Can parents protect their children? Risk comparison analysis between stand-alone commercial banks and bank holding companies' affiliates

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Abstract

We find that multi-bank holding companies (MBHCs) in the U.S. have lower insolvency risk than single-bank holding companies (SBHCs) at the parent level, but have significantly higher insolvency risk than the latter at the subsidiary level. These results suggest that MBHC affiliates face insolvency risks resulting from the increased complexity if the number of subsidiaries in MBHCs increases. MBHC parents tend to manipulate the internal capital market in order to achieve safety at the parent level. The implication of the results is that regulators should devote particular effort to regulating banks at the subsidiary levels to restrict their risk-taking behavior.

Keywords: insolvency risk; complexity; internal capital market; diversification; bank holding companies' affiliates

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1. Introduction

Ever since the passage of the 1956 Bank Holding Company Act, bank holding companies (BHCs) have become dominant in the U.S. banking industry. As of 2012, BHCs as a group controlled well over $15 trillion in total assets, more than 95% of all U.S. banking assets (Avraham et al. 2012). Although the literature has suggested numerous operational advantages of BHC structure, concerning reduced restrictions on scale and scope in various banking activities and greater flexibility in financing at both the parent and subsidiary levels (Pozdena 1988), it is not clear in both theory and empirical evidence whether BHC structure provides an additional layer of protection for their subsidiaries. We attempt to address this question in this paper.

Specifically, we investigate the differences in insolvency risk between Single-BHC (SBHC) and Multi-BHC (MBHC) at their subsidiary levels. We apply internal capital market theory, diversification theory and complexity theory to form our hypotheses. First, we postulate that MBHC affiliates have *lower* insolvency risk than SBHC affiliates, all else being equal. Diversification at the parent level enhances the parents' ability to obtain better external financing deals to enrich the internal financing available to their subsidiaries (Khanna and Palepu 2000), thereby increasing the ability of the parent to relieve financial difficulties faced by their affiliates. The 'source-of-strength' doctrine states that a parent can raise internal funds by divesting a non-banking subsidiary to rescue a troubled banking subsidiary. Also, literature on business groups argues that business groups enable members to share risk by reallocating resources (Marisetty and Subrahmanyam 2010, Gopalan et al. 2007, Khanna and Yafeh 2005, Ferris et al. 2003).

A competing hypothesis is that MBHC affiliates have *higher* insolvency risk than SBHC affiliates, as suggested by complexity theory. In the wake of deregulation, MBHCs have become more organizationally complex over the past two decades in terms of the number of separate legal affiliates and their geographic locations (Cetorelli and Goldberg 2014, Cetorelli et al. 2014, Avraham et al. 2012). On the one hand, complexity theory argues that agency problems between the managers of the parent and affiliates in the organizational hierarchy structure decrease the investment efficiency of subsidiaries (Rajan et al. 2000, Scharfstein and Stein 2000). On the other hand, complexity theory posits that a competitive environment exists in the hierarchy structure (Pina e Cunha and Vieira da Cunha 2006, Anderson 1999). Complexity theory also centers on the limited ability of the parent to equitably provide resources for all of its subsidiaries as the parent adopts increasingly complex structures due to diversification (Kahn and Winton 2004, DeYoung 2003, Hughes et al. 1999). The complexity hypothesis is also consistent with theory and empirical evidence of diversification discount found in both financial and non-financial institutions (Whited 2001, Rajan et al. 2000).

We use a sample of U.S. commercial banks between 1994 and 2012 to test these two hypotheses. We find that MBHC affiliates tend to have higher levels of insolvency risk (measured as the Z-score) than SBHC affiliates. However, an important issue that may arise when attempting to estimate the riskiness of different types of banks is that the choice of banks to become such types may be endogenous. Our identification strategy seeks to address the endogeneity of the bank type decision by applying a propensity score matching (PSM)-based pairwise difference-in-difference approach. Specifically, we consider those banks which change status from SBHC affiliates into MBHC affiliates, i.e. the parent of an SBHC becomes an

MBHC. We match the SBHC affiliates that changed status (treatment) with those SBHC affiliates that did not (control), using the propensity score matching method. We then adopt the difference-in-difference identification strategy to investigate whether the difference in insolvency risk between the treatment and control groups increases after the status changes of the treatment group. We find that SBHC affiliates changing into MBHC affiliates increase their level of risk, as compared to those controlled SBHC affiliates, therefore reaffirming our main results.

Next, we employ causal mediation analysis to test the underlying mechanism driving our main finding by considering the organizational complexity at the parent holding company level. We follow Cetorelli and Goldberg (2014) and measure organizational complexity as the total number of bank and non-bank subsidiaries a BHC has. We find that the total number of BHC subsidiaries is negatively associated with a BHC affiliate's insolvency risk. More importantly, however, we find that the MBHC affiliate indicator has no significant impact on bank risk once organizational complexity is controlled. These results suggest that organizational complexity is the main driver of the higher level of risk of MBHC affiliates compared to SBHC affiliates.

We then consider stand-alone banks as a separate group in addition to SBHC and MBHC affiliates, and compare the insolvency risk among the three groups. We find no significant difference in bank risk between stand-alone banks and SBHC affiliates. This result is not surprising, given that most SBHCs do not have non-bank subsidiaries and hence do not form an internal capital market within the SBHCs. In consistent with our main results, we find that MBHC affiliates are riskier than stand-alone banks.

Finally, we compare the insolvency risks of SBHCs and MBHCs at the parent (the highest position in the bank structure hierarchy) instead of the subsidiary level. We find that

MBHCs have lower insolvency risk than SBHCs. Overall, our findings that MBHC affiliates are riskier than SBHC affiliates but MBHCs are safer than SBHCs at the parent level suggest that MBHCs take advantage of organizational complexity to manipulate the internal capital market among subsidiaries to achieve diversification benefits at the parent level, regardless of the riskiness of subsidiaries. This evidence is consistent with Billett and Mauer (2003) finding that inefficient subsidies to financially constrained divisions significantly increase the excess value of diversified firms. It also explains to some extent the ongoing trend of forming MBHCs in the U.S.

Our paper contributes to multiple strands of the literature. First, our paper is related to the literature that examines the impact of the internal capital market on BHC value. Cremers et al. (2011) examine the distribution of influence within the banking business group. Billett and Mauer (2003) investigate the relationship between the internal capital market and excess value of diversified firms. A number of previous studies, for example Fauver et al. (2003), Lin and Servaes (2002) and Khanna and Palepu (2000), examine the link between capital market development and the value of diversification. Their evidence suggests that large diversified firms are better able to access external financing. Our results suggest that MBHC parents achieve diversification benefits by allowing their subsidiaries to take more risks than their SBHC counterparts.

Second, our paper contributes to the recent growing literature on bank complexity (Cetorelli et al. 2014, Cetorelli and Goldberg 2014, Liu et al. 2016). According to Cetorelli et al. (2014), studies on organizational complexity have policy importance because of its systemic risk implication in spreading shock across many affiliates within multiple industries in the financial

sector. Studies on bank complexity, however, have not been documented comprehensively since the collapse of the banking system during the 2007-2009 financial crisis, which triggered the debate on the role of complex banks. Our paper finds that increased organizational complexity leads to increased insolvency risk of MBHC subsidiaries; however, these increased risks are diversified away at the parent level, resulting in overall gain for MBHC parents.

Third, our results comparing the insolvency risk between stand-alone banks and BHC affiliates extend the substantial literature comparing stand-alone and affiliated banks. This literature has primarily focused on bank performance before and after acquisition (Pozdena 1988; Mayne 1977, Piper and Weiss 1974, Ware 1973,Talley 1972) and with respect to cost efficiency (Yamori et al. 2003, Rose and Scott 1979) and dividend policy (Mayne 1980).

The remainder of this paper is organized as follows. Section 2 reviews related literature and develops the two main hypotheses. Section 3 describes the data and summary statistics. The subsidiary results are presented in Section 4 while Second 5 reports results of the parent level. Section 6 concludes.

2. Hypotheses development

The internal capital market theory suggests that the creation of an internal capital market, where the headquarters allocate capital across different projects, could limit the distortions arising from external financing costs (Shin and Stulz 1998, Lamont 1997, Stein 1997). This theory has advanced the importance of its benefits for banks' affiliates with a banking group. Houston et al. (1997) find that lending activities of bank subsidiaries are closely tied to the BHC's capital position but not the cash flows at the subsidiary level. This evidence suggests that

MBHCs create internal capital markets to allocate scare capital within the organization. Building on Houston et al. (1997), Houston and James (1998) examine the relationship between organizational structure and bank lending by comparing lending behaviours of MBHC affiliates and that of unaffiliated banks. They find a lower cash flow sensitivity for affiliated banks, implying that holding company affiliation reduces the cost of raising funds externally. Cremers et al. (2011) further provide evidence that the headquarters of a retail banking group can provide their member banks with an intertemporal insurance function against funding shortfalls.

The 'source-of-strength' doctrine states that a parent can raise internal funds by divesting a non-banking subsidiary to rescue a troubled banking subsidiary (Gilbert 1991). Also, literature on business groups argues that business groups enable members to share risk by reallocating resources (Marisetty and Subrahmanyam 2010, Gopalan et al. 2007, Khanna and Yafeh 2005, Ferris et al. 2003) or by reducing earnings volatility (Khanna and Yafeh 2007). MBHCs have more subsidiaries than SBHCs and can therefore allow affiliates to access more internal resources than their SBHC counterparts. Hence, we postulate the first hypothesis:

Hypothesis 1*: MBHC affiliates have lower insolvency risk than SBHC affiliates*

However, the organizational complexity of U.S. BHCs has developed through an intensive process of consolidation and substantial acquisition over many subsidiaries (Cetorelli et al. 2014). The increased complexity in the MBHC structure may cast doubt on its bank affiliates' insolvency risk.

On the one hand, complexity theory posits that a competitive environment exists in the hierarchy structure (Pina e Cunha and Vieira da Cunha 2006, Anderson 1999). In a similar vein, Frankel (2013) study on large BHCs defines BHCs as a mall that owns financial shops. Due to

the variety and interconnectedness of the shops, BHCs' management often finds it difficult to manage their complex and varied shops.[2] Each shop may be vulnerable to the risk taken by other shops in the mall. Evidence in the form of the threat of 'poaching' shows that managers of low-growth subsidiaries can 'poach' the surplus of their high-growth counterparts (Rajan et al. 2000). Such activities are associated with a high probability of financial distress among the subsidiaries.

On the other hand, the agency problem between the managers of the parent and affiliates in the organizational hierarchy may lead to less efficient investments for subsidiaries (Rajan et al. 2000, Scharfstein and Stein 2000). Managers of weak subsidiaries prefer larger capital budgets; however, they gain fewer private benefits from less productive investments. Therefore, they increase their bargaining power by negotiating compensation with the parent's manager to entice them to stay. The parent's managers react by offering additional compensation in the form of preferential capital budgeting allocations rather than cash wages. In order words, the parent's managers distort capital allocations in favor of weak affiliates.

An alternative view of the more complex structure (Kahn and Winton 2004) posits that institutions attempt to engage in loan switches to alter the risk postures of their subsidiaries. They find that the parent tends to protect safe subsidiaries by granting them the most attractive low-risk loans, in contrast to the inefficient loans made to risky subsidiaries. DeYoung (2003) suggests that MBHC parents isolate riskier subsidiaries outside of the main bank to protect organizational assets. Hughes et al. (1999) and Deng and Elyasiani (2008) find that MBHCs operating over wider geographic ranges are more likely to be exposed to affiliation risk, which is

[2] MBHC subsidiaries are more likely to compete for financial resources from the parent (Baule, 2014), whereas SBHC affiliates find it easy to access their parent's resources when necessary (Gilbert, 1991). Such a moral hazard problem is limited for SBHC subsidiaries because SBHCs have sole bank subsidiaries. When the parent controls a smaller set of subsidiaries, the internal capital market tends to enhance allocation efficiency and funding is allocated according to an internal ranking (Stein, 1997).

in line with Berger and DeYoung (2001) argument that senior managers tend to concentrate on recently purchased remote subsidiaries. Their attention centers on the limited ability of the parent to provide equitable treatment to all of its subsidiaries.

By combining the insights of different perspectives in complexity theory, we offer the second hypothesis as follows:

Hypothesis 2: *MBHC bank affiliates have higher insolvency risk than SBHC affiliates*

3. Empirical methods

3.1. Data sample

This study uses annual account data of commercial banks in the U.S. from 1994 to 2012 obtained from the Call Reports. We begin the data analysis in 1994 for two reasons. First, Copeland (2012) reports that the largest banks began to organize as BHCs rather than being stand-alone commercial banks in 1994.[3] Second, after 1994, banks were allowed to establish branches in other states. The complete structure of foreign-owned banks is unknown; therefore, we exclude foreign-owned banks from our sample. Our final data set includes 9,265 banks with 4,982 SBHC affiliates and 4,283 MBHC affiliates.

3.2. Empirical methods

To study the effect of bank type on bank insolvency risk, we use the following equation:

[3] The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 removed many restrictions on opening bank branches across state lines and permitted merger and acquisition through the holding company structure, which was the first step in the deregulation process (Jayaratne and Strahan 1996).

$$Z-score_{it} = \alpha_0 + \beta_1 MBHC\_affiliate_i + \sum_{i=1}^{n} \beta_i CONTROLS_{it-1} + \varepsilon_{it} \quad (1)$$

Following the recent literature on bank risk (Demirgüc-Kunt and Huizinga 2010, Laeven and Levine 2009), this study uses the Z-score as the main measure of insolvency risk. It is defined by the sum of return on assets (ROA) and the capital ratio, which is then divided by the standard deviation of ROA. The standard deviation of ROA is calculated over a four- and five-year rolling timeframe. MBHC_affiliate takes a value of 1 if the banks are MBHC affiliates, and 0 is assigned to SBHC affiliates. ε_{it} denotes the error term.

$\sum_{i=1}^{n} \beta_i CONTROLS_{it-1}$ represents the control variables. We use one-year-lagged variables, including Log Total assets, Deposit/Total assets%, Loan/Total assets%, Off-balance-sheet (OBS)/Total assets%, Non-interest income/Operating income%, Cost-to-income%. Size is the logarithm of total assets and can be an important determinant of banks' risk (Huang et al. 2012, Drehmann and Tarashev 2011, Tarashev et al. 2009). Demsetz and Strahan (1995) find evidence that size is an advantage, as larger institutions can more easily diversify risk. Hence, it is expected that larger banks are safer. Deposit/Total assets%, which is deposits as a percentage of total assets, represents a crucial component of the liabilities of traditional commercial banks.

As Foos et al. (2010) point out, loan is regarded as an important driver of bank risk; therefore, loan ratio is employed in this study. Following previous studies on bank risk (Stiroh and Rumble 2006), Loan/Total assets% is used to indicate the extent to which a bank is involved in traditional lending activities. Following Stiroh (2004), we capture income diversification as the ratio of non-interest income as a percentage of total operating income to examine the extent to which a bank moved towards more volatile non-interest income. Lepetit et al. (2008) argue

that banks with high non-interest income activities are riskier. Demsetz and Strahan (1997), on the other hand, find that economies of scale make large BHCs cost-effective in specializing in riskier activities. We follow the recent study on organization complexity in Cetorelli and Goldberg (2014) to measure organizational complexity by the total number of subsidiaries, which is equal to the number of bank subsidiaries plus the number of non-bank subsidiaries.

3.3. Summary statistics

Table 1 provides descriptive statistics of the Z-score and bank-specific variables for all banks, SBHC affiliates and MBHC affiliates. We winsorize all variables except size at the 1st and 99th percentiles to minimize the impact of outliers. The correlation matrix for variables is displayed in Appendix. MBHCs tend to be riskier, larger, have lower Deposit/Total assets, but have higher OBS/Total assets and higher Non-interest income/Operating income.

[Insert Table 1 here]

The last column in Table 1 indicates a significant difference in the means of variables between SBHC and MBHC affiliates. The results show that SBHC affiliates have higher Z-scores than MBHC affiliates (73.34 and 68.48, respectively), indicating that SBHC affiliates have lower insolvency risk than their MBHC counterparts. It appears that MBHC affiliates have a larger size, higher OBS items, and higher non-interest income, and are affiliated with larger banking organizations than SBHC affiliates. In contrast, SBHC affiliates hold a higher proportion of deposit and are less cost-efficient than MBHC counterparts. On average, SBHCs

have four subsidiaries, whereas MBHCs have 48. The mean of Log Total subsidiaries of MBHCs is significantly higher than that of SBHCs, implying that MBHCs are more complex than SBHCs.

4. Risk comparisons between SBHC affiliates and MBHC affiliates

In this section we study the effect of bank structure on insolvency risk. First, we begin with the ordinary least squares model to provide our main finding. Second, we deal with endogeneity issues by employing PSM – based pairwise difference-in-difference approach to provide consistent results. Third, we apply causal mediation analysis to prove the validity of our second hypothesis that MBHC affiliates are riskier due to their organizational complexity.

4.1. Main results

Table 2 reports the regression results of equation (1). Standard errors adjusted for heteroscedasticity and clustered at the bank level are displayed from this table onwards. Time fixed effects are included.

[Insert Table 2 here]

As displayed in the first column of Table 2, the coefficient estimate for MBHC affiliates is negative and significant at the 1% level (-7.10), implying that MBHC affiliates are riskier than SBHC affiliates. The results are consistent for two Z-scores with a four-year and five-year rolling timeframe. Our finding supports the second hypothesis regarding complexity theory's

assumption of agency problems and competition for resources in the internal capital market (Rajan et al. 2000, Scharfstein and Stein 2000, Shin and Stulz 1998). Recent literature (Cetorelli et al. 2014, Cetorelli and Goldberg 2014) shows that the organizational complexity of U.S. BHCs has developed through an intensive process of consolidation and substantial acquisition of many subsidiaries. The agency problem between the managers of the parent and affiliates in the organizational hierarchy may lead to decreased investment efficiency at the subsidiary level (Rajan et al. 2000, Scharfstein and Stein 2000). The more complex structure, modeled by Kahn and Winton (2004), posits that institutions attempt to engage in loan switches to alter the risk postures of their subsidiaries. A different strand of the argument on organizational complexity sheds light on the fact that MBHC affiliates tend to be exposed to higher levels of risk when the number of subsidiaries in MBHCs increase.

We find that larger banks tend to be safer. This is consistent with the argument on the diversification advantage of larger banks (Demsetz and Strahan 1995). However, banks highly engaging in lending activities are riskier, consistent with the finding of Stiroh and Rumble (2006). Banks with higher OBS/Total assets and Non-interest income/Operating income are riskier, consistent with the finding of Lepetit et al. (2008). Confirming the evidence provided by Demsetz and Strahan (1997), we find that banks with higher cost efficiency tend to be safer.

4.2. Propensity score matching-based pairwise difference-in-difference approach

The key result of the analysis reports that MBHC affiliates are riskier than SBHC affiliates. One may argue, however, that our findings of different levels of riskiness among banks may not be caused by the differences in bank types, e.g., SBHC or MBHC organizations, but are

rather endogenous to the decisions made to become such bank types. We attempt to address this issue in this section.

To extract the endogeneity caused by unobserved factors, we rely on those banks that change their status (for example, from SBHC affiliates to MBHC affiliates), within our sample period. We assume that banks that change status do not change their characteristics in a short period other than the level of risk before and after the status change. This strategy provides insights into whether SBHC affiliates changing into MBHC affiliates will increase or decrease their level of risk. In this analysis, we observe the following two groups:

(i) "status-changer"; that is, SBHC affiliates have changed into MBHC affiliates during the observation period (treatment group);

(ii) "non-changer"; that is, SBHC affiliates that have not undertaken status changes into MBHC affiliates during the observation period (control group).

Specifically, we use a propensity score matching-based pairwise difference-in-difference (PSM diff-in-diff) approach for this experiment to test the effect of status changes on the changes of insolvency risk of those banks. This is known as a difference-in-difference approach in which the first difference eliminates the unobserved heterogeneity and the second difference provides the impact estimate. As Blundell and Dias (2000) point out, a non-parametric PSM diff-in-diff has the potential to significantly improve the quality of non-experimental evaluation results. First, we run propensity score matching with the nearest-match method to match the control group with the treatment group year by year upon a vector of bank-specific variables, including bank size, deposit, loan, OBS, income diversification and cost-to-income ratios. Each status-changer is matched with an observation from the non-changer group of the same year that the

status changed. Second, we pool the yearly matched status-changers and non-changers. The empirical setting requires us to restrict the matching to those with data from one year before and one year after the status changes. The process repeats for two-year and three-year windows. Third, we estimate the differences in the mean changes of Z-score between status changers and non-changers by the following diff-in-diff model:

$$Z-score_{it} = \alpha_0 + \beta_1 Post_i * status\_change_i + \sum_{i=1}^{n} \beta_i CONTROLS_{it-1} + \varepsilon_{it} \quad (2)$$

$Post_i$ is a dummy variable equal to 1 for the time after changing status and 0 otherwise. $status\_change_i$ equals 1 for status-changers and 0 for non-changers. This is a bank-specific attribute and does not vary by time. The variable of the primary interest in this set-up is the interaction of $Post_i * status\_change_i$, which shows the changes of the difference in bank risk between status-changers and non-changers before and after the status changes. Because we include both time and bank fixed effects in equation (2), both components of $Post_i$ and $status\_change_i$ are not included in the equation.

The results of the diff-in-diff analysis are presented in Table 3. Regression (1) compares one year before and after the status changes. Regressions (2) and (3) compare two- and three-windows before and after the status changes, respectively.

[Insert Table 3 here]

In three regressions, the interaction term of *Post*Status_change* is negative and significant, indicating that SBHC affiliates changing into MBHC affiliates tend to increase their

level of risk as compared to those controlled SBHC affiliates with no such changes. This experiment reaffirms our main finding that MBHC affiliates are riskier than SBHC counterparts.

4.3. Organizational complexity

Our evidence so far shows that MBHC affiliates are riskier than SBHC affiliates. In this section we try to document the mechanism. The causal mediation analysis recommended by Imai et al. (2011), Imai et al. (2010) and Judd and Kenny (1981) allows researchers to test competing theoretical explanations by identifying intermediate variables or mediators that lie in the causal pathway between the treatment and the outcome. If the treatment has no effect on the outcome once the mediators are controlled, one could conclude that the mediators totally mediate the effect of the treatment on the outcome (Judd and Kenny 1981). In this section, therefore, we test whether the higher level of insolvency risk for MBHC affiliates is due to the level of organizational complexity at its parent level.

Specifically, we include the measure of organizational complexity as the total number of bank and non-bank subsidiaries at the BHC parent level in equation (1) in addition to the MBHC affiliate indicator. The number of non-bank subsidiaries is retrieved from the consolidated BHC data FR Y-9SP, and this data is available from 1998 onwards. Therefore, the analysis includes bank-year observations from 1998 to 2012. Table 4 reports the results in terms of two measures of Z-score with four-year and five-year rolling windows to show the consistency of findings.

[Insert Table 4 here]

As compared with Regression 1 of Table 4, Regression 2 shows interesting evidence that the negative effect of MBHC_affiliate on Z-score is taken away once we control for organizational complexity, indicating that the difference in risk between MBHC and SBHC affiliates is channeled from the organizational complexity, in line with our second hypothesis. There may be agency problems between the managers of the parent and affiliates in the organizational hierarchy structure (Rajan et al. 2000, Scharfstein and Stein 2000), a competitive environment inside the organization (Pina e Cunha and Vieira da Cunha 2006, Anderson 1999), or the limited ability of the parent to equitably provide resources for all of its subsidiaries (Kahn and Winton 2004, DeYoung 2003, Hughes et al. 1999).

4.4. Risk comparisons among stand-alone commercial banks, SBHC affiliates and MBHC affiliates

We then consider stand-alone banks as a separate group in addition to SBHC and MBHC affiliates, and compare the insolvency risk among the three groups in this section. Specifically, we include both SBHC_affiliate and MBHC_affiliate indicator variables in the model:

$$Z-score_{it} = \alpha_0 + \beta_1 SBHC\_affiliate_i + \beta_2 MBHC\_affiliate_i + \sum_{i=1}^{n} \beta_i CONTROLS_{it-1} + \varepsilon_{it} \quad (3)$$

Where SBHC_affiliate equals 1 if the banks are SBHC affiliates, and 0 otherwise. MBHC_affiliate equals 1 if banks are MBHC affiliates, and 0 otherwise. Time fixed effects are included. Table 5 reports the results when a four-year and fiver-year rolling window of Z-score is considered.

[Insert Table 5 here]

Table 5 shows that SBHC_affiliate is insignificant, indicating that bank insolvency risk is not different between stand-alone banks and SBHC affiliates. We find no significant difference in bank risk between stand-alone banks and SBHC affiliates. This result is not surprising, given that most SBHCs do not have non-bank subsidiaries and hence do not form an internal capital market within the SBHCs. In consistent with our main results, we find that MBHC affiliates are riskier than stand-alone banks.

5. Risk comparison between SBHCs and MBHCs at the parent level

The results in the previous sections suggest that MBHC affiliates have higher insolvency risk than both SBHC affiliates and stand-alone commercial banks, and this difference is driven by the level of organizational complexity at the BHC parent level. In this section, we examine the difference in insolvency risk between SBHCs and MBHCs at the parent level.

It is widely perceived that BHCs have become substantially more complex by incorporating a large number of subsidiaries (Cetorelli et al. 2014). On the one hand, Efficient Internal Capital Market models particularly suggest that diversification creates value. That is the reason why earlier studies (Dimitrov and Tice 2006, Claessens et al. 1999, Stein 1997) conclude that diversification at the parent level leads to risk reduction in subsidiaries. On the other hand, Matsusaka and Nanda (2002) argue that diversification can be efficient or inefficient, depending on the characteristics of the firms. They put forward a theory of diversification discount based on

the agency theory suggestion that the headquarters of the conglomerates themselves introduce another layer of agency problems among subsidiaries, causing diversification discount.

We use the consolidated BHC data as Y-9C reports from 1994 to 2012 and the following model:

$$Z-score_{it} = \alpha_0 + \beta_1 MBHC\_parent_i + \sum_{i=1}^{n} \beta_i CONTROLS_{it-1} + \varepsilon_{it} \quad (4)$$

Where MBHC_parent equals 1 if the banks are an MBHC parents and 0 if they are SBHC parents. ε_{it} denotes the error term. Time fixed effects are included. Table 6 reports the results

[Insert Table 6 here]

Our results show that there is a diversification gain at the BHC parent level. According to portfolio theory, portfolio aggregates individual stocks to gain a diversification effect, provided that beta instability is inherent in the individual stocks. Confirming the portfolio view of banking, Demsetz and Strahan (1997) conclude that large banks are able to internally diversify and reduce the risk. Consistent with the portfolio theory view, although MBHC affiliates have a higher level of insolvency risk than their SBHC counterparts, the MBHC can achieve maximum diversification benefits at the parent level.

6. Conclusion

We conduct a risk comparison analysis of SBHC affiliates and MBHC affiliates. Using U.S. commercial bank data from 1994 to 2012, we find that MBHCs in the U.S. have lower

insolvency risk than SBHCs at the parent level, but have significantly higher insolvency risk than the latter at the subsidiary levels. Our results provided by the PSM diff-in-diff approach suggest that SBHC affiliates changing into MBHC affiliates increase their level of risk more than those not changing status, which reaffirms our main finding. Our results are consistent with our hypotheses based on complexity theory – that MBHC affiliates face risks of increased complexity if the number of subsidiaries in MBHCs increases. MBHC parents engage in inefficient internal capital market transactions by subsidizing risky subsidiaries with less risky ones in order to ensure safety at the parent level.

The tendency toward expanding BHC regulation in general and that on commercial banks in particular is best illustrated by the central issue of this study. First, regulators should review the source-of-strength doctrine for BHCs to ensure that MBHC affiliates can receive bailouts from their parents in the event of future distress. Second, regulators should separately consider the risk exposure between banks affiliated with SBHCs and MBHCs. Third, this paper reveals investors' preference for safe bank structures to achieve efficient investment portfolios.

Table 1

Descriptive statistics

Variable	All banks			SBHC affiliates			MBHC affiliates			t-test for difference in means
	N	Mean	Std	N	Mean	Std	N	Mean	Std	
Z-score	94,543	71.96	67.77	67,732	73.34	69.48	26,811	68.48	63.09	***
Log Total assets	94,543	11.83	1.34	67,732	11.76	1.19	26,811	12.02	1.64	***
Deposit/Total assets%	94,543	83.10	9.84	67,732	84.12	6.81	26,811	80.54	14.66	***
Loan/Total assets%	94,543	63.15	15.25	67,732	63.19	14.48	26,811	63.04	17.05	
OBS/Total assets%	94,543	1.68	2.35	67,732	1.49	2.07	26,811	2.14	2.92	***
Non-interest income/Operating income%	94,543	26.31	30.93	67,732	25.53	28.08	26,811	28.27	37.09	***
Cost-to-income%	94,543	101.64	88.93	67,732	106.58	90.24	26,811	89.16	84.24	***
Log Total subsidiaries	87699	0.53	0.93	63,460	0.09	0.34	24,239	1.68	0.99	***

Note: This table describes number of observations, means and standard deviations on all the regression variables for all banks, SBHC affiliates and MBHC affiliates. The dependent variable is insolvency risk measured by Z-score. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year rolling time. All independent variables are Log Total assets, Deposit/Total assets, Loan/Total assets, OBS/Total assets, Non-interest income/Operating income, Cost-to-income and, Log Total subsidiaries. Log Total assets is the logarithm of total assets. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. Log Total subsidiaries is the logarithm of total subsidiaries (bank subsidiaries plus non-bank subsidiaries). In the last column, *** indicate a significant difference of mean at 1% levels between SBHC and MBHC affiliates.

Table 2

Main result: Analysis of insolvency risks between SBHC affiliates and MBHC affiliates

Variable	4-year rolling	5-year rolling
MBHC_affiliate	-7.10***	-5.21***
	(0.94)	(0.79)
Log Total assets$_{t-1}$	2.33***	1.51***
	(0.39)	(0.32)
Deposit/Total assets%$_{t-1}$	-0.10**	-0.07
	(0.05)	(0.04)
Loan/Total assets%$_{t-1}$	-0.55***	-0.48***
	(0.03)	(0.03)
OBS/Total assets%$_{t-1}$	-1.41***	-1.07***
	(0.18)	(0.15)
Non-interest income/Operating income%$_{t-1}$	-0.08***	-0.05***
	(0.02)	(0.01)
Cost-to-income%$_{t-1}$	-0.12***	-0.10***
	(0.01)	(0.00)
Year fixed effects	Yes	Yes
Number of observations	84,582	77,993
R^2	0.06	0.08

Note: This table presents the results of insolvency risk comparison between SBHC affiliates and MBHC affiliates. The dependent variable is Z-score. Z-score is equal to (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year and five-year rolling time. MBHC_affiliate is a dummy variable equal to 1 if banks are MBHC affiliates and equal to 0 if banks are SBHC affiliates. All control variables are Log Total assets, Deposit/Total assets, Loan/Total assets, OBS/Total assets, Non-interest income/Operating income and Cost-to-income. Log Total assets is the logarithm of total assets. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. Standard errors are robust and clustered at bank level. The results for year fixed effects are not reported in the table. ***, ** and * denote significance at 1%, 5% and 10% levels.

Table 3
Propensity score matching-based pairwise difference-in-difference for insolvency risk and status changes

Variable	1-year window	2-year window	3-year window
Post*Status_change	-14.91***	-14.55***	-10.48***
	(4.38)	(4.14)	(3.94)
Log Total assets	-0.63	-4.41	-0.50
	(6.17)	(5.07)	(4.66)
Deposit/Total assets%	-0.42	-0.50**	-0.48**
	(0.35)	(0.25)	(0.21)
Loan/Total assets%	-0.16	-0.04	-0.09
	(0.26)	(0.17)	(0.14)
OBS/Total assets%	0.79	1.26*	1.40**
	(1.32)	(0.72)	(0.62)
Non-interest income/Operating income%	0.04	0.01	0.00
	(0.07)	(0.06)	(0.05)
Cost-to-income%	-0.07***	-0.07***	-0.08***
	(0.03)	(0.02)	(0.02)
Year fixed effects	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
Number of observations	2,409	4,471	6,247
Number of banks	1,256	1,256	1256
R-squared	0.05	0.04	0.04

Note: This table presents the effect of status change on insolvency risk by using propensity score matching-based pairwise difference-in-difference approach. The dependent variable is Z-score. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year rolling time. Post is a dummy variable equal to 1 if year is the year after a bank changes status. Status_change reflects the status transition from SBHC affiliates to MBHC affiliates. Status_change equals 1 if banks change their status and 0 if they do not. Regression (1) compares one year before and one year after status change. Regression (2) compares two years before and two years after status change. Regression (3) compares three years before and three years after status change. Log Total assets is the logarithm of total assets. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. ***, ** and * denote significance at 1%, 5% and 10% levels.

Table 4

Organizational complexity

Variable	4-year rolling		5-year rolling	
	(1)	(2)	(3)	(4)
MBHC_affiliate	-6.84***	-0.50	-5.04***	0.05
	(0.97)	(1.38)	(0.78)	(1.11)
Log Total assets$_{t-1}$	2.03***	2.69***	1.46***	1.99***
	(0.39)	(0.41)	(0.31)	(0.33)
Deposit/Total assets%$_{t-1}$	-0.10*	-0.14***	-0.06	-0.10**
	(0.05)	(0.05)	(0.04)	(0.04)
Loan/Total assets%$_{t-1}$	-0.56***	-0.56***	-0.47***	-0.47***
	(0.03)	(0.03)	(0.03)	(0.02)
OBS/Total assets%$_{t-1}$	-1.30***	-1.20***	-1.04***	-0.96***
	(0.19)	(0.18)	(0.15)	(0.14)
Non-interest income/Operating income%$_{t-1}$	-0.07***	-0.06***	-0.05***	-0.05***
	(0.02)	(0.02)	(0.01)	(0.01)
Cost-to-income%$_{t-1}$	-0.12***	-0.13***	-0.10***	-0.10***
	(0.01)	(0.01)	(0.00)	(0.00)
Log Total subsidiaries$_{t-1}$		-4.60***		-3.69***
		(0.70)		(0.57)
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	78,266	78,266	77,565	77,565
R^2	0.06	0.07	0.08	0.08

Note: This table presents the results by controlling for organizational complexity. The dependent variable is Z-score. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year and five-year rolling time. MBHC_affiliate is a dummy variable equal to 1 if banks are MBHC affiliates and equal to 0 if banks are SBHC affiliates. Log Total assets is logarithm of total asset. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. Organizational complexity is the Log Total subsidiaries equal to the logarithm of total subsidiaries (bank subsidiaries plus non-bank subsidiaries). Standard errors are robust and clustered at bank level. The results for year fixed effects are not reported in the table. ***, ** and * denote significance at 1%, 5% and 10% levels.

Table 5
Analysis of insolvency risk between stand-alone commercial banks, SBHC affiliates and MBHC affiliates

Variable	4-year rolling	5-year rolling
SBHC_affiliate	0.09	1.37
	(1.26)	(1.04)
MBHC_affiliate	-6.64***	-3.45**
	(1.40)	(1.17)
Log Total assets$_{t-1}$	1.93***	1.14***
	(0.37)	(0.30)
Deposit/Total assets%$_{t-1}$	-0.11**	-0.07*
	(0.04)	(0.04)
Loan/Total assets%$_{t-1}$	-0.60***	-0.51***
	(0.03)	(0.02)
OBS/Total assets%$_{t-1}$	-1.47***	-1.15***
	(0.17)	(0.14)
Non-interest income/Operating income%$_{t-1}$	-0.13***	-0.09***
	(0.02)	(0.01)
Cost-to-income%$_{t-1}$	-0.11***	-0.09***
	(0.01)	(0.004)
Year fixed effects	Yes	Yes
Number of observations	103,159	94,640
R^2	0.07	0.08

Note: This table presents the results of insolvency risk comparison among stand-alone banks, SBHC affiliates and MBHC affiliates. The dependent variable is Z-score. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year and five-year rolling time. SBHC_affiliate is a dummy variable equal to 1 if banks are SBHC affiliates and 0 otherwise. MBHC_affiliate is a dummy variable equal to 1 if banks are MBHC affiliates and 0 otherwise. All control variables are Log Total assets, Deposit/Total assets, Loan/Total assets, OBS/Total assets, Non-interest income/Operating income and Cost-to-income. Log Total assets is the logarithm of total assets. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. Standard errors are robust and clustered at bank level. The results for year fixed effects are not reported in the table. ***, ** and * denote significance at 1%, 5% and 10% levels.

Table 6

Analysis of insolvency risk between SBHCs and MBHCs at parent level

Variable	4-year rolling	5-year rolling
MBHC_affiliate	8.58***	7.61***
	(2.56)	(2.28)
Log Total assets$_{t-1}$	-1.31	-2.11**
	(0.99)	(0.86)
Loan/Total assets%$_{t-1}$	-0.56***	-0.50***
	(0.08)	(0.07)
OBS/Total assets%$_{t-1}$	-0.31	-0.17
	(0.79)	(0.68)
Non-interest income/Operating income%$_{t-1}$	0.10***	0.10***
	(0.04)	(0.03)
Cost-to-income%$_{t-1}$	-0.23***	-0.21***
	(0.02)	(0.01)
Log Total subsidiaries$_{t-1}$	-7.01***	-5.85***
	(1.42)	(1.24)
Year fixed effects	Yes	Yes
Number of observations	15,289	15,296
R^2	0.11	0.12

Note: This table presents the results of insolvency risk comparison between SBHCs and MBHCs at a parent level. The dependent variable is Z-score. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year and five-year rolling time. MBHC is a dummy variable equal to 1 if banks are MBHCs and 0 if banks are SBHCs. All control variables are Log Total assets, Loan/Total assets, OBS/Total assets, Non-interest income/Operating income, Cost-to-income and Log Total subsidiaries. Log Total assets is the logarithm of total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income ratio is non-interest expense divided by operating income. Log Total subsidiaries is the logarithm of total subsidiaries (bank subsidiaries plus non-bank subsidiaries). Standard errors are robust and clustered at bank level. The results for year fixed effects are not reported in the table. ***, ** and * denote significance at 1%, 5% and 10% levels.

Appendix

Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) MBHC dummy	1								
(2) Z-score	-0.03*	1							
(3) Log Total assets	0.09*	-0.01*	1						
(4) Deposit/Total assets%	-0.16*	-0.02*	-0.26*	1					
(5) Loan/Total assets%	-0.004	-0.09*	0.17*	0.09*	1				
(6) OBS/Total assets%	0.12*	-0.06*	0.49*	-0.15*	0.19*	1			
(7) Non-interest income/Operating income%	0.04*	-0.13*	0.12*	-0.24*	-0.19*	0.09*	1		
(8) Cost-to-income%	-0.09*	-0.19*	-0.05*	0.006	-0.14*	0.0009	0.66*	1	
(9) Log Total subsidiaries	0.76*	-0.04*	0.32*	-0.29*	0.02*	0.26*	0.10*	-0.09*	1

Note: (1) MBHC dummy, (2) Z-score, (3) Log Total assets, (4) Deposit/Total assets%, (5) Loan/Total assets%, (6) OBS/Total assets%, (7) Non-interest income/Operating income%, (8) Cost-to-income%, (9) Log Total subsidiaries. MBHC dummy variable equals 1 if banks are MBHC affiliates and 0 if banks are SBHC affiliates. Z-score equals (return on assets + capital ratio) / Standard deviation of return on assets. Standard deviation of return on assets is calculated at four-year rolling time. Log Total assets is the logarithm of total assets. Deposit/Total assets is total deposits divided by total assets. Loan/Total assets is total loans divided by total assets. OBS/Total assets is off-balance-sheet activities divided by total assets. Non-interest income/Operating income is non-interest income divided by operating income. Cost-to-income is non-interest expense divided by operating income. Log Total subsidiaries is the logarithm of total subsidiaries (bank subsidiaries plus non-bank subsidiaries). * denotes significance at the 1% level.

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