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ABSTRACT

We assess the impact of the geographic expansion of bank assets on the cost of banks' interest-bearing liabilities. Existing research suggests that expansion can both intensify agency problems that increase funding costs and facilitate risk diversification that decreases funding costs. Using a newly developed identification strategy, we discover that the geographic expansion of banks across U.S. states lowered their funding costs, especially when banks are headquartered in states with lower macroeconomic covariance with the overall U.S. economy. The results are consistent with the view that geographic expansion offers large risk diversification opportunities that reduce funding costs.

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1. Introduction

Does the geographic expansion of a bank's assets affect its funding costs? Several models detail how expansion can reduce funding costs. If geographic expansion adds assets to a bank's portfolio that are imperfectly correlated with existing assets, this can reduce bank risk and lower its funding costs, as emphasized by Diamond (1984) and Boyd and Prescott (1986). Similarly, if a bank expands into geographic areas where the economies are imperfectly correlated with the bank's existing local economy, this will enhance the bank's ability to use its internal capital market to respond effectively to local liquidity or asset-quality shocks (e.g., Houston, James, and Marcus, 1997, Houston and James, 1998, Gatev, Schuermann, and Strahan, 2009, and Cornett et al., 2011). Other models explain how geographic expansion can increase funding costs. For example, the agency-based models of Jensen (1986), Jensen and Meckling (1976), and Scharfstein and Stein (2000) suggest that if geographic dispersion creates barriers to shareholders and creditors governing banks, then bank insiders can more easily extract private rents, which reduce bank valuations and boost funding costs. Similarly, Brickley, Linck, and Smith (2003) and Berger et al. (2005) stress that distance can hinder the ability of a bank's headquarters to monitor its subsidiaries, which can have detrimental effects on efficiency, asset quality, and funding costs.

In this paper, we evaluate the impact of geographic expansion on the cost of a bank's interest-bearing liabilities. This is important for at least two reasons. From a policy perspective, many regulations, laws, taxes, and other policies limit the geographic expansion of banks. In assessing the impact of these policies on the efficiency of financial intermediation, it is critical to evaluate how they shape a bank's funding costs—and interest-bearing liabilities account for about 95% of banking system liabilities. Second, existing empirical work provides valuable, but conflicting, insights into some of the mechanisms through which geographic expansion might shape funding costs. Consistent with the predictions of agency-based models, Goetz, Laeven, and Levine (2013) find that geographic expansion increases lending to bank executives and reduces

bank valuations, putting upward pressure on funding costs. In contrast, when banks diversify geographically, risk tends to fall (e.g., Calomiris, 2000 and Goetz, Laeven, and Levine, 2016) and banks become more effective at responding to local economic shocks (Cortes and Strahan, 2016), putting downward pressure on funding costs.[1] What is missing, however, is an assessment of how geographic expansion influences overall funding costs.

We estimate the effect of the geographic expansion of bank holding company (BHC) assets across the U.S. states on the cost of interest-bearing liabilities. To measure funding costs, we use the implicit interest rate on a bank's interest-bearing liabilities, i.e., total interest expenses divided by interest-bearing liabilities (Demirgüç-Kunt and Huizinga, 2004). To measure the geographic expansion of a BHC's assets, we use the cross-state distribution of its subsidiaries and weight each subsidiary by its share of assets in the BHC. To identify the causal effect of geographic expansion on funding costs, we follow the Goetz, Laeven, and Levine (2013) procedure for constructing an instrumental variable for geographic expansion.

Specifically, we implement a two-step procedure for constructing an instrumental variable for BHCs' geographic expansion. First, we exploit the dynamic process of interstate bank deregulation across the U.S. states from 1982 through 1995. Starting in 1982, individual states removed restrictions on BHCs headquartered in "foreign" states from establishing subsidiaries within the deregulating state's borders. Not only did states start the process of interstate bank deregulation in different years, they also followed very different dynamic paths as states signed bilateral and multilateral reciprocal agreements in a fairly chaotic process over many years. Thus, there is substantial cross-state heterogeneity in the start and dynamics of interstate bank deregulation. The passage of the Riegle-Neal Act in 1994 eliminated all remaining restrictions on interstate banking starting in 1995. An extensive body of research provides evidence that interstate bank deregulation is exogenous to state economic conditions

[1] Also, see Chong (1991), who finds that geographically diversified banks hold less capital, and Houston, James, and Ryngaert (2001), who examine the impact of bank mergers on valuations.

(e.g., Kroszner and Strahan, 1999, Morgan, Rime and Strahan, 2004, and Beck, Levine and Levkov, 2010) as well as to banking system profitability, valuations, and risk (Jayaratne and Strahan, 1998, Goetz, Levine, and Levine, 2013, 2016). This first step yields year-by-year information on whether BHCs headquartered in one state can establish subsidiaries in each foreign state. This first step, however, does not differentiate among BHCs headquartered within the same state; that is, it does not provide information on why some BHCs in a state expand into foreign states and others do not.

The second step in constructing an instrument for geographic expansion uses the gravity model to distinguish among BHCs within the same state.[2] The gravity model predicts that the costs of conducting economic transactions, including the costs of establishing bank subsidiaries, vary positively with distance. Thus, the gravity model predicts that when state *j* allows BHCs from state *i* to establish subsidiaries within *j*'s borders, BHCs headquartered in state *i* that are closer to state *j* will face lower costs to expanding into *j*. Since the physical locations of the headquarters of BHCs were pre-determined before the period of interstate bank deregulation, we exploit this as an exogenous source of variation in how interstate bank deregulation differentially affects BHCs in a state. Indeed, only 2% of BHCs change the state in which they are headquartered during our sample period and the results are robust to including or excluding them. Specifically, we calculate the aerial distance between the headquarters of each BHC and the capital of each foreign state and use this distance to differentiate among BHCs headquartered in the same state. Based on these distances, we use the gravity model to estimate each BHC's cross-state asset holdings in foreign subsidiaries.

The integration of the gravity model of BHC investment with the dynamic process of interstate bank deregulation yields a time-varying, BHC-specific instrumental variable of the cross-state dispersion of each BHC's assets. Specifically, we (1) project the share of each BHC's

[2] The gravity model has been heavily used in international economics, as exemplified by Tinbergen (1962) and Helpman, Melitz, and Rubinstein (2008).

holdings of assets in subsidiaries in each foreign state *j* using the gravity model and (2) impose a value of zero when interstate bank regulations prohibit a BHC from establishing a subsidiary in state *j*. Thus, we use these exogenous sources of variation to project the cross-state holdings of assets for each BHC in each period and then compute the projected Herfindahl index of cross-state asset holdings. We use this as the instrument for a BHC's actual dispersion of assets and evaluate the impact of the geographic expansion on the costs of interest-bearing liabilities.

With respect to the validity of our identification strategy in general and the instrumental variable in particular, we emphasize five points. First, we find that it is strongly correlated with the actual cross-state dispersion of a BHC's assets. That is, the F-test on the instrument in the first-stage regression is above 25, indicating that we do not have a weak instrument problem. Second, in terms of the exclusion restriction, it is valuable to first note that the instrument is constructed from two plausibly exogenous sources of variation: the dynamic process of interstate bank deregulation and pre-determined geographic distance. Third, since the instrumental variable differentiates among BHCs within each state and time period, we address a key concern with using interstate bank deregulation to identify the impact of geographic expansion on funding costs: perhaps, some other factor besides geographic expansion is systematically changing when state *j* allows BHCs from state *i* to enter and it is this other factor that affects funding costs across BHCs in state *i*. We address this concern by including state-time fixed effects to control for all time-varying state influences on funding costs. In this way, identification comes from comparing the differential impact of interstate bank deregulation on BHCs in the same state. Fourth, we address concerns that other BHC-specific factors simultaneously account for both their cross-state dispersion of assets and their funding costs by (1) including BHC-fixed effects to control for all time-invariant BHC traits and (2) controlling for time-varying BHC characteristics such as the competitiveness of the banking market in which a BHC is headquartered, as well as BHC size, capital-asset ratio, and profitability. Fifth, we evaluate the particular theoretical prediction that geographic expansion reduces funding costs by allowing

banks to hold a more diversified portfolio of assets and to manage local economic shocks more effectively. This evaluation both provides information on one potential mechanism linking geographic expansion and funding costs and reduces concerns that the instrument violates the exclusion restriction because our evaluation further differentiates BHCs by the economic comovement between the aggregate U.S. economy and the economy of the state in which the BHC has its headquarters.

The instrumental variable results indicate that geographic diversification materially lowered BHC funding costs. Geographic diversification enters the funding cost regression negatively and statistically significantly at the one percent level, and this result holds when using different measures of the cost of interest-bearing liabilities as the dependent variable and different control variables. The results are also robust to conducting the analyses over (a) subsamples of BHCs, such as BHCs with more than $500 million in total assets or those that generate more than 2/3rd of their total revenues from interest-bearing assets, and (b) different time periods. Furthermore, we show that it is crucial to use instrumental variables to identify the impact of the cross-state dispersion of BHC assets on funding costs. When using ordinary least squares (OLS), we find a *positive* association between diversification and funding costs, which might reflect reverse causality: BHCs with higher funding costs expand to other states in search of lower funding costs, so that OLS yields an upwardly biased coefficient estimate on geographic diversification. When employing our instrumental variable, however, we find strong, robust results that an increase in the cross-state dispersion of assets lowers funding costs. Moreover, the estimated impact is economically large. For example, the estimates imply that a one standard deviation increase in the cross-state dispersion of a BHC's assets will reduce the total interest expense ratio by 13.6% in our sample.

We also examine whether geographic expansion reduces funding costs by allowing banks to diversify away idiosyncratic risk and better manage localized economic shocks. Specifically, if geographic diversification reduces funding costs by lowering risk, then its impact on funding

costs should be greater when BHCs expand into states that offer greater risk diversification opportunities. We evaluate this prediction by testing whether the cost-reducing effects of geographic diversification are greater when BHCs are located in states with economies that have lower correlations with the U.S. economy. We use the Federal Reserve Bank of Philadelphia's *Coincident index* to capture the degree to which each state's economy is correlated with the overall U.S. economy.

The results indicate that geographic expansion reduces BHC funding costs more when the BHC is headquartered in a state that has an economy with a lower correlation with the overall U.S. economy. This is consistent with the risk-reducing view of how geographic diversification lowers funding costs. Furthermore, the estimated impact is large. The estimates suggest that the cost-reducing effect of a BHC that expands from a home state that is perfectly negatively correlated with the U.S. economy into an average state is more than twice as large as that of a similar BHC headquartered in a state that is perfectly correlated with the U.S. economy that expands into the same state. The results in this paper highlight a material cost of restricting banks from using geographic expansion to diversify their risks.

The rest of the paper proceeds as follows. Section 2 describes the data and the process of interstate banking deregulation. Section 3 provides ordinary least squares results on the relation between funding costs and geographic diversification. Section 4 describes the construction of the instrumental variable for geographic diversification, presents the instrumental variable results, and assesses the validity of the instrument. Section 5 conducts additional tests on the mechanisms linking geographic diversity and funding costs, and section 6 concludes.

2. Data and interstate bank deregulation

2.1 BHC and bank subsidiary data sources

We use financial and structural information on BHCs and their chartered subsidiary banks to assess the impact of geographic expansion on a BHC's funding costs. For each domestic

U.S. BHC, the Federal Reserve collects detailed information on consolidated balance sheets, income statements, and detailed supporting information from the FR Y-9C reports. The data is publicly available on a quarterly basis since June 1986. Individual banking institutions regulated by the Federal Deposit Insurance Corporation, the Federal Reserve, or the Office of the Comptroller of the Currency also file Reports of Condition and Income ("Call Reports") that provide financial statements for each banking institution in each quarter. The Call Reports also provide ownership information, so that we can link each bank subsidiary to its parent BHC. In particular, each BHC is considered the parent of a bank subsidiary if it holds at least a 50% ownership stake in the subsidiary. We focus on the ultimate parent holding company, and thus eliminate those that are owned by other financial institutions. Furthermore, the Call Reports give the location of each banking institution. In this way, we can measure a BHC's geographic dispersion of assets across states via its bank subsidiaries.

Our initial sample includes all BHCs in the Y-9C reports from the third quarter of 1986 through the last quarter of 2007 operating within the 48 contiguous states and the District of Columbia (excluding BHCs headquartered in Alaska and Hawaii). We then eliminate BHCs located in the states of Delaware and South Dakota since the two states changed their laws to encourage the entry of credit card banks shortly before removing branching restrictions. We further drop BHCs that change the location of their headquarters from one state to another during the sample period. This reduces the number of BHCs by about 2%, though the results hold when including them. Our final sample contains 111,545 BHC-quarter observations on 3,758 public and private BHCs over the period 1986 – 2007.

2.2 Geographic diversity

We measure a BHC's geographic diversity as the cross-state dispersion of its bank subsidiaries, where each subsidiary is weighted by the book value of its assets. Specifically, *1-Herfindahl index of assets across states* equals one minus the Herfindahl-Hirschman index of a

BHC's assets in subsidiaries located in other states besides the state in which the BHC has its headquarters. Thus, a higher value indicates a more dispersed distribution of assets across states. We construct this measure for each BHC in each quarter.

2.3 Funding costs and other BHC traits

We construct two measures of BHC funding costs. First, *Total cost of funds* equals a BHC's total interest expense during a quarter divided by interest-bearing liabilities at the beginning of the quarter. As argued by Demirgüç-Kunt and Huizinga (2004), *Total cost of funds* is an implicit interest rate on BHC liabilities, which is inferred from its financial statements. While *Total cost of funds* measures the overall cost of a BHC's debts, it can differ across banks and time due to differences in interest rates or in the maturity and structure of a BHC's debt. We therefore construct a second funding cost measure that focuses only on deposits. Following Gilje, Loutskina, and Strahan (2016), we measure the cost of deposits as a BHC's interest expense on domestic deposits during a quarter divided by the stock of domestic deposits at the beginning of the quarter (*Cost of domestic deposits*). Table 1 provides summary statistics for the funding cost measures. The *Total cost of funds* and *Cost of domestic deposits* both range from about 0.3% to 2%, with a mean value of 1.1%. Since banks are highly levered, these non-equity funding costs capture the bulk of funding expenses for BHCs.

In assessing the impact of diversification on funding costs, we control for several time-varying bank characteristics. Since funding costs might differ between large and small banks and between those with greater or smaller leverage, we include *Total assets*, which equals the book value of total assets in billions of US dollars, and the *Capital-asset ratio*, which equals the book value of BHC equity divided by total assets. To account for differences in BHC profitability, we control for *Return on assets*, which equals net income divided by the book value of total assets. All bank-specific controls are measured at the beginning of a quarter. Furthermore, since research suggests that market competition affects bank risk (e.g., Boyd and De Nicolo, 2005), we

control for the competitive pressures facing each BHC by using a measure of the concentration of banks in each Metropolitan Statistical Area (MSA). In particular, *Market concentration (MSA)* equals the Herfindahl-Hirschman index of banking assets in each MSA in each quarter.[3] Appendix Table A1 describes detailed variable definitions and Table 1 reports summary statistics.

2.4 The dynamic process of interstate bank deregulation

For much of the 20th century, U.S. states prohibited banks headquartered in other states from establishing subsidiaries (or branches) within their borders. As shown by Jayaratne and Strahan (1998), these regulatory restrictions protected banks from "foreign" competition and allowed banks to earn monopolistic rents, which created a powerful constituency for maintaining restrictions on interstate banking. Kroszner and Strahan (1999) explain that a series of technological innovations that started in the 1970s reduced the rents associated with these regulatory restrictions as automatic teller machines, banking by phone, and improvements in credit scoring models made it easier for banks to attract customers from states where they had no subsidiaries or branches. These innovations triggered a process of interstate bank deregulation that allowed BHCs to expand across state borders.

From 1982 through 1995, states removed restrictions on interstate banking using three types of deregulation: (1) *national nonreciprocal* means the deregulating state unilaterally allowed entry of banks from all other states; (2) *national reciprocal* means the deregulating allowed entry of banks from reciprocating states, i.e., states that also allowed banks from the deregulating state to enter; and (3) *regional reciprocal* means the deregulating state signed bilateral or multilateral reciprocal agreements with specific states that also allowed entry of banks from those states. For instance, Maine was the first state to relax its interstate banking

[3] In our sample, about 13% of BHCs are not headquartered in an MSA, which typically means they are headquartered in a rural area. For these non-MSA BHCs, we set *Market concentration (MSA)* equal to one, indicating a highly concentrated banking market. To account for potential problems associated with differences in competition between MSA and non-MSA counties, we construct an *MSA indicator* that equals one when a BHC is headquartered in an MSA, and zero otherwise. Although not reported in the tables, when we control for *Market concentration (MSA)*, we always simultaneously include the *MSA indicator*.

restrictions by enacting a national reciprocal policy in 1978, but no state reciprocated until 1982 when New York adopted a similar nationwide reciprocal agreement and Alaska implemented a national nonreciprocal policy. Over the next 12 years, states started the process of interstate banks deregulation in different years and followed different patterns of deregulation over those years. The Riegle-Neal Act of 1994 repealed all remaining regulations restricting BHCs headquartered in one state from acquiring banks in other states (starting in 1995).

There is enormous heterogeneity both in terms of when states started removing impediments to interstate banking and in terms of the dynamic process that each state followed in lowering those barriers. For each state and year, Goetz, Laeven, and Levine (2013) provide information on the foreign states into which a state's BHCs were allowed to open subsidiary banks based on information from each state's bank regulatory authority. Figure 1 shows the dynamic process of interstate banking deregulation over the period from 1982 through 1994. In particular, each bar represents the cumulative percentage of state pairs in which one state is allowed to enter the other one. As shown, less than 10% of state-pair deregulations happened before 1986, which is the first year of our sample period. By 1994, 71% of the state pairs allow interstate banking, and the Riegle-Neal Act allowed interstate banking for all state pairs in 1995.

3. Geographic diversity and BHC funding costs: OLS regression results

We first use ordinary least square (OLS) regressions to estimate the association between BHC funding costs and geographic diversity. The model specification is as follows.

$$\text{Ln}(Cost\ of\ funds)_{bst} = \beta(1 - Herfindahl\ index\ of\ assets\ across\ states)_{bt} + \\ + \theta X'_{bst} + \delta_b + \delta_{st} + \varepsilon_{bst}, \quad (1)$$

where the dependent variable, $Ln(Cost\ of\ funds)_{bst}$, represents either the natural logarithm of the *Total cost of funds* or the natural logarithm of the *Cost of domestic deposits* for BHC *b*

headquartered in state *s* in quarter *t*. The key explanatory variable, $1 - Herfindahl\ index\ of\ assets\ across\ states_{bt}$, denotes the extent to which a holding company *b* diversifies its banking subsidiaries assets across states over quarter *t*, as measured by *1-Herfindahl index of assets across states*. X'_{bst} is a vector of time-varying characteristics for BHC *b*, headquartered in state *s*, at the beginning of the quarter *t*: *Total assets*, *Capital-asset ratio*, and *Return on assets*. These controls account for differences in bank size, leverage, and profitability, respectively. We also include *Market concentration (MSA)* to account for time-varying differences in the concentration of banking assets within the MSA of BHC *b*'s headquarters. θ is a vector of coefficients on these BHC characteristics. We also include (1) BHC fixed effects, δ_b, to account for all time invariant BHC-specific factors and (2) state-quarter fixed effects, δ_{st}, to control for all time-varying state-specific factors, such as economic conditions, tax policies, and regulations. Thus, the estimated coefficient, β, indicates the economic relation between changes in a BHC's cost of funds and changes in its geographic dispersion of assets after controlling for this large set of conditioning variables. Following Goetz, Laeven, and Levine (2013), the standard errors are heteroskedasticity-robust and clustered at the state and quarter level.

As shown in Table 2, the OLS estimates indicate a positive relation between a BHC's cost of funds and its diversity of assets in subsidiaries across states. The geographic diversity measure, *1-Herfindahl index of assets across states*, enters positively and significantly when the dependent variable is either *Ln*(*Total cost of funds*) in columns (1) – (2) or *Ln*(*Cost of domestic deposits*) in columns (3) – (4). The results hold when conditioning on quarter and BHC fixed effects or when controlling for BHC and state-quarter fixed effects.

Identification concerns, however, complicate the interpretation of these OLS estimates. First, a BHC's funding costs might influence its decision to expand into other states. For example, BHCs with higher funding costs might be especially motivated to establish subsidiaries in a foreign state where funds are cheaper. Under these conditions, even if geographic expansion

reduces the cost of funds, OLS will yield an upwardly biased coefficient estimate on *1-Herfindahl index of assets across states*. Second, while equation (1) includes an array of BHC controls and fixed effects, omitted variables might drive both the geographic diversification of BHC assets and its funding costs. We address these endogeneity concerns by employing an instrumental variables approach.

4. Geographic diversification and BHCs funding cost: Instrumental variable results

In this section, we (1) describe the construction of our instrumental variable for the cross-state diversity of BHC assets, (2) present the instrumental variable results on the impact of geographic diversity on funding costs, and (3) analyze the validity of our identification strategy.

4.1. Identification strategy: Constructing gravity-deregulation instrumental variable

4.1.1 Framework

To describe the construction of the instrumental variable, we begin with an overview and then give the details. We develop this instrument by integrating (1) the dynamic, state-specific process of interstate bank deregulation with (2) the gravity model of investment. As explained above, interstate bank deregulation evolved in a rather chaotic manner from 1982 through 1995, where states started removing regulatory restrictions on interstate banking in different years and then followed different dynamic paths of implementing regional reciprocal, national reciprocal, and national nonreciprocal deregulations with other states. This process of interstate bank deregulation provides state-year information on whether BHCs in one state can establish subsidiaries in each other state. This process of interstate bank deregulation, however, does not differentiate among BHCs within the same state, which is crucial for identifying the impact of the cross-state diversification of a BHC's assets on its funding costs.

To differentiate among BHCs within the same state, we use the gravity model of investment. Specifically, an extensive literature finds that the cost of investing varies positively

with geographic distance. Applied to banks, the gravity model predicts that it will be less expensive for BHCs to expand into geographically closer markets. Indeed, for the case of banks across the U.S. states, Goetz, Laeven, and Levine (2013) show that BHCs headquartered in a state that have their headquarters geographically closer to another state than other BHCs in the same state are more likely to expand into that state. For example, they show that a BHC in the southern part of California will tend to have a larger share of assets in Phoenix, Arizona than in Portland, Oregon and a BHC headquartered in northern California will tend to have a larger share of assets in Portland. Thus, we construct a time-varying, BHC-specific instrumental variable for the cross-state diversity of BHC assets by integrating the interstate bank deregulation with the gravity model of investment, where interstate bank deregulation provides state-year information on the states into which BHCs in a state can expand and the gravity model distinguishes among BHCs within each state.

4.1.2 The two-step process for constructing the gravity-deregulation instrument

Following Goetz, Laeven, and Levine (2013, 2016), we use a two-step process for constructing an instrument for the geographic diversity of BHC assets. In the first step ("zero stage"), we estimate the following gravity model.

$$Share_{bijt} = \alpha Ln(Distance_{bij}) + \beta Ln\left(pop_{it}/pop_{jt}\right) + \delta_t + \delta_i + \delta_j + \delta_{ij} + \delta_{ijt} + \varepsilon_{bijt}, \quad (2)$$

where the dependent variable, $Share_{bijt}$, is the share of assets a BHC *b* headquartered in state *i* holds through its subsidiaries in a foreign state *j* over quarter *t*. $Ln(Distance_{bij})$ denotes the natural logarithm of geographic distance between the BHC *b*'s headquarters and the capital city of state *j* (in miles). $Ln\left(pop_{it}/pop_{jt}\right)$ equals the natural logarithm of the ratio of the total population of BHC *b*'s home state *i* to the total population of the foreign state *j* in quarter *t*, where U.S. Census Bureau provides population data. We include the population ratio in the

gravity model to account for the possibility that BHCs expand into comparatively large markets. To assess the independent link between the geographic diversity of a BHC's assets and distance, we consider regression specifications that control for (a) quarter fixed effects, δ_t, to condition out all quarter-specific influences, (b) a BHC's home state fixed effects, δ_i, to control for all time-invariant features of the BHC's home state, (c) fixed effects for each other state, δ_j, or (d) state-pair fixed effects, δ_{ij}, to condition out all time-invariant features of each state pair. We also consider a specification that controls for state-pair-quarter fixed effects, δ_{ijt}, to condition out all time-varying features of each state-pair.

In this first step estimation of the impact of distance and population ratios on the share of assets that BHCs hold in different states, we proceed as follows. We only include observations in which it is legally feasible for BHC *b* headquartered in state *i* to open subsidiaries in a "foreign" state *j* during quarter *t*. To accommodate the quarterly frequency of BHC data, we assume that deregulation occurs during the last quarter of the year in which state *j* relaxed its entry restrictions with state *i*, i.e., when BHCs headquartered in state *i* are allowed to open subsidiaries in state *j*.[4] We provide estimates using both a fractional logit model and OLS. We employ the fractional logit model since (a) the dependent variable is bounded between zero and one, (b) many observations have a value of zero, and (c) the fractional logit ensures that the projected shares are bounded between zero and one. In some cases, we use OLS instead of a fractional logit model because the fractional logit model would not converge when we control for a large number of fixed effects. As shown below, the OLS results are consistent with those from the fractional logit model when we can use both estimation methods. We use the fractional logit model when constructing the instrumental variable so that we do not have projected share values less than zero.

Table 3 reports the estimation results from this zero-stage regression and shows that geographic distance is negatively associated with the share of a BHC's assets in a foreign state.

[4] The results hold when assuming that deregulation occurs in the first quarter of the year.

As shown in columns (1) and (2), the average marginal effect of *Ln(Distance)* on the share of a BHC's assets in foreign states enters negatively and statistically significant at the 1% level, suggesting that BHCs tend to invest more in closer states. Moreover, there is a significant negative relation between a BHC's investment and the relative size of its home state banking market to the foreign banking market, indicating that a BHC is more likely to diversify into a comparatively large market. The estimates hold when adding quarter fixed effects in column (3) or when using OLS, as shown in columns (4) and (5). Moreover, we continue to find that both distance and population remain significantly related to a BHC's investments in foreign states when controlling for home state fixed effects and foreign state fixed effects, or when including state-pair fixed effects or state-pair-quarter fixed effects, as shown in columns (6) – (9), respectively. When including state-pair fixed effects, the regression controls for the distance between the two states. Thus, it shows that the differential distance between two BHCs headquartered in state *i* and state *j* shapes their holdings of bank assets in state *j*. Specifically, BHCs headquartered in state *i* that are physically closer to state *j* tend to have subsidiaries with larger asset holding in state *j* than BHCs headquartered in state *i* but are physically farther away from state *j*.

In the second step of the construction of the gravity-deregulation instrument, we use the coefficient estimates from Table 3 to project, for each BHC in each quarter, its dispersion of assets in subsidiaries across all states. Specifically, we use the coefficient estimates from column (2) in Table 3 to predict a BHC's asset share in each state in each period.[5] We impose a predicted value of zero for states in which the BHC is prohibited from establishing a subsidiary. Based on these projected shares, we compute the projected diversity measure, *1 - Herfindahl index of assets across states (predicted)*, for each BHC in each quarter. This projected diversity measure serves as the time-varying, BHC-specific instrumental variable for a BHC's actual degree of

[5] We do not include quarter, home state, foreign state, state-pair, or state-pair-quarter fixed effects in the projection because including them in the construction of the instrument can lead to biased estimates in the two-stage least squares regressions, as explained in Goetz, Laeven, and Levine, 2013, 2016).

diversification. We show below that the results are robust to using the Table 3 estimates from column (1) that are only based on distance, instead of those from column (2) that are based on distance and relative population, to construct the instrumental variable. This alternative instrument, *1 - Herfindahl index of assets across states (predicted Distance only)*, yields very similar findings.

Several checks advertise the validity of the gravity-deregulation instrumental variable. With respect to the correlation between the instrument and *1-Herfindahl index of assets across states*, the instrument is "strong." As shown in the first-stage regression results reported in Panel B of Table 4, the F-statistic of the null hypothesis that the instrument is irrelevant is above 25. With respect to the exclusion restriction, we first note that the instrument is explicitly constructed from two plausibly exogenous sources of variation in the ability and cost of a BHC establishing subsidiaries in other states: interstate bank regulations and geographic distance. Furthermore, although our instrumental variable specification is exactly identified, so that we cannot employ a test of the over-identifying restrictions, we can provide evidence on specific concerns. One concern is that some other characteristic of state *j* systematically changes when another state, state *i*, deregulates and allows state *j*'s BHCs to enter state *i* and this other factor affects BHC funding costs. However, by using a time-varying, BHC-specific instrumental variable that distinguishes among BHCs within each state and period, we can include state-time fixed effects to condition out the potentially confounding influences of such state-time characteristics. A second concern is that particular characteristics of a BHC, beyond its distance to other states, account for its cross-state expansion and funding costs. These characteristics could include the culture of the BHC, its size, fragility, profitability, or the structure of the local banking market. However, we include BHC-fixed effects to control for all time-invariant BHC

traits and control for BHC size, capital ratio, profitability, and bank concentration at the MSA-level to condition out these time-varying factors.[6]

4.2 IV results

The instrument variable results indicate that geographic diversity reduces BHC funding costs. As reported in Panel A of Table 4, geographic diversity, *1-Herfindahl index of assets across states*, enters the funding cost regressions negatively and significantly at the 1% level. The results hold when examining either *Ln(Total cost of funds)* in columns (1) and (2), or *Ln(Cost of domestic deposits)* in columns (3) and (4). The results are also robust to controlling for time-varying characteristics (bank size, leverage, profitability, and market concentration), BHC fixed effects, and state-quarter fixed effects. Moreover, the results are robust to using a different zero-stage estimation to construct the instrument. In particular, we use the coefficient estimates from column (1) in Table 3, where only *Ln(Distance)* is included while *Ln(Population ratio)* is excluded, to construct a different instrument, *1-Herfindahl index of assets across states (predicted Distance only)*. All the results in Table 4 remain highly robust to this alternative instrument. The corresponding robustness tests are reported in Appendix Table A2.

The estimated impact of diversity on funding costs is economically large. One way to illustrate the economic size of the relationship is to consider a one standard deviation increase in geographic diversity. The coefficient estimate in column (2) indicates that a one standard deviation increase in *1-Herfindahl index of assets across states* (0.096) reduces *Total cost of funds* by 13.6% (=0.096 * 1.419), corresponding to 15 basis points given that the sample mean of *Total cost of funds* equals 1.1 percentage points. The estimated impact of geographic diversity on *Cost of domestic deposit* is similar in magnitude. A second way to illustrate the economic size of the estimated impact of geographic diversity on funding costs is to consider the case of

[6] Furthermore, as noted in the Introduction, many papers show that economic conditions in general and banking conditions in particular do not predict the timing of interstate bank deregulation.

California. If the state of California changes from a situation in which its BHCs are not allowed to open subsidiaries in any other states to a situation in which its BHCs can diversify into all other states, then the estimates from column (2) indicate that funding costs for BHCs headquartered in California will drop by about 58% (=1.419*0.410). Although this is not a marginal change, it illustrates large estimated impact of geographic diversity on funding costs. Given that total interest expenses across all California BHCs in 1987 was $13.5 billion, holding other factors constant, the estimated effect implies a drop of over $7.8 billion in funding expenses per year.

Panel C of Table 4 demonstrates that the reduced form estimates are consistent with the IV results. It reports the reduced-form estimates of BHC funding costs on the gravity-deregulation instrument variable *1-Herfindahl index of assets across states (predicted)*, while controlling for BHC and state-quarter fixed effects, market competition (*Market concentration (MSA)*), and the time-varying BHC traits (bank size, capital-asset ratio, and return on assets). The results show that the projected degree of diversity from the gravity-deregulation model is negatively associated with the cost of raising interest-bearing liabilities. Consistent with classical discussions on the differences between the "intent to treat" effects (reduced form results) and the "treatment" effects (IV results), the estimated coefficients from the reduced from regressions are smaller in absolute value terms than those from the IV regressions.

The differences between the OLS results in Table 2 and the IV results in Table 4 advertise the importance of using instrumental variables to evaluate the impact of the geographic diversity of BHC assets on funding costs. The differences between the OLS and IV results are consistent with the view that BHCs with higher funding costs are more likely to diversify their subsidiaries across states, potentially in search of lower funding costs, confounding the ability to identify the impact of the geographic diversity of BHC assets on funding costs using OLS. When using the gravity-deregulation instrumental variable to extract the exogenous component of

geographic diversity, we find that an increase in a BHC's cross-state diversity of asset holdings materially lowers its funding costs.

These IV results are robust to three additional sensitivity checks, as shown in Table 5. First, since the full implementation of the Riegle-Neal Act, including the relaxation of interstate branching restrictions, was completed in 1997, we redid the analyses over the 1986 through 1997 period. As shown in Panel A, although the number of observations falls by almost half, the coefficient estimates on *1-Herfindahl index of assets across states* remain statistically and economically significant using this alternative sample period. Second, to account for the possibility that relatively large banks are more likely to expand geographically, we redid the analyses with a subsample of BHCs with total assets above $500 million (in Panel B). Third, to account for potential differences in the product mixes of BHCs, we redid the analyses with a subsample of BHCs that earn a minimum of 2/3rd of their total revenues in the form of interest income (in Panel C, columns (3) and (4)). As a further check on the potential role of different product mixes, we include an additional control variable to account for differences in the structure of BHC earnings. In particular, we control for *Noninterest income*, which equals one minus the absolute difference between net interest income and total noninterest income divided by total operating income, in Panel C (columns (1) and (2)).[7] As shown, the results are highly robust to these three tests.

5. Mechanisms: Risk diversification

If the cross-state diversification of a BHC's assets reduces funding costs by lowering risk, then the impact of geographic diversification on funding costs should be greater when the BHC is located in a state with an economy that commoves less with the rest of the economy. That is, geographic expansion should have a bigger impact on funding costs when there are greater opportunities to diversify risk through geographical expansion. In this subsection, we test this

[7] This variable has been used to assess the diversity of BHC earnings, e.g., Laeven and Levine (2007).

potential channel from cross-state diversification to funding costs. Furthermore, by isolating and assessing this "risk" channel, we reduce concerns that the instrumental variable violates the exclusion restriction because we further differentiate BHCs by the comovement between the economy of the state in which the BHC has its headquarters and the aggregate U.S. economy.

To assess this risk reduction channel, we need to (a) measure the degree to which a state's economy commoves with the U.S. economy and (b) modify the regression model. To measure the degree to which expanding into a state will provide risk-reducing opportunities, we use the degree to which the state's economy is correlated with the U.S. economy. Specifically, *US/State comovement* equals the Federal Reserve Bank of Philadelphia's *Coincident index* of the degree to which each state's economy commoves with the overall U.S. economy. The coincident index combines four indicators of state-level economic conditions: nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index (U.S. city average). The trend for each state's index is set to the trend of its gross state product (GSP), so long-term growth in the state's index matches long-term growth in its GSP. For each quarter, we compute the correlation between a state's economy and the U.S. using monthly data of the coincident index over the previous 12 quarters. Thus, a higher value of *US/State comovement* suggests a higher covariation between a BHC's home state and the rest of U.S. economy.

In terms of modifying the regression model used to assess the impact of geographic diversity on funding costs, we add the interaction term between *1-Herfindahl index of assets across states* (which is measured at the BHC-time level) and *US/State comovement* (which is measured at the state-time level). If the coefficient on this interaction term is positive, it suggests that the cost-reducing impact of cross-state asset diversification is smaller when the BHC is headquartered in a state that comoves more with the overall U.S. economy and, hence, where there are correspondingly more modest diversification benefits. To conduct the instrumental variable analyses with this modified regression model, we use the following instruments: *1-*

Herfindahl index of assets across states (predicted) and its interaction with *US/State comovement*. As shown in Panel A of Table 6, the F-statistics of these excluded instruments are greater than 14.

The results show that geographic expansion reduces BHC funding costs by an especially large amount when the BHC expands into economically different states. Columns (1) and (2) of Table 6 Panel A show that the linear term, *1-Herfindahl index of assets across states*, enters the regression negatively and significantly, whereas its interaction term with *US/State comovement* enters positively and significantly. That is, geographic expansion, on average, reduces BHCs' funding cost, but the effects are less profound among BHCs located in states where the economic conditions covary highly with the U.S. economy. As shown, these results hold when examining either *Ln(Total cost of funds)* or *Ln(Cost of domestic deposits)*. Furthermore, these IV findings are consistent with the reduced-form analyses reported in Panel B of Table 6, where *1-Herfindahl index of assets across states (predicted)* enters negatively and significantly, while its interaction with *US/State comovement* enters positively and significantly. Taken together, the results reported in Table 6 suggest that risk diversification is an important mechanism through which geographic expansion reduces funding costs.

The economic impact is large. Consider a BHC headquartered in a state where its economy has a correlation of -1 with the rest of the U.S. economy. The regression estimates from column (2) of Panel A indicate that a one standard deviation increases in the geographic diversity across states (0.096) reduces the BHC's total funding cost by 35% (= - 2.432*0.096 + 1.254*(-1)*0.096). Next, consider another BHC headquartered in a state where its economy has a correlation of +1 with the rest of the U.S. The regression estimates from column (2) indicate that a one standard deviation increases in the geographic diversity across states (0.096) reduces the BHC's total funding cost by 11% (= - 2.432*0.096 + 1.254*(+1)*0.096). Thus, the cost-reducing benefits for BHCs in a perfect procyclical economy is 68% (= (11-35)/35) less than in a perfect countercyclical economy.

6. Conclusion

This paper assesses how cross-state diversity of BHC assets affects the cost of raising external funds. To identify the impact of geographic diversification on BHCs funding costs, we employ a gravity-deregulation model to construct an instrument for the distribution of BHC assets across states. The time-varying, BHC-specific instrument exploits (1) the dynamic process of interstate banking deregulation that varies at the state-time level, and (2) the BHC-specific geographic tendency to diversify across state borders. We provide evidence on the validity of the gravity-deregulation instrumental variable.

The IV regression results suggest that geographic diversification materially lowers BHC funding costs. The results hold when we control for state-quarter fixed effects, BHC fixed effects, market concentration at the MSA level, and time-varying BHC traits (size, capital-asset ratio, and profitability). The results also remain highly robust to the analyses over subsamples of BHCs, and different time periods. Moreover, the cost-reducing effects of geographic diversification are more profound when the economy of a BHCs' home state is less correlated with the overall U.S. economy. These results are consistent with the view that geographic diversity reduces BHCs funding costs by lowering risk.

References

Beck, T., Levine, R., Levkov, A., 2010. Big bad banks? The winners and losers from bank deregulation in the United States. *Journal of Finance* 65, 1637-1667.

Berger, A.N., Miller, N.H., Petersen, M.A., Rajan, R.G., Stein, J.C., 2005. Does function follow organizational form? Evidence from the lending practices of large and small banks. *Journal of Financial Economics* 76, 237-269.

Boyd, J.H., De Nicolo, G., 2005. The theory of bank risk taking and competition revisited. *Journal of Finance* 60, 1329-1343.

Boyd, J.H., Prescott, E.C., 1986. Financial intermediary-coalitions. *Journal of Economic Theory* 38, 211-232.

Brickley, J.A., Linck, J.S., Smith, C.W., 2003. Boundaries of the firm: evidence from the banking industry. *Journal of Financial Economics* 70, 351-383.

Calomiris, C., 2000, U.S. Bank Deregulation in Historical Perspective. Cambridge University Press, New York.

Chong, B.S., 1991. The effects of interstate banking on commercial banks' risk and profitability. *Review of Economics and Statistics* 73, 78-84.

Cornett, M.M., McNutt, J.J., Strahan, P.E., Tehranian, H., 2011. Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics* 101, 297-312.

Cortes, K.R., Strahan, P.E., 2016. Tracing out capital flows: how financially integrated banks respond to natural disasters. *Journal of Financial Economics*, forthcoming.

Demirgüç-Kunt, A., Huizinga, H., 2004. Market discipline and deposit insurance. *Journal of Monetary Economics* 51, 375-399.

Diamond, D.W., 1984. Financial intermediation and delegated monitoring. *Review of Economic Studies* 51, 393-414.

Gatev, E., Schuermann, T., Strahan, P.E., 2009. Managing bank liquidity risk: how deposit-Loan synergies vary with market conditions. *Review of Financial Studies* 22, 995-1020.

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., 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.

Helpman, E., Melitz, M., Rubinstein, Y., 2008. Estimating trade flows: trading partners and trading volumes. *Quarterly Journal of Economics* 123, 441-487.

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.

Houston, J., James, C., Ryngaert, M., 2001. Where do merger gains come from? Bank mergers from the perspective of insiders and outsiders. *Journal of Financial Economics* 60, 285–331.

Jayaratne, J., Strahan, P.E., 1998. Entry restrictions, industry evolution, and dynamic efficiency: evidence from commercial banking. *Journal of Law and Economics* 41, 239-273.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review* 76, 323-329.

Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3, 305-360.

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.

Laeven, L., Levine, R., 2007. Is there a diversification discount in financial conglomerates? *Journal of Financial Economics* 85, 331-367.

Morgan, D.P., Rime, B., Strahan, P.E., 2004. Bank integration and state business cycles. *Quarterly Journal of Economics* 119, 1555-1584.

Scharfstein, D.S., Stein, J.C., 2000. The dark side of internal capital markets: divisional rent-seeking and inefficient investment. *Journal of Finance* 55, 2537-2564.

Tinbergen, J., 1962. Shaping the World Economy. The Twentieth Century Fund, New York.

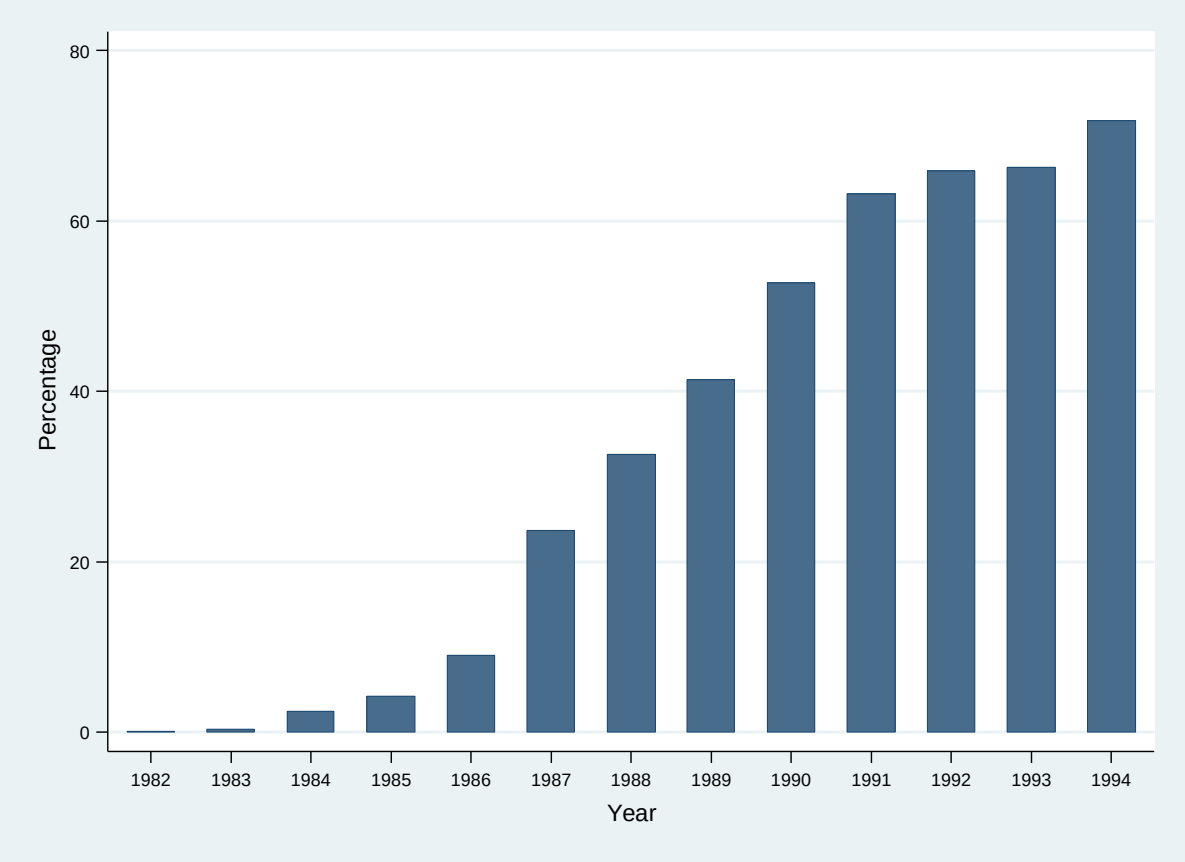

Figure 1. Dynamic process of interstate banking deregulation

This figure shows the cumulative percentage of state pairs when one state is allowed to enter the other state from 1982 through 1994 when the Riegle-Neal Interstate Banking and Branching Efficiency Act passed and removed all the remaining entry barriers across all states. The sample covers all the state pairs among the 48 contiguous states and the District of Columbia. Each bar represents the fraction of state pairs in which BHCs from state A are allowed to enter state B in the indicated year.

Table 1 Summary statistics

For all of the variables used in the analyses, this table provides the following summary statistics: number of observations (N), the average value (Mean), the standard deviation (SD), the minimum value (Min), the Maximum value (Max), and the values at the 25th, 50th, and 75th percentiles. Each of the variables is defined in Appendix Table A.1. "All" represents the full sample of BHC-quarter observations, while "Non-Diversified BHCs" represents the subsample of BHC-quarter where a BHC owns zero out-of-state bank subsidiary in a particular quarter, and "Diversified BHCs" refers to the subsample of BHC-quarter where a BHC has at least one out-of-state bank subsidiary in a given quarter.

Variables	**N**	**Mean**	**SD**	**Min**	**P25**	**P50**	**P75**	**Max**
				All				
Ln(Total cost of funds)	107884	-4.627	0.433	-5.833	-4.893	-4.560	-4.316	-3.901
Total cost of funds	107884	0.011	0.004	0.003	0.008	0.010	0.013	0.020
Ln(Cost of domestic deposits)	107784	-4.657	0.464	-5.926	-4.941	-4.577	-4.322	-3.904
Cost of domestic deposits	107784	0.010	0.004	0.003	0.007	0.010	0.013	0.020
1-Herfindahl index of assets across states	107884	0.024	0.096	0	0	0	0	0.852
Total assets(lag)	107884	1.767	6.735	0.035	0.196	0.307	0.667	57.350
Capital-asset ratio(lag)	107884	0.085	0.027	0.026	0.068	0.083	0.099	0.188
Return on assets(lag)	107884	0.003	0.002	-0.007	0.002	0.003	0.003	0.008
Market concentration (MSA)	36256	0.409	0.253	0.030	0.218	0.343	0.529	1.000
US/State comovement	3844	0.820	0.437	-0.985	0.949	0.992	0.998	1.000
				Non-Diversified BHCs				
Ln(Total cost of funds)	98074	-4.633	0.435	-5.833	-4.907	-4.566	-4.320	-3.901
Total cost of funds	98074	0.011	0.004	0.003	0.007	0.010	0.013	0.020
Ln(Cost of domestic deposits)	98001	-4.662	0.467	-5.926	-4.958	-4.581	-4.323	-3.904
Cost of domestic deposits	98001	0.010	0.004	0.003	0.007	0.010	0.013	0.020
1-Herfindahl index of assets across states	98074	0	0	0	0	0	0	0
Total assets(lag)	98074	0.945	3.948	0.035	0.191	0.285	0.555	57.350
Capital-asset ratio(lag)	98074	0.086	0.027	0.026	0.068	0.083	0.099	0.188
Return on assets(lag)	98074	0.003	0.002	-0.007	0.002	0.003	0.003	0.008
Market concentration (MSA)	34824	0.407	0.251	0.030	0.218	0.342	0.526	1.000
US/State comovement	3781	0.817	0.440	-0.985	0.947	0.992	0.998	1.000
				Diversified BHCs				
Ln(Total cost of funds)	9810	-4.559	0.406	-5.833	-4.766	-4.517	-4.288	-3.901
Total cost of funds	9810	0.011	0.004	0.003	0.009	0.011	0.014	0.020
Ln(Cost of domestic deposits)	9783	-4.600	0.435	-5.926	-4.805	-4.551	-4.302	-3.904
Cost of domestic deposits	9783	0.011	0.004	0.003	0.008	0.011	0.014	0.020
1-Herfindahl index of assets across states	9810	0.269	0.191	0.000	0.102	0.243	0.422	0.852

Total assets(lag)	9810	9.982	16.396	0.035	0.560	2.354	9.840	57.350
Capital-asset ratio(lag)	9810	0.083	0.025	0.026	0.067	0.081	0.094	0.188
Return on assets(lag)	9810	0.003	0.002	-0.007	0.002	0.003	0.004	0.008
Market concentration (MSA)	5876	0.347	0.228	0.035	0.180	0.283	0.468	1.000
US/State comovement	2884	0.831	0.417	-0.978	0.957	0.992	0.998	1.000

Table 2 Geographic diversification and cost of funds

This table reports the baseline regressions using ordinary least squares (OLS). The dependent variable is the natural logarithm of total cost of funds in columns 1-2, and natural logarithm of cost of domestic deposits in columns 3-4. *Total cost of funds* is the ratio of Total interest expenses /Interest-bearing liability at the beginning of a period. *Cost of domestic deposits* equals Interest expenses on domestic deposits/Interest-bearing domestic deposits at the beginning of a period. *1-Herfindahl index of assets across states* equals one minus the sum of squared share of assets held in different states among a BHC's subsidiaries. *Total asset (lag)* is the book value of total assets in billion US dollars at the beginning of a period. *Capital-asset ratio (lag)* is the fraction of bank equity over total assets, measured at the beginning of a period. *Return on assets (lag)* equals net income divided by the book value of total asset, measured at the beginning of a period. *Market concentration (MSA)* is the Herfindahl index of banking asset concentration in a Metropolitan Statistical Area (MSA). We impose a value of one for non-MSA. Although not reported, we include across all columns an *MSA indicator*, that equals one if a BHC is headquartered in an MSA, and zero otherwise. The corresponding fixed effects are indicated in the table. Standard errors are heteroskedasticity robust and clustered at the state and quarter, and reported in parentheses. *,**, and *** indicate significance at 10%, 5%, and 1%.

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1-Herfindahl index of assets across states	0.0623***	0.0498***	0.0573***	0.0489***
	(0.00752)	(0.00758)	(0.00781)	(0.00802)
Capital-asset ratio(lag)	-0.663***	-0.911***	-0.337***	-0.689***
	(0.0384)	(0.0345)	(0.0378)	(0.0346)
Return on assets(lag)	-1.194***	-0.397	-1.147***	-0.381
	(0.314)	(0.277)	(0.322)	(0.272)
Total assets(lag)	-0.000526**	-0.000619**	-0.00195***	-0.00166***
	(0.000216)	(0.000240)	(0.000251)	(0.000269)
Market concentration (MSA)	-0.0262***	-0.0327***	-0.0397***	-0.0457***
	(0.00548)	(0.00518)	(0.00568)	(0.00537)
Quarter fixed effects	Yes		Yes	
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects		Yes		Yes
Observations	107,884	107,884	107,784	107,784
R-squared	0.943	0.951	0.947	0.955

Table 3 Zero-stage estimation for the gravity model

This table shows the relation between distance, population and BHC asset holdings estimated from ordinary least squares (OLS) regressions. The gravity model includes observations in which it is legally feasible for BHC *b* with headquarters in state *i* to open a subsidiary in state *j* at time *t*. We exclude Alaska and Hawaii from the analyses and focus on the 49 contiguous states. Specifically, we estimate the following model:

$$Share_{bijt} = \alpha Ln(Distance_{bij}) + \beta Ln\left(\frac{pop_{it}}{pop_{jt}}\right) + \delta_t + \delta_i + \delta_j + \delta_{ij} + \delta_{ijt} + \varepsilon_{bijt},$$

where the dependent variable, $Share_{bijt}$, is the share of assets a BHC *b* headquartered in state *i* holds in its subsidiaries in a foreign state *j* over the quarter *t*. $Ln(Distance_{bij})$ denotes the natural logarithm of geographic distance between the BHC *b*'s headquarter and the capital city of state *j* (in miles). $Ln(Population\ ratio)$ equals the natural logarithm of (pop_{it}/pop_{jt}), defined as the ratio of the total population of the BHC *b*'s home state *i* to the total population of the foreign state *j* in quarter *t*. The corresponding fixed effects are indicated in the table. Note that all the coefficients and standard errors are multiplied by 100 for expositional purposes. Standard errors are heteroskedasticity robust and clustered at the state and quarter, and reported in parentheses. *,**, and *** indicate significance at 10%, 5%, and 1%.

Variables	Asset share								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln(*Distance*)	-0.108***	-0.111***	-0.111***	-0.169***	-0.169***	-0.188***	-0.251***	-0.630***	-0.616***
	(0.00262)	(0.00244)	(0.00245)	(0.00373)	(0.00372)	(0.00402)	(0.00581)	(0.0221)	(0.0221)
Ln(*Population ratio*)		-0.0217***	-0.0218***	-0.0103***	-0.0107***	-0.00319***	-0.103***	-0.153***	
		(0.00137)	(0.00137)	(0.00114)	(0.00114)	(0.00123)	(0.0202)	(0.0155)	
Quarter fixed effects			Yes		Yes	Yes	Yes	Yes	
Home-state fixed effects						Yes	Yes		
Foreign-state fixed effects							Yes		
State-pair fixed effects								Yes	
State-pair-quarter fixed effects									Yes
Estimation model	Fractional logit	Fractional logit	Fractional logit	OLS	OLS	OLS	OLS	OLS	OLS
Observations	4,317,019	4,317,019	4,317,019	4,317,019	4,317,019	4,317,019	4,317,019	4,317,019	4,317,019

Table 4 Geographic diversification and cost of funds: Instrumental variables based on a gravity-deregulation model

This table reports the second-stage regression results from 2SLS analysis in Panel A, the first-stage results in Panel B, and the reduced form results in Panel C. The dependent variable is the natural logarithm of cost of total funds in columns 1-2 and the natural logarithm of cost of domestic deposits in columns 3-4. *Total cost of funds* is the ratio of Total interest expenses/Interest-bearing liability at the beginning of a period. *Cost of domestic deposits* equals Interest expenses on domestic deposits/Interest-bearing domestic deposits at the beginning of a period. The endogenous variable is *1-Herfindahl index of assets across state*, defined as one minus the sum of squared share of assets held in different states. The excluded instrument is *1 - Herfindahl index of assets across states (Predicted)*, which is computed as follows: Using the coefficient estimates from the gravity-deregulation model (column 2 in Table 3), we predict the share a BHC holds in a state and year, where we impose that BHCs' projected holdings of assets as zero in states that they cannot enter because of interstate bank regulations. Finally, we aggregate the information for each BHC at the BHC-quarter level and compute the Herfindahl index of assets across states (Predicted). Bank controls include *Capital-asset ratio (lag) Return to assets (lag)*, and *Total assets (lag)*, all measured at the beginning of a period. *Market concentration (MSA)* is the Herfindahl index of banking asset concentration in a Metropolitan Statistical Area (MSA). We impose a value of one for non-MSA. Although not reported, we include across all columns an *MSA indicator*, that equals one if a BHC is headquartered in an MSA, and zero otherwise. Bank holding company fixed effects and state-quarter fixed effects are included throughout the table. Standard errors are heteroskedasticity robust and clustered at the state and quarter, and reported in parentheses. *,**, and *** indicate significance at 10%, 5%, and 1%.

Panel A: Second-stage results

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1-Herfindahl index of assets across states	-1.509***	-1.419***	-1.422***	-1.252***
	(0.366)	(0.329)	(0.349)	(0.313)
Capital-asset ratio(lag)		-0.954***		-0.727***
		(0.0411)		(0.0399)
Return on assets(lag)		-0.811**		-0.738**
		(0.336)		(0.322)
Total assets(lag)		-2.94e-07		-0.00112**
		(0.000471)		(0.000458)
Market concentration (MSA)		-0.0383***		-0.0509***
		(0.00661)		(0.00659)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
R-squared	0.917	0.921	0.928	0.934

Panel B: First-stage results

Variables	*1-Herfindahl index of assets across states*			
	(1)	(2)	(3)	(4)
1 - Herfindahl index of assets across states (predicted)	0.362***	0.410***	0.364***	0.412***
	(0.0674)	(0.0669)	(0.0675)	(0.0670)
Capital-asset ratio(lag)		-0.0278*		-0.0282*
		(0.0157)		(0.0157)
Return on assets(lag)		-0.287**		-0.285**
		(0.117)		(0.118)
Total assets(lag)		0.000401		0.000390
		(0.000251)		(0.000251)
Market concentration (MSA)		-0.00388		-0.00402
		(0.00268)		(0.00268)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
F-statistics of Weak IV	28.84	37.46	29.07	37.87

Panel C: Reduced form

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1 - Herfindahl index of assets across states (predicted)	-0.546***	-0.581***	-0.518***	-0.516***
	(0.0900)	(0.105)	(0.0919)	(0.106)
Capital-asset ratio(lag)		-0.914***		-0.692***
		(0.0344)		(0.0345)
Return on assets(lag)		-0.403		-0.382
		(0.277)		(0.272)
Total assets(lag)		-0.000569**		-0.00161***
		(0.000241)		(0.000270)
Market concentration (MSA)		-0.0328***		-0.0459***
		(0.00519)		(0.00538)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
R-squared	0.950	0.951	0.954	0.955

Table 5 Geographic diversification and cost of funds: Robustness tests on subsamples

This table reports three robustness tests of the impact of geographic diversification on BHC funding costs. Using the same empirical methods as in Table 4, Panel A reports the second stage results using the sample period from 1986 through 1997; Panel B reports the second stage results on a subsample of large BHCs, i.e., BHCs with total assets greater $500 million; Panel C, columns (1) – (2) includes the additional control variable, *Noninterest income*, which equals one minus the absolute difference between net interest income and total noninterest income divided by the total operating income; and Panel C, columns (3) – (4) reports the second stage results using the subsample of BHCs in which interest income accounts for at least 2/3 of total operating income. *BHC controls* include the same set of controls as in Table 4, namely *Capital-asset ratio (lag)*, *Return to assets (lag)*, and *Total assets (lag)*, *Market concentration (MSA)*, and *MSA indicator*.

Panel A: Subsample before the full implementation of the Riegle-Neal Act

Variables	*Ln(Total cost of funds)*	*Ln(Cost of domestic deposits)*
	(1)	(2)
1-Herfindahl index of assets across states	-1.353**	-1.573***
	(0.571)	(0.596)
BHC controls	Yes	Yes
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
Observations	51,146	51,120
R-squared	0.893	0.877
F-statistics of Weak IV	15.18	15.51

Panel B: Subsample with large BHCs

Variables	*Ln(Total cost of funds)*	*Ln(Cost of domestic deposits)*
	(1)	(2)
1-Herfindahl index of assets across states	-1.284***	-1.097***
	(0.332)	(0.305)
BHC controls	Yes	Yes
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
Observations	37,601	37,563
R-squared	0.888	0.912
F-statistics of Weak IV	27.93	28.34

Panel C: Product mix

Variables	*Ln(Total cost of funds)* (1)	*Ln(Cost of domestic deposits)* (2)	*Ln(Total cost of funds)* (3)	*Ln(Cost of domestic deposits)* (4)
1-Herfindahl index of assets across states	-1.524***	-1.327***	-1.423***	-1.372***
	(0.349)	(0.328)	(0.307)	(0.301)
Noninterest income	0.138***	0.0618***		
	(0.0113)	(0.0108)		
BHC controls	Yes	Yes	Yes	Yes
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	106,295	106,200	105,589	105,545
R-squared	0.917	0.932	0.924	0.933
F-statistics of Weak IV	35.45	35.85	41.98	42.40

Table 6 Geographic diversification and cost of funds: Economic comovement

This table reports the 2SLS and reduced form regression results that are similar to the specification in Table 4, while differentiating the correlation between a BHC's home state and foreign states. The dependent variable is the natural logarithm of Total cost of funds in columns 1, and the natural logarithm of Cost of domestic deposits in columns 2. *Total cost of funds* is the ratio of Total interest expenses/Interest-bearing liability at the beginning of a period. *Cost of domestic deposits* equals Interest expenses on domestic deposits/Interest-bearing domestic deposits at the beginning of a period. The endogenous variable is 1-Herfindahl index of assets across state, defined as one minus the sum of squared share of assets held in different states. The excluded instrument is 1 - Herfindahl index of assets across states (Predicted), which is computed using the same gravity-deregulation model as described in Table 4. *US/State comovement* equals the correlation between a BHC's home state's coincident index and the US coincident index. The coincident indexes summarize the economic conditions in a specific state. The indexes combine four state-level variables, namely nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index (U.S. city average). For each quarter, we estimate the pairwise correlations using the monthly values of the coincident index over the previous 12 quarters. Bank controls include *Capital-asset ratio (lag) Return to assets (lag),* and *Total assets (lag),* all measured at the beginning of a period. *Market concentration (MSA)* is the Herfindahl index of banking asset concentration in a Metropolitan Statistical Area (MSA). We impose a value of one for non-MSA. Although not reported, we include across all columns an *MSA indicator,* that equals one if a BHC is headquartered in an MSA, and zero otherwise. Bank holding company fixed effects and state-quarter fixed effects are included throughout the table. Standard errors are heteroskedasticity robust and clustered at the state and quarter, and reported in parentheses. *,**, and *** indicate significance at 10%, 5%, and 1%.

Panel A: Second-stage results

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1-Herfindahl index of assets across states	-2.458***	-2.432***	-2.920***	-2.779***
	(0.583)	(0.567)	(0.617)	(0.602)
US/State correlation (1-Herfindahl index of assets across states)*	1.200***	1.254***	1.899***	1.890***
	(0.437)	(0.442)	(0.490)	(0.485)
Capital-asset ratio(lag)		-0.945***		-0.722***
		(0.0443)		(0.0455)
Return on assets(lag)		-0.466		-0.241
		(0.372)		(0.390)
Total assets(lag)		0.000227		-0.000786
		(0.000477)		(0.000488)
Market concentration (MSA)		-0.0279***		-0.0350***
		(0.00782)		(0.00846)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,325	107,331	111,222	107,234
R-squared	0.909	0.911	0.910	0.914
F-statistics of Weak IV	14.05	17.54	14.19	17.77

Panel B: Reduced form

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1 - Herfindahl index of assets across states (predicted)	-0.681***	-0.730***	-0.765***	-0.772***
	(0.0996)	(0.113)	(0.101)	(0.115)
US/State comovement(1-Herfindahl index of assets across states(predicted))*	0.179***	0.199***	0.323***	0.335***
	(0.0567)	(0.0574)	(0.0538)	(0.0544)
Capital-asset ratio(lag)		-0.918***		-0.697***
		(0.0344)		(0.0345)
Return on assets(lag)		-0.404		-0.397
		(0.277)		(0.272)
Total assets(lag)		-0.000567**		-0.00160***
		(0.000241)		(0.000270)
Market concentration (MSA)		-0.0331***		-0.0464***
		(0.00517)		(0.00534)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,325	107,331	111,222	107,234
R-squared	0.950	0.951	0.954	0.955

Appendix

Table A1 Variable definition and sources

Variable	Definition	Sources
Ln(Total cost of funds)	Natural logarithm of *Total cost of funds*. *Total cost of funds* is the ratio of Total interest expenses to Interest-bearing liability at the beginning of a period.	Calculated by authors, FR-Y9C
Ln(Cost of domestic deposits)	Natural logarithm of *Cost of domestic deposits*. *Cost of domestic deposits* equals Interest expenses on domestic deposits divided by Interest-bearing domestic deposits at the beginning of a period.	Calculated by authors, FR-Y9C
1-Herfindahl index of assets across states	BHC diversification measure, defined as one minus the sum of squared share of assets held in different states.	Calculated by authors, FR-Y9C, Call reports
Total assets (lag)	Book value of total assets in billion US dollars, measured at the beginning of a period.	Calculated by authors, FR-Y9C
Capital-asset ratio (lag)	The fraction of bank equity over total assets, measured at the beginning of a period.	Calculated by authors, FR-Y9C
Return on assets (lag)	Net income divided by the book value of total assets, measured at the beginning of a period.	Calculated by authors, FR-Y9C
Market concentration(MSA)	Herfindahl index of bank asset concentration in a holding company's market, defined as the sum of squared share of total assets among all the bank institutions operated in a Metropolitan Statistical Area (MSA). We impose a value of one for non-MSA.	Calculated by authors, FR-Y9C, Call reports, U.S. Census Bureau
Noninterest income	One minus the absolute difference between net interest income and total noninterest income divided by the total operating income.	Calculated by authors, FR-Y9C
US/State comovement	The correlation between individual state's coincident index and the US nationwide coincident index. Thus, a higher value of US/State correlation indicates a higher correlation between a state and the rest of the US. The coincident indexes summarize the economic conditions in a specific state. The indexes combine four state-level variables, namely nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index (U.S. city average). For each quarter, we estimate the correlations between individual states and the US using the monthly values of the coincident index over the previous 12 quarters.	Calculated by authors, Federal Reserve Bank of Philadelphia

Table A2 Geographic diversification and cost of funds: Instrumental variable based only on distance

This table reports the second-stage regression results that are similar to Table 4 in the main text, except that the instruments are predicted only using geographic distance, not population. The dependent variables and explanatory variables have the same meaning as in the previous table. Bank holding company fixed effects and state-quarter fixed effects are included throughout the table. Standard errors are heteroskedasticity robust and clustered at the state and quarter, and reported in parentheses. *,**, and *** indicate significance at 10%, 5%, and 1%.

Panel A: Second-stage results

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1-Herfindahl index of assets across states	-2.233***	-2.201***	-2.015***	-1.845***
	(0.538)	(0.520)	(0.494)	(0.468)
Capital-asset ratio(lag)		-0.976***		-0.744***
		(0.0497)		(0.0461)
Return on assets(lag)		-1.033**		-0.905**
		(0.405)		(0.372)
Total assets(lag)		0.000324		-0.000881
		(0.000664)		(0.000599)
Market concentration (MSA)		-0.0413***		-0.0533***
		(0.00813)		(0.00769)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
R-squared	0.879	0.881	0.903	0.912

Panel B: First-stage results

Variables	*1-Herfindahl index of assets across states*			
	(1)	(2)	(3)	(4)
1 - Herfindahl index of assets across states (predicted Distance only)	0.298***	0.325***	0.299***	0.327***
	(0.0602)	(0.0633)	(0.0603)	(0.0634)
Capital-asset ratio(lag)		-0.0279*		-0.0282*
		(0.0157)		(0.0157)
Return on assets(lag)		-0.286**		-0.284**
		(0.117)		(0.118)
Total assets(lag)		0.000405		0.000394
		(0.000251)		(0.000251)
Market concentration (MSA)		-0.00388		-0.00402
		(0.00268)		(0.00268)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
F-statistics of Weak IV	24.50	26.41	24.67	26.65

Panel C: Reduced form

Variables	*Ln(Total cost of funds)*		*Ln(Cost of domestic deposits)*	
	(1)	(2)	(3)	(4)
1 - Herfindahl index of assets across states (predicted Distance only)	-0.665***	-0.716***	-0.603***	-0.604***
	(0.100)	(0.112)	(0.102)	(0.116)
Capital-asset ratio(lag)		-0.915***		-0.692***
		(0.0344)		(0.0345)
Return on assets(lag)		-0.402		-0.381
		(0.277)		(0.272)
Total assets(lag)		-0.000568**		-0.00161***
		(0.000241)		(0.000270)
Market concentration (MSA)		-0.0328***		-0.0458***
		(0.00519)		(0.00538)
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	111,545	107,543	111,442	107,446
R-squared	0.950	0.951	0.954	0.955