NBER WORKING PAPER SERIES

DOES THE GEOGRAPHIC EXPANSION OF BANK ASSETS REDUCE RISK?

Martin Goetz
Luc Laeven
Ross Levine

Working Paper 20758
http://www.nber.org/papers/w20758

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2014

Martin Goetz gratefully acknowledges financial support from the Center of Excellence SAFE, funded by the State of Hessen initiative for research LOEWE. The views expressed here are our own and should not be attributed to those of the IMF or IMF Board. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Does the Geographic Expansion of Bank Assets Reduce Risk?
Martin Goetz, Luc Laeven, and Ross Levine
NBER Working Paper No. 20758
December 2014
JEL No. G11,G21,G28

ABSTRACT

We develop a new identification strategy to evaluate the impact of the geographic expansion of bank holding company (BHC) assets across U.S. metropolitan statistical areas (MSAs) on BHC risk. We find that the geographic expansion of bank assets reduces risk. Moreover, geographic expansion reduces risk more when BHCs expand into economically dissimilar MSAs, i.e., MSAs with different industrial structures and business cycles. We do not find that geographic diversification improves loan quality. Our results are consistent with arguments that geographic expansion lowers risk by reducing exposure to idiosyncratic local risks and inconsistent with arguments that geographic expansion, on net, increases risk by reducing the ability of BHCs to monitor loans and manage risks.

Martin Goetz
Professor
SAFE and Goethe University
Frankfurt
GERMANY
goetz@econ.uni-frankfurt.de

Luc Laeven
Deputy Division Chief
International Monetary Fund
700 19th Avenue, NW
Washington, DC 20431
and CEPR
Llaeven@imf.org

Ross Levine
Haas School of Business
University of California at Berkeley
545 Student Services Building, #1900 (F685)
Berkeley, CA 94720-1900
and NBER
Ross_levine@haas.berkeley.edu

1. Introduction

Economic theory provides conflicting views on a basic question in banking: Does the geographic expansion of bank assets reduce risk? Textbook portfolio theory suggests that geographic expansion will lower a bank's risk if it involves adding assets whose returns are imperfectly correlated with existing assets. Diamond (1984) and Boyd and Prescott (1986) emphasize that diversified banks enjoy cost-efficiencies that can enhance stability. And, if diversification makes a bank too big, or too interconnected, to fail, implicit or explicit government guarantees can lower the risk of investing in the bank (Gropp et al., 2010).

Other theories stress that expansion increases bank risk. Agency-based models of corporate expansion (Jensen, 1986; Berger and Ofek, 1996; Servaes, 1996; and Denis et al., 1997) suggest that bankers might expand geographically to extract the private benefits of managing a larger "empire" even if this lowers loan quality and increases bank fragility. Furthermore, Brickley et al. (2003) and Berger et al. (2005) stress that distance can hinder the ability of a bank's headquarters to monitor its subsidiaries, with potentially adverse effects on asset quality. And, to the extent that diversification increases complexity, it could hinder the ability of banks to monitor loans and manage risk (Winton, 1999).

Empirical assessments of these views have yielded mixed results. Demsetz and Strahan (1997) and Chong (1991) find that geographical diversified BHCs hold less capital and choose riskier loans. Acharya et al. (2006) find that as BHCs expand geographically, their loans become riskier. On the other hand, Akhigbe and Whyte (2003) and Deng and Elyasiani (2008) find that risk falls as BHCs expand geographically.

The ambiguity of existing findings might reflect the challenges of identifying an exogenous source of variation in geographic expansion and accounting for where BHCs choose to expand. First, if BHCs increase the riskiness of their assets when they expand geographically, then an ordinary least squares (OLS) regression of risk on geographic diversity will yield an upwardly biased estimate of the impact of geographic expansion on risk. That is, OLS estimates will understate any risk-reducing effects of geographic expansion due to attenuation bias. Second, BHCs not only choose whether to expand; they choose where to expand. Textbook portfolio theory suggests that geographic expansion will appreciably lower risk only if the BHCs expands into "dissimilar" economies—economies whose asset returns have low correlation with the BHC's existing investments. Failing to account for where BHCs expand could yield misleading inferences about the impact of geographic expansion on risk.

To address these challenges and assess the impact of geographic expansion on BHC risk, we develop and use a new instrumental variable strategy. We both identify an exogenous increase in geographic diversity at the BHC-level and account for BHCs choosing to expand into more similar or dissimilar local economies. To measure BHC risk, we use the standard deviation of a BHC's stock returns, which Atkeson et al. (2014) show theoretically and empirically is a sound measure of a firm's risk of default. Furthermore, our results hold when using the Z-score and other measures of risk. To measure geographic diversity, we use the distribution of BHC assets across U.S. Metropolitan Statistical Areas (MSAs). MSAs have different business cycle frequencies and industrial structures that we use to measure the similarity of local economies.

Our identification strategy has two building blocks. First, we exploit the cross-state, cross-time variation in the removal of interstate bank branching prohibitions to identify an exogenous increase in geographic diversity. From the 1970s through the 1990s, individual states of the United States removed restrictions on the entry of out-of-state banks. Not only did states start deregulating in different years, states also signed bilateral and multilateral reciprocal interstate banking agreements in a somewhat chaotic manner over time. There is enormous cross-state variation in the twenty-year process of interstate bank deregulation, which culminated in the Riegle-Neal Interstate Banking Act of 1995. As we discuss and show below, there are good economic and statistical reasons for treating the process of interstate bank deregulation as exogenous to bank risk and for using interstate bank deregulation as an exogenous source of variation in BHC diversity.

The second building block involves embedding this state-time dynamic process of interstate bank deregulation into a gravity model of individual BHC investments in “foreign” MSAs—MSAs other than the MSA where the BHC is headquartered. This methodology yields a BHC-specific instrumental variable of cross-MSA diversification. Specifically, in each time period, we use a gravity model to compute the projected share of assets that each BHC will hold in each “foreign” MSA and impose a value of zero when there are interstate bank regulatory prohibitions on a BHC owning a subsidiary in that MSA. Our gravity-deregulation model explains bank expansion behavior very well and produces the BHC-specific instrumental variable that we employ to identify the causal impact of geographic diversity across different MSAs on risk.

We start with OLS regressions that confirm past findings and advertise the value of our instrumental variable strategy. In regressions of BHC risk on BHC diversification, the results depend on the control variables. In some specifications, diversification enters with a negative coefficient; while in other specifications, it enters with a positive coefficient. Since attenuation bias could drive these results, we use the instruments described above to assess the impact of diversification on risk.

Using instrumental variables, we find that geographic expansion of BHC assets materially reduces BHC risk. This finding holds after controlling for a wide-array of time-varying BHC characteristics, such as size, growth, profitability, and the capital-asset ratio, as well as BHC fixed effects. Furthermore, we find no evidence that short-run valuation effects around the time of mergers and acquisitions drive the results. Across an array of specifications and robustness tests, we find an economically large effect. A one-standard deviation increase in the geographic diversification of BHC assets across MSAs reduces BHC risk by 34%, or about 70% of its sample standard deviation.

We also find that geographic expansion reduces risk more when BHCs expand into economically dissimilar MSAs—MSAs with different industrial structures and business cycles—than when they expand into similar MSAs. We use measures of the similarity of industrial structures (Kalemli-Ozcan et al., 2001; 2003) and the synchronicity of business cycles across MSAs (Morgan et al., 2004; Kalemli-Ozcan et al., 2013) to measure the degree to which a BHC expands into an economically dissimilar area. To evaluate the economic magnitude of the risk-reducing effects from expanding into dissimilar MSAs, we rank all MSA-pairs by the degree of industrial structure similarity or business cycle co-movement and compare MSA-pairs with below and above the median similarity. Our estimates suggest that BHCs that expand into dissimilar MSAs experience a four-fold larger reduction in risk than those that expand into similar MSAs. Geographic expansion lowers risk by enabling banks to reduce their exposure to idiosyncratic local risks.

We also assess an additional channel through which geographic expansion might influence BHC fragility: changes in loan quality. As noted above, some research suggests that geographic expansion might reduce the quality of banks loan and the monitoring of those loans. We, however, find that an increase in the geographic diversity of BHC assets does not have an impact on loan loss provisions, nonperforming loans, or loan charge-offs. The results do not indicate that geographic expansion is reducing bank risk by improving loan quality.

It is important to emphasize the boundaries of our analyses. We do not assess each of the potential mechanisms linking geographic expansion and risk. Rather, we develop a new identification strategy that allows us to (a) assess the net impact of geographic diversity on BHC risk more precisely than past studies, (b) evaluate the hypothesized gains from diversifying into different local economies, and (c) gauge whether the effects of geographic on risk are driven by changes in loan quality. The findings indicate that geographic expansion—especially diversification into dissimilar MSAs—materially reduces BHC risk.

These findings relate to recent research on the valuation effects of BHC diversification. DeLong (2001) and Goetz et al. (2013) find that the geographic diversification of BHCs assets destroys shareholder value, which can arise because insiders extract private rents. For instance, Goetz et al. (2013) show that diversification increases the size and lowers the interest rate on BHC loans to executives. In turn, our results indicate that the geographic diversification of BHC assets reduces risk, where the risk-reducing effects of geographic expansion are particularly pronounced when BHCs enter economically different markets. Furthermore, we extend and improve on the identification strategy developed in Goetz et al. (2013) by examining how the cross-*MSA* expansion of BHCs influences BHC risk while differentiating by the similarity of MSA economies.

Our findings relate to long-standing policy deliberations. As emphasized by Bernanke (1983), Calomiris and Mason (1997, 2003a, 2003b), Keeley (1990), Boyd and DeNicolo (2005) and recent financial turmoil, the risk-taking behavior of banks affects financial and economic fragility. In turn, national regulatory agencies have adopted, or are considering adopting, an array of regulations, including geographic concentration limits, to shape bank risk. For instance, in the U.S. no BHC is permitted to gain more than a 10% share in the market for deposits. And the Basel Committee for Banking Supervision (2011), in its effort to contain the financial system's systemic risk, has proposed capital surcharges for systemically important banks and considers a bank's global footprint to be an important indicator of its systemic importance. Yet, the literature has not offered conclusive evidence on the impact of restrictions on geographic diversity on the risk taking behavior of individual banks, in part due to identification challenges.

The paper is organized as follows. Section 2 summarizes the data and describes the process of interstate bank deregulation in the United States. Section 3 presents OLS regression results of the relation between geographic diversity of bank assets and bank risk. Section 4 presents instrumental variables regression results based on the removal of interstate banking restrictions. Section 5 considers heterogeneous effects of diversification across geographies and markets. Section 6 considers the effects of geographic diversity on loan quality. Section 7 concludes.

2. Data and interstate bank deregulation

2.1. Sources

We use balance sheet information on BHCs and their chartered subsidiary banks to assess the relationship between bank risk and the geographic diversification of BHC assets. The Federal Reserve collects data on a quarterly basis on BHCs and publishes the data in the Financial Statements for Bank Holding Companies. Since June of 1986, the Federal Reserve has provided consolidated balance sheets, income statements, and detailed supporting schedules for domestic BHCs. Furthermore, all banks regulated by the Federal Deposit Insurance Corporation, the Federal Reserve, or the Office of the Comptroller of the Currency file Reports of Condition and Income, known as Call Reports, that include balance sheet and income data. We link bank subsidiaries to their parent BHCs by using the reported identity of the entity that holds at least 50% of a bank's equity (RSSD9364). We exclude subsidiaries that only conduct foreign activities (e.g., Edge corporations).

The Center of Research in Security Prices (CRSP) provides data on the stock prices of publicly traded BHCs at the quarterly frequency. We use these data to measure BHC risk as the natural logarithm of the standard deviation of stock returns. We link BHC balance sheet information to stock prices using CRSP-FRB link from the New York Federal Reserve Bank website.[1]

For interstate deregulation, Amel (1993) and the updates by Goetz, Laeven, Levine (2013) and Goetz and Gozzi (2014) provide information on changes in state laws that affect the ability of commercial banks to expand across state borders. Commercial banks in the U.S. were prohibited from entering other states due to regulations on interstate banking. Over the period from 1978 through 1994, states removed these restrictions by either (1) unilaterally opening their state borders and allowing out-of-state banks to enter or (2) signing reciprocal bilateral and multilateral branching agreements with other states and

[1] A current link can be found at: http://www.newyorkfed.org/research/banking_research/datasets.html.

thereby allowing out-of-state banks to enter. The Riegle-Neal Act of 1994 repealed restrictions on BHCs headquartered in one state from acquiring banks in other states. Amel (1993) reports for each state and year, the states in which a state's BHC can open subsidiary banks. After confirming this dating, we extended the data for the full sample period using information from each state's bank regulatory authority. Consistent with earlier research on the liberalization of branching restrictions (e.g., Jayaratne and Strahan, 1996), we exclude the states of Delaware and South Dakota from these analyses since both states changed their laws to encourage the formation and entry of credit card banks in 1980, shortly before removing branching restrictions, which makes it difficult to isolate the independent effect of interstate banking deregulation on BHC diversification.

The Bureau of Economic Analysis provides data on social and economic demographics at the level of MSAs. Defined by the Office of Management and Budget, MSAs are geographic entities that contain a core urban area of 50,000 or more inhabitants and include adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. We use the 2003 definitions of MSAs. There are 381 distinct MSAs in the United States. Since a few urban areas span two (or more states), we consider an MSA to have removed its restriction to the entry of banks from other areas if at least one state of the MSA removed its entry restrictions.

2.2. Geographic diversification

For each BHC, in each quarter, we determine the cross-MSA distribution of its bank subsidiaries, weighting the subsidiaries by their assets. We use the location of the BHC's subsidiaries across MSAs as reported in the Call Reports and define BHC diversification in terms of the location of its bank network, not the physical location of the firms and individuals receiving loans as such information is unavailable.

We consider each MSA to be a distinct banking market and compute a BHC's asset diversification across MSAs as in Berger and Hannan (1989) and Rhoades (1997). Thus, we only consider BHCs headquartered in an MSA and we only measure diversification of BHC assets across MSAs. These filters do not exclude much of the US banking system. Publicly traded BHCs headquartered in MSAs held on average about 85% of US commercial banking system assets during our sample period. And, of these BHCs, about 95% of their commercial banking assets are held by subsidiaries in MSAs. Thus, we capture about 80% of the US commercial banking industry.

We use two measures of geographic diversity. First, *Diversification Dummy* is a dummy variable that equals one if a BHC has subsidiaries in more than one MSA, and zero otherwise. Second, *1 – Herfindahl Index of assets across MSAs* equals one minus the Herfindahl-Hirschman Index of a BHC's assets across the MSAs in which it has subsidiary banks. This measures the dispersion of a BHC's assets across MSAs. Note, the measures of BHC asset diversification are defined at the MSA level, not at the state level.

2.3. Exposure to Liquidity Risk

Building on Kashyap, Rajan, and Stein (2002) and Gatev, Schuermann, and Strahan (2009), we control for the liquidity risk of each BHC. Kashyap et al. (2002) focus on the synergies associated with banks taking deposits and making loan commitments. Banks often provide liquidity to borrowers through loan commitments, but this exposes them to the liquidity risk that a borrower draws down a committed line of credit. By combining loan commitments with deposit-taking, banks can hedge such risks if deposit withdrawals and loan commitment drawdowns are negatively correlated. Gatev et al. (2009) show that on average a U.S. BHC's risk is higher if it has a greater share of undrawn credit lines, but lower if it has a greater share of demand deposits, indicating that BHCs can hedge liquidity risk. To measure liquidity risk, we follow Gatev et al. (2009) and include three variables: (1) the undrawn, but committed, credit lines as a share of BHC loan volume, (2) transaction deposits as a share of total BHC deposit volume, and (3) the interaction between these two terms (to account for the mitigating effect of a BHCs' liability structure on risk).

2.4. Activity diversity

We account for the diversity of each BHC's financial activities to focus on the independent impact of geographic diversity on risk. Following Laeven and Levine (2007), we use both an index of income diversity and an index of asset diversity. The income diversity index measures the degree to which the income of the bank is diversified between interest and noninterest income. The asset diversity index measures the diversity of assets between interest and noninterest generating assets. The indexes take on values between zero and one, where larger values imply that the BHC's income and assets are more diversified.

In particular, $\text{Income Diversity} = 1 - \left|\frac{\text{Net Interest Income} - \text{Total Noninterest Income}}{\text{Total Operating Income}}\right|$, where Net interest income equals total interest income minus total interest expenses. Other operating income includes net fee income, net commission income, and net trading income.

And, $\text{Asset Diversity} = 1 - \left|\frac{\text{Net Loans} - \text{Other Earning Assets}}{\text{Total Earning Assets}}\right|$, where Net loans equals gross loans minus loan loss provisions. Other earning assets include all earning assets other than loans (such as Treasuries, mortgage-backed securities, and other fixed income securities).

2.4. Other factors

We also control for an array of bank-specific and MSA-specific traits that influence bank risk (e.g., Avraham et al., 2012). The analyses control for a BHC's assets (i.e., bank size[2]), Tobin's *q*, operating income, capital-asset ratio, and return on assets. We also control for the concentration of banking assets within an MSA and quarter, and the real growth rate of average personal income within an MSA. Since reliable estimates of personal income at the MSA-level are only available at an annual frequency, we use the annual growth rate for each quarter within a year. Furthermore, in several analyses reported below, we include MSA- and BHC-fixed effects to account for all time invariant MSA and BHC effects.

[2] A considerable body of research examines economies of scale in banking, including Berger et al. (1987), Boyd and Gertler (1993), and Boyd and Runkle (1993).

2.5. Sample construction

We first match subsidiaries of BHCs to their ultimate parent company using information from the Call Reports. Each subsidiary reports its unique parent company, and there can be several layers of subsidiaries and parent companies before reaching the ultimate parent company. We assign a subsidiary to the ultimate parent BHC that owns at least 50% of the subsidiary's equity. We only focus on BHCs located in the U.S. and therefore drop holding companies chartered in Puerto Rico. Furthermore, we eliminate BHCs that change the location of their headquarters across MSAs during the sample period.

We next link these data with information on stock prices and market capitalization to measure the volatility of each BHC's market capitalization in each quarter. We first obtain stock prices and outstanding shares from the Center for Research in Security Prices (CRSP) and calculate market capitalization for each BHC over the period from 1986 through 2007. For the few cases in which two different classes of shares for a BHC are traded in a quarter, we use the sum of the capitalizations of each class of share for the BHC. Similar to Gatev at al. (2009), we compute weekly returns from market values observed on Wednesdays, as this is the weekday with the fewest public holidays. For each BHC, we then compute the standard deviation of weekly market returns over a quarter, and use this as our main proxy for BHC risk. We set a BHC-quarter observation equal to missing if we do not have stock price data for more than 25% of Wednesdays in a quarter. This reduces the BHC-quarter observations by less than 3%. Further, we exclude observations below the 1st and above the 99th percentile of the standard deviation of weekly returns to mitigate the influence of outliers.

Our final sample contains 25,667 BHC-quarter observations of 788 BHCs. The time period of our sample ranges from the third quarter of 1986 to the last quarter of 2007 and includes all publicly traded BHCs, headquartered in one of the 381 MSAs of the United States.

Table 1 reports descriptive statistics of the main variables, with the sample of 788 BHCs split into diversified and nondiversified BHC-quarter observations. Since BHCs diversify during our sample period, the same entity can appear in both columns of Table 1, being categorized as a nondiversified BHC in the quarters before it diversifies and a diversified BHC afterwards. About 35% of our sample consists of BHC-quarters with subsidiaries in more than one MSA. Furthermore, about 295 BHCs have assets in more than one banking market over the sample period. Regarding our risk measures, Table 1 indicates that diversified banks exhibit a smaller volatility of stock returns. Moreover, diversified banks tend to (1) be much larger, (2) be more exposed to liquidity risk due to their greater share of undrawn credit lines, and (3) also have a greater share of transaction deposits. T-tests indicate that all of these differences are significant at the 1% level.

3. Geographic diversity of BHC assets across MSAs and Risk: OLS results

As a preliminary assessment of the relationship between the risk of a BHC and its geographic diversification of assets across MSAs, we estimate OLS regressions. The reduced form model is specified as follows:

$$\ln(\sigma)_{b,t} = \beta D_{b,t} + X'_{b,m,t}\varphi + \delta_b + \delta_t + \varepsilon_{b,t} \qquad (1)$$

where $\ln(\sigma)_{b,t}$ denotes the natural logarithm of weekly market returns of BHC *b* in quarter *t*, denotes our measures of a BHC's geographic diversification, $X'_{b,m,t}$ is a matrix of conditioning information, and *δ*'s are fixed effects, where we use BHC and quarter fixed effects in various specifications. Throughout the paper, the reported standard errors are heteroskedasticity robust and adjusted for clustering at the MSA-quarter level, thereby controlling for potential error correlation within an MSA and quarter. We cluster at this level, because BHCs in the same MSA and quarter are affected by the same factors. The BHC fixed effects account for unobserved, time-invariant differences across BHCs and focuses the analysis on how changes in BHC risk vary with changes in BHC diversification.

Table 2 provides regression results on the relationship between BHC risk and the cross-market diversification of BHC assets. We separately examine two measures of geographic diversification: the Diversification Dummy and 1 – Herfindahl Index of assets across MSAs. We first present the results using the Diversification Dummy, adding bank-level and MSA-level control variables across regressions (1) through (3). We then repeat the analysis using the Herfindahl index in regression (4) through (6). In these first six regressions, we include time fixed effects to account for unobserved time trends at the national level. Finally, in regressions (7) and (8), we include BHC fixed effects.

The relationship between geographic diversification and risk depends on whether the regression includes BHC fixed effects. Without BHC effects, there is a negative association between geographic diversification and risk, and this relationship holds when using either measure of geographic diversification or when controlling for an array of BHC and MSA characteristics. However, the relationship between BHC risk and diversification switches signs when including BHC fixed effects. The negative relationship between BHC risk and the Diversification Dummy becomes positive and insignificant when controlling for BHC effects. Moreover, the relationship between BHC risk and the Herfindahl Index measure of diversity becomes positive and significant when conditioning on BHC effects. These findings are consistent with the view that less risky BHCs diversify, but that risk does not change, or might even increase, after a BHC diversifies geographically.

Regarding the ability to hedge liquidity risk by holding more transaction deposits, the findings in Table 2 provide mixed results. Consistent with Gatev et al. (2009), regressions (2) and (5) indicate that BHCs with a greater share of committed, but undrawn, lines of credit tend to have greater risk, but this risk falls for BHCs with a greater share of transaction deposits. However, the significant risk-hedging effect of transactions deposits vanishes when we control for a wider array of BHC and banking market conditions in regressions (3) and (6). These results indicate that past findings on liquidity risk might reflect omitted characteristics of banks and markets.

Endogeneity and selection issues might confound the interpretation of the regression results in Table 2. First, BHCs choose whether to diversify or not. For instance, assume that diversification lowers risk, and also assume that when BHCs decide to increase the risk profile of their assets they diversify geographically to offset that risk. Under these assumptions, an OLS regression will provide an upwardly biased estimate of the impact of diversity on risk, yielding either a positive coefficient on diversification or attenuating an estimated negative effect. Second, BHCs not only choose whether to diversify, they also choose where to diversify. BHCs can reduce idiosyncratic local economy risk by diversifying into MSAs with different economies (i.e., imperfectly correlated risks). While including BHC fixed effect accounts for a BHC's unobservable characteristics, it does not fully address these issues. Consequently, we employ an instrumental variable strategy to identify the impact of diversification on BHC risk.

4. Instrumental variables based on the removal of interstate banking restrictions

To identify the impact of BHC diversity across MSAs on risk, we need an instrumental variable that is correlated with the time-varying, cross-MSA dispersion of BHC assets but not independently correlated with the evolution of BHC risk through other channels. Thus, our first goal is to construct a valid instrumental variable that explains the geographic diversity of assets. Our second goal is to use this instrument to evaluate the impact of the geographic diversity of BHC assets on risk. In the remainder of this section, we first outline our strategy for constructing an instrumental variable for geographic diversification. We then provide a detailed description of the two-step process for constructing the instrument. Finally, we use the instrument to assess the relationship between BHC diversity and risk.

4.1. Identification Strategy: Gravity-Deregulation Model

4.1.1. Overview

There are two key ingredients in our strategy for constructing such an instrument. First, we exploit the process through which individual states removed restrictions on interstate banking with other states. As discussed in detail below, the state-specific elimination of prohibitions on the entry of banks from other states evolved over decades and the dynamics differed by state. This first ingredient provides state-year information on the ability of BHCs in a state to enter every other state. But, the process of interstate bank deregulation alone does not provide an instrument that differentiates BHCs *within* a MSA.

To overcome this shortcoming and construct and instrument at the BHC-level, we embed the state-specific timing of the removal of interstate banking restrictions into a gravity model of BHC diversification. This second ingredient—a gravity model of BHC diversification—in conjunction with interstate bank deregulation yields an instrument for the time-varying geographic dispersion of each BHC's assets across MSAs. The well-established gravity model is built on the empirically confirmed assumption that geographic proximity facilitates economic interactions. Applying this to banks, Goetz et al. (2013) showed that BHCs are more likely to expand into geographically close markets than into more distant ones. BHCs that are close to another banking market might have greater familiarity with its economic conditions and face lower costs to establishing and maintaining subsidiaries than farther markets (Aguirregabiria et al., 2013). From this perspective, a BHC in the southern part of California, e.g. Los Angeles, will tend to invest more in Flagstaff, Arizona than in Portland, Oregon and a BHC in San Francisco (northern part of California) might find it correspondingly more appealing to open a subsidiary in nearby Portland, Oregon.

4.1.2. Interstate Bank Deregulation

Before describing the construction of the instrument, we provide additional information on the process of interstate bank deregulation. For many decades, banks in the U.S. were not allowed to expand across states. States imposed limits on the location of bank branches and offices in the 19th century, and these impediments restricted the expansion of banks both within states through branches (intrastate branching restrictions) and across state lines through subsidiaries and branches (interstate banking restrictions). These restrictions were supported by the argument that allowing banks to expand freely could lead to a monopolistic banking system, with detrimental effects for economic development. Furthermore, the granting of bank charters was a profitable income source for states, increasing incentives for states to enact regulatory policies.

Starting in the 1970s, technological and financial innovations eroded the value of these restrictions for banks. Particularly, improvements in data processing, telecommunications, and credit scoring weakened the advantages of local banks, reducing their willingness to fight for the maintenance of restrictions on entry by out-of-state banks and triggering deregulation (Kroszner and Strahan, 1999).

Maine was the first state to allow entry by out-of-state BHCs in 1978. In particular, BHCs from other states were allowed to enter Maine if that other state reciprocated and also allowed entry by BHCs headquartered in Maine. While Maine enacted this policy in 1978, no other state changed its entry restrictions on out-of-state BHCs until 1982, when New York put in place a similar legislation and Alaska completely removed its entry restrictions. Over the following 12 years, states removed entry restrictions by unilaterally opening their state borders and allowing out-of-state banks to enter, or by signing reciprocal bilateral and multilateral agreements with other states to allow interstate banking. The Riegle-Neal

Interstate Banking and Branching Efficiency Act of 1994 was the culmination of this liberalization process, and removed all remaining barriers to entry at the federal level.[3]

Figure 1 illustrates the evolution of the interstate banking deregulation process. For each year, it shows the percentage of state-pairs among the contiguous U.S. states that have removed barriers to interstate banking with each other. It also differentiates by the type deregulation, where (a) unilateral deregulation refers to cases in which at least one of the states in a state-pair unilaterally allows entry from the other state; (b) reciprocal deregulation refers to cases in which both states in a state-pair have enacted nationwide reciprocal agreements with all other states that allow BHCs from reciprocating states to enter each other's market; and (c) bilateral deregulation refers to cases in which the two states in a pair have signed an agreement allowing each other's banks to enter.

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. The pace of interstate deregulation accelerated significantly in the second half of the 1980s, and by 1994 (before the Riegle-Neal Act removed all remaining barriers at the federal level), 76 percent of the state pairs in the contiguous states of the US had removed restrictions to bank entry with each other. Moreover, Figure 1 shows that the most common method for removing entry restrictions was the unilateral opening of entry to BHCs from all other states (45 percent of all state pairs). National reciprocal agreements were the second most frequent form of deregulating interstate banking (about 18 percent of all state-pair deregulations), while only 13 percent of state-pairs had signed bilateral banking agreements in 1994.

In our analysis, we focus on diversification of assets across MSAs and therefore apply the dates of interstate banking deregulation at the state level to MSAs within each

[3] In particular, the Riegle-Neal Act allowed both unrestricted interstate banking (effective in 1995) and interstate branching (in effect in 1997). Interstate banking means the ability of a BHC to own and operate separate bank subsidiaries in more than one state. Interstate branching means that a bank can expand its branch network into more than one state without establishing separate subsidiaries.

corresponding state to determine when BHCs located in out-of-state MSAs were allowed to enter that MSA. Several of the 381 MSAs span more than one state. In such cases, we use the state with the earliest entry date when determining the date when BHCs from another MSA can enter the MSA that spans more than one state. For example, the Boston-Cambridge-Newton MSA includes counties from Massachusetts and New Hampshire while the Los Angeles-Long Beach-Anaheim MSA only includes counties from California. BHCs from California were allowed to enter the state of Massachusetts in 1991 and the state of New Hampshire in 1990. Hence we define the date on which BHCs from Los Angeles were allowed to enter the Boston-Cambridge-Newton MSA as 1990.[4]

Figure 2 highlights the geographic distribution of the removal of entry restriction across metropolitan areas, where we focus on the situation of BHCs located in an MSA in California. The figure shows for each MSA, the year when BHCs from, say, Los Angeles were allowed to enter that MSA. Darker colors indicate that the specific MSA was open to entry at later years. Prior to 1982, BHCs located in Los Angeles could only expand across MSAs that include Californian counties. Over time, the number of accessible MSAs steadily increases until in 1995 the passage of the Riegle-Neal Act removed all remaining entry barriers.

We were concerned that the pattern of MSA-pair specific banking agreements might be associated with differences in risk between MSAs. When examining all MSA-pair bank deregulation agreements, however, we find no evidence that there are systematic differences in the average level of risk between markets prior to deregulation. The average pairwise correlation between the average standard deviation of market valuation returns of BHCs across each pair of MSAs before both markets removed their interstate banking restrictions is close to zero. The evidence is consistent with the assumption that the timing of interstate agreements is not driven by differences in risk between markets.

[4] Our results also hold if we define the year of interstate banking deregulation for a multi-state MSA as the year in which the last state lowered restrictions on interstate banking.

4.2. The gravity-deregulation model: two-step process

We build on the two-step gravity-deregulation identification strategy developed in Goetz et al. (2013) to assess the impact of geographic diversification on BHC risk. While they consider exogenous sources of variation in the diversity of BHC assets across *states*, we seek to assess the impact of the diversity of BHC assets across a finer market, *MSAs*, on BHC risk. Specifically, we use (a) the dynamic process of interstate bank deregulation to differentiate across states and time and (b) the distance between each BHC's headquarters and all other banking markets into which that BHC can legally enter to construct a time-varying, BHC-specific instrumental variable for the geographic diversity of BHC assets across MSAs.

In the first step ("zero stage"), we estimate the following equations:

$$share_{b,i,j,t} = \alpha_1 \ln(\text{distance})_{b,j,t} + \alpha_2 (\ln(\text{distance})_{b,j,t})^2 + \beta \ \ln(\text{population}_{i,t} / \text{population}_{j,t}) + \delta_t + \varepsilon_{b,i,j,t} \quad (2)$$

$$entry_{b,i,j,t} = \alpha_1 \ln(\text{distance})_{b,j,t} + \alpha_2 (\ln(\text{distance})_{b,j,t})^2 + \beta \ \ln(\text{population}_{i,t} / \text{population}_{j,t}) + \delta_t + \varepsilon_{b,i,j,t} \quad (3)$$

where $share_{b,i,j,t}$ is the percentage of assets of BHC *b*, headquartered in MSA *i*, held in its subsidiaries in MSA *j* in quarter *t*; $entry_{b,i,j,t}$ is a dummy variable that equals one if BHC *b*, headquartered in MSA *i*, owns a subsidiary in MSA *j* in quarter *t* and zero otherwise; $\ln(\text{distance})_{b,j,t}$ is the natural logarithm of the miles between BHC *b*'s headquarters and MSA *j*; $\ln(\text{population}_{i,t} / \text{population}_{j,t})$ is the natural logarithm of the population differential between BHC *b*'s home MSA *i* and MSA *j*; and δ_t are quarter fixed effects. The equations allow for a non-linear effect of distance on BHC diversification by entering $\ln(\text{distance})_{b,j,t}$ as a quadratic.

To account for BHC diversity, the equations consider both distance and comparative market size. With respect to the pure gravity component, we use the natural logarithm of miles between each BHC's headquarters to each other metropolitan area to measure distance. Furthermore, the "gravitational pull of a market" might also vary positively with its size, so that BHCs might be more attracted to larger markets than smaller ones. That is, holding other things constant, BHCs in San Francisco, California will invest more in Portland, Oregon than in Reno, Nevada. To incorporate relative market size into the gravity model, we compute the logarithm of the population of the BHC's home MSA divided by the population of a foreign MSA (in period *t*).

To estimate these equations, we use a fractional logit to estimate the share regression and a logit to estimate the entry regression. Since the dependent variable in the entry regression is zero or one, it is natural to use either a logit or probit estimator. We obtain similar results from both approaches and report the results from logit regressions. With respect to the share regression, the share of assets a BHC can have in any banking market lies between zero and one, where a value of one indicates that a BHC holds all of its assets in one market. Since the dependent variable is bounded between zero and one and we observe many observations with a value of zero, we follow Papke and Wooldridge (1996) and use a fractional logit model.[5] In estimating these equations, we only include observations in which it is legally feasible for BHC *b* with headquarters in MSA *i* to open a subsidiary in MSA *j* during quarter *t*.

As reported in Table 3, the gravity model explains BHC investment in "foreign" MSAs. First, across all specifications, there is a negative relationship between a BHC's entry into an MSA and distance to that MSA. We also include additional fixed effects into the gravity model to examine the robustness of the relationship between distance and a BHC's investment decision. Furthermore, as highlighted by column (6), distance exhibits a nonlinear relationship with a BHC's share of assets in an MSA. While we find that the predicted share of assets a BHC has in a foreign MSA decreases more with distance, our results differ when using the entry dummy. The negative effect of distance on the likelihood if entering another MSA diminishes with distance. Nonetheless, for the range of distances in our sample, the

[5] Papke and Wooldridge (1996) propose a fractional logit estimation when examining determinants of employee participation rates in 401(k) pension plans. Papke and Wooldridge (2008) use a fractional probit model to estimate the relationship between spending and student performance, measured using test pass rates. We obtain similar results when using a fractional probit regression.

estimated effect of a marginal increase in distance is always negative. Second, there is a strong negative relationship between a BHC's entry into an MSA and distance from that MSA. Third, the size of the "foreign" banking market matters for the investment decisions of a BHC. BHCs invest less, and are less likely to invest at all, in smaller MSAs.

In the second step of the gravity-deregulation model, we use the estimates from Table 3 to construct two instrumental variables: one for the projected diversification measure for each BHC in each quarter (Predicted Diversification Index) and one for the probability that a BHC enters a particular banking market (Max Entry Probability). For the Predicted Diversification Index, we use the coefficient estimates from the Table 3 gravity model to obtain the projected share of a BHC's assets in an MSA for periods in which regulations do not prohibit the BHC from investing in the MSA. Using a fractional logit model in the first step of the gravity-deregulation model to predict shares also ensures that these predicted shares are between zero and one. For observations in which regulations do prohibit a BHC from opening a subsidiary in an MSA, we set the projected share equal to zero. Then, we use these projected shares to compute the Predicted Diversification Index—one minus the projected Herfindahl index of each BHC assets across markets in each period. We use this Predicted Diversification Index as the instrument for actual diversification in our first stage regression to assess the impact of diversification on risk.

To construct the instrumental variable for the Diversification Dummy—Max Entry Probability, we first set the value to zero when interstate bank regulations prohibit a BHC from investing in an MSA. Second, for other observations in which a BHC is legally permitted to open a subsidiary in the MSA, we (a) predict the probability that the BHC enters every other MSA and (b) select the maximum value of these projected entry probabilities to complete the construction of the 'Max Entry Probability' variable. By doing this, we estimate for each BHC *b* and quarter *t*, the probability of being active in another banking market while accounting for the fact that not all banking markets are open to any particular BHC in that quarter. This becomes the instrumental variable for the Diversification Dummy.

The first-stage results in Panel B of Table 4 suggest that the instrumental variables are closely associated with BHC diversity. As expected, a higher probability of entering a foreign banking market (Max Entry Probability) is positively associated with the incidence of being active in another MSA. Similarly, we find that a higher level of a BHC's predicted geographic diversification (Predicted Diversification Index) is positively associated with observed diversification at the 1% level even when conditioning on BHC and quarter fixed effects. Moreover, the *F*-test results in Table 4, Panel B show that our instrumental variables explain BHC diversification after controlling for many potential influences. The *F*-test is always above 20, even when we condition on BHC fixed effects, indicating that there is a strong statistical link between deregulation and BHC diversity.[6] Overall, the first stage results show that the gravity-deregulation model explains diversification at the BHC level.

4.3. Results using BHC instruments based on the gravity-deregulation model

Based on these instruments, we find that geographic diversification significantly reduces bank risk. As shown in Panel A of Table 4, the second-stage results indicate that both measures of diversification—the Diversification Dummy and the 1 – Herfindahl Index of assets across MSAs variable—enter negatively and significantly. The Diversification Dummy results indicate once a BHC diversifies, this reduces risk. The results from the 1 – Herfindahl Index of assets across MSAs indicate that as BHCs become more diversified risk decreases.

The negative effect of geographic diversification on BHC risk also holds when including BHC fixed effects and when examining the reduced form results. Indeed the estimated negative effect is larger when including BHC effects. As discussed below, these estimates are economically large. Moreover, the strong statistical significance for the Herfindahl-based index of the diversity of BHCs across MSAs indicates that the pattern of

[6] In Table 4, we present regression results from our Table 3 benchmark specification, (i.e. the equation (2) specification that includes time fixed effects) and using other specifications from Table 3 that account for the nonlinear effect of distance on the share of assets and entry probabilities.

diversification across markets is important when analyzing the impact of diversification on BHC risk. When identifying exogenous changes in BHC diversity and controlling for BHC fixed effects, the results indicate that diversity reduces a BHC's risk. Furthermore, the reduced form regressions of BHC risk on the instrumental variables are consistent with these findings: the projected values of BHC diversification computed from the zero-stage estimates are negatively, and significantly associated with BHC risk as shown in Appendix 1.

The estimated economic magnitude is large. Consider, for example, the estimates from column (7) of Table 4 that included BHC fixed effects for Herfindahl-based measure of the geographic diversity of a BHC's assets. The estimates indicate that a one-standard deviation increase in the exogenous component of BHC diversification (0.205) will reduce BHC risk (the natural logarithm of the standard deviation of weekly stock returns) by 34% (=0.205*1.6) or about 70% of its sample standard deviation (0.49). The estimates in Table 4 also confirm empirically the concern expressed above: OLS yields strongly biased estimates of the impact of diversity on risk. The results are consistent with the view that there is a strong attenuation bias, as banks that diversify geographically also tend to increase the riskiness of their assets. Thus, by identifying the impact of diversification, the instruments provide more precise estimates of diversification on BHC risk.

5. Heterogeneous effects of diversification

We now examine whether all geographic diversity is the same. Based on Pyle (1971), we assess whether the impact of diversification on risk is stronger when the BHC diversifies into an MSA with different economic characteristics from the BHC's home market. The choice of BHCs to diversify into new banking markets, however, is endogenous and may also be driven by risk and strategic considerations. For example, some banks might diversify into areas that are more similar to their home market to build on their specialized expertise. However, similar markets might offer lower diversification benefits.

The gravity-deregulation model allows us to construct individual instruments at the BHC-level that account for the expansion of BHCs into different banking markets. That is, besides having an instrument that identifies an exogenous source of variation in diversification, we have an instrument that identifies an exogenous source of variation in the *location* of that diversification. Hence, we can account for the endogenous selection of banking markets by BHCs and can identify the exogenous component of diversifying into an MSA with particular characteristics on that BHC's risk.

This analysis also sheds more light on the mechanism through which diversification affects risk. If greater diversification reduces BHC's exposure to the idiosyncrasies of local economies, then we should find that diversification into MSAs with dissimilar economies should reduce risk more than expansion into economically similar MSAs. That is, we assess whether a BHC located in MSA m and expanding into n experiences a smaller reduction in risk from diversification if n's business cycle and economic structure is similar to m's.

5.1. Three measures of MSA similarity

We construct three measures of the economic similarity of MSAs. Since the integration of states' banking sectors in the United States over the last decades affected the co-movement of states' economic activity (Morgan et al., 2004; Goetz and Gozzi, 2014), we use only the period between 1969 and 1986 (which is also the period prior to the start of our sample period) in computing the three measures of MSA similarity.

First, we measure the similarity of industry structure. For each MSA-pair (m, n), we compute the negative absolute difference between the MSAs' share of total employment across the eight one-digit SIC sectors (Kalemli-Ozcan et al., 2001).[7]

[7] These sectors are mining, construction, manufacturing, transportation, trade, services, government, and finance, insurance and real estate. Data on total employment by industry at the county level come from the Bureau of Economic Analysis and we aggregate this information to the MSA level.

$$Industry\ differences_{m,n} = \sum_{i=1}^{i=8} -\left|share_{i,m} - share_{i,n}\right|, \quad (4)$$

where $share_{i,m}$ is the employment share of industry *i* in MSA *m*. Greater values indicate that MSAs within an MSA-pair have more similar industry structures. Since the integration of states' banking sectors in the United States over the last decades may have affected industry structure across MSAs, we use information on employment shares in 1986 to measure industry differences (Kalemli-Ozcan et al., 2003).

Second, we measure the similarity of economic growth in MSA pairs. We compute the co-movement of economic output for each MSA-pair following the procedure outlined in Morgan, et al. (2004). We use data from the Bureau of Economic Analysis to estimate the following regression, including separate MSA and year fixed effects:

$$Income\ growth_{m,t} = \alpha_m + \delta_t + \varepsilon_{m,t}, \quad (5)$$

where $Income\ growth_{m,t}$ is the growth rate of real personal income for MSA *m* in year *t*. The residuals $\varepsilon_{m,t}$ capture deviations of a MSA's real growth rate in a given year from the MSA's conditional mean real growth rate and the average growth rate across all MSAs in that year. We then compute the co-movement of economic activity between MSA *m* and MSA *n* as the negative of the absolute difference of the residuals (Kalemli-Ozcan, et al. 2013):

$$Co\text{-}movement_{m,n,t} = -\left|\varepsilon_{m,t} - \varepsilon_{n,t}\right|. \quad (6)$$

Greater values indicate greater similarity in the output fluctuations of the MSAs.

Third, we measure the similarity of business cycles. We do this by estimating the correlation of the cyclical component of MSAs' real personal income growth for each MSA pair. Using a Baxter and King (1999) band-pass (2, 8) filter, we determine the cyclical component for each MSA. We then calculate for each MSA pair (*m, n*) the correlation of the cyclical cycle components (Baxter and Kouparitsas, 2005).

Based on each of these three measures of MSA similarity, we compute a simple zero-one indicator, where zero signifies similar economies and one signifies different. We do this as follows. For MSA *m* we designate *n* as having a different industry structure or economic cycle from *m* if the measure of similarity between *m* and *n* is smaller than the median computed similarities between *m* and all other MSAs. Hence, for each MSA we identify two equally sized groups: MSAs that are similar to *m* and MSAs that are different.

5.2. Measuring BHC diversity while differentiating by MSA similarity

Based on our definitions of MSA similarity, we compute measures of the degree to which a BHC's assets are diversified geographically, where we now differentiate and incorporate information on whether the BHC has diversified into MSAs with similar or different economies from the MSA of the BHC's headquarters. That is, we compute the share of "hedged assets" for each BHC, where we compute a BHC's total share of assets that are held in banking markets that exhibit different economies based on our aforementioned definitions. Thus, the share of hedged assets for BHC *b* in period *t* is:

$$H_{b,t} = \min(\text{asset share in different MSAs, asset share in similar MSAs})^2, \qquad (7)$$

where asset share in different/similar MSAs is the total share of assets held in subsidiaries located in an MSA that exhibits a different/similar output fluctuation or industry structure as the BHC's headquarter MSA. $H_{b,t}$ is between zero and one, where larger values indicate that the BHC has a larger portion of its total assets in banking markets that exhibit different economic activities. $H_{b,t}$ reaches a maximum if the BHC holds half of its assets in (at least) two banking markets that are dissimilar based on our definitions. Similarly, this measure is zero if a BHC has all of its assets in banking markets that are similar according to our measures.

5.3. Heterogeneous impact of diversification on risk

We now estimate the following 2SLS regression:

$$\ln(\sigma)_{b,t} = \beta_1 D_{b,t} + \beta_2 D_{b,t} * H_{b,t} + X'_{b,m,t}\,\varphi + \delta_b + \delta_t + \varepsilon_{b,t} \qquad (8)$$

where $H_{b,t}$ is the share of hedged assets for BHC *b* in quarter *t* and $D_{b,t}$ is the Diversification Dummy for BHC *b* in quarter *t*. As before, the excluded instrument for $D_{b,t}$ is the maximum predicted entry probability from the gravity-deregulation model. We also use the gravity-deregulation model to construct an instrument for the share of hedged assets ($H_{b,t}$) by predicting the asset shares in economically "different" MSAs, based on the three measures of economic similarity defined above. We use predictions ($\hat{H}_{b,t}$) as excluded instruments.

The results in Table 5 indicate that geographic diversification reduces risk more when a BHC diversifies into an economically different MSA—an MSA with different economic structure or business cycle fluctuations than when it diversifies into an MSA with similar structure or business cycles fluctuations to its base MSA. Consistent with Table 4, the Diversification Dummy enters negatively: geographic diversification reduces risk. Moreover, the interaction between diversification and the share of hedged assets also enters negatively and significantly: diversification reduces risk more if the BHC diversifies into a banking market that exhibits a different business cycle.

Furthermore, there are large benefits from diversifying into different banking markets. Consider the case of a BHC, headquartered in San Francisco that chooses to diversify half of its operations. Assume that it can choose either to expand into Las Vegas, Nevada or Flagstaff, Arizona. Based on our measures of the similarity of MSA industrial structures, we find that San Francisco and Flagstaff are similar, but the industrial compositions of San Francisco and Las Vegas differ markedly.[8] Using the estimated

[8] This becomes apparent when examining the largest industry ("Services") in each of the three MSAs: San Francisco's share of total employment in "Services" is about 33.5 percent, which is similar to Flagstaff's share (37.1 percent), but very different from Las Vegas's share (52.3 percent).

coefficients from column 1, the predicted reduction from this BHC expanding into Las Vegas diversification for this BHC is more than four times larger (= (0.785 + 2.799)/0.785) than if it expands into Flagstaff. Our findings are consistent with the idea that diversification lowers bank risk, particularly if it enables banks to reduce their exposure to idiosyncratic local market risks. Our findings also imply that to the extent that state business cycles are becoming more similar, as documented by Morgan et al. (2004), the risk-reducing effects of geographic diversity will diminish.

5.4. Mergers and acquisitions and alternative risk measures

There is considerable M&A activity among banks over the period we analyze. Since BHCs' M&As might trigger short-run valuation effects (Graham et al., 2002; Custodio, 2010), we were concerned that this biases the risk measure. Based on reported merger information in Call Reports, as well as information provided by CRSP, we therefore drop BHC-quarter observations in which the BHC engages in a merger, acquisition or sale. Regression results from this subset confirm the earlier results as we still find that diversification reduces risk, especially if the BHC increases its share of hedged assets (Table 6).

To examine the sensitivity of our results to the definition of our risk measure we remove three systematic risk factors before constructing weekly returns (Gatev et al., 2009) and compute residual volatility as follows:

$$r_{b,t} = \alpha_b + \beta_{1,b} r_{m,t} + \beta_{2,b} \Delta(Baa - Aaa)_t + \beta_{3,b} \Delta(3\text{-}Month\ T\text{-}Bill)_t + \varepsilon_{b,t} \quad (10)$$

where $r_{m,t}$ is the weekly return on the S&P 500; $\Delta(Baa - Aaa)$ is a default risk factor as it represents the change in the yield on Baa-rated vs. Aaa-rated corporate bonds; and $\Delta(3\text{-}Month\ T\text{-}Bill)$ is the change in yield on 3-month treasury bills and thus an interest rate risk factor. Note that we estimate this relationship for each BHC separately to account for the fact that the relationship between these factors and BHC returns differs across banks. Data on the factors are obtained from the Federal Reserve Economic Data provided by the Federal Reserve Bank of St. Louis. Similar to before, we take the natural logarithm of the standard deviation of these residual market returns as our risk measure. Additionally, we compute each bank's *Z*-Score (following Laeven and Levine, 2007) as:

$$Z_{b,t} = \frac{ROA_{b,t} + CAR_{b,t}}{\sigma_{b,t}} \quad (11)$$

where $ROA_{b,t}$ is the return on assets from BHC *b* in quarter *t*, $CAR_{b,t}$ is the capital-asset-ratio for BHC *b* in quarter *t*, and $\sigma_{b,t}$ is the standard deviation of market returns for BHC *b* in quarter *t*. In addition to the standard deviation of market returns, *Z* includes information about a BHC's current level of capital and can therefore be interpreted as the number of standard deviations profit can fall before a bank is bankrupt (Roy, 1952).

Regression results using these two alternative measures of bank risk are presented in Table 6 and confirm our earlier findings and indicate that diversification primarily reduces

BHC risk if the BHC also increases its share of hedged assets and thereby reduces its current exposure to home banking market fluctuations.

6. Loan quality

Thus far we have shown that the riskiness of BHCs decreases with geographic expansion and that this risk reduction is particularly pronounced for BHCs that expand into MSAs that have different economic cycles. Does this imply that there are pure diversification benefits from geographic expansion, or could it be that risk declines with geographic expansion due to improved asset quality?

A key channel through which banks can improve asset quality is through the monitoring of their loans. If banks that expand geographically improve their monitoring of loans in such a way that it results in lower riskiness of loans, then this could explain the findings thus far. For example, if banks that expand geographically invest in better risk management systems, this could enhance their monitoring skills and reduce bank risk. Other work, however, provides a skeptical take on this monitoring channel . Distance matters in relationship lending as it is more costly and difficult to monitor distant loans, and it is likely that the bank's monitoring effectiveness is lower in new geographic areas (Winton, 1999).

We test for the relevance of this monitoring channel using three alternative measures of loan quality: loan charge-offs, nonperforming loans, and loan loss provisions, all expressed as a fraction of total loans. All three measures are decreasing in loan quality. We regress these measures of loan quality on our measure of geographic diversity, using the same instruments for geographic diversification as before. The 2SLS results are presented in Table 7. We follow our earlier specification and include bank fixed effects as we are interested how diversification changes loan quality within a BHC when that institution expands. We find that there is no evidence that geographic expansion improves loan quality. If anything, we find that loan charge offs increase when banks expand geographically, although the effect is significant only at the 10% level and also only for one specification. Geographic diversity does not enter significantly in the nonperforming loan and loan loss provisioning regressions. Taken together, these results indicate that geographic expansion does not improve BHC loan quality. Taken together, our results are consistent with the view that geographic expansion reduces risk by allowing BHCs to diversify their assets.

7. Conclusions

What is the impact of the geographic expansion of BHC assets on risk? While some theories suggest that geographic expansion makes it more complex for executives to monitor activities and manage risk, other theories advertise the cost-efficiencies and risk-reducing benefits of holding a diversified portfolio of assets.

This paper develops and uses a new identification strategy to evaluate the net impact of the geographic expansion of BHC assets across U.S. MSAs on BHC risk and loan quality. Specifically, we embed cross-state, cross-time variation in interstate bank deregulation into a gravity model of BHC expansion to create a BHC-specific instrumental variable of its assets across MSAs over time. We use this instrument to identify the exogenous component of the geographic diversity of each BHC's assets across MSAs. Although we use this identification strategy to evaluate the net effect of geographic diversification on BHC risk and loan quality, it can be employed to address other questions about bank behavior.

We find that the diversification of BHC assets across MSAs lowers BHC risk. Moreover, we discover that the geographic expansion of BHC assets across MSAs reduces risk more when the BHC diversifies into economically different MSAs. When BHCs expand into MSAs with different industrial structures and different business cycle fluctuations, risk falls more than when they expand into economically similar MSAs. At the same time, we do not find that loan quality increases with geographic expansion. These findings are consistent with the view that geographic expansion lowers bank risk by enabling banks to diversify their exposure to idiosyncratic local market risks.

References

Acharya, V., Hasan, I., Saunders, A., 2006. Should banks be diversified? Evidence from individual bank loan portfolios. Journal of Business 79, 1355 – 1411.

Aguirregabiria, V., Clark, R. C., Wang, H., 2013. Diversification of geographic risk in retail bank networks: evidence from bank expansion after the Riegle-Neal Act. Unpublished working paper.

Akhigbe, A., Whyte, A. M., 2003. Changes in market assessment of bank risk following the Riegle-Neal Act of 1994. Journal of Banking and Finance 27, 87–102.

Amel, D., 1993. State laws affecting the geographic expansion of commercial banks. Manuscript, Board of Governors of the Federal Reserve System.

Atkeson, A. G., Eisfeldt, A. L., Weill, P., 2014. Measuring the financial soundness of U.S. firms, 1926-2012. Mimeo, UCLA.

Avraham, D., Selvaggi, P., Vickery, J., 2012. A structural view of U.S. bank holding companies. FRBNY Economic Policy Review, July, 65 – 81.

Basel Committee on Banking Supervision, 2011. Global systemically important banks: assessment methodology and the additional loss absorbency requirement. Rules text, November 2011. Available at: http://www.bis.org/publ/bcbs207.pdf.

Baxter, M., King, R. G., 1999. Measuring business cycles: approximate band-pass filters for economic time series. Review of Economics and Statistics 81, 575 – 593.

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

Berger, A., Hannan, T. H., 1989. The price-concentration relationship in banking. Review of Economics and Statistics 71, 291 – 299.

Berger, A., Hanweck, G., Humphrey, D., 1987. Competitive viability in banking: scale, scope, and product mix economies. Journal of Monetary Economics 20, 501 – 520.

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

Berger, P., Ofek, E., 1995. Diversification's effect on firm value, Journal of Financial Economics 37, 39 – 65.

Bernanke, B. S., 1983. Nonmonetary effects of the financial crisis in the propagation of the Great Depression. American Economic Review 73(3), 257 – 276.

Boyd, J. H., De Nicolo, G., 2005, The Theory of Bank Risk Taking Revisited. Journal of Finance 60, 1329-1343

Boyd, J. H., Gertler, M., 1993. US commercial banking: trends, cycles, and policy. NBER Macroeconomics Annual 1993, Volume 8. MIT Press. 319-377.

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

Boyd, J. H., Runkle, D.E. 1993. Size and performance of banking firms. Journal of Monetary Economics 31, 47-67.

Brickley, J., Linck, J., Smith, C., Jr., 2003. Boundaries of the firm: evidence from the banking industry. Journal of Financial Economics 70, 351 – 383.

Calomiris, C., Mason, J., 1997. Contagion and bank failures during the Great Depression: the June 1932 Chicago banking panic. American Economic Review 87, 863 – 883.

Calomiris, C., Mason, J., 2003a. Consequences of U.S. bank distress during the depression. American Economic Review 93, 937 – 947.

Calomiris, C., Mason, J., 2003b. Fundamentals, panics and bank distress during the depression. American Economic Review 93, 1615 – 1647.

Calomiris, C., Nissim, D., 2007. Activity-based valuation of bank holding companies. NBER Working Paper No. 12918.

Chong, B. S., 1991. Interstate banking on commercial banks' risk and profitability. The Review of Economics and Statistics 73, 78–84.

Custodio, C., 2010. Mergers and acquisitions can explain the diversification discount. Mimeo, Arizona State University, W.P. Carey School of Business.

DeLong, G., 2001. Stockholder gains from focusing versus diversifying bank mergers. Journal of Financial Economics 59, 221–252.

Demsetz, R. S., Strahan, P. E., 1997. Diversification, size, and risk at bank holding companies. Journal of Money, Credit, and Banking 29, 300 – 313.

Deng, S., Elyasiani, E., 2008. Geographic diversification, bank holding company value, and risk. Journal of Money, Credit and Banking 40, 1217 – 1238.

Denis, D. J., Denis D. K., Sarin, A., 1997. Agency problems, equity ownership, and corporate diversification. Journal of Finance 52, 135 – 160.

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

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

Gertner, R., Scharfstein, D., Stein, J., 1994. Internal vs. external capital markets. Quarterly Journal of Economics 109, 1211 – 1230.

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

Goetz, M.R, Gozzi, J.C., 2014, Financial Integration and the Co-Movement of Economic Activity: Evidence from U.S. States, Mimeo, Goethe University Frankfurt

Graham, J., Lemmon, M., Wolf, J., 2002. Does corporate diversification destroy value? Journal of Finance 57, 695 – 720.

Gropp, R., Hakenes, H., Schnabel, I., 2011. Competition, risk-shifting, and public bail-out policies. Review of Financial Studies 24, 2084 – 2120.

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.

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

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers, American Economic Review 76, 332 – 329.

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

Kalemli-Ozcan, S., Sorensen, B., Yosha, O., 2003. Risk Sharing and industrial specialization: regional and international evidence. American Economic Review 93, 903 – 918.

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

Kashyap, A., Rajan, R., Stein, J., 2002. Banks as liquidity providers: an explanation for the coexistence of lending and deposit-taking. Journal of Finance 57, 33 – 73.

Keeley, M., 1990. Deposit insurance, risk, and market power in banking. American Economic Review 80, 1183 – 1200.

Kroszner, R., Strahan, P., 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., Rime, B., Strahan, P., 2004. Bank integration and state business cycles. Quarterly Journal of Economics 119, 1555 – 1584.

Papke, L. E., Wooldridge, J. M., 1996. Econometric methods for fractional response variables with an application to 401 (K) plan participation rates. Journal of Applied Econometrics 11, 619 – 632.

Papke, L. E., Wooldridge, J. M., 2008. Panel data methods for fractional response variables with an application to test pass rates. Journal of Econometrics 145, 121 – 133.

Pyle, D.H., 1971. On the theory of financial intermediation. Journal of Finance 26, 737 – 747.

Rhoades, S., 1997. Have barriers to entry in retail commercial banking disappeared? Antitrust Bulletin 42, 997 – 1013.

Servaes, H., 1996. The value of diversification during the conglomerate merger wave. Journal of Finance 51, 1201 – 1225.

Winton, A., 1999. Don't put all your eggs in one basket? Diversification and specialization in lending. Mimeo, University of Minnesota.

Figure 1
Evolution of Interstate Banking Deregulation

This figure shows the cumulative fraction of state pairs in our sample that had removed barriers to bank entry among each other by each year over the period 1976-1994, differentiating between different methods for removing restrictions. Unilateral deregulation refers to cases in which (at least) one of the states in a given pair unilaterally allowed entry by bank holding companies 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 entry by signing a bilateral interstate banking agreement. The sample covers the 48 contiguous states of the United States, excluding Delaware and South Dakota.

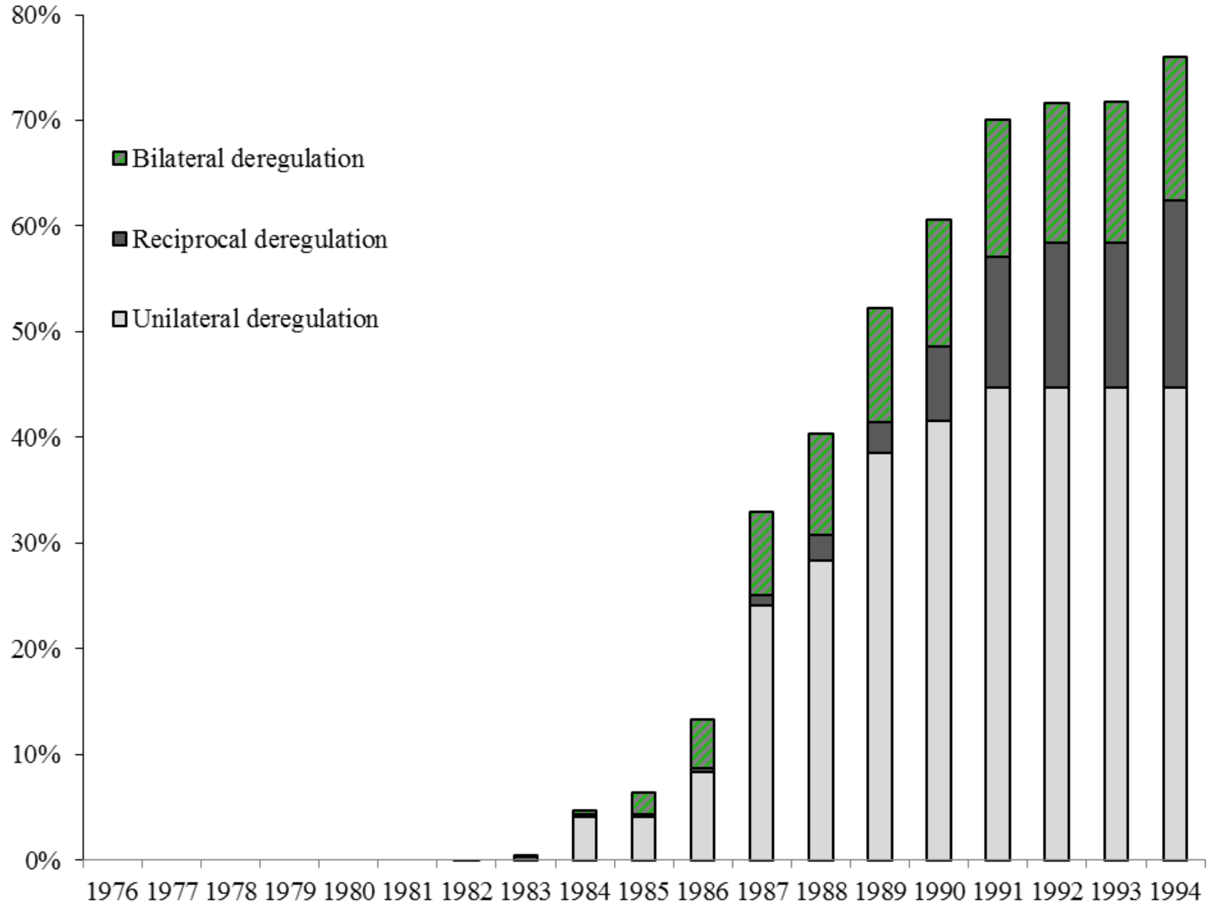

Figure 2

Evolution of Entry Restrictions across US urban areas for banks located in California

This figure shows the evolution of the removal of entry restrictions across metropolitan statistical areas for bank holding companies located in California. Darker colors indicate that these urban areas allowed entry to Californian banks earlier. For this figure, we consider the 48 contiguous states of the United States.

Table 1
Summary Statistics

This table shows summary statistics for the used samples. Banks are 'nondiversified' if they have subsidiaries in only one MSA 'Diversified' banks have subsidiaries in at least two MSAs. The sample ranges from the second quarter of 1986 to the last quarter of 2007.

	Nondiversified bank holding companies						Diversified bank holding companies					
	N	Mean	Std. Dev.	Min.	Max.	Median	N	Mean	Std. Dev.	Min.	Max.	Median
(Standard deviation of weekly market returns over quarter)*100	16,705	3.97	2.20	0.88	15.05	3.44	8,962	3.91	2.15	0.88	14.99	3.37
(Standard deviation of weekly residual market returns over quarter)*100	16,705	3.92	2.13	0.63	15.62	3.40	8,962	3.68	2.07	0.75	15.82	3.16
Total Loan Charge-Offs / Total Loans (%)	16,221	0.11	0.15	0	1.14	.06	8,749	0.17	0.17	0	1.15	0.12
Nonperforming Loans / Total Loans (%)	14,803	1.07	1.23	0	8.04	0.67	6,779	1.16	1.16	0	8.00	0.81
Loan Loss Provisions / Total Loans (%)	15,856	0.11	0.15	0	1.33	0.07	8,627	0.15	0.16	0	1.32	0.10
Tobins Q	16,290	105.27	5.73	94.66	128.30	104.30	8,726	105.05	5.63	94.67	128.30	103.81
Loan Commitments / (Loan Commitments + Loans)	16,567	0.18	0.10	0.00	0.97	0.17	8,815	0.24	0.13	0.00	0.83	0.22
Transactions Deposits / Total Deposits	15,980	0.23	0.13	0.00	1.00	0.22	8,939	0.27	0.09	0.00	0.75	0.27
Return on Assets	16,097	0.25	0.15	-0.73	0.65	0.26	8,688	0.26	0.15	-0.72	0.65	0.27
1 - Herfindahl Index of Assets across MSAs	16,705	0	0	0	0	0	8,962	0.39	0.24	0.00	0.93	0.40
Income Diversity	16,393	0.63	0.13	0.03	1.00	0.62	8,824	0.72	0.13	0.02	1.00	0.73
Asset Diversity	16,705	0.36	0.14	0.05	1.00	0.34	8,961	0.38	0.12	0.08	0.97	0.35
=1 if BHC has international activity	16,705	0	0	0	1	0	8,962	0	0	0	1	0
Total Equity (in million $)	16,705	288	1360	1	35200	66	8,962	2403	9861	6	147000	353
Total Assets (in million $)	16,705	3728	20400	73	563000	759	8,962	31800	130000	95	2360000	4445
Net Interest Income (in million $)	16,402	29	146	-78	4202	7	8,827	236	842	-65	12900	42
Total Operating Income (in million $)	16,402	80	503	1	14500	15	8,827	715	2680	-685	45700	100
Capital / Assets	16,705	9	4	0	85	8	8,962	8	4	1	74	8

Table 2

Geographic Diversification and Bank Holding Company Risk - OLS Regressions

This table reports OLS regressions at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is the natural logarithm of the standard deviation of weekly stock market returns for US holding companies, measured over a quarter. A BHC's stock market return is based on a BHC's market capitalization is measured as the change in a BHC's market capitalization between two Wednesdays within a quarter. Only BHC-quarters with at least 75% of nonmissing stock market returns are included. 'Diversification Dummy' is an indicator variable taking on the value of one if a BHC has assets in another MSA in a quarter. 'Income Diversity' is 1 - |(Net Interest Income - Total Interest Income) / Total Operating Income |, 'Asset Diversity' = 1 - |Total Loans and Leases / Total Assets|. All regressions include year fixed effects, and metropolitan statistical area (MSA) fixed effects when indicated. Standard errors are clustered at the MSA-quarter level, and reported in in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Diversification Dummy	-0.031***	-0.025***	-0.025***				0.010	
	(0.007)	(0.007)	(0.007)				(0.011)	
1 - Herfindahl Index of Assets across MSAs				-0.055***	-0.049***	-0.045***		0.044*
				(0.013)	(0.014)	(0.014)		(0.023)
ln(Total Assets)	-0.003	-0.010***	-0.304***	-0.004*	-0.010***	-0.303***	-0.084**	-0.084**
	(0.002)	(0.003)	(0.026)	(0.002)	(0.003)	(0.026)	(0.038)	(0.038)
Loan Commitments / (Loan Commitments + Loans)		0.326***	0.175***		0.322***	0.173***	0.058	0.069
		(0.066)	(0.066)		(0.066)	(0.066)	(0.090)	(0.090)
Transactions Deposits / Total Deposits		0.239***	0.103*		0.239***	0.103*	-0.036	-0.033
		(0.055)	(0.057)		(0.055)	(0.057)	(0.082)	(0.082)
Commitments / (Commitments + Loans) * Transactions Deposits / Total Deposits		-0.574***	-0.117		-0.570***	-0.110	0.054	0.027
		(0.206)	(0.209)		(0.206)	(0.209)	(0.262)	(0.261)
Tobin's q			0.001			0.001	0.001	0.001
			(0.001)			(0.001)	(0.001)	(0.001)
Income Diversity			-0.317***			-0.322***	0.138***	0.147***
			(0.030)			(0.030)	(0.042)	(0.042)
Asset Diversity			-0.108***			-0.113***	-0.016	-0.016
			(0.029)			(0.029)	(0.050)	(0.049)
=1 if BHC has international acticity			0.015			0.014	0.001	0.004
			(0.012)			(0.012)	(0.018)	(0.018)
Herfindahl Index of Assets in MSA			-0.028**			-0.028**	0.017	0.018
			(0.013)			(0.013)	(0.021)	(0.021)
Return on Assets			-0.622***			-0.622***	-0.434***	-0.432***
			(0.030)			(0.030)	(0.030)	(0.030)
Capital / Assets			-0.013***			-0.013***	-0.005**	-0.005**
			(0.002)			(0.002)	(0.003)	(0.003)
ln(Total Operating Income)			0.307***			0.306***	0.100***	0.097**
			(0.026)			(0.026)	(0.038)	(0.038)
Annual Growth of Real Personal income in MSA			-0.015			-0.011	-0.269	-0.273
			(0.179)			(0.179)	(0.169)	(0.169)
Annual Growth of Real Personal income in MSA (lag)			0.269			0.271	-0.265	-0.268
			(0.182)			(0.182)	(0.173)	(0.173)
Quarter Fixed Effects	x	x	x	x	x	x	x	x
BHC Fixed Effects							x	x
Observations	25,667	24,639	23,619	25,667	24,639	23,619	23,619	23,619
R-squared	0.173	0.173	0.212	0.173	0.173	0.212	0.349	0.349

Table 3
Gravity Model of Geographic Diversification

This table reports average marginal effects from a fractional logit (columns 1 to 5) or a logit regression (column 6). The dependent variable is the share of assets a BHC has in a MSA (columns 1 to 5) or a dummy variable taking on the value of one whether a BHC has a subsidiary in a MSA (column 6). 'Miles between HQ and MSA' are the miles between a BHC's HQ and a MSA. 'Population Difference' is the natural logarithm of the ratio of a foreign MSA's total population to the BHC's home MSA's population. Standard errors are reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:			Share of assets in MSA			=1 if Entry
ln(Miles between HQ and MSA)	-0.352***	-0.351***	-0.302***	-0.302***	-0.260***	-1.809***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.008)	(0.018)
[ln(Miles between HQ and MSA)]^2					-0.008***	0.109***
					(0.001)	(0.002)
Population Difference	-0.077***	-0.077***	-0.123***	-0.143***	-0.150***	-0.709***
	(0.001)	(0.001)	(0.001)	(0.015)	(0.016)	(0.033)
Quarter Fixed Effects		x	x	x	x	x
Home-Market Fixed Effects			x	x	x	x
Foreign-Market Fixed Effects				x	x	x
Observations	8,326,674	8,326,674	8,326,674	8,326,674	8,326,674	7,538,835

Table 4

The Impact of Geographic Diversification on Bank Holding Company Risk - 2SLS Regressions

This table reports results from a 2SLS regression at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is the natural logarithm of the standard deviation of weekly stock market returns for US holding companies, measured over a quarter. A BHC's stock market return is based on a BHC's market capitalization is measured as the change in a BHC's market capitalization between two Wednesdays within a quarter. Only BHC-quarters with at least 75% of nonmissing stock market returns are included. The endogenous variables are 'Diversification Dummy' and '1 - Herfindahl Index of assets across MSAs'. The employed instruments are reported in the table and are based on a gravity-deregulation model. 'Max Entry' is a the maximum of predicted entry probabilities for entering a foreign market. 'Predicted Diversification Index' is the predicted 1 - Herfindahl Index of assets across MSA obtained from a gravity-deregulation model. The benchmark model is provided in column 2 of Table 3. We also construct the instrument adding a quadratic term for distance to this model. Regression models (1) to (4) include quarter fixed effects, model (5) to (8) include quarter and BHC fixed effects. Standard errors are clustered at the MSA-quarter level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Second Stage								
Diversification Dummy	-0.127***	-0.133**			-0.623***	-0.888***		
	(0.048)	(0.052)			(0.224)	(0.339)		
1 - Herfindahl Index of Assets across MSAs			-0.808***	-0.752***			-1.611**	-1.740**
			(0.119)	(0.116)			(0.628)	(0.677)
Bank and Macro Controls	x	x	x	x	x	x	x	x
Quarter Fixed Effects	x	x	x	x	x	x	x	x
Bank Fixed Effects					x	x	x	x
Excluded Instruments:								
Max Entry Probability (benchmark)	x				x			
Max Entry Probability (+ quadratic distance effect)		x				x		
Predicted Diversification Index (benchmark)			x				x	
Predicted Diversification Index (+ quadratic distance effect)				x				x

Panel B: First Stage

Dependent Variable:	Diversification Dummy		1 - Herfindahl Index of assets across MSAs		Diversification Dummy		1 - Herfindahl Index of assets across MSAs	
Max Entry Probability (Model II)	0.431***				0.449***			
	(0.021)				(0.070)			
Max Entry Probability (Model IV)		0.338***				0.266***		
		(0.018)				(0.059)		
Predicted Diversification Index (Model II)			0.120***				0.088***	
			(0.006)				(0.016)	
Predicted Diversification Index (Model IV)				0.123***				0.086***
				(0.007)				(0.016)
Observations	23,286	23,286	23,625	23,625	23,286	23,286	23,625	23,625
F-Test	430.6	369.0	345.6	353.6	40.83	20.34	29.90	27.65

Table 5

The Impact of Geographic Diversification on Bank Holding Company Risk by Diversification Potential- 2SLS Regressions

This table reports results from a 2SLS regression at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is the natural logarithm of the standard deviation of weekly stock market returns for US holding companies, measured over a quarter. A BHC's stock market return is based on a BHC's market capitalization is measured as the change in a BHC's market capitalization between two Wednesdays within a quarter. Only BHC-quarters with at least 75% of nonmissing stock market returns are included. The endogenous variable 'Diversification Dummy' is an indicator variable taking on the value of one whether a BHC has assets in another MSA; 'Share of hedged assets' is the fraction of total BHC assets that are held in MSAs that exhibit different business cycles based on the measure provided in the column header. Two MSAs within an MSA-pair (i,j) are supposed to exhibit a similar business cycle if (a) the negative absolute difference in the employment shares across industries between i and j are below the within MSA i- median (columns 1 and 2), (b) the negative absolute difference in the residual real personal income growth between i and j are below the within MSA i- median (columns 3 and 4) or (c) the correlation of a Baxter-King filtered business cycle series between i and j are below the MSA i-median (columns 5 and 6). These endogenous variables are instrumented by instruments obtained from a gravity-deregulation model as well as the interaction of these predicted entry dummy (see Table 3) and the predicted share of hedged assets based on predicted share across all MSAs obtained from a gravity-deregulation model. 'Max Entry Probability' is the maximum of predicted probabilities of entering a foreign market. 'Predicted Share of Hedged Assets' is the total fraction of a BHC's predicted assets that are held in MSAs that are different based on the measures provided in the column header. The benchmark model to construct these instruments is provided in column 2 of Table 3. We also construct the instrument adding a quadratic term for distance to this model. All regressions include year fixed effects, and metropolitan statistical area (MSA) fixed effects. Standard errors are clustered at the MSA-quarter level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Hedge-/Output Similarity - measure:	Difference in employment shares		Negative absolute difference in residual growth rates		Correlation of Baxter-King (5,2) filtered business cycle	
Diversification Dummy	-0.785**	-1.112*	-1.310***	-2.119*	-1.139**	-1.226**
	(0.362)	(0.627)	(0.505)	(1.209)	(0.474)	(0.576)
Diversification Dummy * Share of Hedged Assets	-2.799**	-3.739*	-1.511*	-2.137	-2.719***	-2.872***
	(1.388)	(2.164)	(0.847)	(1.670)	(0.976)	(1.013)
Bank and Macro Controls	x	x	x	x	x	x
Quarter Fixed Effects	x	x	x	x	x	x
Bank Fixed Effects	x	x	x	x	x	x
Excluded Instruments						
Max Entry Probability (benchmark)	x		x		x	
Max Entry Probability * Predicted share of hedged Assets (benchmark)	x		x		x	
Max Entry Probability (+ quadratic distance effect)		x		x		x
Max Entry Probability * Predicted share of hedged Assets (+ quadratic distance effect)		x		x		x
Observations	23,280	23,280	23,280	23,280	23,280	23,280
F-Test (1st instrument)	25.92	14.70	20.62	10.34	24.82	14.63
F-Test (2nd instrument)	17.55	12.19	99.16	71.66	72.64	49.10

Table 6

The Impact of Geographic Diversification on Bank Holding Company Risk by Diversification Potential- 2SLS Regressions - Robustness

This table reports results from a 2SLS regression at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is the natural logarithm of the standard deviation of weekly stock market returns for US holding companies, measured over a quarter. A BHC's stock market return is based on a BHC's market capitalization is measured as the change in a BHC's market capitalization between two Wednesdays within a quarter. Only BHC-quarters with at least 75% of nonmissing stock market returns are included. The endogenous variable 'Diversification Dummy' is an indicator variable taking on the value of one whether a BHC has assets in another MSA; 'Share of hedged assets' is the fraction of total BHC assets that are held in MSAs that exhibit different business cycles based on the measure provided in the column header. Two MSAs within an MSA-pair (i,j) are supposed to exhibit a similar business cycle if (a) the negative absolute difference in the real personal income growth between i and j are below the within MSA i- median (column 1), (a) the negative absolute difference in the residual real personal income growth between i and j are below the within MSA i- median (column 2) or (c) the correlation of a Baxter-King filtered business cycle series between i and j are below the MSA i-median (column 3). These endogenous variables are instrumented by instruments obtained from a gravity-deregulation model as well as the interaction of these predicted entry dummy (see earlier Tables) and the predicted share of hedged assets based on predicted share across all MSAs obtained from a gravity-deregulation model. 'Max Entry Probability' is the maximum of predicted probabilities of entering a foreign market. 'Predicted share of hedged Assets' is the total fraction of a BHC's predicted assets that are held in MSAs that are different based on the measures provided in the column header. The benchmark model to construct these instruments is provided in column 2 of Table 3. We also construct the instrument adding a quadratic term for distance to this model. All regressions include year fixed effects, and metropolitan statistical area (MSA) fixed effects. Standard errors are clustered at the MSA-quarter level, and reported in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)
Hedge-/Business Cycle Similarity - measure:	Difference in employment shares between markets	Negative absolute difference in residual growth rates	Correlation of business cycle
		ln(stdev of observed weekly returns)	
Diversification Dummy	-0.817*	-1.512**	-1.159*
	(0.456)	(0.704)	(0.624)
Diversification Dummy * Share of Hedged Assets	-2.931*	-2.012	-3.284**
	(1.696)	(1.263)	(1.493)
Observations	20,653	20,653	20,653
F-Test (1st instrument)	21.49	16.65	22.32
F-Test (2nd instrument)	17.99	69.71	52.82
		ln(stdev of residual weekly returns)	
Diversification Dummy	-0.620	-1.602**	-0.952*
	(0.410)	(0.817)	(0.561)
Diversification Dummy * Share of Hedged Assets	-2.963*	-2.659*	-3.346**
	(1.517)	(1.458)	(1.354)
Observations	20,640	20,640	20,640
F-Test (1st instrument)	21.97	17.19	22.67
F-Test (2nd instrument)	18.47	69.12	53.43
		ln(Z-Score)	
Diversification Dummy	0.927*	1.549**	1.278*
	(0.485)	(0.705)	(0.657)
Diversification Dummy * Share of hedged assets	3.118*	1.894	3.421**
	(1.796)	(1.268)	(1.566)
Observations	20,653	20,653	20,653
F-Test (1st instrument)	21.49	16.65	22.32
F-Test (2nd instrument)	17.99	69.71	52.82
Bank and Macro Controls	x	x	x
Quarter Fixed Effects	x	x	x
Bank Fixed Effects	x	x	x
Excluded Instruments			
Max Entry Probability(Model II)	x	x	x
Max Entry Probability(Model II) * Predicted share of hedged Assets (Model II)	x	x	x

Table 7

The Impact of Geographic Diversification on Loan Quality - 2SLS Regressions

This table reports results from a 2SLS regression at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is given in the column header: Loan Charge Offs/ Total Loans in the share of total loan charge-offs in the BHC's total loan portfolio; Nonperforming loans / Total Loans is the share of nonperforming loans in the BHC's total loan portfolio Loan Loss Provisions / Total Loans is the share of Loan loss provisions in the BHC's total loan portfolio. The endogenous variables are 'Diversification Dummy' and '1 - Herfindahl Index of assets across MSAs'. The employed instruments are reported in the table and are based on a gravity-deregulation model. 'Max Entry' is a the maximum of predicted entry probabilities for entering a foreign market. 'Predicted Diversification Index' is the predicted 1 - Herfindahl Index of assets across MSA obtained from a gravity-deregulation model where we also add a quadratic term for distance to this model. All regression models include quarter fixed effects and BHC fixed effects where indicated. Standard errors are clustered at the MSA-quarter level, and reported in in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Loan Charge Offs / Total Loans		Nonperforming Loans / Total Loans		Loan Loss Provisions / Total Loans	
1 - Herfindahl Index of Assets across MSAs	0.300	0.397*	0.644	0.532	0.236	0.293
	(0.187)	(0.210)	(1.152)	(1.204)	(0.166)	(0.182)
Bank and Macro Controls	x	x	x	x	x	x
Quarter Fixed Effects	x	x	x	x	x	x
Bank Fixed Effects	x	x	x	x	x	x
Excluded Instruments:						
Predicted Diversification Index (benchmark)	x		x		x	
Predicted Diversification Index (+ quadratic distance effect)		x		x		x

Table A1

Predicted Geographic Diversification and Bank Holding Company Risk - Reduced Form

This table reports results from an OLS regression at the bank holding company level over the period Q2/1976-Q4/2007. The dependent variable is the natural logarithm of the standard deviation of weekly stock market returns for US holding companies, measured over a quarter. A BHC's stock market return is based on a BHC's market capitalization is measured as the change in a BHC's market capitalization between two Wednesdays within a quarter. Only BHC-quarters with at least 75% of nonmissing stock market returns are included. The variables are 'Max Entry Probability' and 'Predicted Diversification Index'. 'Max Entry' is the maximum value of predicted entry probabilities for entering a foreign market. 'Predicted Diversification Index' is the predicted 1 - Herfindahl Index of assets across MSA obtained from a gravity-deregulation model. The benchmark model is provided in column 2 of Table 3. We also construct the instrument adding a quadratic term for distance to this model. Regression models (1) to (4) include quarter fixed effects, model (5) to (8) include quarter and BHC fixed effects. Standard errors are clustered at the MSA-quarter level, and reported in in parentheses. *, **, *** mean significance at ten, five, and one percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Max Entry Probability (benchmark)	-0.054***				-0.280***			
	(0.021)				(0.092)			
Max Entry Probability (+ quadratic distance effect)		-0.045**				-0.236***		
		(0.018)				(0.074)		
Predicted Diversification Index (benchmark)			-0.097***				-0.142***	
			(0.013)				(0.050)	
Predicted Diversification Index (+ quadratic distance effect)				-0.092***				-0.150***
				(0.013)				(0.052)
Bank and Macro Controls	x	x	x	x	x	x	x	x
Quarter Fixed Effects	x	x	x	x	x	x	x	x
Bank Fixed Effects					x	x	x	x
Observations	23,280	23,280	23,619	23,619	23,286	23,286	23,625	23,625