banking Integration and Output Synchronization between States

3.1 OLS Estimates

As a preliminary assessment of the relationship between banking integration and output synchronization we estimate OLS regressions, specified as follows:

$$Synchronization_{i,j,t} = \alpha_{i,j} + \delta_{r,t} + \beta * Banking\ integration_{i,j,t} + \mathbf{X'}_{i,j,t}\gamma + \varepsilon_{i,j,t} \quad (3)$$

where $Synchronization_{i,j,t}$ is a measure of the synchronization of economic activity between states i and j in year t; $Banking\ integration_{i,j,t}$ measures the integration of state i and j's banking systems; $\mathbf{X}_{i,j,t}$ are state-pair time-varying controls. To account for time-varying changes at the regional level we include Census-region time

fixed effects ($\delta_{r,t}$); $\alpha_{i,j}$ represent state-pair fixed effects to capture state-pair time-invariant characteristics. The coefficient β estimates the relationship between within-state pair changes in banking integration and output synchronization. Standard errors are clustered at the state-pair level similar to Kalemli-Ozcan et al. (2013b).

Table 2 presents OLS results from estimating equation (3) where we report standardized coefficients to represent economic magnitudes.[25] The results in Table 2 show mixed evidence regarding the link between banking integration and output synchronization. While we find a positive link between banking integration and output synchronization when we use the negative absolute difference in residual real GDP growth between states (columns 1 and 2)[26] or the correlation between real GDP growth between states (column 5),[27] we obtain a negative link between financial integration and output synchronization when focusing on the instantaneous quasi-correlation of real GDP growth between states (columns 3 and 4). This negative association between banking integration and output co-movement is even statistically significant at the 5 percent level once we control for time-varying heterogeneity at the state-level by including state-specific linear time trends.

Our results suggest that the relationship between banking integration and output co-movement is not robust and we find different effects when using different definitions of output co-movement. However, as discussed above, it is not possible to draw causal inferences from these OLS results, as they are likely to be affected by selection and omitted variables which could bias our estimates.

[25] Thus, the reported coefficient estimates represent by how many standard deviations the dependent variable changes for a one standard deviation change in the share of jointly owned assets and deposits.

[26] Morgan et al. (2004) find a positive link between banking integration and the negative absolute difference in residual real GDP growth between states. Different to their empirical specification, we also include Census-region year fixed effects and state-specific linear time trends to account for additional unobservable heterogeneity across states and time.

[27] When analyzing the five-year correlation of real GDP growth we do not include state-specific linear time trends because we only have four observations for each state in a state pair.

3.2 Instrumental Variables (IV) Estimates: Causal Effect of Banking Integration on Synchronization

To identify the causal effect of banking integration on the co-movement of economic activity, we use an IV approach based on the deregulation of interstate banking restrictions. We first briefly describe the process of interstate banking deregulation and then present our IV approach and results.

3.2.1 Interstate Banking Deregulation

For many decades, banks in the U.S. were not allowed to expand their geographical scope. States imposed limits on the location of bank branches and offices in the 19th century, restricting the expansion of banks both within states through branches (intrastate branching restrictions) and across state lines (interstate banking restrictions).[28] These restrictions were supported by the argument that allowing banks to expand freely could lead to a monopolistic banking system. Furthermore, granting bank charters was a profitable income source for states.

Starting in the 1970s, technological and financial innovations weakened the advantages of local banks, reducing their willingness to fight for the maintenance of restrictions on entry by out-of-state banks and triggered deregulation (Kroszner and Strahan, 1999). Maine was the first state to allow entry by out-of-state BHCs in 1978. In particular, BHCs from another state were allowed to enter Maine if that other state reciprocated and allowed entry by BHCs headquartered in Maine. While Maine enacted this policy in 1978, no other state changed its entry restrictions until 1982, when New York put in place a similar legislation and Alaska completely removed entry restrictions

[28] While state-chartered banks were always subject to state banking laws, the McFadden Act of 1927 extended the application of these laws to national-chartered banks. The ability of states to exclude out-of-state BHCs from entering was strengthened in the Douglas Amendment to the 1956 Bank Holding Company Act. The Douglas Amendment prohibited a BHC that had its principal place of business in one state from acquiring a bank located in another state.

on out-of-state BHCs. Over the following 12 years, states removed entry restrictions by unilaterally allowing out-of-state BHCs to enter or by signing reciprocal bilateral and multilateral agreements with other states. This deregulation process culminated with the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994, which removed all remaining entry barriers at the federal level.[29]

To analyze the process of interstate banking deregulation, we use data from Amel (2000) and Goetz (2018) on changes to state laws, affecting the ability of out-of-state banks to enter. We define the effective date of deregulation for each state pair i, j as the date when state i allows entry by BHCs headquartered in state j, or vice versa.

Figure 3 illustrates the evolution of the interstate banking deregulation process, showing the cumulative fraction of state pairs in our sample that had removed entry restrictions between each other by each year, differentiating between methods of deregulation. Although Maine opened up its banking system to all states on a reciprocal manner in 1978, the fraction of state pairs that removed restrictions remained at zero until 1982, when New York reciprocated and put in place similar legislation.[30] The pace of interstate deregulation accelerated in the second half of the 1980s, and by 1994 76 percent of state pairs in our sample had removed entry restrictions between each other. Figure 3 also shows that the most common form of deregulation was unilaterally opening entry to BHCs from all states (about 60 percent of interstate banking deregulations), followed by nationwide reciprocal agreements (18 percent of deregulations).

[29] Although this act removed all remaining barriers for BHCs to enter other states by establishing subsidiaries, some states continued to restrict entry via branching after 1994. While the removal of these interstate branching restrictions after 1994 fostered financial integration further, the removal of interstate banking restrictions was an earlier shock to banking integration as it removed initial entry barriers, providing BHCs with the opportunity to expand across state lines for the first time.

[30] Although Alaska eliminated all entry restrictions in 1982, it is not included in Figure 3 because our sample is restricted to the 48 contiguous states.

3.2.2 Empirical Strategy: Timing of Interstate Banking Deregulation

To identify the causal effect of banking integration on the synchronization of economic activity we use the timing of interstate banking deregulation between two states as an instrument for their bilateral banking integration. As described above, different state pairs eliminated entry restrictions between each other at different points in time, allowing us to construct an instrument for each state pair. We hypothesize that state pairs that deregulated earlier have a greater degree of banking integration. Our first stage regression is given by:

$$Bank\ integration_{i,j,t} = \alpha_{i,j} + \delta_{r,t} + \beta * Years\ since\ deregulation_{i,j,t} + \mathbf{X'}_{i,j,t}\gamma + \varepsilon_{i,j,t}, \quad (4)$$

where $Bank\ integration_{i,j,t}$ is the share of jointly owned assets and deposits for a state pair i, j in year t; $Years\ since\ deregulation_{i,j,t}$ represents the number of years BHCs headquartered in state i are allowed to enter state j or vice versa; and $\mathbf{X}_{i,j,t}$ are a set of state-pair time-varying controls. We also include Census-region time fixed effects ($\delta_{r,t}$) to capture common time-varying factors at the regional level and state-pair fixed effects ($\alpha_{i,j}$) to account for time-invariant characteristics at the state-pair level.

The underlying assumption of our econometric strategy is that the timing of deregulation is not associated with expected changes in output synchronization, or with unobserved variables that might drive these changes. Several arguments support this hypothesis. First, deregulation occurred in a somewhat chaotic manner over time and through different methods. The most common form of deregulation was unilaterally opening entry to BHCs from *all* states. Changes in bilateral output synchronization with a particular state are unlikely to have played a role in the decision to allow entry by BHCs from all states. Second, empirical evidence suggests that deregulation was driven by political economy considerations related to the private benefits of local

banks, and not by changes in economic conditions (Kroszner and Strahan, 1999).

We examine whether the timing of deregulation between two states is associated with their level of output synchronization or its change, prior to deregulation. Specifically, for each state pair we first compute the median level of and change in our main synchronization measure over the five years prior to deregulation. We account for state-specific differences by computing the within-state difference in these variables and in the timing of deregulation.[31] Figure 4 plots the within-state timing of interstate deregulation against (a) the within-state level of output synchronization before deregulation (top panel) and (b) the within-state change in synchronization before deregulation (bottom panel). Figure 4 shows that there is no relationship between the timing of interstate banking deregulation and prior levels of and changes in bilateral synchronization.

Our IV approach assumes that state pairs that deregulated earlier have greater bilateral banking integration. To examine this we estimate the following regression:

$$Bank\ integration_{i,j,t} = \alpha_{i,j} + \delta_{r,t} + \rho_1 T_i + \rho_2 T_j + \sum_{r=-10}^{+10} \beta_r Y_{i,j,r,t} + \varepsilon_{i,j,t} \qquad (5)$$

where $Bank\ integration_{i,j,t}$ is the share of jointly-owned assets and deposits for state pair i, j in year t; $Y_{i,j,r,t}$ are dummy variables equal to one if in year t, states i and j deregulated r years before; $\delta_{r,t}$ are Census-region time fixed effects; T_i and T_j are state-specific linear time trends and $\alpha_{i,j}$ are state-pair fixed effects, respectively. The coefficient on integration for the year of interstate banking deregulation is excluded due to collinearity and the coefficients β_r capture differences relative to the year of

[31] We compute the within-state differences by subtracting the state-level mean from each of the state-pair variables. For instance, to calculate the within-state difference in the timing of deregulation, for each state pair i, j we take the difference between the year of interstate deregulation between states i and j and the average year of state i's deregulation with all states. We also take the difference between the year deregulation between states i and j and the average year of state j's deregulation with all states. Thus, each state pair in our sample is included twice in this analysis.

deregulation. Standard errors are clustered at the state-pair level.

Figure 5 shows that the removal of interstate banking restrictions has a first order effect on the integration of state banking systems. This figure plots the estimated β_r coefficients from equation (6), as well as their 99 percent confidence interval. Banking integration does not change significantly prior to deregulation but, once states remove bilateral entry barriers, integration increases significantly over time.

3.2.3 2SLS Estimates

Table 3 reports first stage, second stage and reduced form results from our 2SLS estimation of the effect of banking integration on output co-movement. As before, we include state-pair, Census-region time fixed effects and the full set of controls used in Table 2. We also include state-specific linear trends as indicated.

Table 3B reports the first stage regression results. Consistent with Figure 5, the results show that the removal of interstate banking restrictions significantly increases bilateral banking integration.[32] This result holds if we include state-specific linear time trends. F-test statistics of the instruments' joint significance are very high, even in the regressions using the five-year correlation of real GDP growth as a measure of output synchronization (column 3) where we only have four observations for each state pair.

The second stage results presented in Table 3A show that banking integration increases output synchronization. Different from the OLS results in Table 2, the estimated coefficients on the banking integration measures from our 2SLS estimations are positive and statistically significant in all the regressions, indicating that these results are robust to different specifications and alternative definitions of output synchronization. Moreover, the estimated magnitudes are economically relevant. Consider, for

[32]Note that we only report coefficient estimates for 3 first stage regressions but 5 second stage regression results since the first stage regression is the same whether we use the negative absolute difference in residual real GDP growth rates or the instantaneous quasi-correlation in the second stage.

instance, the results in column 2 in Table 3A. The estimated coefficient (0.202) implies that an increase in the share of jointly-owned assets and deposits between two states by one standard deviation leads to an increase in output synchronization of 20 percent of its standard deviation. Similarly, the reduced form results (Panel B) show that the removal of interstate banking restrictions is associated with an increase in the synchronization of economic activity. To examine the dynamic behavior of output synchronization around the removal of interstate banking restrictions we re-estimate regression model (5) where we replace the dependent variable, banking integration, with the negative absolute difference in residual GDP growth between states and plot estimated coefficients in Figure 6. We find that output synchronization is higher once states removed their interstate banking restrictions.

Figure 7 displays the causal relationship between banking integration and output synchronization. Specifically, we first use our IV to predict the exogenous component of banking integration using the full specification (i.e. column 2 of Table 3A). We then group observations into decile bins based on the predicted banking integration where the first bin contains observations with the lowest predicted share of jointly owned assets and deposits and the last bin holds observations with the highest predicted share. We then compute the average negative absolute difference in residual real GDP growth between states and the average predicted share of jointly owned assets and deposits in each bin and plot these in Figure 7. Figure 7 shows a strong positive and linear effect of banking integration on output synchronization.

The positive causal effect of banking integration on the co-movement of economic activity between states suggests that integration contributed to the transmission of idiosyncratic shocks that affect financial constraints across state borders, making state economic fluctuations more similar. Comparing the results in Table 3 to those in Table 2 indicates that OLS estimates are biased downwards. This downward bias could arise,

for instance, because banks might choose to expand into areas with different economic fluctuations than their home area to diversify their operations (Goetz et al., 2016). We conducted several additional tests to confirm the robustness of our results, which are described in detail in the Appendix.

4 Effect of Banking Integration on Output Synchronization: Differences across States and Industries

The results in Table 3 show that banking integration increases output synchronization between states. In this section, we analyze whether this effect varies across state pairs and industries to better understand what drives our findings.

4.1 Differences across States

As discussed above, theoretical arguments predict that the effect of financial integration on the synchronization of economic activity depends on the nature of the idiosyncratic shocks faced by different regions. Testing this prediction requires identifying periods when states face different types of shocks.

To identify financial shocks at the state level, we rely on aggregate measure of bank failures.[33] In particular, we first determine the total assets and deposits held by all commercial banks that failed in a state and year. Specifically, we combine data from the FDIC's Historical Statistics on Banking, which report detailed information on bank failures starting in 1934, with balance sheet data from Call Reports. During our sample period there were 1,448 commercial bank failures in the United States, with

[33]Bank failures in some cases might have been driven by shocks to the real economy. As stressed by Cesa-Bianchi et al. (2019), in a two-country real business cycle model augmented with credit or collateral constraints, any country-specific shock that makes these constraints binding will lead to a positive effect of integration on synchronization, irrespective of whether it is a supply or demand shock or a shock to financial intermediaries. Thus, we interpret our aggregate measure of bank failures as proxying for how binding these constraints are, irrespective of the nature of the shock that caused the failures in the first place.

average total assets and deposits of 254 million U.S. dollars at 1994 prices per failure. We add up the assets and deposits held by all failing banks in a given state and year and then scale this amount by the state's GDP in the previous year.[34] We classify a state as facing a financial shock in a year if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds two percent. We consider a relatively high threshold for our classification because we want to clearly identify periods when state banking systems face distress. Based on this definition, 21 states are classified as having experienced financial shocks for an average of two years each over our sample period.[35] This classification identifies states and periods when local banking crises in the U.S. are considered to have occurred, including the Southern states in the second half of the 1980s (Grant, 1998) and New England in the early 1990s (Jordan, 1998).

To identify real shocks at the state level, we focus on the monetary losses caused by natural disasters, as these can be considered exogenous shocks that affect a state's real sector. In particular, for each state and year we first determine the monetary losses caused by all natural disasters. To do this, we use data from the Spatial Hazard Events and Losses Database for the United States, which is a county-level dataset that reports the date and monetary losses for different types of natural hazard events, such as thunderstorms, hurricanes, floods, wildfires, and tornados. We aggregate the county-level losses up to the state level and then scale this amount by the state's GDP in the previous year. We classify states as experiencing a real shock due to natural disasters in a given year if the ratio of total losses to lagged GDP exceeds 0.75 percent.[36] Based on this definition, 23 states are classified as having experienced real shocks due to natural disasters at least once during our sample period.[37] We consider a relatively

[34] We use lagged GDP as a denominator to avoid capturing the potential effects of bank failures on GDP. We obtain similar results if we used contemporaneous GDP as the denominator instead.

[35] See Appendix Table A.11 for summary statistics and states and years included in this classification.

[36] See Appendix Table A.12 for summary statistics and states and years included in this classification.

[37] A state's banking sector may also be affected by a negative real shock and financial shocks may thus be driven by real shocks. To examine this we estimate a state- and Census-region-year fixed effects

high threshold for our classification as we want to identify periods when a state's real economy faces a large shock.[38]

To analyze whether the effect of financial integration on the synchronization of economic activity depends on the nature of the idiosyncratic shocks faced by different states, we estimate 2SLS regressions similar to those reported in Table 3 including the interaction between our measures of integration and different dummy variables that capture whether one (or both) state in a given pair experienced financial or real shocks.[39] Based on our classification, 19 percent of the state-pair year observations in our sample are classified as experiencing a financial shock and 8 percent are classified as experiencing a real shock due to natural disasters.[40] Table 4 presents the second stage 2SLS results, showing estimations similar to those in columns 3 and 4 of Table 3 including the interaction terms.[41]

The results in Table 4 show that the effect of financial integration on output synchronization depends on the nature of the idiosyncratic shocks experienced by states, consistent with theoretical arguments. In particular, the results in columns 1 and 2 show that the interaction between our integration measures and a dummy variable that captures whether (at least) one state in a given pair and year experienced banking

regression at the state level where we regress a dummy variable, taking on the value of one whether a state faces a financial shock on a set of dummy variables, taking on the value of one whether a real shock happened one year/two years/three years before (see Appendix Table A.14). We do not find that states face financial turmoil after they experience a negative real shock.

[38] Several papers have analyzed the short-run impact of natural disasters on economic activity, with some papers documenting a negative effect (Raddatz, 2007; Hochrainer, 2009; Noy, 2009), while others find no or even positive effects, as a result of the stimulus generated by reconstruction efforts (Albala-Bertrand, 1993; Belasen and Polachek, 2009; Cavallo et al., 2013). We find that the states and years included in our classification are associated with a decrease in state-level real GDP growth of about one percentage point (see Appendix Table A.13).

[39] In these regressions we have more than one endogenous variable. Thus, we use as an additional set of IVs the interaction between our IVs and the dummies that capture different shocks.

[40] See Appendix Table A.15 for the number of states and state-pairs classified as experiencing different shocks in each year.

[41] To keep the size of the table manageable we focus on our main measure of output synchronization (the negative absolute difference in residual real GDP growth between states). We obtain similar results for other synchronization measures.

system distress is positive and statistically significant, indicating that banking integration increases synchronization relatively more when states experience financial shocks. Columns 3 and 4 show that the interaction between our integration measures and a dummy variable that captures whether (at least) one state in a given pair and year experienced large losses due to natural disasters is negative and statistically significant, indicating that the effect of banking integration on output synchronization is smaller when states experience real shocks. Indeed, we find that the overall effect of integration (i.e., the sum of the coefficients on the integration variable and the interaction term) is not statistically significant when states experience large losses due to natural disasters. Columns 5 and 6 confirm our results when including the dummies and interactions for both financial and real shocks jointly.[42] We conducted additional robustness tests, where we consider alternative cut-offs to define periods when states face financial or real shocks or use state-level military spending shocks. Robustness tests, described in detail in the Appendix, confirm our findings.

4.2 Differences across Industries

The theoretical arguments outlined above suggest that multi-market banks transmit shocks across states through changes in their lending. Thus, we expect integration to have a larger effect on synchronization for those industries that rely more on bank financing. To test this, we construct measures of synchronization between states for different industry groups based on their dependence on external financing.

We first calculate the dependence on external finance at the industry level following the methodology of Rajan and Zingales (1998).[43] Then, we define high (low) financial

[42] Interestingly, we find that financial integration leads to a reduction in output co-movement when at least one state faces a real shock once we control for state-specific linear time trends (column 6).

[43] Using data from Compustat for the period 1980-1990, we aggregate firm-level data on reliance on external funds (proxied by the fraction of investment not financed with funds from operations) up to the two-digit SIC sector.

dependence industries as those that are above (below) the median level of external financial dependence across all industries. We then use information on GDP at the state-industry-level, provided by the BEA and sum up the GDP of all industries in each of the aforementioned two groups to calculate aggregate GDP of high and low financial dependence industries for each state and year.[44] We deflate these data using the national U.S. consumer price index from the BLS and compute the annual growth rate of real GDP for high (low) financial dependent industries in each year and state as the change in the natural logarithm. To calculate the residual real GDP growth, we estimate separate regressions of the real GDP growth of each industry type in a state and year on state and year fixed effects. Thus, we have two measures of synchronization for each state pair and year, one for industries with high financial dependence and one for industries with low dependence.

To analyze whether the effect of financial integration on the synchronization of economic activity varies across industry types (high/low financial dependence), we augment our baseline regression model:

$$\begin{aligned} Synchronization_{i,j,d,t} = \alpha_{i,j,d} + \delta_{r,t} + \beta_1 * Bank\ integration_{i,j,t} + \\ + \beta_2 * Bank\ integration_{i,j,t} * High\ financial\ dependence_d + \\ + \mathbf{X'}_{i,j,t}\gamma + \varepsilon^d_{i,j,t} \end{aligned} \tag{6}$$

[44] We follow other research (e.g. Chor and Manova, 2012, Cetorelli and Strahan, 2006, Duygan-Bump et al., 2015) and utilize these industry-specific measures of dependence on external finance to also classify firms in the U.S. regarding their dependence on external finance. Using information from U.S. firms to construct industry-measures of external financial dependence is motivated by the idea that the U.S. has one of the most advanced financial systems and the financing decision of U.S. firms should thus reflect an optimal choice if an industry's dependence on external finance is technologically determined. In our analysis we are not using the precise value of external financial dependence, but rather classify all industries above the sample median as industries with a high financial dependence. While the precise magnitude an industry's measure of dependence on external finance may vary, the rank ordering of industries with respect to their dependence on external finance is thought to be stable (Rajan and Zingales, 1998). Differentiating industries above/below the sample median also mitigates concerns regarding the use of this measure for U.S. firms.

where $Synchronization_{i,j,d,t}$ is the synchronization of economic activity between states i and j for industry-type d (high/low financial dependence) in year t; $Bank\ integration_{i,j,t}$ measures the integration of state i and j's banking systems in year t; $High\ financial\ dependence_d$ is a dummy variable taking on the value of one whether industry-type d is the high financial dependent industry type, or zero otherwise; and $\mathbf{X}_{i,j,t}$ are state-pair time-varying controls. To account for time-varying changes at the regional level we include Census-region time fixed effects ($\delta_{r,t}$). $\alpha_{i,j,d}$ represent industry-type-state-pair fixed effects to capture time-invariant characteristics at the industry-type-state-pair level. The coefficient β_1 estimates the baseline effect of banking integration on output synchronization while the coefficient β_2 represents the differential effect of banking integration on output co-movement for industries with high financial dependence. As before, we instrument the endogenous variable *Banking integration* and its interaction with $High\ financial\ dependence$ using the years since the removal of interstate banking restrictions and its interaction term as excluded IVs.

Table 5 presents regression results from estimating equation (6) using 2SLS where we cluster standard errors at the industry-type-state-pair level to account for correlation of industries at the state-pair over time. Column 1 of Table 5 shows that financial integration only exerts a positive and statistically significant effect on the co-movement of output for industries with high financial dependence. This finding holds if we allow the Census-region year fixed effects and the state linear time trends to vary by industry-type to capture different time-varying changes in the output of industries with high/low dependence (column 2). In column 3 we further include state-pair year fixed effects to account for all unobservable time-varying effects on output synchronizazion at the state-pair level.[45] While we cannot identify β_1 once we include these

[45]These state-pair year fixed effects capture time-varying unobservable factors that also affect the overall co-movement of output, such as the integration of states' real sectors or capital flows within states in a state pair.

state-pair year fixed effects we can still estimate the differential effect for industries with high financial dependence (β_2). We find that banking integration significantly boosts the co-movement of output for industries with high financial dependence even when conditioning on time-varying state-pair fixed effects.

The results in Table 5 show that the effect of banking integration varies across industries depending on their dependence on external finance. This is consistent with the argument that multi-market banks transmit shocks across states as financial integration particularly affects industries that rely (more) on finance.

To examine the potential transmission of shocks via banks further, we build on our earlier analysis examining differential effects when states face real or financial shocks. Specifically, we analyze whether the differential effect of banking integration on output synchronization of industries with high financial dependence varies if a state-pair experiences a real or financial shock. If multi-market banks transmit shocks across states, causing the co-movement of state output to increase, then we hypothesize that industries with high dependence on external finance within a state-pair are also more affected when states experience financial turmoil.

We thus extend our regression model and introduce additional interaction terms to estimate the differential effect of financial integration on output co-movement of industries with high financial dependence if states face financial shocks. In column 4 of Table 5, we present results focusing on the role of financial shocks and find that integration has a significantly larger effect on the synchronization of output for industries with high dependence on finance within a state-pair in the presence of financial shocks.[46] Regarding economic magnitudes, we find that the effect of financial integration on the synchronization of output for industries with high financial dependence more than

[46]Since we account for underlying time-varying differences at the state-pair level we cannot identify (1) the baseline effect of financial integration, (2) the baseline effect of financial shocks and (3) the differential effect of financial integration on output synchronization in the presence of financial shocks as these coefficients are absorbed by the state-pair time fixed effects.

doubles when at least one state experiences a financial shock. Assessing the role of real shocks (column 5), we do not find a significantly differential effect of financial integration on the output co-movement of industries with high financial dependence within a state-pair when states experience a real shock. This finding also holds when we examine the differential effect of real and financial shocks jointly (column 6).

The pattern that the output co-movement of industries with a high financial dependence within a state-pair increases more when (a) states in a state pair increase their financial integration and that this effect is (b) significantly stronger when at least one state in a state-pair experiences a financial shock, but is (c) not different in the presence of real shocks, is consistent with the idea that multi-market banks transmit financial shocks across states, contributing positively to the synchronization of output.

5 Banking Integration and Output Synchronization: Evidence on Underlying Mechanisms

Since multi-market BHCs operate internal capital markets they may respond to shocks originating in one state by changing their lending in other states where they are active. This creates a commonality in aggregate lending among these states, which then increases their output synchronization. We now focus on banks and provide evidence on this underlying channel by analyzing whether banking integration (1) increases the similarity of bank lending fluctuations between states and (2) contributes to the transmission of bank funding shocks across state borders.

5.1 Banking Integration and Lending Synchronization between States

To analyze whether integration increases the similarity of state-level fluctuations in bank lending, we first compute the total Commercial and Industrial (C&I) loans by

banks in a given state and year by aggregating bank-level data from the Call Reports.[47] Over our sample period, C&I loans accounted for about 28 percent of total lending by commercial banks. Similar to before we calculate the growth rate of real C&I lending for each state and year and use these data to construct our main measure of synchronization. We estimate 2SLS regressions using C&I lending synchronization between states as the dependent variable. Results are presented in Table 6.[48]

We find that banking integration increases the synchronization of C&I lending between states. In particular, the results in columns 1 and 2 of Table 6 show that the coefficients on the share of jointly owned assets are positive and statistically significant. One potential concern about these results is that our main findings show that banking integration increases output synchronization. Thus, the finding that integration leads to a higher co-movement of C&I lending between states may just reflect the higher co-movement of output between states. In columns 3 and 4 of Table 6 we address this by including the lagged value of output synchronization as an additional control variable in columns 3 and 4. We find that banking integration has a significant positive effect on C&I lending synchronization between states, even controlling for lagged output synchronization.

5.2 Banking Integration and the Transmission of Bank Funding Shocks across States

This section analyzes whether banking integration contributes to the transmission of bank funding shocks across states and analyzes whether aggregate C&I lending in a state responds to changes in aggregate deposits in other states with which it is

[47] We focus on C&I loans following the literature on the bank lending channel in the U.S. (Kashyap and Stein, 2000; Driscoll, 2004).

[48] Given that bank balance sheet data are available starting in 1976, we lose one annual observation when computing the growth rate of C&I lending. Therefore, the sample for this analysis covers the period 1977 to 1994.

financially integrated. This analysis has to be conducted at the state-year level, and not at the state-pair year level as the earlier analyses. In particular, we estimate the following baseline regression model:

$$\Delta Bank\ loan_{i,t} = \beta * \Delta Deposit\ in\ integrated\ states_{i,t-1} + \alpha_i + \delta_t + \varepsilon_{i,t} \qquad (7)$$

where $\Delta Bank\ loan_{i,t}$ is the growth rate of real C&I loans in state i in year t; Δ *Deposit in integrated states*$_{i,t-1}$ is a lagged measure of the deposit growth in other states with which state i is financially integrated. In particular, for each state i and year t we take the weighted average of the growth rate of real state-level bank deposits across all other states, using as weights the share of jointly-owned assets and deposits between state i and each state. We also include time (δ_t) and state fixed effects (α_i) to account for common national time-varying factors and state time-invariant characteristics. Standard errors are clustered at the state level.

A key empirical challenge for this analysis is how to distinguish the transmission of shocks through the internal capital markets of multi-state BHCs from common factors that affect states that are financially integrated. For instance, states are more likely to integrate with geographically close states which might be subject to similar macroeconomic shocks, and lending and deposits in financially integrated states may move together, even if BHCs are not transmitting shocks across state borders.[49]

To overcome this challenge, we use a second identification strategy that exploits the process of interstate banking deregulation, following Goetz et al. (2013, 2016). Specifically, we first estimate an OLS regression of the share of jointly-owned assets and deposits between two states on the number of years since the removal of interstate banking restrictions and its square, state-pair fixed effects, year fixed effects, state-pair

[49]In all the other analyses reported throughout the paper we account for common time-invariant factors between states such as distance by including state-pair fixed effects; we cannot do this for the analysis in this section, as it is conducted at the state-year level.

linear time trends, and other state-pair controls. We then generate the predicted level of banking integration between two states, imposing a zero for state pairs that do not allow interstate banking. Then, for each state i and year t we calculate the weighted average of the growth rate of real state-level bank deposits across all other states, using as weights the predicted share of jointly-owned assets and deposits between state i and each state. Finally, we use this predicted weighted average deposit growth rate as an IV for the actual weighted average deposit growth rate.

Table 7 presents OLS and 2SLS results of estimating equation (7). The results in Table 7 show that there is a positive correlation between aggregate lending in a state and aggregate deposit growth in other states with which it is financially integrated. This correlation, however, seems to reflect common regional shocks: results in column 1 show that the coefficient of deposit growth in other states with which state i is financially integrated is positive and statistically significant, but this coefficient becomes statistically insignificant once we control for regional time-varying shocks (column 2).

The 2SLS results in Table 7 show that aggregate lending in a state responds to changes in deposits in other states with which it is financially integrated. The first-stage results in Panel B indicate that the IV constructed as described above explains the actual deposit growth in other states with which state i is financially integrated. The second stage results in Panel A show that the coefficient on deposit growth in financially integrated states is positive and significant in all specifications. Different from the OLS estimates, these results are robust to controlling for Census-region year fixed effects (column 4). In column 5 we also include state-linear time trends to account for unobservable time-varying factors and find that this does not affect our results. Furthermore, in column 6 we control for the lagged growth rate of deposits in state i to capture state-level funding shocks. This does not affect our results, suggesting that our findings reflect the transmission of shocks to deposits in other states, and not common

shocks that affect deposits in both state i and other states.

6 Conclusion

This paper analyzes the effect of the geographic expansion of banks across U.S. states on the co-movement of economic activity between states. By exploiting cross-state, cross-time variation in the removal of interstate banking restrictions to construct an instrumental variable we identify the causal effect of banking integration on output co-movement and find that integration increases output synchronization between states.

We also find that the impact of financial integration on output co-movement depends on the nature of the idiosyncratic shocks faced by different states and varies across industries. Our results show that the effect of banking integration on output synchronization between two states is larger when at least one of the states faces financial shocks, whereas this effect is smaller or statistically insignificant in the presence of real shocks. Our results also show that financial integration has a strong positive effect on output synchronization for industries with a high dependence on external finance. Moreover, we find that - within a state-pair - financial integration particularly increases the output co-movement of industries with a high dependence on external finance if states face financial shocks. These findings stress the role of shock transmission through financial intermediaries in accounting for the positive effect of integration on output co-movement.

Finally, we show that integration increases the similarity of fluctuations in bank lending between states and that aggregate lending in a state responds to deposit changes in other states with which it is financially integrated. These findings are consistent with the idea that banks operating in several states transmit shocks through their internal capital markets, creating a commonality in lending among these states, which then increases output synchronization.

Our findings provide novel information on the effects of interstate banking deregulation and financial integration across U.S. states and also offer insights about current policy debates. In particular, our findings indicate that increased integration following interstate banking deregulation contributed to capital flows through banks across states and highlight the role of multi-state banks in the geographic transmission of shocks. Our results also show that increased financial integration can contribute to making economic fluctuations more alike, especially during periods of systemic bank distress.

References

Abiad, A., Furceri, D., Kalemli-Ozcan, S., Pescatori., A., 2013. Dancing together? Spillovers, common shocks, and the role of financial and trade linkages. In: *World Economic Outlook - October*, International Monetary Fund, pp. 81–111.

Albala-Bertrand, J. M., 1993. Natural disaster situations and growth: A macroeconomic model for sudden disaster impacts. World Development 21, 1417–1434.

Allen, F., Gale, D., 2000. Financial contagion. Journal of Finance 108, 1–33.

Amel, D., 2000. State laws affecting the geographic expansion of commercial banks, Board of Governors of The Federal Reserve System, Unpublished Working Paper.

Ashcraft, A. B., 2006. New evidence on the lending channel. Journal of Money, Credit and Banking 38, 751–775.

Avraham, D., Selvaggi, P., Vickery, J. I., 2012. A structural view of us bank holding companies. Economic Policy Review 18, 65–81.

Backus, D., Kehoe, P. J., Kydland, F. E., 1992. International real business cycles. Journal of Political Economy 100, 745–775.

Baxter, M., Kouparitsas, M., 2005. Determinants of business cycle co-movement: A robust analysis. Journal of Monetary Economics 52, 113–157.

Belasen, A. R., Polachek, S. W., 2009. How disasters affect local labor markets: The effects of hurricanes in Florida. The Journal of Human Resources 44, 251–276.

Ben-David, I., Palvia, A., Spatt, C., 2017. Banks' internal capital markets and deposit rates. Journal of Financial and Quantitative Analysis 52, 1797–1826.

Black, S. E., Strahan, P. E., 2002. Entrepreneurship and bank credit availability. Journal of Finance 57, 2807–2833.

Calvo, G. A., Mendoza, E. G., 2000. Rational contagion and the globalization in securities markets. Journal of International Economics 51, 79–119.

Cavallo, E., Galiani, S., Noy, I., Pantano, J., 2013. Catastrophic natural disasters and economic growth. Review of Economics and Statistics 95, 1549–1561.

Cesa-Bianchi, A., Imbs, J., Saleheen, J., 2019. Finance and synchronization. Journal of International Economics 116, 74–87.

Cetorelli, N., Strahan, P. E., 2006. Finance as a barrier to entry: Bank competition and industry structure in local U.S. markets. Journal of Finance 56, 437–461.

Chakraborty, I., Goldstein, I., Mackinlay, A., 2018. Housing price booms and crowding-out effects in bank lending. Review of Financial Studies 31, 2806–2853.

Chavaz, M., 2016. Dis-integrating credit markets: Diversification, securitization, and lending in a recovery, Bank of England Working Paper No. 617.

Chor, D., Manova, K., 2012. Off the cliff and back? credit conditions and international trade during the global financial crisis. Journal of international economics 87, 117–133.

Corsetti, G., Pericoli, M., Sbracia, M., 2005. Some contagion, some interdependence: More pitfalls in tests of financial contagion. Journal of International Money and Finance 24, 1177–1199.

Cortes, K. R., Strahan, P. E., 2017. Tracing out capital flows: How financially integrated banks respond to natural disasters. Journal of Financial Economics 125, 182–199.

Dedola, L., Lombardo, G., Broner, F., 2012. Financial frictions, financial integration and the international propagation of shocks. Economic Policy 27, 319–359.

Devereux, M. B., Yetman, J., 2010. Leverage constraints and the international transmission of shocks. Journal of Money, Credit and Banking 42, 71–105.

Devereux, M. B., Yu, C., 2014. International financial integration and crisis contagion, NBER Working Paper No. 20526.

Driscoll, J. C., 2004. Does bank lending affect output? Evidence from the U.S. states. Journal of Monetary Economics 51, 451–471.

Duval, R., Li, N., Saraf, R., Seneviratne, D., 2016. Value-added trade and business cycle synchronization. Journal of International Economics 99, 251–262.

Duygan-Bump, B., Levkov, A., Montoriol-Garriga, J., 2015. Financing constraints and unemployment: Evidence from the great recession. Journal of Monetary Economics 75, 89–105.

Forbes, K., Rigobon, R., 2002. No contagion, only interdependence: Measuring stock market comovements. Journal of Finance 57, 2223–2261.

Gilje, E. P., Loutskina, E., Strahan, P. E., 2016. Exporting liquidity: Branch banking and financial integration. Journal of Finance 71, 1159–1184.

Goetz, M. R., 2018. Competition and bank stability. Journal of Financial Intermediation 35, 57–69.

Goetz, M. R., Laeven, L., Levine, R., 2013. Identifying the valuation effects and agency costs of corporate diversification: Evidence from the geographic diversification of U.S. banks. Review of Financial Studies 26, 1787–1823.

Goetz, M. R., Laeven, L., Levine, R., 2016. Does the geographic expansion of banks reduce risk? Journal of Financial Economics 120, 346–362.

Grant, J. M., 1998. The Great Texas Banking Crash: An Insider's Account. University of Texas Press.

Heathcote, J., Perri, F., 2004. Financial globalization and real regionalization. Journal of Economic Theory 119, 207–243.

Hochrainer, S., 2009. Assessing the macroeconomic impacts of natural disasters: Are there any?, World Bank Policy Research Working Paper No. 4968.

Holmstrom, B., Tirole, J., 1997. Financial intermediation, loanable funds, and the real sector. Quarterley Journal of Economics 112, 663–691.

Holod, D., Peek, J., 2010. Capital constraints, asymmetric information, and internal capital markets in banking: New evidence. Journal of Money, Credit and Banking 42, 879–906.

Houston, J., James, C., 1998. Do bank internal capital markets promote lending? Journal of Banking and Finance 22, 899–918.

Houston, J., James, C., Marcus, D., 1997. Capital market frictions and the role of internal capital markets in banking. Journal of Financial Economics 46, 135–164.

Imbs, J., 2006. The real effects of financial integration. Journal of International Economics 68, 296–324.

Jayaratne, J., Strahan, P. E., 1996. The finance-growth nexus: Evidence from bank branch deregulation. Quarterly Journal of Economics 111, 639–670.

Jordan, J., 1998. Resolving a banking crisis: What worked in New England. New England Economic Review, Federal Reserve Bank of Boston pp. 49–62.

Kalemli-Ozcan, S., Papaioannou, E., Perri, F., 2013a. Global banks and crisis transmission. Journal of International Economics 89, 495–510.

Kalemli-Ozcan, S., Papaioannou, E., Peydro, J., 2013b. Financial regulation, financial globalization and the synchronization of economic activity. Journal of Finance 68, 1179–1228.

Kalemli-Ozcan, S., Sorenson, B. E., Yosha, O., 2001. Regional integrationm industrial specialization and the asymmetry of shocks across regions. Journal of International Economics 55, 107–137.

Kashyap, A. K., Stein, J. C., 2000. What do a million observations on banks say about the transmission of monetary policy? American Economic Review 90, 407–428.

Kerr, W. R., Nanda, R., 2009. Democratizing entry: Banking deregulations, financing constraints, and entrepreneurship. Journal of Financial Economics 94, 124–149.

Kose, M. A., Prasad, E., Terrones, M., 2004. Volatility and co-movement in an integrated world economy: An exploration. In: Siebert, H. (ed.), *Macroeconomic Policies In The World Economy*, pp. 89–122.

Kroszner, R. S., Strahan, P. E., 1999. What drives deregulation? Economics and politics of the relaxation of bank branching restrictions. Quarterly Journal of Economics 114, 1437–1467.

Landier, A., Sraer, D., Thesmar, D., 2017. Banking deregulation and the rise in house price comovement. Journal of Financial Economics 125, 1–25.

Mendoza, E. G., Quadrini, V., 2010. Financial globalization, financial crises and contagion. Journal of Monetary Economics 57, 24–39.

Morgan, D. P., Rime, B., Strahan, P. E., 2004. Bank integration and state business cycles. Quarterly Journal of Economics pp. 1555–1584.

Morse, A., 2011. Payday lenders: Heroes or villains? Journal of Financial Economics 102, 28–44.

Noy, I., 2009. The macroeconomic consequences of disasters. Journal of Development Economics 88, 221–231.

Obstfeld, M., 1994. Risk-taking, global diversification, and growth. American Economic Review 84, 1555–1585.

Raddatz, C., 2007. Are external shocks responsible for the instability of output in low-income countries? Journal of Development Economics 84, 155187.

Rajan, R. G., Zingales, L., 1998. Financial dependence and growth. American Economic Review 88, 559–586.

Rice, T., Strahan, P. E., 2010. Does credit competition affect small-firm finance? Journal of Finance 65, 861–889.

Rose, A. K., 2009. Is EMU becoming an optimum currency area? The evidence on trade and business cycle synchronization. In: Mackowiak, B., Mongelli, F., Noblet, G., Smets, F. (eds.), *The Euro at Ten - Lessons and Challenges*, European Central Bank.

Table 1
Panel A: Summary Statistics

This table shows descriptive statistics for the main variables employed in our empirical analyses. Data correspond to observations at the state pair and year level. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	N	Mean	Std. Deviation	1st Percentile	99th Percentile	Median
Output co-movement measures						
Negative absolute difference in residual real GDP growth between states * 100	19,665	-2.97	2.76	-14.62	-0.04	-2.21
Instantaneous quasi-correlation of real GDP growth between states * 100	19,665	39.37	104.78	-242.80	508.83	15.76
Five-year correlation of real GDP growth between states * 100	4,140	57.31	44.40	-70.31	99.43	75.32
Banking integration measures						
Share of jointly owned assets and deposits (jointly owned assets and deposits/sum of assets and deposits of both states)	19,665	0.03	0.08	0	0.44	0
Additional state pair controls						
Difference in employment shares between states	19,665	0.11	0.05	0.03	0.28	0.103
Dummy =1 if intrastate branching allowed in any of the two states	19,665	0.40	0.49	0	1	0
ln(GDP of state i)*ln(GDP of state j)	19,665	21.52	1.60	17.84	25.18	21.52

Table 1 (continued)
Panel B: Correlatation Table

This table shows pairwise correlation coefficients for the main variables employed in our empirical analyses.A3 *, **, *** denote significance at ten, five, and one percent level, respectively. P-values are reported in parenthese below. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994

	Negative absolute difference in residual real GDP growth between states	Instantaneous quasi-correlation of real GDP growth between states	Five-year correlation of real GDP growth between states	Share of jointly owned assets and deposits	Difference in employment shares between states	ln(GDP of state i)*ln(GDP of state j)	Dummy =1 if intrastate branching allowed in any of the two states
Negative absolute difference in residual real GDP growth between states	1						
Instantaneous quasi-correlation of real GDP growth between states	0.342*** (0.000)	1					
Five-year correlation of real GDP growth between states	0.689*** (0.000)	0.456*** (0.000)	1				
Share of jointly owned assets and deposits	0.0369*** (0.000)	-0.00741 (0.299)	0.00179 (0.909)	1			
Difference in employment shares between states	-0.271*** (0.000)	-0.0863*** (0.000)	-0.283*** (0.000)	-0.0682*** (0.000)	1		
ln(GDP of state i)*ln(GDP of state j)	0.178*** (0.000)	-0.0848*** (0.000)	0.0646*** (0.000)	0.0599*** (0.000)	-0.324*** (0.000)	1	
Dummy =1 if intrastate branching allowed in any of the two states	0.156*** (0.000)	-0.0834*** (0.000)	0.0989*** (0.000)	0.158*** (0.000)	-0.103*** (0.000)	0.338*** (0.000)	1

Table 2
Interstate Banking Integration and Output Co-movement between States
OLS Regressions

This table reports OLS regressions at the state pair and year level. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: five-year correlation of real GDP growth between two states. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
Share of jointly owned assets and deposits	0.005	0.005	-0.011	-0.021**	0.020
	(0.013)	(0.017)	(0.011)	(0.010)	(0.024)
Difference in employment shares between states	-0.007***	-0.020***	-0.006***	-0.006***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(GDP of state i)*ln(GDP of state j)	-0.624***	-0.638***	0.139**	0.056	-0.180**
	(0.068)	(0.113)	(0.060)	(0.102)	(0.087)
Dummy =1 if intrastate branching allowed in any of the two states	0.178***	0.135***	0.119***	0.127***	0.222***
	(0.023)	(0.025)	(0.020)	(0.022)	(0.044)
State pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	19,665	19,665	19,665	19,665	4,140

Table 3A
Interstate Banking Integration and Output Co-movement between States
Second stage and Reduced form

This table reports 2nd stage (Panel A) and reduced form (Panel B) regression results from 2SLS analysis at the state- pair and year level. Endogenous variable: 'Share of jointly owned assets and deposits'. Excluded instrument: number of years since the liberalization of interstate banking restrictions between two states. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: five-year correlation of real GDP growth between two states. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
	Panel A: Second Stage				
Share of jointly owned assets and deposits	0.301***	0.202***	0.129***	0.137***	0.357***
	(0.058)	(0.045)	(0.039)	(0.038)	(0.099)
F-test of instruments' joint significance	92.46	104.1	92.46	104.1	68.22
	Panel B: Reduced form				
Years since interstate banking deregulation	0.035***	0.038***	0.015***	0.026***	0.041***
	(0.006)	(0.007)	(0.004)	(0.006)	(0.011)
State pair controls	x	x	x	x	x
State pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	19,665	19,665	19,665	19,665	4,140

Table 3B
First Stage

This table reports correpsonding first stage regression results from 2SLS analysis at the state-pair and year level. Dependent variable: 'Share of jointly owned assets and deposits'. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states. State pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)
Years since interstate banking deregulation	0.115***	0.187***	0.116***
	(0.012)	(0.012)	(0.014)
State pair controls	x	x	x
State pair fixed effects	x	x	x
Census-region year fixed effects	x	x	x
State *i* - linear time trend		x	
State *j* - linear time trend		x	
Observations	19,665	19,665	4,140

Table 4
Interstate Banking Integration and Output Co-movement between States
2SLS Regressions - Second Stage
Differences between State-Pairs

This panel reports 2nd stage regression results from 2SLS regressions at the state pair and year level. Dependent variable: negative absolute difference in residual real GDP growth between two states. Endogenous variables: 'Share of jointly owned assets and deposits' and their interactions with dummy variables for high bank failures in a state and/or high natural disaster losses in a state. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states, and its interaction with dummy variables for high bank failures in a state and/or high natural disaster losses in a state. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)	(6)
	Negative absolute difference in residual real GDP growth between states					
	Financial shocks		Real shocks		Financial and real shocks	
Share of jointly owned assets and deposits (a)	0.236***	0.129***	0.311***	0.216***	0.248***	0.145***
	(0.054)	(0.042)	(0.058)	(0.046)	(0.055)	(0.043)
Share of jointly owned assets and deposits *	0.468***	0.507***			0.462***	0.501***
Dummy =1 if high bank failures in a state (b)	(0.126)	(0.125)			(0.124)	(0.123)
Share of jointly owned assets and deposits *			-0.324***	-0.290***	-0.360***	-0.336***
Dummy =1 if high natural disaster losses in a			(0.082)	(0.080)	(0.087)	(0.085)
Dummy =1 if high bank failures in a state	-0.123***	-0.177***			-0.129***	-0.183***
	(0.031)	(0.031)			(0.031)	(0.031)
Dummy =1 if high natural disaster losses in a			-0.115***	-0.111***	-0.128***	-0.129***
state			(0.025)	(0.027)	(0.026)	(0.027)
State pair controls	x	x	x	x	x	x
State pair fixed effects	x	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x	x
State *i* - linear time trend		x		x		x
State *j* - linear time trend		x		x		x
Observations	19,665	19,665	19,665	19,665	19,665	19,665
Effect of banking integration if high bank	0.704***	0.636***			0.710***	0.646***
failures in a state (a)+(b) [test (a)+(b)=0 p-value]	[0.000]	[0.000]			[0.000]	[0.000]
Effect of banking integration if high natural			-0.0123	-0.0746	-0.111	-0.192**
disaster losses in a state (a)+(c) [test (a)+(c)=0 p-			[0.896]	[0.375]	[0.259]	[0.0342]
Excluded instruments						
Years since interstate banking deregulation	x	x	x	x	x	x
Interactions	x	x	x	x	x	x

Table 5
Interstate Banking Integration and Output Co-movement between States
2SLS Regressions - Second Stage
Differences between Industries: External Finance Dependence

This table reports 2nd stage regression results from 2SLS regressions at the state-indutry type pair and year level. Industries are classified in two groups: High/low external finance dependence based on whether they are above/below the median across industries of the Rajan and Zingales (1998) external finance dependence measure. We aggregate the GDP of all industries in each of these groups in a given state and year and calculate the aggregate real growth rate of high/low financial dependence industries. These series are then used to construct our measure of output co-movement at the state pair, year, and industry type level. Endogenous variables: 'Share of jointly owned assets and deposits', interaction with a dummy variable, whether the industry type depends on external finance and further interactions with dummy variables for high bank failures in a state and/or high natural disaster losses in a state. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states, interaction with a dummy variable, whether the industry type depends on external finance and further interactions with dummy variables for high bank failures in a state and/or high natural disaster losses in a state. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state pair-industry type (high/low financial dependence) level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)	(6)
	Negative absolute difference in residual real GDP growth between states					
Share of jointly owned assets and deposits (a)	0.041	-0.044				
	(0.032)	(0.029)				
Share of jointly owned assets and deposits * Dummy =1 if industry dependent on finance (b)	0.126***	0.296***	0.296***	0.254***	0.296***	0.254***
	(0.035)	(0.059)	(0.060)	(0.061)	(0.061)	(0.061)
Share of jointly owned assets and deposits * Dummy =1 if industry dependent on finance * Dummy =1 if high bank failures in a state (c1)				0.361**		0.361**
				(0.177)		(0.176)
Share of jointly owned assets and deposits * Dummy =1 if industry dependent on finance * Dummy =1 if high natural disaster losses in a state (c2)					0.003	-0.013
					(0.146)	(0.147)
Observations	39,330	39,330	39,330	39,330	39,330	39,330
Effect of banking integration for industries that depend on finance (a)+(b) [test (a)+(b)=0 p-value]	0.167***	0.252***				
	[0.000]	[0.000]				
Effect of banking integration for industries that depend on finance (a) if high bank failures in a state (b)+(c1) [test (b)+(c1)=0 p-value]				0.614***		0.615***
				[0.000]		[0.000]
Effect of banking integration for industries that depend on finance if high natural disaster losses in a state (b)+(c2) [test (b)+(c2)=0 p-value]					0.298**	0.241
					[0.046]	[0.117]
State pair controls	x	x				
State pair year fixed effects			x	x	x	x
State pair industry type fixed effects	x	x	x	x	x	x
Census-region year fixed effects	x					
State *i* - linear time trend	x					
State *j* - linear time trend	x					
Industry type census-region year fixed effects		x	x	x	x	x
Industry type state *i* - linear time trend		x	x	x	x	x
Industry type state *j* - linear time trend		x	x	x	x	x
Excluded instruments						
Years since interstate banking deregulation	x	x	x	x	x	x
Interactions	x	x	x	x	x	x

Table 6
Interstate Banking Integration and Bank Lending Co-Movement between States
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS regressions at the state pair and year level. Dependent variable: negative absolute difference in residual real growth rate of Commercial and Industrial (C&I) loans between two states. Endogenous variable: 'Share of jointly owned assets and deposits'. Excluded instruments: number of years since the liberalization of interstate restrictions between two states. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1977-1994.

	(1)	(2)	(3)	(4)
	Negative absolute difference in residual real C&I loan growth rates between states			
Share of jointly owned assets and deposits	0.187***	0.101**	0.151***	0.075*
	(0.056)	(0.042)	(0.053)	(0.040)
Business cycle synchronization (lag)			0.048***	0.049***
			(0.003)	(0.003)
State pair controls	x	x	x	x
State pair fixed effects	x	x	x	x
Census-region year fixed effects	x	x	x	x
State *i* - linear time trend		x		x
State *j* - linear time trend		x		x
Observations	18,630	18,630	18,630	18,630
F-test of instruments' joint significance	95.02	103.2	94.78	103.1
Excluded instruments				
Years since interstate banking deregulation	x	x	x	x

Table 7

State-level C&I Loan Growth and Deposit Growth in Financially Integrated States

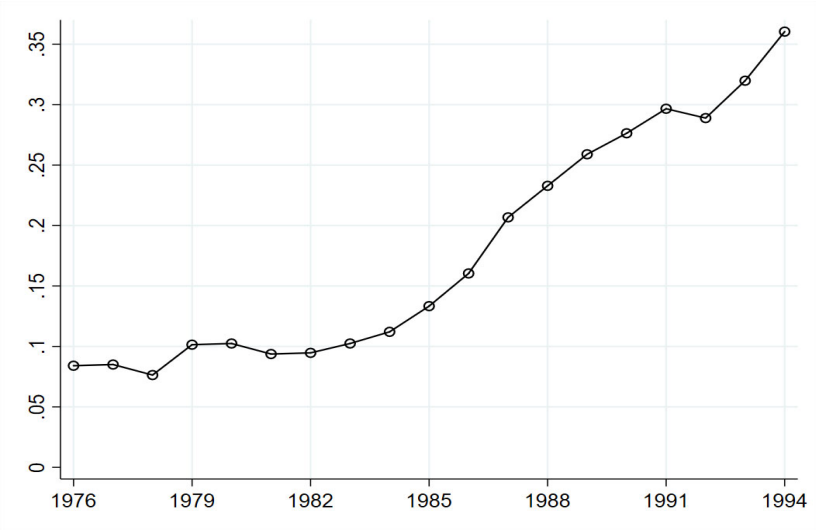
This table reports regressions at the state and year level following equation (7) in the main text of the paper. Dependent variable: annual real growth rate of state-level Commercial and Industrial (C&I) loans. Columns (1) and (2) report OLS regressions. Columns (3) to (6) report 2SLS regressions. Endogenous variable: Weighted average of the growth rate of real bank deposits across all other states, weighted by the bilateral share of jointly-owned assets and deposits. Excluded instrument: Weighted average of the growth rate of real bank deposits across all other states, weighted by the predicted bilateral share of jointly-owned assets and deposits. The predicted share is constructed as follows. We first estimate a regression of the share of jointly-owned assets and deposits between two states on state-pair fixed effects, year fixed effects, state-pair linear time trends, the number of years since the liberalization of interstate banking restrictions between two states and its square, and other state pair controls. Using the coefficients from this regression, we predict the share of jointly-owned assets and deposits for each state pair, imposing a zero for state pairs that do not allow interstate banking. First-stage results are reported in Panel B. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

Panel A: OLS and 2nd stage results from 2SLS regressions						
	(1)	(2)	(3)	(4)	(5)	(6)
	State-level C&I loans real growth rate					
	OLS		2SLS			
Weighted average real deposit growth rate of other states, weighted by share of jointly owned assets and deposits (lag)	0.297***	0.105	1.285***	1.554**	1.396**	1.409**
	(0.101)	(0.105)	(0.323)	(0.629)	(0.594)	(0.628)
State-level real deposit growth rate (lag)					0.371***	0.315***
					(0.124)	(0.113)
State fixed effects	x	x	x	x	x	x
Year fixed effects	x		x			
Census region-year fixed effects		x		x	x	x
State linear time trends					x	x
Observations	782	782	782	782	782	782
F-test of instruments' joint significance			31.28	12.62	12.70	11.84
Panel B: First Stage - Excluded instruments						
Weighted average real deposit growth rate of other states, weighted by predicted share of jointly owned assets and deposits (lag)			1.224***	0.909***	0.906***	0.891***
			(0.219)	(0.256)	(0.254)	(0.259)

Figure 1
Evolution of Banking Integration between States

This figure illustrates the evolution of banking integration between states. Panel A shows the fraction of all unique state pairs in our sample that were integrated (i.e., had any jointly-owned bank assets or deposits) in each year over the period 1976-1994. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota). Panel B shows the evolution of the share of jointly-owned assets and deposits between California and three other states (Florida, Texas, and Washington) over our sample period.

Panel A: Fraction of State Pairs with Jointly-Owned Assets or Deposits



Panel B: Share of Jointly-Owned Assets and Deposits between Selected State Pairs

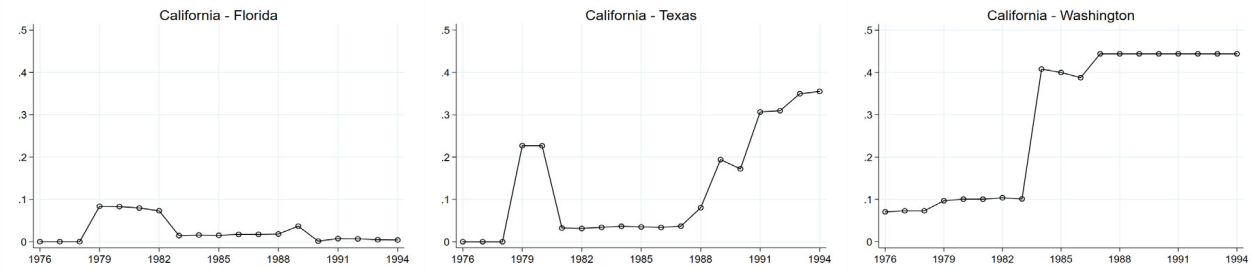
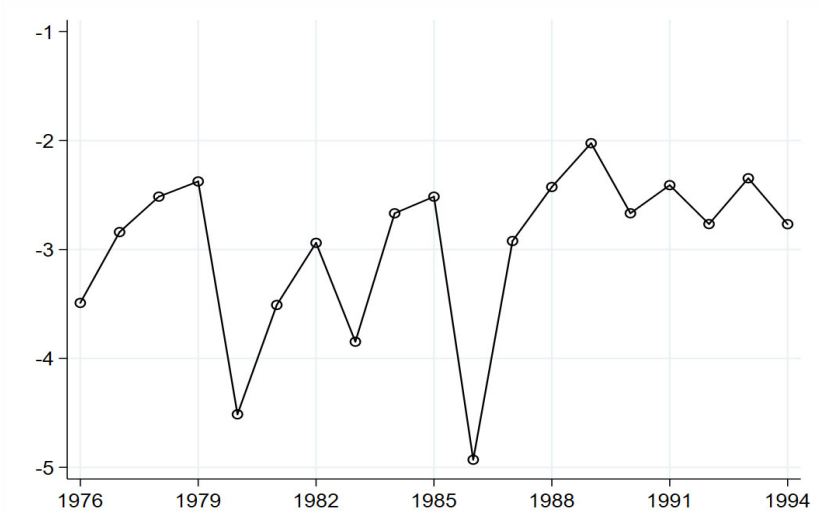


Figure 2
Evolution of Output Co-movement between States

This figure illustrates the evolution of output co-movement between states. Panel A shows the mean across all unique state pairs in our sample of the negative absolute difference in residual real GDP growth between two states (multiplied by 100) over the period 1976-1994. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota). Panel B shows the evolution of the negative absolute difference in residual real GDP growth between California and three other states (Florida, Texas, and Washington) over our sample period.

Panel A: Negative Absolute Difference in Residual Real GDP Growth between States - Average across all state pairs



Panel B: Negative Absolute Difference in Residual Real GDP Growth between States - Selected State Pairs

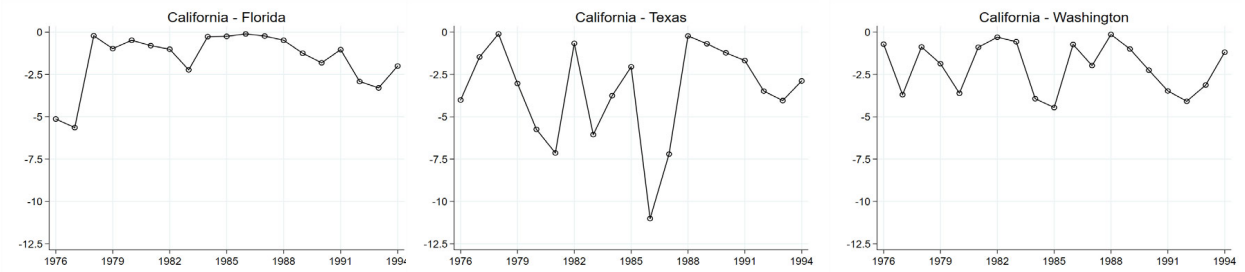


Figure 3
Evolution of Interstate Banking Deregulation

This figure shows the cumulative fraction of state pairs in our sample that had removed barriers to bank entry between each other by each year over the period 1976-1994, differentiating between methods of deregulation. Unilateral deregulation refers to cases in which (at least) one of the states in a given pair unilaterally allowed entry by bank holding companies (BHCs) from all other states. Reciprocal deregulation are cases in which states enacted nationwide reciprocal agreements with all other states. In these cases, the date of effective deregulation for a given state pair depends not only on the decision of the state that deregulated on a reciprocal manner, but also on the other state's decision to reciprocate. Bilateral deregulation refers to cases in which the two states in a given pair allowed BHC entry by signing a bilateral interstate banking agreement. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota).

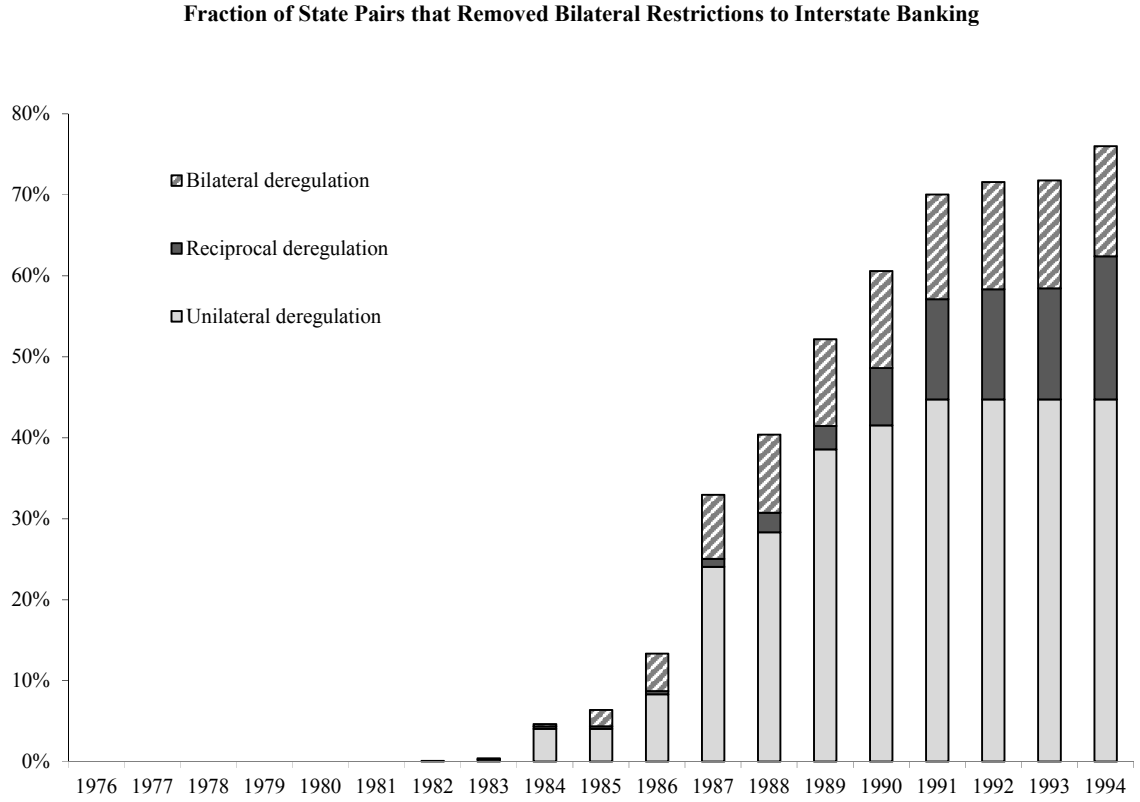
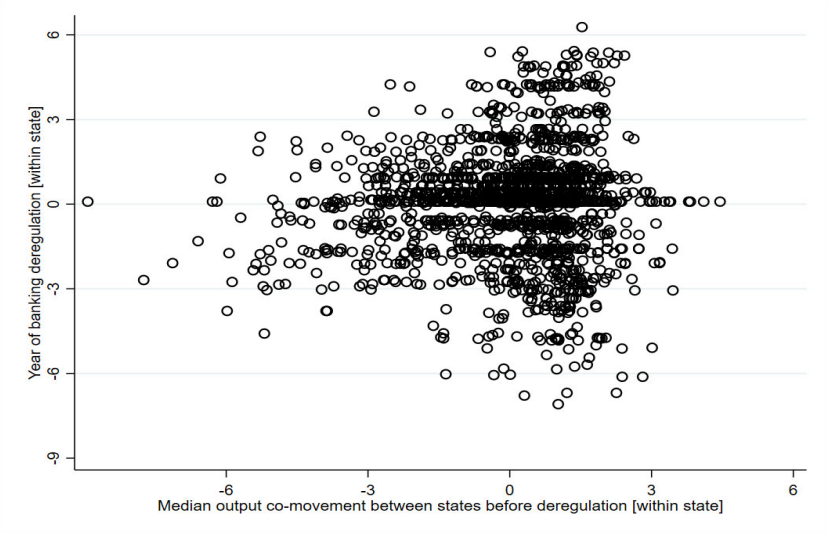


Figure 4

Interstate Banking Deregulation and Output Co-movement Before Deregulation -Within State Differences

This figure plots the relationship between the timing of bilateral interstate banking deregulation and the level of or change in output co-movement beween states prior to deregulation. For each state-pair *i,j* we first determine the year of interstate banking deregulation and then compute the median level of (Panel A) or median change in (Panel B) the negative absolute difference in residual real GDP growth between the two states over the five years prior to deregulation. To focus on within-state differences, we substract the state-level mean from all the variables.

Panel A: Timing of Interstate Banking Deregulation and Level of Output Co-movement Before Deregulation



Panel B: Timing of Interstate Banking Deregulation and Change in Output Co-movement Before Deregulation

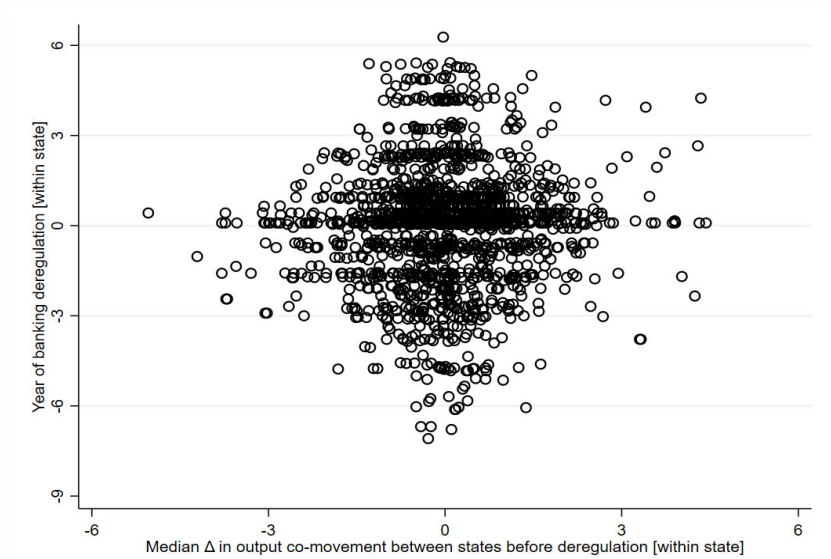


Figure 5

Dynamic Effect of Interstate Banking Deregulation on Banking Integration between States

This figure illustrates the impact of bilateral interstate banking deregulation on banking integration between states. In particular, the figure shows coefficients from the following regression:

$$Banking\ integration_{i,j,t} = \alpha_{i,j} + \delta_{r,t} + \rho_1 T_i + \rho_2 T_j + \sum_{r=-10}^{+10} \beta_r Y_{i,j,r,t} + \varepsilon_{i,j,t}$$

where *Banking integration* $_{i,j,t}$ is the share of jointly-owned assets and deposits for state pair *i, j* in year *t*; $Y_{i,j,r,t}$ are dummy variables equal to one if in year *t*, states *i* and *j* deregulated *r* years before; *T* are state(*i*/*j*)-specific linear time trends; $\delta_{r,t}$ and $\alpha_{i,j}$ are Census-region year and state-pair fixed effects, respectively. The dots show the estimated br coefficients, while the dashed lines show the 99 percent cofidence interval. The coefficient on integration for the year of interstate banking deregulation is excluded due to collinearity, so the coefficients β_r capture differences relative to the year of deregulation. Standard errors are clustered at the state-pair level.

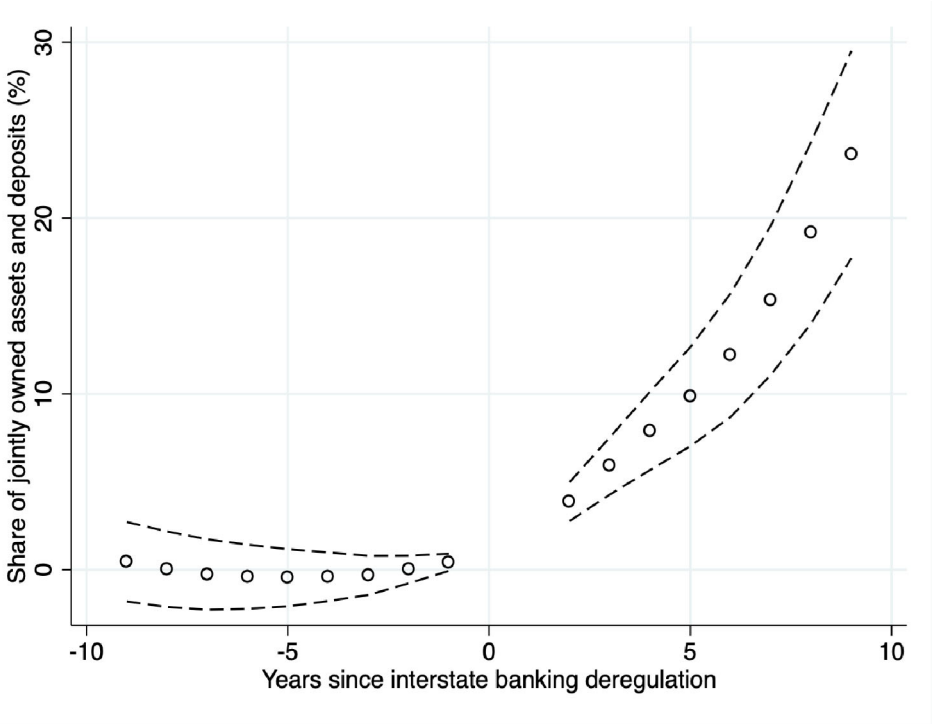


Figure 6
Dynamic Effect of Interstate Banking Deregulation on Outout Synchronization

This figure illustrates the impact of interstate banking deregulation on the co-movement of output between states. In particular, the figure shows coefficients from the following regression:

$$Synchronization_{i,j,t} = \alpha_{i,j} + \delta_{r,t} + \rho_1 T_i + \rho_2 T_j + \sum_{r=-10}^{+10} \beta_r Y_{i,j,r,t} + \varepsilon_{i,j,t}$$

where Synchronization$_{i,j,t}$ is the negative absolute difference in residual real GDP growth between two states for state pair i, j in year t ; $Y_{i,j,r,t}$ are dummy variables equal to one if in year t, states i and j deregulated r years before; T are state(i/j)-specific linear time trends; $\delta_{r,t}$ and $\alpha_{i,j}$ are Census-region year and state-pair fixed effects, respectively. The dots show the estimated β coefficients, while the dashed lines show the 99 percent cofidence interval. The coefficient on integration for the year of interstate banking deregulation is excluded due to collinearity, so the coefficients β_r capture differences relative to the year of deregulation. Standard errors are clustered at the state-pair level.

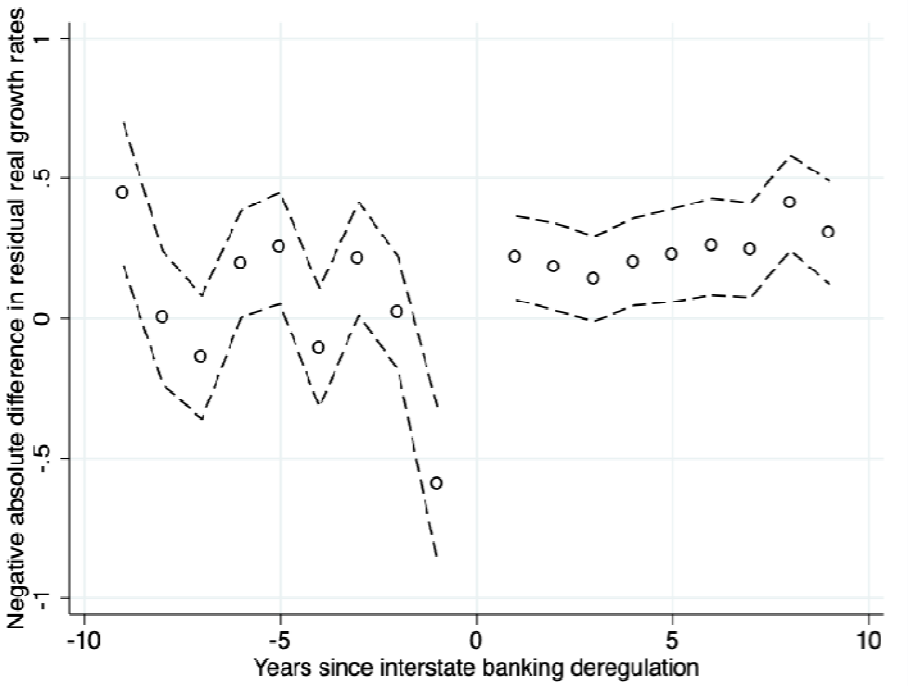
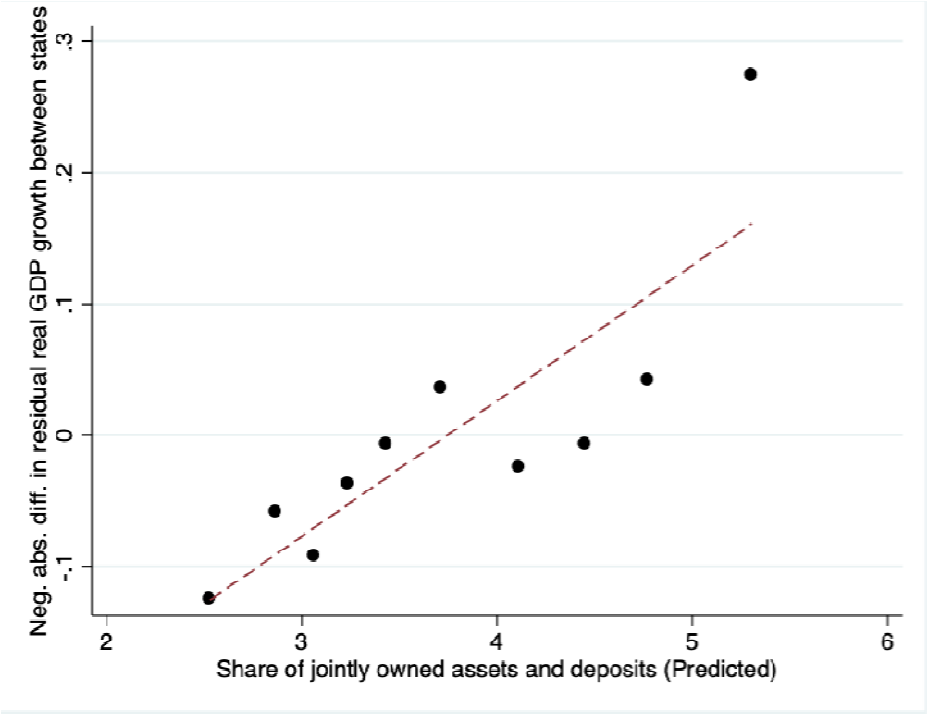


Figure 7
Output Sychronization and predicted interstate banking integration

This figure represents the causal effect of interstate banking integration on the co-movement of output between states. The horizontal axis represents the exogenous component of interstate banking deregulation, obtained from a regression of the share of jointly owned assets and deposits on years since interstate banking deregulation where we control for Census region-year fixed effects, state-linear time trends and additional control variables. We compute ten deciles based on the predicted interstate banking integration and compute the average value of our preferred measure of output synchronization, i.e. negative absolute difference in residual real GDP growth between states. Dots represent the average output synchronization for each decile of predicted share of jointly owned assets and deposits. The dotted line represent the linear fit.



Appendix

This document provides supplementary materials to the paper Financial Integration and the Co-Movement of Economic Activity: Evidence from U.S. States.

Description of Appendix Tables

Appendix Table A.1: This table reports OLS regressions similar to those in Table 2 of the main text of the paper where we introduce different fixed effects in our empirical model.

Appendix Table A.2: This table reports reduced form regressions similar to those reported in Table 3 in the main text of the paper.

Appendix Table A.3: This table reports regressions similar to those in Table 3 in the main text of the paper using years since the liberalization of interstate banking restrictions and its square as excluded instrumental variables.

Appendix Table A.4: This table reports regressions similar to those in Table 3 in the main text of the paper using alternative measures of the synchronization of economic activity between states.[1] Panel A of Appendix Table A.1 reports results constructing our synchronization variables using state-level employment growth. Panel B reports results based on real state-level personal income growth. These results confirm our main findings.

Appendix Table A.5: This table reports regressions similar to those in Table 3 in the main text of the paper using alternative measures of banking integration. Panel A reports results using, alternatively, (1) only deposits or (2) only bank assets to construct our continuous measure of banking integration, instead of their sum as in our main variable. Panel B presents results scaling jointly-owned assets and deposits by the sums of (1) the GDP or (2) the population of the two states in a pair, alternatively. These results confirm our main findings.

Appendix Table A.6: This table reports regressions similar to those in Table 3 in the main text of the paper extending our sample to the period 1976-2018. After 1994 we cannot identify the assets of a bank holding company in different states because the

[1] To keep the size of the tables manageable, in the robustness and extensions based on Table 3 we only report results controlling for state-pair linear time trends and considering one set of instrumental variables, the number of years since a state pair removed entry restrictions and its square.

Riegle-Neal Act allowed BHCs to consolidate bank charters across states. Therefore, for this analysis we construct our banking integration measures using only deposits, as data on the geographic location of deposits are available for a longer period. Moreover, the Riegle-Neal Act removed all remaining barriers to entry at the federal level, thus we consider all states as having deregulated interstate banking after 1994 to construct our instrumental variables. We find results similar to those reported throughout the paper when analyzing a longer time period.[2]

Appendix Table A.7: This table reports regressions similar to those in Table 3 in the main text of the paper controlling for bilateral interstate trade. Bilateral integration through trade may affect output co-movement (Frankel and Rose, 1998; Clark and Wincoop, 2001; Imbs, 2004) and trade in goods and in financial assets tend to move together (Rose and Spiegel, 2004; Aviat and Coeurdacier, 2007).[3] Michalski and Ors (2012) find that banking integration across U.S. states increases interstate trade. Given that trade can impact output co-movement, this suggests that banking integration can indirectly affect co-movement between states through its effect on bilateral trade, in addition to any potential direct effects. By controlling for trade in our regressions, we can abstract from this channel of influence.

Data on interstate trade come from the Commodity Flow Survey conducted by the Department of Transportation, which provides information on interstate shipments. We measure bilateral interstate trade as the bilateral trade flows (shipments) between states i and j divided by the total trade flows (shipments) between each of these states and all other states. Unfortunately, only two Commodity Flow surveys were conducted during our sample period, in 1977 and 1993. Thus, we cannot make use of the full time series in our data and must limit our dataset to two observations per state pair for this analysis. For all control variables, including our measures of banking integration, we take data as of 1977 and 1993. For our dependent variables (negative absolute dif-

[2]The estimated coefficients on the banking integration measures in Appendix Table A.3 are smaller than those reported in Table 4 in the main text of the paper, suggesting that the effect of integration on output co-movement decreased after the mid-1990s. This could reflect changes in the banking system that might have affected its role in transmitting shocks across states. For instance, Stiroh and Metli (2003) find that the share of non-performing loans decreased in the early 1990s, suggesting that banks became safer. Similarly, Stiroh and Strahan (2003) show that more efficient banks gained market share following the deregulation of interstate banking and intrastate branching restrictions. Dick (2006) finds that banks became more efficient in the provision of deposit services after the Riegle-Neal Act. The smaller effect of integration on output co-movement could also reflect changes in the nature of the idiosyncratic shocks that drive state economic fluctuations since the mid-1990s.

[3]From a theoretical perspective, the impact of bilateral trade on output co-movement is ambiguous (Frankel and Rose, 1998; Calderón et al., 2007). On the one hand, if demand shocks are the main source of fluctuations, then the synchronization of economic activity between regions will increase as trade increases. On the other hand, if industry-specific shocks dominate, the relationship between trade and synchronization will depend on the patterns of specialization. If increasing specialization leads to inter-industry trade, then trade will result in more asymmetric fluctuations. In contrast, if intra-industry trade prevails, then increased trade will result in higher output co-movement.

ference in residual real GDP growth and instantaneous quasi-correlation of real GDP growth), we take five-year forward-looking average on these dates (i.,e., averages over the periods 1977-1981 and 1993-1997) to mitigate the effect of measurement error. Given that we only have two data points for these regressions, we cannot include state-pair linear trends and only include year fixed effects.

The results in Appendix Table A.7 show that our findings are robust to restricting our sample to two observations per state pair and controlling for interstate trade. In addition, our results show that bilateral trade tends to be negatively correlated with output co-movement between states.

Appendix Table A.8: This table reports regressions similar to those in Table 3 in the main text of the paper considering alternative samples based on the form of interstate deregulation. Panel A reports results excluding state pairs that deregulated through bilateral agreements, as the decision to deregulate in a bilateral manner could be correlated with changes in other forms of bilateral integration. Panel B reports results restricting the sample to states that deregulated by unilaterally opening entry to BHCs from all states, because changes in synchronization with a particular state are unlikely to have driven this form of deregulation. The results in Appendix Table A.5 confirm our main findings.

Appendix Table A.9: This table reports results focusing on differences in banking integration and output synchronization between state pairs that share a metropolitan statistical area (MSA), adapting the approaches by Huang (2008) and Michalski and Ors (2012) to our setting.[4] In particular, for each state pair (m, k) that shares an MSA, we analyze whether the difference in output synchronization between every state i and states k and m, respectively, changes more when i and k become more financially integrated (compared to i and m). If states that share a common MSA are subject to similar shocks, this approach allows us to control for unobserved time-varying state-pair shocks.

Using the 1993 MSA definitions from the Census Bureau, there are 47 state pairs (m, k) in our sample that share a common MSA. We then determine the difference in synchronization and integration between those states and every other state i that does not share a common MSA with either k and/or m.[5,6] To identify the effect of

[4]MSAs are geographic entities that contain a core urban area of 50,000 or more inhabitants and also include any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core.

[5]We order the data such that the state in the pair k, m that liberalized its banking restrictions with i earlier will be the subtrahend. This ensures that the differenced instruments are always positive.

[6]A state can also share a MSA with more than two states. We do not include these states in our analysis to isolate the differential effect of integration on synchronization. Consider, for instance, the states of Alabama and Georgia that share a common MSA (Columbus, AL-GA). Georgia also shares a common MSA with South Carolina (Augusta-Aiken, GA-SC) and Tennessee (Chattanooga,

integration on synchronization, our regression model then becomes:

$$\begin{aligned}\Delta Synchronization_{i,k,m,t} &= \alpha_{i,k,m} + \delta_t + \beta * \Delta Banking\ Integration_{i,k,m,t} + \\ &+ \Delta \mathbf{X'}_{i,k,m,t}\gamma + \varepsilon_{i,k,m,t}, \end{aligned} \quad (1)$$

where $\Delta Synchronization_{i,k,m,t} = Synchronization_{i,k,t} - Synchronization_{i,m,t}$ and thus measures the difference in co-movement between states i and k and states i and m, respectively. Similarly $\Delta Banking\ Integration_{i,k,m,t}$ measures the difference in banking integration between states i and k and states i and m, respectively, and $\Delta \mathbf{X'}_{i,k,m,t}$ measure the differences in the additional state-pair time-varying control variables between these two sets of states. Furthermore, we also difference our instrumental variables following a similar approach and use 2SLS estimation to identify the causal impact of integration on output co-movement. We also include time fixed effects δ_t and state-triplet fixed effects ($\alpha_{i,k,m}$).

Appendix Table A.9 presents the 2SLS results of these estimations, which confirm our main findings. In particular, higher banking integration between states i and k (relative to the integration between states i and m, where m shares an MSA with k) significantly increases their output synchronization, beyond the level of synchronization between i and m. Thus, even when using a pair of states that shares an MSA to control for potential omitted variables, we find that banking integration leads to higher output synchronization.

Appendix Table A.10: This table reports regressions similar to those in Table 3 in the main text of the paper controlling for linear time trends as the state-pair level or state-year fixed effects to address any remaining concerns that our results might be affected by time-varying state shocks. The state-year fixed effects absorb a significant part of the variation in our deregulation instruments, because the most common form of deregulation was unilaterally opening up entry to BHCs from all states, which varies at the state-year level. Nevertheless, we confirm our main findings when including these fixed effects.[7]

Appendix Table A.11: This table presents information on our definition of state-level financial shocks associated with bank failures. Panel A shows the distribution of the ratio of total assets and deposits held by failing banks to lagged GDP. Panel B shows the states and years classified as experiencing financial shocks associated with bank failures, defined as those where the ratio of total assets and deposits held by

TN-GA). Thus we take each of the remaining 44 states in our sample and compute the difference in synchronization and integration between that state and Alabama and Georgia, respectively. The same applies, for instance, when computing differences in synchronization and integration between the state pair Georgia-South Carolina and all other states.

[7] We do not analyze the five-year correlation of real GDP growth because we only have four observations for each state pair for this variable and the state-year fixed effects absorb most of the variation.

failing banks to lagged GDP exceeds two percent.

Appendix Table A.12: This table presents information on our definition of state-level real shocks associated with natural disasters. Panel A shows the distribution of the ratio of total monetary losses due to natural disasters to lagged GDP. Panel B shows the states and years classified as experiencing real shocks associated with natural disasters, defined as those where the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent.

Appendix Table A.13: This table analyzes whether the periods when states experience real shocks associated with natural disasters according to our definition are associated with changes in state economic activity. In particular, this table reports OLS regressions of state-level real GDP growth on state fixed effects and a dummy variable that equals one if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent in a state and year. Column (1) reports results controlling for year fixed effects. Column (2) includes census region-year fixed effects, to account for time-varying regional shocks, and column (3) includes state linear time trends. The results show that the states and years classified as experiencing real shocks according to our definition are associated with a decrease in state-level real GDP growth of about one percentage point.

Appendix Table A.14: This table examines the link between financial and real shocks at the state and reports results from a regression of our financial shock indicator variable in year t on a set of dummy variables, taking on the value of one whether the state experienced a real shock in years $t-1$, $t-2$ and/or $t-3$. To account for time-varying differences we include Census-region time fixed effects and state fixed effects. We do not find a significant relationship between a state's likelihood of facing a financial shock in a year and the presence of real shocks in the prior years.

Appendix Table A.15: This table shows the number of states and state pairs experiencing financial and/or real shocks in each year of our sample period.

Appendix Table A.16: This table reports regressions similar to those in Table 4 in the main text of the paper considering alternative cut-offs to define periods when states face financial shocks. In particular, columns (1) and (2) report results classifying states as facing a financial shock in a given year if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds 1.5 percent. Columns (3) and (4) report results considering a 2.5 percent threshold. These results confirm our main findings.

Appendix Table A.17: This table reports regressions similar to those in Table 4 in the main text of the paper considering alternative cut-offs to define periods when states face real shocks. In particular, columns (1) and (2) report results classifying states as experiencing a real shock due to natural disasters in a given year if the ratio

of monetary losses from natural disasters to lagged GDP exceeds 0.5 percent. Columns (3) and (4) report results considering a one percent threshold. These results confirm our main findings.

Appendix Table A.18: As an alternative to exploiting natural disasters to identify real shocks, we also analyze changes in state-level military spending driven by national military buildups and draw-downs. Following Nakamura and Steinsson (2014), we first estimate exogenous changes in military spending for each state and year as the predicted value from a regression of changes in state-level military spending as a share of GDP on changes in national military spending as a share of GDP, the interaction between changes in national military spending (as a share of GDP) and state dummies, and state and year fixed effects. Panel A of Appendix Table A.14 shows the distribution these predicted values. Then, we classify states as experiencing a real shock due to exogenous changes in military spending in a given year if this predicted value is in the top 95 percent or bottom 5 percent of its distribution for our sample.[8] We consider a relatively high threshold for our classification as we want to identify periods when a state's real economy faces a large shock. Based on this definition, 19 states are classified as having experienced real shocks due to exogenous changes in military spending at least once during our sample period. Panel B of Appendix Table A.14 shows the states and years included in this classification.

Appendix Table A.19: This table reports regressions similar to those in Table 4 in the main text of the paper considering changes in state-level military spending driven by national military buildups and draw-downs to define periods when states face real shocks. In particular, we estimate 2SLS regressions including the interaction between our measures of banking integration and a dummy variable that captures whether one (or both) state in a given pair experienced real shocks due to changes in military spending, following the definition described above. The results in Appendix Table A.15 show that this interaction term is negative and statistically significant, indicating that, consistent with theoretical arguments, the effect of banking integration on output synchronization is smaller when states experience real shocks.

We conducted additional tests to confirm the robustness of these results. First, we re-estimated our regressions considering alternative cut-offs to define periods when states face real shocks. In particular, we classified states as experiencing a real shock in a given year if our measure of exogenous changes in state-level military spending is in the top 90 percent or bottom 10 percent of its distribution for our sample. We also classified states as facing a real shock in a given year if our measure of exogenous changes in state-level military spending (in absolute terms) exceeds, alternatively, 0.5

[8] We consider both the top and bottom of the distribution of this variable as military spending shocks could be either positive or negative and we want to capture both. According to theoretical arguments, the effect of banking integration on output synchronization is smaller when states experience real shocks, irrespective of the sign of these shocks.

or 1 percent. In all cases we obtained similar results. Second, as shown in Appendix Table A.14, a few states where military spending represents a relatively high share of GDP (Kansas, Missouri, and California) are classified as experiencing real shocks in most years of our sample period. We re-estimated our regressions excluding these states and obtained similar results.

References

Aviat, A., Coeurdacier, N., 2007. The geography of trade in goods and asset holdings. Journal of International Economics 71, 22–51.

Calderón, C., Chong, A., Stein, E., 2007. Trade intensity and business cycle synchronization: Are developing countries any different? Journal of International Economics 71, 2–21.

Clark, T. E., Wincoop, E. V., 2001. Borders and business cycles. Journal of International Economics 55, 59–85.

Dick, A. A., 2006. Nationwide branching and its impact on market structure, quality and bank performance. Journal of Business 79, 567–591.

Frankel, J. A., Rose, A. K., 1998. The endogeneity of the optimum currency area criterion. Economic Journal 108, 1009–1025.

Huang, R., 2008. Evaluating the real effect of bank branching deregulation: Comparing contiguous counties across U.S. state borders. Journal of Financial Economics 87, 678–705.

Imbs, J., 2004. Trade, specialization and synchronization. Review of Economics and Statistics 6, 723–734.

Michalski, T. K., Ors, E., 2012. (interstate) banking and (interstate) trade: Does real integration follow financial integration. Journal of Financial Economics 104, 89–117.

Rose, A. K., Spiegel, M. M., 2004. A gravity model of sovereign lending: Trade, default, and credit. IMF Staff Papers 51, 50–63.

Stiroh, K. J., Metli, C., 2003. Now and then: The evolution of loan quality for U.S. banks. Current Issues In Economics and Finance .

Stiroh, K. J., Strahan, P. E., 2003. Competitive dynamics of deregulation: Evidence from U.S. banking. Journal of Money, Credit, and Banking 35, 801–828.

Appendix Table A.1
Interstate Banking Integration and Output Co-movement between States
OLS Regressions with different fixed effects

This table reports OLS regressions at the state pair and year level. Panel A dependent variable: negative absolute difference in residual real GDP growth between two states. Panel B dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)
	Panel A: Negative absolute difference in residual real GDP growth between states				
Share of jointly owned assets and deposits	-0.000	0.021*	0.024**	0.005	-0.008
	(0.013)	(0.012)	(0.012)	(0.013)	(0.010)
Difference in employment shares between states	-0.005***	-0.007***	-0.006***	-0.007***	-0.008***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
ln(GDP of state i)*ln(GDP of state j)	0.040***	-0.118***	-0.666***	-0.624***	-0.501***
	(0.009)	(0.013)	(0.062)	(0.068)	(0.100)
Dummy =1 if intrastate branching allowed in any of the two states	0.223***	0.316***	0.180***	0.178***	0.149***
	(0.024)	(0.028)	(0.024)	(0.023)	(0.023)
	Panel B: Instantaneous quasi-correlation of real GDP growth between states				
Share of jointly owned assets and deposits	-0.000	0.006	0.005	-0.011	-0.021**
	(0.007)	(0.012)	(0.011)	(0.011)	(0.010)
Difference in employment shares between states	-0.002***	-0.003***	-0.006***	-0.006***	-0.006***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
ln(GDP of state i)*ln(GDP of state j)	-0.066***	-0.269***	0.239***	0.139**	0.056
	(0.005)	(0.014)	(0.054)	(0.060)	(0.102)
Dummy =1 if intrastate branching allowed in any of the two states	-0.124***	0.046*	0.170***	0.119***	0.127***
	(0.017)	(0.025)	(0.021)	(0.020)	(0.022)
State pair fixed effects		x	x	x	x
Year fixed effects			x		
Census-region year fixed effects				x	x
State *i* - linear time trend					x
State *j* - linear time trend					x
Observations	19,665	19,665	19,665	19,665	19,665

Appendix Table A.2
Interstate Banking Liberlization and Output Co-movement between States
OLS Regressions - Reduced form

This table reports 2nd stage regression results from 2SLS analysis at the state pair and year level. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: five-year correlation of real GDP growth between two states. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
Years since interstate banking deregulation	0.035***	0.038***	0.015***	0.026***	0.041***
	(0.006)	(0.007)	(0.004)	(0.006)	(0.011)
State pair controls	x	x	x	x	x
State pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	19,665	19,665	19,665	19,665	4,140

Appendix Table A.3
Interstate Banking Integration and Output Co-movement between States
Alternative Instrument Specifications
2SLS Regressions - Second Stage

This table reports 2nd and 1st stage regression results from 2SLS analysis at the state pair and year level. Panel A: Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: five-year correlation of real GDP growth between two states. Endogenous variable: 'Share of jointly owned assets and deposits'. Excluded instrument: number of years since the liberalization of interstate banking restrictions between two states and its squares. Panel B reports associated first stage regression results. State pair controls: product of the natural logarithm of real GDP of the two states, difference in employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota, over the period 1976-1994.

Panel A: Second stage regression					
	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual growth between states		Instantaneous quasi-correlation of growth between states		Five-year correlation of growth between states
Share of jointly-owned assets and deposits	0.258***	0.155***	0.100***	0.112***	0.301***
	(0.053)	(0.040)	(0.037)	(0.036)	(0.093)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	x
State *j* - linear time trend		x		x	x
Observations	19,665	19,665	19,665	19,665	4,140
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
Years since interstate banking deregulation squa	x	x	x	x	x
F-test of instruments' joint significance	46.31	60.95	46.31	60.95	34.99
Panel B: First stage regression					
	(1)	(2)	(3)	(4)	(5)
Years since interstate banking deregulation	0.121***	0.262***	0.121***	0.262***	0.039
	(0.032)	(0.044)	(0.032)	(0.044)	(0.054)
Years since interstate banking deregulation squared	0.137***	0.177***	0.137***	0.177***	0.256***
	(0.030)	(0.030)	(0.030)	(0.030)	(0.064)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	19,665	19,665	19,665	19,665	4,140

Appendix Table A.4
Interstate Banking Integration and Output Co-movement between States
Alternative Synchronization Measures
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. Panel A dependent variables: Synchronization measures based on state-level employment growth. Panel B dependent variables: Synchronization measures based on state-level real personal income growth. Endogenous variables: banking integration measures 'Dummy=1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits'. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Synchronization measures based on state-level employment growth					
	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual employment growth between states		Instantaneous quasi-correlation of employment growth between states		Five-year correlation of employment growth between states
Share of jointly-owned assets and deposits	0.485***	0.262***	0.066	0.149***	0.753***
	(0.076)	(0.051)	(0.048)	(0.043)	(0.127)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	x
State *j* - linear time trend		x		x	x
Observations	19,665	19,665	19,665	19,665	4,140
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
F-test of instruments' joint significance	92.46	104.1	92.46	104.1	68.22

Panel B: Synchronization measures based on real state-level personal income growth					
	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real personal income growth between states		Instantaneous quasi-correlation of real personal income growth between states		Five-year correlation of real personal income growth between states
Share of jointly-owned assets and deposits	0.280***	0.266***	0.149***	0.103***	0.784***
	(0.057)	(0.047)	(0.039)	(0.031)	(0.139)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend	x	x	x	x	x
State *j* - linear time trend	x	x	x	x	x
Observations	19,665	19,665	19,665	19,665	4,140
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
F-test of instruments' joint significance	92.46	104.1	92.46	104.1	68.22

Appendix Table A.5
Interstate Banking Integration and Output Co-movement between States
Alternative Banking Integration Measures
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Columns (5) and (6) dependent variable: forward-looking five-year correlation of real GDP growth between two states. Endogenous variables - Panel A: banking integration measures 'Share of jointly-owned assets' and 'Share of jointly-owned deposits'. Endogenous variables - Panel B: banking integration measures 'Jointly-owned assets and deposits/(GDP of state i+GDP of state j)' and 'Share of jointly-owned assets and deposits/(population of state i+population of state j)'. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Banking integration measures considering only assets or deposits						
	(1)	(2)	(3)	(4)	(5)	(6)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states	
Share of jointly-owned assets [jointly-owned assets/(bank assets in state *i* +bank assets in state *j*)]	0.199***		0.135***		0.351***	
	(0.044)		(0.038)		(0.098)	
Share of jointly-owned deposits [jointly-owned deposits/(deposits in state *i* +deposits in state *j*)]		0.211***		0.143***		0.361***
		(0.047)		(0.040)		(0.101)
State-pair controls	x	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x	x
State *i* - linear time trend	x	x	x	x		
State *j* - linear time trend	x	x	x	x		
Observations	19,665	19,665	19,665	19,665	4,140	4,140
Excluded instruments						
Years since interstate banking deregulation	x	x	x	x	x	x
F-test of instruments' joint significance	105	101.7	105	101.7	68.34	67.70

Panel B: Banking integration measures considering alternative denominators						
	(1)	(2)	(3)	(4)	(5)	(6)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states	
Jointly-owned assets and deposits/(GDP of state *i* +GDP of state *j*)	0.193***		0.131***		0.312***	
	(0.043)		(0.036)		(0.087)	
Jointly-owned assets and deposits/(population of state *i* +population of state *j*)		0.178***		0.121***		0.312***
		(0.039)		(0.033)		(0.088)
State-pair controls	x	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x	x
State *i* - linear time trend	x	x	x	x		
State *j* - linear time trend	x	x	x	x		
Observations	19,665	19,665	19,665	19,665	4,140	4,140
Excluded instruments						
Years since interstate banking deregulation	x	x	x	x	x	x
F-test of instruments' joint significance	106.1	109.9	106.1	109.9	66.50	58.79

Appendix Table A.6
Interstate Banking Integration and Output Co-movement between States
Longer Time Period - 1976-2018
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: forward-looking five-year correlation of real GDP growth between two states. Endogenous variables: banking integration measure 'Share of jointly-owned deposits'. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-2018.

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
			Panel A: Second stage		
Share of jointly-owned assets and deposits	0.386**	0.339***	0.836***	0.164***	0.499*
	(0.196)	(0.064)	(0.303)	(0.049)	(0.298)
F-test of instruments' joint significance	13.06	147.6	13.06	147.6	8.683
			Panel B: Reduced form		
Years since interstate banking deregulation	0.008**	0.025***	0.016***	0.014***	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
			Panel C: First stage		
Dependent variable:			Share of jointly owned assets and deposits		
Years since interstate banking deregulation	0.023***	0.075***	0.023***	0.075***	0.022***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	44,505	44,505	44,505	44,505	9,315
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x

Appendix Table A.7
Interstate Banking Integration and Output Co-movement between States
Controlling for Interstate Trade
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. Column (1) dependent variable: negative absolute difference in residual real GDP growth between two states. Column (2) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (3) dependent variable: forward-looking five-year correlation of real GDP growth between two states. Endogenous variables: banking integration measure 'Share of jointly-owned deposits'. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states. Bilateral interstate trade share is defined as bilateral trade flows between states i and j/(total trade flows between state i and all states+total trade flows between state j and all states). Additional state-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Sample includes only two observations per state pair for the years 1977 and 1993. All control variables correspond to data as of 1977 and 1993. Dependent variables in columns (1) to (3) are five-year forward looking averages on these dates (i.e., averages over the periods 1977-1981 and 1993-1997). Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota).

	(1)	(2)	(3)
	Negative absolute difference in residual real GDP growth between states	Instantaneous quasi-correlation of real GDP growth between states	Five-year correlation of real GDP growth between states
Share of jointly-owned assets and deposits	0.810***	0.833***	0.445***
	(0.154)	(0.156)	(0.128)
Bilateral interstate trade share	-0.479***	-0.401***	-0.176
	(0.143)	(0.155)	(0.122)
State-pair controls	x	x	x
State-pair fixed effects	x	x	x
Census-region year fixed effects	x	x	x
Observations	2,070	2,070	2,070
Excluded instruments			
Years since interstate banking deregulation	x	x	x
F-test of instruments' joint significance	67.61	67.61	67.61

Appendix Table A.8
Interstate Banking Integration and Output Co-movement between States
Alternative Samples Based on Form of Interstate Banking Deregulation
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. Panel A: Sample excludes state pairs that deregulated through bilateral agreements. Panel B: Sample includes only states that deregulated by unilaterally opening entry to bank holding companies (BHCs) from all states. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Column (5) dependent variable: forward-looking five-year correlation of real GDP growth between two states. Endogenous variables: banking integration measures 'Share of jointly-owned assets and deposits'. Excluded instruments: number of years since the liberalization of interstate banking restrictions between two states. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Excluding state pairs that deregulated through bilateral agreements

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
Share of jointly-owned assets and deposits	0.578***	0.779***	0.294***	0.558***	0.808***
	(0.105)	(0.179)	(0.065)	(0.149)	(0.195)
State-pair controls	x	x	x	x	x
State-pair fixed effects	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	17,689	17,689	17,689	17,689	3,724
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
F-test of instruments' joint significance	51.81	31.05	51.81	31.05	30.86

Panel B: Only states that deregulated by unilaterally opening entry to BHCs from all states

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
Share of jointly-owned assets and deposits	0.585***	0.618***	0.258***	0.333***	0.931***
	(0.109)	(0.158)	(0.068)	(0.124)	(0.230)
State-pair fixed effects	x	x	x	x	x
State-pair controls	x	x	x	x	x
Census-region year fixed effects	x	x	x	x	x
State *i* - linear time trend		x		x	
State *j* - linear time trend		x		x	
Observations	13,566	13,566	13,566	13,566	2,856
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
F-test of instruments' joint significance	46.46	28.85	46.46	28.85	25.67

Appendix Table A.9
Interstate Banking Integration and Output Co-movement between States
Differences between State Pairs that Share an MSA
2SLS Regressions - Second Stage

This panel reports 2nd stage regression results from 2SLS analysis. For each state pair m,k that shares an MSA, we analyze whether the difference in output synchronization between every state i and states k and m, respectively, changes more when i and k become more financially integrated (compared to i and m). Observations are at the state triplet level (i,k,m). Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Columns (5) and (6) dependent variable: five-year correlation of real GDP growth between two states. Endogenous variables: banking integration measures 'Dummy=1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits'. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. All variables are defined as differences between states i and k and states i and m, respectively. We order the data such that the state in the pair k,m that liberalized its banking restrictions with i earlier will be the subtrahend. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square. We difference our instrumental variables following a similar approach (i.e., taking the difference in our instrumental variables between states i and k and states i and m, respectively). Standard errors clustered at the at the state-triplet level (i,k,m) in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)	(4)	(5)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states		Five-year correlation of real GDP growth between states
Share of jointly-owned assets and deposits	0.339***	0.377***	0.065	0.089*	0.671***
	(0.065)	(0.072)	(0.045)	(0.049)	(0.132)
State-pair controls	x	x	x	x	x
State-triplet fixed effects	x	x	x	x	x
Year fixed effects	x	x	x	x	x
State-triplet linear time trends	x	x	x	x	
Observations	36,347	36,347	36,347	36,347	7,652
Excluded instruments					
Years since interstate banking deregulation	x	x	x	x	x
F-test of instruments' joint significance	101.5	92.10	101.5	92.10	71.74

Appendix Table A.10
Interstate Banking Integration and Output Co-movement between States
Controlling for Unobserved State-level Time-varying Factors
2SLS Regressions - Second Stage

This table reports 2nd stage regression results from 2SLS analysis at the state-pair and year level. All regressions include fixed effects for each state and year. Columns (1) and (2) dependent variable: negative absolute difference in residual real GDP growth between two states. Columns (3) and (4) dependent variable: instantaneous quasi-correlation of real GDP growth between two states. Endogenous variables: banking integration measures 'Dummy =1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits'. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)	(4)
	Negative absolute difference in residual real GDP growth between states		Instantaneous quasi-correlation of real GDP growth between states	
Share of jointly-owned assets and deposits	0.548***	0.033*	0.182*	0.042**
	(0.119)	(0.019)	(0.109)	(0.019)
State-pair controls	x	x	x	x
State-pair fixed effects	x	x	x	x
Census-region year fixed effects	x	x	x	x
State-pair linear trends	x		x	
State *i* - year fixed effects		x		x
State *j* - year fixed effects		x		x
Observations	19,665	19,665	19,665	19,665
Excluded instruments				
Years since interstate banking deregulation	x	x	x	x
F-test of instruments' joint significance	105.3	85.10	105.3	85.10

Appendix Table A.11
State-level Financial Shocks Associated with Bank Failures

Panel A shows the distribution of the ratio of total assets and deposits held by failing banks to lagged GDP. Observations are at the state and year level. Panel B shows the states and years classified as experiencing financial shocks associated with bank failures, defined as those where the ratio of total assets and deposits held by failing banks to lagged GDP exceeds two percent. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Distribution of ratio of total assets and deposits held by failing banks to lagged GDP

	N	1st percentile	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile	99th percentile
Total assets and deposits held by failing banks/lagged GDP * 100	874	0.000	0.000	0.000	0.000	0.000	0.070	0.609	1.846	9.968

Panel B: States and years classified as experiencing financial shocks associated with bank failures

Connecticut	1990, 1991, 1992, 1993
Florida	1991
Iowa	1986
Kansas	1986
Louisiana	1986, 1987, 1988, 1990
Maine	1990
Massachusetts	1990, 1991, 1992
Mississippi	1984
Missouri	1992
New Hampshire	1991
New Jersey	1991, 1992
New Mexico	1985, 1986
New York	1991, 1992
Oklahoma	1986, 1987, 1988
Pennsylvania	1992
Rhode Island	1992
Tennessee	1983
Texas	1987, 1988, 1989, 1990, 1992
Utah	1985
Vermont	1992
Wyoming	1985, 1986, 1987

Appendix Table A.12
State-level Real Shocks Associated with Natural Disasters

Panel A shows the distribution of the ratio of total monetary losses due to natural disasters to lagged GDP. Observations are at the state and year level. Panel B shows the states and years classified as experiencing real shocks associated with natural disasters, defined as those where the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Distribution of ratio of total monetary losses due to natural disasters to lagged GDP

	N	1st percentile	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile	99th percentile
Monetary losses due to natural disasters/lagged	874	0.000	0.001	0.002	0.008	0.028	0.105	0.287	0.631	3.315

Panel B: States and years classified as experiencing real shocks associated with natural disasters

Alabama	1979
Arkansas	1978, 1980
California	1989, 1994
Colorado	1990
Florida	1992
Idaho	1992
Indiana	1978
Iowa	1988, 1991, 1992, 1993
Kansas	1993
Louisiana	1992
Maine	1992
Mississippi	1979, 1983, 1985, 1988, 1994
Missouri	1993
Nebraska	1978, 1986
North Dakota	1979, 1988, 1993
Rhode Island	1978
South Carolina	1989, 1993
Utah	1983
Vermont	1984, 1987
Virginia	1985
Washington	1980
West Virginia	1985
Wisconsin	1976

Appendix Table A.13
Natural Disasters and State-level GDP growth

This table reports OLS regressions at the state and year level. Dependent variable: state-level real GDP growth. 'Dummy =1 if real shocks associated with natural disasters' is a dummy variable equal to one if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent in a state and year. Standard errors clustered at the state level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)
	Real GDP growth		
Dummy =1 if high natural disaster losses in a state	-0.234*	-0.232*	-0.251**
	(0.125)	(0.126)	(0.109)
State fixed effects	x	x	x
Year fixed effects	x		
Census region-year fixed effects		x	x
State linear time trends			x
Observations	874	874	874

Appendix Table A.14
Natural Disasters and Financial Shocks

This table reports OLS regressions at the state and year level. Dependent variable: Dummy =1 if state experiences high bank failures in year or zero otherwise. 'Dummy =1 if real shocks associated with natural disasters' is a dummy variable equal to one if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent in a state and year. Standard errors clustered at the state level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)
	Dummy =1 if high bank failures in a state		
Dummy =1 if high natural disaster losses in a state	-0.040	-0.040	-0.039
	(0.028)	(0.030)	(0.030)
Dummy =1 if high natural disaster losses in a state (lag)		0.015	0.016
		(0.030)	(0.032)
Dummy =1 if high natural disaster losses in a state (2 year lag)			0.014
			(0.036)
State fixed effects	x	x	x
Census region-year fixed effects	x	x	x
Observations	874	828	782

Appendix Table A.15
State-level Shocks per Year

This table shows the number of states and state pairs experiencing financial and/or real shocks in each year of our sample period. States are classified as experiencing financial shocks associated with bank failures in a given year if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds two percent. States are classified as experiencing real shocks associated with natural disasters in a given year if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.75 percent. State pairs are classified as experiencing financial and/or real shocks in a given year if at least one of the states in the pair experiences these shocks. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	Financial shocks associated with bank failures		Real shocks associated with natural disasters	
Year	No. of states	No. of state pairs	No. of states	No. of state pairs
1976	0	0	1	45
1977	0	0	0	0
1978	0	0	4	174
1979	0	0	3	132
1980	0	0	2	89
1981	0	0	0	0
1982	0	0	0	0
1983	1	45	2	89
1984	1	45	1	45
1985	3	132	3	132
1986	6	255	1	45
1987	4	174	1	45
1988	3	132	3	132
1989	1	45	2	89
1990	5	215	1	45
1991	6	255	1	45
1992	9	369	5	215
1993	1	45	5	215
1994	0	0	2	89

Appendix Table A.16
Interstate Banking Integration and Output Co-movement between States
2SLS Regressions - Second Stage
Differences between State-Pairs - Alternative Definitions of Financial Shocks

This panel reports 2nd stage regression results from 2SLS regressions at the state-pair and year level. Dependent variable: negative absolute difference in residual real GDP growth between two states. Endogenous variables: banking integration measures 'Dummy=1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits', and their interactions with dummy variables for high bank failures in a state. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square, and their interactions with dummy variables for financial shocks. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. In columns (1) and (2) 'Dummy=1 if financial shocks associated with bank failures' is a dummy variable equal to one if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds 1.5 percent in (at least) one of the states in a given state pair and year. In columns (3) and (4) 'Dummy=1 if financial shocks associated with bank failures' is a dummy variable equal to one if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds 2.5 percent in (at least) one of the states in a given state pair and year. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)	(4)
	Negative absolute difference in residual real GDP growth between states			
	Financial shocks = assets and deposits of failing banks/lagged GDP >1.5 percent		Financial shocks = assets and deposits of failing banks/lagged GDP >2.5 percent	
Share of jointly-owned assets and deposits (a)	0.255***	0.152***	0.261***	0.164***
	(0.056)	(0.043)	(0.056)	(0.044)
Share of jointly-owned assets and deposits *	0.292***	0.303***	0.357***	0.400***
Dummy =1 if financial shocks associated with bank failures (b)	(0.100)	(0.093)	(0.109)	(0.112)
Dummy =1 if financial shocks associated with bank failures	-0.018	-0.053**	0.037	-0.013
	(0.024)	(0.024)	(0.032)	(0.033)
State-pair fixed effects	x	x	x	x
State-pair controls	x	x	x	x
Census-region year fixed effects	x	x	x	x
State *i* - linear time trend		x		x
State *j* - linear time trend		x		x
Observations	19,665	19,665	19,665	19,665
Effect of banking integration if financial shocks associated with bank failures (a)+(b) [test (a)+(b)=0 p-value]	0.547***	0.454***	0.618***	0.564***
	[0.000]	[0.000]	[0.000]	[0.000]
Excluded instruments				
Years since interstate banking deregulation	x	x	x	x
Interactions	x	x	x	x
F-test of instruments' joint significance	45.78	45.78	45.78	45.78

Appendix Table A.17
2SLS Regressions - Second Stage
Differences between State-Pairs - Alternative Definitions of Real Shocks

This panel reports 2nd stage regression results from 2SLS regressions at the state-pair and year level. Dependent variable: negative absolute difference in residual real GDP growth between two states. Endogenous variables: banking integration measures 'Dummy =1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits', and their interactions with dummy variables for high monetary losses from natural disasters in a state. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square, and their interactions with dummy variables for real shocks. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. In columns (1) and (2) 'Dummy =1 if real shocks associated with natural disasters' is a dummy variable equal to one if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds 0.5 percent in (at least) one of the states in a given state pair and year. In columns (3) and (4) 'Dummy =1 if real shocks associated with natural disasters' is a dummy variable equal to one if the ratio of total monetary losses due to natural disasters to lagged GDP exceeds one percent in (at least) one of the states in a given state pair and year. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)	(4)
	Negative absolute difference in residual real GDP growth between states			
	Real shocks = monetary losses due to natural disasters/lagged GDP >0.5 percent		Real shocks = monetary losses due to natural disasters/lagged GDP >1 percent	
Share of jointly-owned assets and deposits (a)	0.323***	0.230***	0.317***	0.214***
	(0.060)	(0.048)	(0.059)	(0.046)
Share of jointly-owned assets and deposits *	-0.215***	-0.203***	-0.412***	-0.389***
Dummy =1 if real shocks associated with natural disasters (b)	(0.066)	(0.063)	(0.106)	(0.105)
Dummy =1 if real shocks associated with natural disasters	-0.104***	-0.105***	-0.138***	-0.123***
	(0.019)	(0.020)	(0.030)	(0.031)
State-pair fixed effects	x	x	x	x
State-pair controls	x	x	x	x
Census-region year fixed effects	x	x	x	x
State *i* - linear time trend		x		x
State *j* - linear time trend		x		x
Observations	19,665	19,665	19,665	19,665
Effect of banking integration if real shocks associated with natural disasters (a)+(b) [test (a)+(b)=0 p-value]	0.108	0.0264	-0.0948	-0.175
	[0.165]	[0.687]	[0.412]	[0.1110]
Excluded instruments				
Years since interstate banking deregulation	x	x	x	x
Interactions	x	x	x	x
F-test of instruments' joint significance	41.49	53.66	37.43	33.29

Appendix Table A.18
State-level Real Shocks Based on Military Spending

Panel A shows the distribution of our measure of exogenous changes in state-level military spending. Observations are at the state and year level. Following Nakamura and Steinsson (2014), we estimate exogenous changes in military spending for each state and year as the predicted value from a regression of changes in state-level military spending as a share of GDP on changes in national military spending as a share of GDP, the interaction between changes in national military spending (as a share of GDP) and state dummies, and state and year fixed effects. Panel B shows the states and years classified as experiencing large exogenous changes in military spending, defined as those where the measure of exogenous changes in state-level military spending is in the top 95 percent or bottom 5 percent of its distribution for our sample. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

Panel A: Distribution of exogenous changes in state-level military spending

	N	1st percentile	5th percentile	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile	95th percentile	99th percentile
Exogenous changes in state-level military spending * 100	874	-0,897	-0,621	-0,441	-0,167	-0,011	0,198	0,584	0,894	1,486

Panel B: States and years classified as experiencing large exogenous changes in military spending

Arizona	1976, 1982
Arkansas	1976, 1982, 1983, 1989
California	1976, 1981, 1982, 1983, 1988, 1989, 1990, 1992, 1993
Connecticut	1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994
Florida	1982
Georgia	1976, 1982, 1983
Indiana	1989
Kansas	1976, 1981, 1982, 1983, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994
Maine	1976, 1981, 1982, 1983
Maryland	1976, 1981, 1982, 1983
Massachusetts	1976, 1981, 1982, 1983, 1988, 1989, 1990, 1992
Mississippi	1989, 1990, 1992, 1993
Missouri	1976, 1981, 1982, 1983, 1984, 1985, 1987, 1988, 1989, 1990, 1992, 1993
New Hampshire	1976, 1982
North Dakota	1989
Utah	1982
Vermont	1989
Virginia	1976, 1981, 1982, 1983
Washington	1982, 1988, 1989, 1990, 1992

Appendix Table A.19
Interstate Banking Integration and Output Co-movement between States
2SLS Regressions - Second Stage
Differences between State-Pairs - Real Shocks Based on Military Spending

This panel reports 2nd stage regression results from 2SLS regressions at the state-pair and year level. Dependent variable: negative absolute difference in residual real GDP growth between two states. Endogenous variables: banking integration measures 'Dummy=1 if jointly-owned assets or deposits between states' and 'Share of jointly-owned assets and deposits', and their interactions with dummy variables for real and/or financial shocks. Excluded instruments: number of years since the liberalization of interstate restrictions between two states and its square, and their interactions with dummy variables for financial and/or real shocks. State-pair controls: product of the natural logarithm of real GDP of the two states, difference in industry employment shares between states, and dummy variable equal to one after at least one of the states in a given state pair eliminates restrictions to intrastate branching. 'Dummy=1 if real shocks associated with changes in local military spending' is a dummy variable equal to one if (at least) one of the states in a given state pair and year experiences a large exogenous change in military spending. Following Nakamura and Steinsson (2014), we estimate exogenous changes in military spending for each state and year as the predicted value from a regression of changes in state-level military spending as a share of GDP on changes in national military spending as a share of GDP, the interaction between changes in national military spending (as a share of GDP) and state dummies, and state and year fixed effects.We define a state as experiencing a large exogenous change in military spending in a given year if this predicted value is in top 95 percent or bottom 5 percent of its distribution for our sample. 'Dummy =1 if financial shocks associated with bank failures' is a dummy variable equal to one if the ratio of total assets and deposits held by failing banks to lagged GDP exceeds two percent in (at least) one of the states in a given state pair and year. Standard errors clustered at the state-pair level in parentheses. *, **, *** denote significance at ten, five, and one percent level, respectively. Sample covers the 48 contiguous states of the United States (excluding Delaware and South Dakota) over the period 1976-1994.

	(1)	(2)	(3)	(4)
	Negative absolute difference in residual real GDP growth between			
	Real shocks		Real and financial shocks	
Share of jointly-owned assets and deposits (a)	0.339***	0.247***	0.276***	0.181***
	(0.063)	(0.052)	(0.059)	(0.048)
Share of jointly-owned assets and deposits * Dummy =1 if real shocks associated with changes in local military spending (b)	-0.202***	-0.193***	-0.252***	-0.245***
	(0.074)	(0.058)	(0.079)	(0.064)
Share of jointly-owned assets and deposits * Dummy =1 if financial shocks associated with bank failures (c)			0.524***	0.552***
			(0.124)	(0.127)
Dummy =1 if real shocks associated with changes in local military spending	-0.027	-0.053**	-0.028	-0.059***
	(0.023)	(0.022)	(0.024)	(0.023)
Dummy =1 if financial shocks associated with bank failures			-0.105***	-0.156***
			(0.029)	(0.030)
State-pair controls	x	x	x	x
State-pair fixed effects	x	x	x	x
Census-region year fixed effects	x	x	x	x
State *i* - linear time trend		x		x
State *j* - linear time trend		x		x
Observations	19,665	19,665	19,665	19,665
Effect of banking integration if real shocks associated with changes in local military spending (a)+(b) [test (a)+(b)=0 p-value]	0.137*	0.0542	-0.0530	-0.0638
	[0.0803]	[0.328]	[0.773]	[0.285]
Effect of banking integration if financial shocks associated with bank failures (a)+(c) [test (a)+(c)=0 p-value]			0.800***	0.733***
			[0.000]	[0.000]
Excluded instruments				
Years since interstate banking deregulation	x	x	x	x
Interactions	x	x	x	x
F-test of instruments' joint significance	46.02	55.93	30.96	29.58