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**NONCONSOLIDATED AFFILIATES, BANK CAPITALIZATION,
AND RISK TAKING**

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Nonconsolidated affiliates, bank capitalization, and risk taking¹

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Abstract: This paper is the first to show that financial institutions may be effectively undercapitalized as a result of incomplete consolidation of minority ownership. Using two approaches – consolidating the minority-owned affiliates with the parent or deducting equity investments in minority ownership from the parent’s capital – we find that the effective capitalization ratios of small US bank holding companies (BHCs) are substantially lower than the reported ratios. Empirical evidence suggests that the effectively lower capitalization ratios are associated with higher riskiness at the BHC level. Capital adjustments following pro forma consolidation better capture the additional risks than capital adjustments in the form of equity deductions for investments in minority-owned affiliates. These findings have important implications for the regulation of bank capital.

Key words: Capital regulation, organizational structure, undercapitalization, bank leverage, risk taking

JEL Classification: G21, G32

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1. Introduction

The recent financial crisis has shown the importance of bank capital in determining bank stability. Berger and Bouwman (2013) show that higher levels of pre-crisis capital increased a bank's probability of survival during the crisis. Similarly, Beltratti and Stulz (2012) and Demirguc-Kunt, Detragiache and Merrouche (2013) find that banks that were better capitalized before the crisis had a better stock market performance during the crisis.

The thrust of post-crisis regulatory banking-sector reform has been to require banks to hold more and higher-quality capital. One issue addressed by policy makers concerns the regulatory treatment of a bank's investments in nonconsolidated banking subsidiaries. To be compliant with Basel III, in March 2014 the US has started to require commercial banks filing Call Reports to deduct part of their investments in unconsolidated banking subsidiaries from their Tier 1 capital in recognition of the risks posed by such investments.² Before 2014, the US only required large bank holding companies (BHCs) to make such a deduction from Tier 1 capital, but this regulation did not apply to small BHCs, which constitute the vast majority of the number of BHCs in the United States.

This paper is the first to provide empirical evidence of the capital arbitrage opportunities offered to financial institutions by the nonconsolidation of their affiliates. These capital arbitrage opportunities are identified by analyzing the period 2000-2013 which is when large BHCs were subject to a minimum leverage ratio requirement but small BHCs were not subject to such a requirement, and by extension did not have to adjust their regulatory leverage ratio for their nonconsolidated investments in banking affiliates.³ Although our empirical analysis focuses on small BHCs, it provides insights into the appropriate capital

² According to Basel III, investments in equity or regulatory capital instruments issued by banks or securities firms are risk-weighted at 250% unless deduction applies. See Basel Committee on Banking Supervision (2010, p. 26).

³ Throughout we use the term leverage ratio to represent the degree of capitalization following regulatory practice.

regulatory treatment of investments in banking affiliates that apply to large BHCs as well. By focusing on investments in affiliates, our analysis allows to directly identify capital arbitrage using publicly available balance sheet information, and therefore contributes to the literature on the regulatory arbitrage and forbearance that has been hampered by the limited information content of publicly available information (an exception is Agarwal et al. (2014) who have used confidential supervisory information to infer regulatory capital forbearance).

Specifically, we document the use of minority-owned banking affiliates by small BHCs, and we consider their implications for effective capitalization and for risk taking. To assess the capitalization implications, we perform a counterfactual, pro forma consolidation of minority-owned affiliates for the parent BHC. This exercise yields a ‘decompressed’ BHC with larger, ‘decompressed’ assets than actually reported assets, but with equal equity and hence a lower ‘decompressed’ leverage ratio calculated as the ratio of equity to ‘decompressed’ assets.

To be able to consolidate a BHC’s minority-owned affiliates, we use information on its entire corporate structure, including the ownership relationships among its constituent parts, as reported to the Federal Reserve and made available by the National Information Center (NIC). For the sample of small BHCs where we can complete the decompression exercise, we find that decompression reduces the leverage ratio by 26% on average.

As an alternative to pro rata consolidation, we consider that the parent BHC is required to deduct its investments in nonconsolidated banking subsidiaries from its own equity. Theoretically, we show that this ‘deduction method’ of adjusting the parent bank’s reported leverage ratio is less accurate than the pro rata consolidation of these affiliates by way of the ‘decompression method’. For the benchmark case of a parent firm that has a single minority-owned subsidiary with equal reported leverage ratios and full deduction of the parent’s equity investment in its subsidiary from its regulatory capital, we show that the ‘deduction method’

leads to an adjusted leverage ratio that is too low relative to the ‘decompressed’ leverage ratio. Consistent with this, for our sample of small BHCs we find empirically that the BHC’s leverage ratio after adjustment through deduction on average is lower than the ‘decompressed’ leverage ratio.

BHC risk is expected to reflect the lower leverage ratios that follow from decompression or deduction. In line with this, we find evidence that a bank’s Z-score (a commonly used measure of bank stability that is inversely related to bank risk) is negatively related to calculated downward leverage ratio adjustments, while the standard deviation of its return on equity (an alternative measure of bank risk) is positively related to these adjustments. This is evidence that small US BHCs were able to increase their riskiness for a given reported leverage ratio by investing in nonconsolidated banking affiliates. These results provide evidence of a direct link between capital arbitrage and the risk taking behavior of banks. Furthermore, capital ratio adjustments following decompression are more closely associated with bank risk than the alternative capital ratio adjustments following deduction. This suggests that capital ratio adjustments using the decompression method are preferred, in line with our theoretical analysis.

Several papers examine how banks have used off-balance-sheet structures other than nonconsolidated banking affiliates to arbitrage capital regulations.⁴ Acharya, Schnabl and Suarez (2013) analyze how banks have deployed asset-backed commercial paper conduits enhanced with liquidity guarantees to reduce their regulatory capital requirements for a sample of large US and European banks over the 2000-2006 period. Shin (2009) argues that securitization enabled the banking system to materially expand credit leading up to the crisis by increasing effective leverage of the banking system. Papanikolaou and Wolff (2014)

⁴See Acharya and Ryan (2016, pp. 319-232) for a discussion of channels by which banks’ financial reporting for securitizations related to the consolidation decision affect financial stability.

provide empirical evidence for a sample of large US banks that off-balance-sheet leverage as implicit in derivatives positions and securitizations contributed to bank risk as measured by bank stock price variability in the pre-crisis period. Calomiris and Mason (2004), however, conclude that US banks used off-balance-sheet conduits with implicit recourse to hold credit card receivables for efficient contracting reasons rather than to arbitrage capital adequacy rules.

Off-balance-sheet structures such as nonconsolidated, minority-owned banks do not only enable banks to operate with low effective capitalization rates, but they may also provide banks with incentives to increase the riskiness of their assets. Furlong and Keeley (1989) show that a lowly capitalized bank optimally chooses a riskier asset portfolio. Furthermore, Holmstrom and Tirole (1997) and Allen, Carletti, and Marquez (2011) model how better capitalized banks have a stronger incentive to monitor their borrowers, thereby reducing the riskiness of their loan portfolio.

In related research, Kahn and Winton (2004) show that banks may optimally place more and less risky assets in separate subsidiaries to contain risk-shifting incentives for the overall banking organization. Slovin and Sushka (1997) further find that firms generally may be able to enhance financing flexibility by maintaining a parent-subsidiary organizational form.⁵

Mian and Smith (1990) examine whether Fortune 500 US firms report their financial subsidiaries on a consolidated or unconsolidated basis in 1985.⁶ These authors show that consolidation is more likely in case of greater operational, financial and informational interdependence between the parent and the subsidiary, possibly reflecting that interdependence makes consolidated accounting data more useful for internal control

⁵ Desai et al. (2004) find that multinational, nonfinancial firms with wholly owned affiliates rather than joint ventures expand intrafirm trade and technology transfer. In addition, Chang, Chung and Moon (2013) find that wholly owned subsidiaries outperform joint ventures in industries characterized by high levels of intangible assets.

⁶ Before the adoption of Financial Accounting Standard 94 in 1987, US firms had discretion regarding the consolidation of majority-owned financial subsidiaries.

purposes. Further, they do not find that the use of unconsolidated financial subsidiaries is associated with the use of other off-balance-sheet financing such as operating leases and unfunded pension benefits. This is taken to be evidence against the hypothesis that US firms use unconsolidated subsidiaries in order to reduce the parent firm's effective capitalization rate. Most of the large firms examined in Mian and Smith (1990), however, are not banks and hence do not face incentives to increase their de facto leverage by using off-balance-sheet financing so as to shift risk towards the financial safety net.

The contribution of this paper is to show that small US BHCs were able to use nonconsolidated financial institutions to increase their effective leverage resulting in additional BHC risk. Importantly, our empirical results provide lessons about the appropriate method and size of the adjustment of BHC capitalization for investments in nonconsolidated banking firms that translate to large BHCs as well. In particular, our research shows that leverage ratio adjustments following a pro rata consolidation better reflect the risks associated with nonconsolidated banking subsidiaries than leverage ratios adjustments following a deduction approach. This finding suggests that the direction of pertinent regulatory reform at the Basel level has been misguided, as Basel II generally provided a choice between pro rata consolidation and deduction, while Basel III prescribes a deduction approach (see Basel Committee on Banking Supervision, 2006 and 2010).

The remainder of the paper is organized as follows. Section 2 discusses the accounting and regulatory treatment of minority-owned banking affiliates in the US. Section 3 compares the 'decompression' and 'deduction' methods of adjusting a bank's reported capital for its minority-owned affiliates.. Section 4 discusses the data. Section 5 presents empirical evidence of the relationships between BHC risk variables and computed gaps between reported and adjusted BHC leverage ratios to reflect the minority ownership of banking institutions. Section 6 concludes.

2. Accounting and regulatory treatment of minority-owned banks in the US

According to US GAAP, parent banks need to consolidate the subsidiaries that they unilaterally control as indicated by Accounting Research Bulletin (ARB) 51 issued in 1959. As traditionally interpreted, majority ownership of a subsidiary, defined as an ownership share of common stock exceeding 50%, is taken to imply control.⁷

Whether or not a subsidiary is consolidated into the parent's balance sheet may have little impact on the parent firm's requirement to stand behind its subsidiary. According to the Federal Reserve Board's 'source of strength' principle, BHCs are expected to support their distressed banking affiliates and to effectively guarantee their liabilities with their own capital.⁸ Accordingly, Gilbert (1991) finds that very large BHCs tend to inject more capital into their distressed subsidiaries than other bank owners inject into their banks as evidence that these BHCs act as a source of strength. Similarly, Ashcraft (2008) shows that distressed banks affiliated with a multi-bank holding company receive more capital, recover more quickly and are less likely to fail over the next year than other banks. These two studies do not distinguish between consolidated and nonconsolidated affiliates, but there is no reason why the source of strength principle should not apply to nonconsolidated banking affiliates.

⁷ According to the glossary of the FR Y-9C report, a majority-owned subsidiary of the reporting holding company is a subsidiary in which the parent bank directly or indirectly owns more than 50 percent of the outstanding voting stock. On the other hand, minority ownership takes the form of an associated company or a joint venture, which are not required to be consolidated into the parent's balance sheet. An associated company is a corporation in which the bank, directly or indirectly, owns 20 to 50 percent of the outstanding voting stock and over which the bank exercises significant influence. A corporate joint venture is a corporation owned and operated by a group of banks or other businesses, no one of which has a majority interest. The equity ownership in associated companies and joint ventures shall be accounted for using the equity method of accounting.

⁸ A summary of the doctrine can be found in Gilbert (1991). A legal reference is the Federal Deposit Insurance Corporation Improvement Act of 1991, Sec. 38A, stating: "SOURCE OF STRENGTH. (a) HOLDING COMPANIES.--The appropriate Federal banking agency for a bank holding company or savings and loan holding company shall require the bank holding company or savings and loan holding company to serve as a source of financial strength for any subsidiary of the bank holding company or savings and loan holding company that is a depository institution. (b) OTHER COMPANIES.--If an insured depository institution is not the subsidiary of a bank holding company or savings and loan holding company, the appropriate Federal banking agency for the insured depository institution shall require any company that directly or indirectly controls the insured depository institution to serve as a source of financial strength for such institution."

There thus is little, if any, scope for BHCs to use nonconsolidated, minority-owned affiliates to offload asset risk.⁹

To prevent capital regulatory arbitrage related to investments in nonconsolidated subsidiaries, the US Bank Holding Company Act stipulated that one-half of the aggregate investments in unconsolidated banking subsidiaries had to be deducted from Tier 1 capital (and the other one-half from Tier 2 capital) during our sample period. Importantly, however, this regulation only applied to large BHCs. More broadly, small BHCs have been exempt from the risk-based capital regulations applicable to large BHCs and commercial banks, and also from the minimum leverage ratio requirement, which specified that the ratio of Tier 1 capital to total assets should be no less than 3%.¹⁰

The different regulatory approaches to large and small BHCs have also been reflected in the regulatory reports that BHCs have been required to file with the Federal Reserve. Specifically, large BHCs have been filing form FR Y-9C, which required a deduction of half of nonconsolidated investments in banking and finance subsidiaries from Tier 1 capital. Small BHCs instead have filed form FR Y-9SP which does not require BHCs to report a Tier 1 capital measure reflecting such a deduction.

Similarly to small BHCs, commercial banks also were not required to adjust their

⁹ In line with this, the Bank Holding Company Act states that “experience has shown that banking organizations stand behind the losses of affiliated institutions, such as joint ventures and associated companies, in order to protect the reputation of the organization as a whole. In some cases, this has led to losses that have exceeded the investments in such organizations.”

¹⁰ The exemption of small BHCs from the minimum leverage ratio requirement is stated as follows: “The tier 1 leverage guidelines apply on a consolidated basis to any bank holding company with consolidated assets of \$500 million or more. The tier 1 leverage guidelines also apply on a consolidated basis to any bank holding company with consolidated assets of less than \$500 million if the holding company (i) is engaged in significant nonbanking activities either directly or through a nonbank subsidiary; (ii) conducts significant off-balance sheet activities (including securitization and asset management or administration) either directly or through a nonbank subsidiary; or (iii) has a material amount of debt or equity securities outstanding (other than trust preferred securities) that are registered with the Securities and Exchange Commission. The Federal Reserve may apply the tier 1 leverage guidelines at its discretion to any bank holding company, regardless of asset size, if such action is warranted for supervisory purposes.” See <https://www.fdic.gov/regulations/laws/rules/7500-4500.html#fdic7500appendixd> . The threshold of \$ 500 million for a BHC to be large applied from March 2006, and was subsequently raised to \$ 1 billion in March 2015 (see Appendix A).

reported Tier 1 capital for any nonconsolidated investments in banking and finance subsidiaries during the 2000-2013 period in the Call reports filed with the Federal Financial Institutions Examinations Council (FFIEC). Commercial banks, however, have been required to make such adjustments since March 2014, when Basel III started to be implemented in the US (see Appendix A for details on the regulatory reporting requirements as to the Tier 1 capital measures that have applied to US BHCs of different sizes, and to commercial banks during the 2000-2014 period).

Small BHCs continue to be exempt from Basel III, and also from any requirement to adjust their capitalization for their investments in minority-owned affiliates. According to Killian (2015), there were 4,248 ‘small’ BHCs with assets less than \$ 1 billion at the end of 2014, representing 88.0% of the total number of BHCs. These small BHCs had combined assets of \$ 436 billion, amounting to 2.4 % of the total assets of BHCs. These figures indicate that small BHCs constitute a material share of the US banking market.¹¹

In the empirical work below, we examine the relationship between BHC risk and investments in nonconsolidated banking subsidiaries for a sample of small BHCs. Data limitations prevent us from conducting a similar analysis for a sample of large BHCs to see whether the regulation in force applicable to large BHCs was adequate to eliminate capital arbitrage opportunities. However our analysis of small BHCs also provides insights into the appropriate capital regulatory treatment of minority investments for large BHCs.

3. Adjusting the leverage ratio for minority-owned subsidiaries

In this section, we examine the ‘decompression’ and ‘deduction’ methods of adjusting a parent bank’s reported leverage ratio for its minority-owned subsidiaries. Specifically, we

¹¹ Killian (2015) discusses a range of strategies that banks can use to reduce their effective capitalization through the use of a small BHC structure, including letting the small BHC (rather than any subsidiary bank) invest in financial institution capital instruments.

outline and compare the two methods for the case of a parent bank that is a minority owner of a single subsidiary. A description of how these two adjustment methods can be extended to deal with more complicated banking structures is provided in Appendix B.

The parent is assumed to report its minority ownership of the subsidiary as an investment among other assets. The parent bank act as a source of strength for its subsidiary, which implies that the parent's equity is required to absorb any losses stemming from the assets of the subsidiary proportionally to the parent's ownership share of the subsidiary.

The parent has assets, A_p , liabilities, L_p , and equity, E_p . The reported leverage ratio of the parent, λ_p , is given by E_p/A_p . Similarly, the subsidiary has assets, A_s , liabilities, L_s , and equity, E_s , with a reported leverage ratio, λ_s , given by E_s/A_s .

The parent owns a share α of the equity of the subsidiary, implying an equity investment of αE_s in the subsidiary. The parent's ownership share is assumed to be non-controlling, i.e. $\alpha \leq 50\%$, so that the subsidiary is not consolidated. Instead, the equity investment of αE_s is carried as an investment implying the parent's outside assets, A_p^o , are equal to $A_p - \alpha E_s$. Figure 1, Part A and Part B, display the balance sheets of the parent and the subsidiary, respectively.

The decompression method of adjusting the parent's reported leverage ratio for its minority-owned subsidiary pro forma consolidates the minority-owned subsidiary with the parent bank proportionally to the parent banks ownership share, α .¹² Specifically, on the parent's balance sheet we replace the equity investment, αE_s , by the proportionally owned subsidiary assets, αA_s , given rise to assets for the decompressed parent equal to $A_p +$

¹² Consolidation of the subsidiary's assets on the parent bank's balance in proportion to the ownership share α provides a more accurate picture of the asset exposure of the parent bank's equity holders than full consolidation. Consolidation of a majority-owned subsidiary according to GAAP implies fully placing the assets and liabilities of the subsidiary on the parent's balance sheet. The minority equity ownership of the subsidiary by third parties is placed within equity, but separate from the parent's equity according to an amendment of ARB 51 by the FSAB in 2008.

$\alpha(A_s - E_s)$. The leverage ratio after decompression, $\lambda_{p,c}$, is defined as the parent's reported equity divided by its decompressed assets. Hence, $\lambda_{p,c} = \frac{E_p}{A_p + \alpha(A_s - E_s)}$, or equivalently

$$\lambda_{p,c} = \frac{\lambda_p}{1 + \alpha\rho(1 - \lambda_s)} \quad (1)$$

where ρ is the relative asset size of the subsidiary, i.e. A_s/A_p . The extension of the balance sheet through decompression implies that the leverage ratio after decompression is less than the parent's reported leverage ratio, i.e. $\lambda_{p,c} < \lambda_p$.¹³

In the empirical work, we will use two measures of the reduction in the leverage ratio brought about by decompression. First, we consider the absolute adjustment of the reported leverage ratio, $\delta_{c,a}$, given by $\lambda_p - \lambda_{p,c}$ or $\lambda_p - \frac{\lambda_p}{1 + \alpha\rho(1 - \lambda_s)}$. Second, the relative adjustment, $\delta_{c,r}$, is computed as $\frac{\lambda_p - \lambda_{p,c}}{\lambda_p}$ or $1 - \frac{1}{1 + \alpha\rho(1 - \lambda_s)}$.

Alternatively, the deduction method adjusts the parent's reported capital for its minority-owned subsidiary by deducting the equity investment in the subsidiary, αE_s , from the parent's reported capital, E_p , yielding an adjusted capital, $E_p - \alpha E_s$. The leverage ratio after deduction, $\lambda_{p,d}$, is computed as the ratio of the parent's adjusted equity to its reported assets, or $\frac{E_p - \alpha E_s}{A_p}$ which implies

$$\lambda_{p,d} = \lambda_p - \alpha\rho\lambda_s \quad (2)$$

Deduction also yields a lower leverage ratio than the parent's reported leverage ratio, i.e. $\lambda_{p,d} < \lambda_p$. We can again construct two measures of the reduction in the parent's reported leverage ratio brought about by deduction. First, the absolute adjustment $\lambda_p - \lambda_{p,d}$, denoted,

¹³ The leverage ratio after decompression, $\lambda_{p,c}$, declines with the subsidiary's relative size, ρ , but increases with its reported leverage ratio, λ_s .

$\delta_{d,a}$, is given by $\alpha\rho\lambda_s$, while the relative adjustment $\frac{\lambda_p - \lambda_{p,d}}{\lambda_p}$, denoted $\delta_{d,r}$, is given by $\alpha\rho \frac{\lambda_s}{\lambda_p}$.

The deduction method is in principle easier to implement than the decompression method, as the only information about the subsidiary that is required is the parent's equity investment in the minority-owned subsidiary as reported on the parent's balance sheet, while the decompression method in addition requires information about the subsidiary's assets. The facility of the deduction method may explain that relevant US regulations require banks to use a deduction method rather than a decompression method.

A disadvantage of the deduction method, however, is that it is a rather crude way to adjust the parent's reported capital for its minority-owned subsidiary relative to the decompression method. To see this, note that the decompression method is 'correct' on the assumption that the subsidiary's assets and the parent's outside assets are similar in terms of risk and return, implying that proportionally equal amounts of outside capital are required to support the two sets of outside assets.¹⁴

Comparing the two methods, we can consider the 'bias' the deduction method introduces in the adjusted leverage ratio after deduction relative to the 'correct' leverage ratio after decompression. Specifically, this 'bias', Δ , is the difference between the leverage ratios after deduction and after decompression, i.e., $\lambda_{p,d} - \lambda_{p,c}$, which implies

$$\Delta = \lambda_p - \alpha\rho\lambda_s - \frac{\lambda_p}{1 + \alpha\rho(1 - \lambda_s)} \quad (3)$$

The difference, Δ , can be either positive or negative, depending on the parameters α ,

¹⁴ A shortcoming of our leverage ratio adjustment measures is that they ignore the existence of any internal debt relationships between the bank and the subsidiary. We do not take into account internal debt, as US banks are not required to report their internal debt financing on the regulatory reports that we use in this study.

λ_s , λ_p , and ρ . For the benchmark case of equal reported leverage ratios of the parent and the subsidiary, i.e. $\lambda_s = \lambda_p$, we have $\Delta < 0$, indicating that the leverage ratio resulting from deduction is less than the leverage ratio resulting from decompression. This suggests that the deduction method on average will yield an adjusted leverage ratio that is too low. Our calculations in the empirical section confirm that the leverage ratio with deduction on average is lower than the leverage ratio after decompression.

In Table 1, we present a numerical example where we calculate the leverage ratio adjustments under decompression and deduction for a parent bank with a single minority-owned subsidiary bank.

4. The data

BHCs are required to report information on their organizational structures via form FR Y-6 and changes in organizational charts via form FR Y-10. This structural information can be represented as a series of ownership relationships where each relationship is characterized by a parent institution, a subsidiary institution, a percentage of direct ownership, a starting date, and an ending date, if applicable. Information on ownership relationships among US financial institutions along these lines is collected in the control relationship database available from the National Information Center (NIC) repository. Using these ownership relationships, we have reconstructed the hierarchies of US BHCs on a quarterly basis over the years 2000-2013, preceding the introduction of new US regulations to adjust a commercial bank's equity for investments in minority-owned financial institutions in the first quarter of 2014 as reflecting in the Call report.

Our assemblage results in 8,179 top-tier BHCs, and 43,137 top-to-bottom ownership chains. Chains vary in length, with the longest chain having 12 layers including the top-tier BHC. Next, we restrict the sample to small top-tier BHCs that file report FR 9-SP rather than

report Y9-C, as only small BHCs are exempt from constructing and reporting a leverage ratio that is adjusted for investments in minority-owned subsidiaries. This reduces the sample to 5,258 top-tier BHCs that have 9,463 top-to-bottom ownership chains with a maximum length of 6 layers.

The hierarchies can harbor a range of financial institutions, including BHCs, national banks, non-member banks, and foreign banks.¹⁵ Appendix C provides a classification of financial institutions active in the US. Importantly for our analysis, some types of financial institutions, but not all, are required to report accounting information to US regulators including their equity and assets. BHCs, national banks, and non-member banks, for instance, are required to file standard regulatory reports, while foreign banks are not (see Appendix C).

Our leverage ratio adjustments only take into account minority-owned affiliates that are required to file regulatory reports providing accounting data, as we need basic accounting data for the subsidiary to adjust the parent's leverage ratio through either decompression or deduction.¹⁶ Based on only reporting subsidiary financial institutions, we can divide the top BHCs into two groups based on whether they have at least one minority-owned financial institution somewhere in the overall hierarchy. Based on this criterion, we can distinguish 268 small top-tier BHCs with minority ownership, and 5,048 small top-tier BHCs without such ownership.¹⁷ Figure 2 shows that BHCs with minority-owned affiliates are relatively complex, as these banks' distribution of the number of layers indicates relatively more layers. In fact, banks with and without minority ownership have on average 2.9 and 2.2 layers.¹⁸

¹⁵ A national bank is a commercial bank with a charter approved by the Office of the Comptroller of the Currency (OCC) rather than by a state banking department. National banks are required to be members of the Federal Reserve System and belong to the Federal Deposit Insurance Corporation. A non-member bank is a commercial bank that is state-chartered and not a member of the Federal Reserve System.

¹⁶ Our adjustments of the parent's reported leverage ratio for its ownership of minority-owned financial institutions may be too small as we ignore minority ownership of non-reporting financial institutions, in particular foreign financial institutions. Similarly, we ignore the parent's minority ownership of any non-financial firms.

¹⁷ 58 small top-tier BHCs had minority ownership in certain periods and then switched to majority ownership over our sample period.

¹⁸ Previously Avraham, Selvaggi, and Vickery (2012) have presented statistics on the complexity of US bank

Similarly, Figure 3 shows that BHCs with minority-owned affiliates have a distribution of the number of affiliates implying relatively many affiliates. BHCs with and without minority-owned affiliates have on average 3 and 1.6 affiliates.

For BHCs with minority ownership, we aim to adjust the reported leverage ratio through applying the decompression and deduction methods. To do the decompression, we need to have information on the equity and assets of pertinent affiliates in the hierarchies as well on their ownership relationships, while the deduction approach only requires information on the parent's investments in their minority-owned affiliates, calculated as the ownership share of a subsidiary by the parent times the equity of a subsidiary. Accounting data are matched to all reporting financial institutions in the hierarchies using information from the Y9-SP forms and the Call Report.¹⁹ This results in semi-annual data, as small BHCs file the FR Y-9SP report on a semi-annual basis.

We consider our attempt to adjust a BHC's reported leverage ratio through decompression successful only if we can complete the pro forma consolidation for all reporting minority-owned financial affiliates located anywhere in the BHC's hierarchical structure.²⁰ Obstacles we can encounter are missing accounting data for a reporting minority-owned subsidiary (despite the reporting requirement), missing ownership data in the control relationship database, and, not least, non-reporting financial institutions positioned somewhere in the tree above a reporting minority-owned subsidiary that 'blocks' its consolidation. Our requirement that we need to be able to consolidate all reporting minority-owned affiliates in practice means that we can only complete the decompression for BHCs with relatively small banking hierarchies.

holding companies without making a distinction between majority-owned and minority-owned affiliates.

¹⁹ For small BHCs, consolidated assets are available from form Y-9SP, while for banks consolidated assets are available from form the Call Report.

²⁰ We also disregard observations where the parent BHC experiences asset growth higher than 200% or has a reported leverage ratio in excess of 70%.

In fact, we are able to complete the decompression for a sample of 93 top-tier BHCs, yielding 635 BHC-quarter observations. These BHCs on average report a capital ratio of 0.1004, while the average leverage ratio after decompression is 0.0637 as shown in Panel A of Table 2 (see Appendix D for variable descriptions and data sources).²¹

Figure 4 shows time plots of the average yearly reported leverage ratio and the leverage ratio after decompression over the 2000-2013 period. Both peaked before the crisis in 2005, and went down during the crisis and its aftermath. Interestingly, the leverage ratio after decompression appears to be more stable over time than the reported leverage ratio, which suggests that some of the time variation of the reported leverage ratio materializes on account of varying ownership of minority-owned financial institutions. The average difference between the reported leverage ratio and the leverage ratio after decompression is 0.0367, or 36.6% of the reported leverage ratio.

Figure 5 plots the time trends of the absolute and relative adjustments of the leverage ratio following decompression. These adjustments are seen to have peaked in 2005, and to have declined subsequently as evidence of reduced use of minority-owned financial affiliates driving a wedge between the reported and adjusted leverage ratios.

Figure 6 plots the leverage ratio after decompression against the reported leverage ratio using biannual data. As discussed before, small BHCs have been exempt from a formal leverage ratio requirement. All the same, the figure is instructive as to how small BHCs could have used investments in nonconsolidated banking affiliates to circumvent a hypothetical leverage ratio requirement of 0.03 if it had been in place. Specifically, there are 66 observations in the figure (out of 635) where the reported leverage ratio exceeds 0.03 but where the leverage ratio after decompression is less than 0.03. These BHCs would be problematic from a regulatory point of view if a leverage ratio requirement existed, as they

²¹ Note that these averages are for the observations in the regressions reported in Table 2.

meet a hypothetical leverage requirement of 0.03 on the basis of the reported leverage ratio, but not on the basis of the leverage ratio after decompression.

The sample of BHCs to which we can successfully apply the deduction method is somewhat larger, as deduction only requires information on ownership relationships and on the equity of minority-owned affiliates. We can apply the deduction method to 131 top BHCs with minority-owned financial institutions, providing a sample of 958 semi-annual observations. The average calculated deduction from the leverage ratio is 0.0513 as seen in Panel B of Table 2, somewhat larger than the average reduction in the leverage ratio of 0.0367 if decompression is applied. In specific cases, however, the deduction method gives rise to a smaller downward adjustment of the leverage ratio than the decompression method, as suggested by the theoretical analysis of section 3. To illustrate this, Figure 7 plots the leverage ratio after deduction (relative to the reported leverage ratio) against the leverage ratio after decompression (relative to the reported leverage ratio) for banks where both adjustment methods can be applied. For observations above the 45°-line, the deduction method gives rise to a smaller adjustment to the reported leverage ratio than the decompression method. The majority of the observations are below this line, indicating that the deduction method gives rise to a relatively large downward adjustment in the leverage ratio.²²

In the empirical work, we examine whether bank risk reflects effective capitalization obtained through decompression or deduction. We consider two indices of bank risk. First, the Z-score is a measure of bank solvency that reflects the number of standard deviations that a bank's return on assets can fall below its average level before the bank becomes insolvent (see Roy, 1952). The Z-score is calculated as the logarithm of the sum of the return on assets and the equity to assets ratio divided by the standard deviation of the return on assets

²² The figure does not show that the leverage ratio after deduction is negative for 219 (out of 958) observations.

(calculated using a rolling window of three biannual observations). Second, earnings volatility is calculated as the standard deviation of the return on equity based on three biannual observations.

A nice feature of the Z-score is that it is not affected by the consolidation of minority-owned financial institutions as long as the outside assets of the parent and the financial affiliates are uniform (so that there is no change in the relative valuation of these assets over time). In that instance, consolidation simply blows up the assets of the parent bank by a constant factor in each period, leaving the calculated Z-score unchanged (as the return on assets, the equity to assets ratio, and the standard deviation of the return on assets are all scaled by assets). Earnings volatility is neutral to the degree of consolidation even more broadly, as neither yearly earnings nor the parent's equity are affected by consolidation by way of decompression.

While being unaffected by consolidation, the Z-score and earnings volatility do reflect the BHC's overall risk (which stems from the bank's overall outside assets) relative to the parent BHC's equity. A BHC with minority-owned affiliates, in particular, will carry the economic risk of relatively more outside assets for a given amount of equity, and hence should display a lower Z-score and higher earnings volatility. To test this, in the empirical work we relate the Z-score and earnings volatility to our leverage ratio adjustments calculated using either the decompression or deduction methods, as proxies for the intensity of a bank's use of minority-owned financial institutions. We hypothesize that a bank's Z-score (earnings volatility) will be lower (higher) the larger the calculated capital adjustments while controlling for the parent banks' reported leverage ratio.

The regressions include four BHC-level control variables. First, size is calculated as the logarithm of total assets.²³ A larger BHC may be less risky due to greater asset

²³ The few reported items in form Y-9SP limit our choice of control variables.

diversification. Second, asset growth is the growth rate of assets divided by the GDP deflator. Faster growing BHCs may be more risky, as fast growth may only be realizable at a cost of a more risky loan portfolio and other bank investments. Third, concentration measures the share of a BHC's assets in the aggregate assets of all banks in a county. BHCs with a larger market share may be either less or more risky.²⁴ Finally, number of offspring is total number of offspring at various levels regardless of equity ownership.

Panels A and B of Table 3 provide correlations among the bank risk, capitalization, and control variables for the samples of banks to which we have been able to apply the decompression and deduction methods, respectively.

To conclude this section, it is interesting to consider how the BHC and banking market characteristics that serve as controls in the basic regression analysis correlate with whether a BHC has a minority-owned subsidiary and also with the share of minority-owned affiliates in total affiliates.²⁵ These correlations are displayed in Table 4. It is seen that BHC size correlates positively with the existence of a minority-owned subsidiary, but negatively with the share of minority-owned affiliates. The total number of offspring in turn is positively correlated with the existence of a minority-owned subsidiary as well as with the share of minority-owned affiliates.

5. Empirical results

In this section, we examine empirically the relationships between BHC risk, as proxied by the Z-score and earnings volatility variables, and the non-consolidation of minority-owned

²⁴ Hellman, Murdoch, and Stiglitz (2000) argue that less competition induces prudent investments of banks in a static setting. Keeley (1990) find in a dynamic model that monopoly rents are conducive to bank stability. On the contrary, Boyd and De Nicolo (2005) argue that banks with monopoly power can extract rents by charging higher loans rates, which worsens the problem of moral hazard at the borrower level. As a consequence, market power may render bank more risky.

²⁵ Overall 268 out of 5,258, or 5.1%, of small BHCs have a minority-owned subsidiary, and 2.3% of affiliates is minority-owned, i.e. with an ownership share of 50% or less.

financial institutions, as reflected in calculated capital adjustments following the decompression and deductions methods. The regressions include the reported leverage ratio as one of the control variables. Further, semi-annual fixed effects are included, and standard errors are clustered at the BHC level.

We start with considering regressions that include capital adjustments following decompression for the sample of BHCs to which decompression can be applied in Table 5. In regressions 1-6, the Z-score is the dependent variable.²⁶ In regression 1, the reported leverage ratio obtains a positive coefficient of 3.315 that is significant at 5%, while the relative reduction following decompression obtains a negative coefficient of -1.570 that is significant at 1%. The negative coefficient for the relative capital adjustment variable suggests that the use of minority-owned affiliates increases bank risk. To assess the economic importance of this effect, we can consider a one standard deviation increase in the relative capital adjustment of 0.177, which reduces the Z-score by 0.278 ($=0.177*1.570$) amounting to 32% of the standard deviation of the Z-score of 0.862. This is a material effect. Among the control variables, the Z-score is negatively and significantly related to the concentration variable. A negative relationship between the Z-score and a bank's market share is in line with research by Boyd and De Nicolo (2005) who find that banks with higher market power are riskier. In regression 2, we alternatively include the absolute reduction in the leverage ratio following decompression, yielding a negative coefficient of -3.926 that is insignificant.

Next, we consider the relationship between the Z-score and our capital adjustment variables separately for the pre-crisis period 2000q1-2007q2, and the crisis-and-aftermath period 2007q3-2013q4 to reflect that banks faced a more volatile environment during the crisis. Regressions 3-4 and 5-6 reflect the pre-crisis, and crisis and subsequent periods,

²⁶ All variables except number of offspring are winsorized at the 1% and 99% levels to reduce the influence of outliers.

respectively. For the pre-crisis sample, the relative capital adjustment variable is negative and significant in regression 3. For the crisis-and-aftermath sample, the relative and absolute capital adjustments following decompression are both estimated with negative and significant coefficients in regressions 5 and 6, respectively.

In regressions 7-12, the dependent variable is earnings volatility in regressions that are analogous to 1-6. In regression 7, the estimated coefficient for the relative capital reduction variable is positive and significant, suggesting that BHCs that make use of nonconsolidated financial affiliates are relatively risky. To examine the economic magnitude of the effect, we can see that a one standard deviation increase in the relative reduction of 0.177 implies an increase in earnings volatility of 0.019 ($= 0.177 * 0.107$), which is 26% of the standard deviation of earnings volatility of 0.074 amounting to a material effect. In regression 8, the absolute capital reduction also obtains a positive and significant coefficient. In regressions 9 and 11, the relative capital adjustment variables obtain positive and significant coefficients for the pre-crisis and crisis-and-aftermath samples, respectively.

In Table 6, we show analogous Z-score and earnings volatility regressions for an enlarged sample that includes all top-tier BHCs that do not report any minority-owned affiliates. The included relative and absolute reductions of the leverage ratio after decompression are statistically significant in all regressions in the table apart from regressions 1 and 3, providing additional evidence that nonconsolidated banking affiliates entail risks that are not reflecting in the reported leverage ratio. One caveat to these results, however, is that BHCs to which decompression can be applied and BHCs without minority ownership differ significantly in their size and other characteristics, as evident from Table 4. This suggests that this estimation may be subject to selection bias.

As a remedy, we next consider a sample consisting of banks to which decompression is applied as well as banks without minority ownership constructed by applying propensity

score matching. To estimate the propensity scores, we use a probit model of a dummy variable that takes a value of 1 for a bank to which decompression has been applied, and zero otherwise. The explanatory variables are the set of bank-level controls in our estimations, i.e. the reported leverage ratio, size, asset growth, concentration, and the number of offspring. Having estimated the propensity score, we year by year match the set of decompressed banks with those banks without minority ownership that are closest in their propensity scores. We impose the common support condition that prohibits the perfect predictability of decompression given the observed covariates to ensure the existence of potential matches in the group of banks without minority ownership. In the end, we obtain a PSM sample composed of 78 decompressed bank and 406 banks without minority ownership.²⁷ Columns 4-6 of Table 7 shows that decompressed and non-decompressed banks in the PSM sample have average bank characteristics that do not differ significantly.

Table 8 shows the results of bank risk regressions analogous to Table 5 for the PSM sample. The relative adjustment with decompression variable is estimated with insignificant coefficients, while the absolute adjustment with decompression variable has negative and significant coefficients in the Z-score regressions 2 and 6, and has positive and significant coefficients in the earnings volatility regressions 8 and 12. Hence, there is evidence that the leverage adjustment following decompression explains BHC risk after we control for differences in observed BHC characteristics between the groups of decompressed bank and banks without minority ownership.

The sizes of the estimated coefficients in regressions 2, 6, 8, and 12 inform about the magnitude of the capital deductions, as shares of the calculated absolute leverage adjustments after decompression, that are necessary to control for the additional risk stemming from

²⁷ We have 523 bank-year observations for the group of 78 decompressed banks. Note that a decompressed bank may be matched with a number of different banks without minority ownership in different years.

nonconsolidated banking affiliates. For these four regressions, the ratios of the coefficients on the absolute adjustment with decompression range and the reported leverage ratio and between 0.62 and 0.91. This suggests that the share of investments in nonconsolidated banking affiliates to be deducted from Tier 1 capital should be in the 0.62-0.91 range to adequately control for the additional risk. This estimated range is somewhat larger than the 50% of investments in nonconsolidated banking affiliates that large BHCs were required to deduct from their Tier 1 capital during most of the sample period (see Appendix A).

Next, we examine how bank risk is related to capital adjustments calculated using the deduction method as potential indices of the deployment of minority-owned affiliates. Table 9 presents the results of BHC risk regressions including capital adjustment variables following the deduction method that are analogous to Table 5. In section 3, we argued that the decompression method is expected to yield more accurate capital adjustments than the deduction method. For this reason, we expect stronger relationships between BHC risk variables and capital adjustment variables if decompression rather than deduction is applied. Comparing Tables 5 and 9, this seems to be the case. The relative capital adjustment variable is negative and significant in Z-score regression 3, while the absolute (relative) capital adjustment variable is positive and significant in regressions 8 and 12 (regression 9). This shows that capital adjustments under deduction are useful in explaining bank risk, but the evidence is less strong than in Table 5. The relative capital adjustment variable, for instance, fails to be significant in the Z-score regression 1 of Table 9, while it is significant in the corresponding regression in Table 5.

A shortcoming in comparing Table 5 based on capital adjustments following decompression with Table 9 based on capital adjustments following deduction is that the samples of BHCs differ. This follows from the fact that the deduction method can be applied to relatively more BHCs, as it requires less information. To remedy this, we performed bank

risk regressions including capital adjustment variables following the deduction method, but based on the sample of BHCs in Table 5 for which decompression as well as deduction are possible. In these unreported regressions, the included capital adjustment variable is significant at 10% in the corresponding regressions 3, 8 and 9 (with negative, positive, and positive coefficients, respectively). This provides additional evidence that capital adjustment following deduction is related to BHC risk taking. This evidence, however, is rather weak compared to the evidence of Table 5. This suggests that capital adjustments following decompression more accurately explain bank risk than the corresponding adjustments following deduction as motivated in section 3.

6. Conclusions

Small US BHCs do not need to consolidate their minority-owned financial affiliates. As a result, their effective rate of capitalization is lower than the reported one. In this paper, we consider two methods to adjust the capitalization rates of financial institutions for their minority-owned affiliates. First, one can pro forma consolidate the minority-owned financial institutions onto the balance sheet of the parent institutions. Second, one can deduct the parent institution's equity investments in minority-owned financial institutions from the parent's equity. Both methods lead to downward adjustments in leverage ratios.

We argue that effective consolidation of minority-owned financial affiliates is the preferred method of adjusting reported leverage ratios. In fact, relative to this consolidation method, the deduction method produces biases in the adjustment that can be either positive or negative, depending on the exact structure of the overall financial institution. For the case of equal leverage ratios of a parent and a single minority-owned subsidiary, we show that the deduction method leads to a downward adjustment in the leverage ratio that is too large.

For a sample of small US BHCs in the 2000-2013 period, we calculate the downward

adjustment in the leverage ratio using the two methods, showing that the downward adjustment using the deduction method on average is larger.

Empirically we find that BHC risk, as reflected in the Z-score and earnings volatility, is positively related to calculated downward adjustments in bank capitalization while controlling for reported capitalization. This implies that reported capitalization does not adequately reflect BHC risk as generated by minority-owned affiliates, and that small BHCs have been able to increase their riskiness for a given level of capitalization by maintaining nonconsolidated investments in banking affiliates.

Overall, we find that capitalization adjustments using pro rata consolidation better reflect BHC risk than the alternative adjustments using the deduction method. This suggests that regulatory capitalization adjustments ideally follow a pro forma consolidation approach rather than the more simple deduction approach. As a corollary, the direction of recent regulatory reform at the Basel level appears to be misguided, as Basel II generally provided a choice between pro rata consolidation and deduction, while Basel III prescribes a deduction approach. Our estimated coefficients suggest that a share between 50% and 100% of any calculated capital adjustment should be subtracted from a parent institution's equity to adequately control for the additional risks.

Throughout the Basel II period, the US required large BHCs to implement a deduction for their unconsolidated investments in banking and finance subsidiaries consistent with Basel II. However, there were no corresponding deductions for small BHCs and banks filing Call reports. From March 2014, the US has been implementing Basel III and its deduction regime in the cases of large BHCs and banks (see Federal Reserve Board, 2013).²⁸ This reform in principle eliminates capital arbitrage opportunities related to nonconsolidated banking

²⁸ The European Union correspondingly adopted a regulation on prudential requirements for credit institutions in 2013 including required deductions from common equity Tier 1 for investments in nonconsolidated financial sector entities (see European Commission, 2013, section 3).

subsidiaries that were previously available to commercial banks. Small BHCs, however, continue to be exempt from any systematic risk-based capital requirements or formal leverage ratio requirement, and hence also from any capital deductions for their investments in minority-owned banking affiliates.

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Appendix A. Regulatory treatment of nonconsolidated investments

This appendix summarizes US regulation as to whether US BHCs and commercial banks had to apply deductions from Tier 1 capital for their nonconsolidated *investments in banking and finance subsidiaries* over the 2000-2014 period. Information on this is collected from official documents and regulatory forms that BHCs and commercial banks had to file over this period.

A distinction is made between:

- Large BHCs that had to file report **FR Y-9C** to the Federal Reserve
- Small BHCs that had to file report **FR Y-9SP** to the Federal Reserve
- Commercial banks that had to file **Call reports** to the Federal Financial Institutions Examinations Council (FFIEC)

The asset threshold for requiring a BHC to file report FR Y-9C for ‘large BHCs’ increased from \$ 150 million to \$ 500 million in March 2006 (and it was subsequently raised to \$ 1 billion in March 2015). Reporting requirements for large BHCs, small BHCs and commercial banks are summarized in turn.

Large BHCs

In 2000, large BHCs reported capital information in **Schedule HC-I—Risk-Based Capital**. No deduction for nonconsolidated *investments in banking and finance subsidiaries* was required.

From March 2001 to December 2013, **Schedule HC-R—Regulatory Capital** requires a deduction of 50% of nonconsolidated *investments in banking and finance subsidiaries* in item 10, i.e., other additions to (deductions from) Tier 1 capital. During this period, large BHCs are not required to make a deduction for *investments in financial subsidiaries* (which relate to non-banking financial activities that are beyond the scope of this study).

Starting in March 2014, **Schedule HC-R—Regulatory Capital** has two parts. Part A is the same as the historical format during 2001-2013, whereas part B has more items and requires richer information. The holding companies using the advanced approach fill out part B, whereas other holding companies continued to use part A until the end of 2014. As of March 2015, part A was abolished and every BHC used only part B.

In part A, BHCs are to report a deduction from Tier 1 capital of 50% of their *investments in banking and finance subsidiaries* that are not consolidated in item 10. Alternatively, in part B deductions vary depending on several thresholds regarding the investment.²⁹

²⁹ In particular, a distinction is made between non-significant and significant investments as follows. A banking organization has a non-significant investment in the capital of an unconsolidated financial institutions in the form of common stock, if it owns equal to or less than 10% of common stock of the unconsolidated affiliate.

- If aggregate amount of the banking organization’s non-significant investments in the capital of unconsolidated financial institutions > the 10% threshold of the banking organization’s Common Equity Tier 1 capital after applying certain regulatory adjustments and deductions, then the amount above 10% is deducted from the banking organization’s regulatory capital using the deduction approach, and the amount equal to or below 10% is not deducted and is risk weighted in the usual manner.

Small BHCs

Throughout 2000-2014, small BHCs are not required to report any deductions from Tier 1 capital for investments in either *investments in banking and finance subsidiaries* or *investments in financial subsidiaries*. This implies that during this period there was no systematic regulatory adjustment of the capitalization of small BHCs for such investments.

Commercial banks

During 2000, commercial banks did not report any relevant deductions from Tier 1 capital on **Schedule HC-R—Regulatory Capital**.

From March 2001 to December 2013, **Schedule HC-R—Regulatory Capital** does not require a deduction from Tier 1 capital for nonconsolidated *investments in banking and finance subsidiaries*. However, there is a deduction from Tier 1 capital of 50% of nonconsolidated *investments in financial subsidiaries* from Tier 1 capital in item 10, i.e. Other additions to (deductions from) Tier 1 capital.

Similarly to form **FR Y-9C**, from March 2014 **Schedule HC-R—Regulatory Capital** of the call report has two parts. Part A corresponds to the historical version of 2001-2013, whereas part B has more items and requires richer information. The commercial banks using advanced approaches banks started reporting using B, whereas other banks continued to use part A until the end of 2014. From March 2015, Part A was abolished and every bank reports using the prior part B. In part A, banks are to report a deduction from Tier 1 of capital of 50% of their nonconsolidated *investments in financial subsidiaries* in item 10. Alternatively, in part B deductions vary depending on several thresholds regarding the investment similar those in form FR Y-9C.

From March 31, 2014, Part B of **Schedule HC-R—Regulatory Capital** in both the **FR Y-9C** and **Call Report** requires deductions from Tier 1 capital related to investments in the capital of unconsolidated financial institutions, no longer making a distinction between *investments in banking and finance subsidiaries* versus *investments in financial subsidiaries*.

-
- If the non-significant investments is below the 10% threshold, then the amount is risk weighted in the usual manner.

Alternatively, a banking organization has a significant investment in the capital of an unconsolidated financial institutions in the form of common stock, if it owns more than 10% of common stock of the unconsolidated affiliate.

- For investment in common stock, the banks needs to apply the threshold deduction approach – amount exceeding individual threshold (10% of adjusted Common Equity Tier 1) or aggregate threshold (15% of adjusted Common Equity Tier 1) is deducted from banking organization’s Common Equity Tier 1 capital. Amount not deducted is risk weighted at 250%.
- For other investments not in the form of common stock, amount is fully deducted from banking organization’s regulatory capital using the deduction approach

Sources: Davis Polk, ‘U.S. Basel III Final Rule: Visual Memorandum’, available from <http://www.usbasel3.com>, and Federal Reserve System (2013).

Appendix B. Algorithms to compute adjusted leverage ratios for complex banks

The structure of the bank considered in section 3 is particularly simple as the parent bank has only a single subsidiary. In practice, parent banks tend to have more complex corporate structures with multiple affiliates that are connected to the parent by multi-layered ownership hierarchies. In this subsection, we describe our algorithms for adjusting the reported leverage ratio of a more complex bank using the decompression and deduction methods, starting with the former.

Consider a bank that generally has n layers, including the parent level. Decompression is done from the bottom up. In particular, we first consider whether any subsidiary in the n th layer is minority-owned. If not, we next consider whether there is any minority-owned subsidiary in the $n-1$ th layer, etc. Generally, let $m \leq n$ be the lowest layer where any minority-owned subsidiary is located. This implies that the $m-1$ th layer is the lowest layer where at least one reported assets figure can be adjusted by way of decompression. Consider that a bank in the $m-1$ th layer has K affiliates that are minority-owned. The decompressed assets of the owning bank $A_{m-1,c}$ are then calculated as

$$A_{m-1,c} = A_{m-1} + \sum_{k=1}^K \alpha_k \times (A_{m,k} - E_{m,k}) \quad (\text{A1})$$

where A_{m-1} are the owning bank's reported assets, α_k is the ownership share of subsidiary k , and $A_{m,k}$ and $E_{m,k}$ are the assets and equity of subsidiary k . The assets of all banks in layer $m-1$ that have at least one minority-owned subsidiary are decompressed using (A1).

Next, we move one layer up, i.e. to layer $m-2$. Now consider a bank in this layer that has K minority-owned affiliates and L majority-owned subsidiaries. This bank's assets after decompression, $A_{m-2,c}$, are given by

$$A_{m-2,c} = A_{m-2} + \sum_{k=1}^K \alpha_k \times (A_{m-1,k,c} - E_{m-1,k}) + \sum_{l=1}^L \alpha_l \times (A_{m-1,l,c} - A_{m-1,l}) \quad (\text{A2})$$

where $A_{m-1,k,c}$ and $A_{m-1,l,c}$ are the assets of affiliates k and l after decompression has been considered, i.e. these are the decompressed assets if decompression occurred, and the reported assets if decompression was not indicated. The first summation in (A2) reflects a generalization of the decompression of minority-owned affiliates in (A1) to take into account that the assets of these affiliates may have been decompressed themselves. The second summation in (A2) recognizes that the assets of a majority-owned bank, as already consolidated in the balance sheet of the directly owning parent bank, have to be increased to reflect any prior decompression of its affiliates' assets. The asset adjustment algorithm in (A2) is applied to the reported assets of all banks located in layer $m-2$. The procedure is next applied to all banks in the layer above, and repeated until the assets of the top parent bank have been adjusted. This yields a leverage ratio of the parent after decompression, $\lambda_{p,c}$, as given by

$$\lambda_{p,c} = \frac{E_1}{A_{1,c}} \quad (\text{A3})$$

which generalizes equation (1). The leverage ratio after decompression, $\lambda_{p,c}$, is generally less

than the reported leverage ratio given by $\frac{E_1}{A_1}$.

Next, we describe how the deduction method of adjusting the leverage ratio of the parent bank for minority-owned banks can be generalized to complex banks. Let us consider a bank that has Q minority-owned affiliates that can be located at any layer in the bank (apart from the top layer). In particular, consider a subsidiary q that is located in layer m with equity $E_{s,q}$. The ownership chain from the parent bank to this subsidiary q involves $m - 1$ ownership shares $\alpha_{1,q}, \alpha_{2,q}, \dots, \alpha_{m-1,q}$ from the parent to subsidiary q .

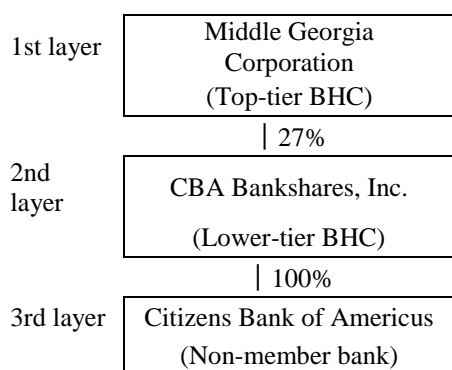
The deduction D_q from the parent's reported equity E_1 to account for minority-owned subsidiary q is computed as $\alpha_{1,q} \times \alpha_{2,q} \times \dots \times \alpha_{m-1,q} \times E_{s,q}$. The parent's adjusted leverage ratio after deduction, $\lambda_{p,d}$, accounts for the deductions required for all Q minority-owned affiliates as follows

$$\lambda_{p,d} = \frac{E_1 - \sum_{q=1}^Q D_q}{A_1} \tag{A4}$$

which generalizes equation (2) in the main text of the paper.

In Table B1, we display the example of the corporate structure of a BHC called Middle Georgia Corporation consisting of three layers. Middle Georgia Corporation has a single minority-owned bank in the second layer. We adjust the reported leverage ratio for Middle Georgia Corporation using both the decompression and deduction algorithms. In this example, the deduction algorithm yields a slightly lower adjusted leverage ratio.

Table B1. Structure of Middle Georgia Corporation, Q2 2007.



Percentages are ownership percentages. Non-member bank refers to a commercial bank that is state-chartered and not a member of the Federal Reserve System. Source: Control relationship database from the National Information Center (NIC).

A subsidiary in the second layer, CBA Bankshares, Inc., is minority-owned by the top-tier BHC, Middle Georgia Corporation, with an equity ownership is 27%. The method of leverage ratio adjustment by way of decompression starts at the second layer. The reported leverage ratio is 0.076; the leverage ratio after decompression is 0.064; and the leverage ratio after deduction is 0.061.

Appendix C. Regulatory classification of financial institutions

This appendix lists categories of financial institutions that do and do not file regulatory reports in the form of Call reports, forms Y9-C, and forms Y9-SP. Foreign banks, for instance, do not file standard regulatory reports in the US.

Regulatory reports		No regulatory reports	
Code	Type	Code	Type
AGB	Agreement Corporation - Banking	DPS	Data Processing Servicer
AGI	Agreement Corporation – Investment	FBH	Foreign Banking Organization as a BHC
BHC	Bank Holding Company	FBK	Foreign Bank
CPB	Cooperative Bank	FBO	Foreign Banking Organization
DEO	Domestic Entity Other	FCU	Federal Credit Union
EDB	Edge Corporation - Banking	FEO	Foreign Entity Other
EDI	Edge Corporation - Investment	FHF	Financial Holding Company/FBO
FSB	Federal Savings Bank	FNC	Finance Company
MTC	Non-deposit Trust Company Member	IBK	International Bank of a US Depository - Edge or Trust Co.
NAT	National Bank	INB	International Non-bank Subs of Domestic Entities
NMB	Non-member Bank	NTC	Non-deposit Trust Company - Non-member
SAL	Savings & Loan Association	SBD	Securities Broker/Dealer
SLH	Savings and Loan Holding Company		
SMB	State Member Bank		
SSB	State Savings Bank		

Source: Control relationship database from the National Information Center (NIC).

Appendix D. Variable descriptions and data sources

Variable	Description	Source
Z-score	Index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window comprising 3 observations. ROA is defined as net income to total assets.	Y9-SP
Earnings volatility	Standard deviation of return on equity calculated over a one-and-half-year rolling window comprising 3 observations. Return on equity is defined as net income to equity.	Y9-SP
Minority ownership	Dummy variable that equals one if a bank has minority ownership of at least one subsidiary	NIC
Minority ownership share	Share of a bank's affiliates that is minority-owned	NIC
Reported leverage ratio	Ratio of equity to assets	Y9-SP
Leverage ratio after decompression	Ratio of equity to assets after consolidation of minority-owned affiliates	Call Report, Y9-SP
Leverage ratio after deduction	Ratio of equity net of equity investments in minority-owned affiliates to assets	Call Report, Y9-SP
Absolute adjustment with decompression	Difference between the reported leverage ratio and the leverage ratio after decompression	Call Report, Y9-SP
Relative adjustment with decompression	Difference between the reported leverage ratio and the leverage ratio after decompression divided by the reported leverage ratio	Call Report, Y9-SP
Absolute adjustment with deduction	Difference between the reported leverage ratio and the leverage ratio after deduction	Call Report, Y9-SP
Relative adjustment with deduction	Difference between the reported leverage ratio and the leverage ratio after deduction divided by the reported leverage ratio	Call Report, Y9-SP
Size	Natural logarithm of assets	Y9-SP
Asset growth	Real growth rate of assets divided by GDP deflator	Y9-SP
Concentration	Share of bank assets in county of location	Y9-SP
Number of offspring	Total number of offspring at various levels	NIC

Figure 1. Balance sheets for a parent bank with a minority-owned subsidiary bank

Part A. Balance sheet of the parent

Parent	
A_p^o	L_p
αE_s	E_p

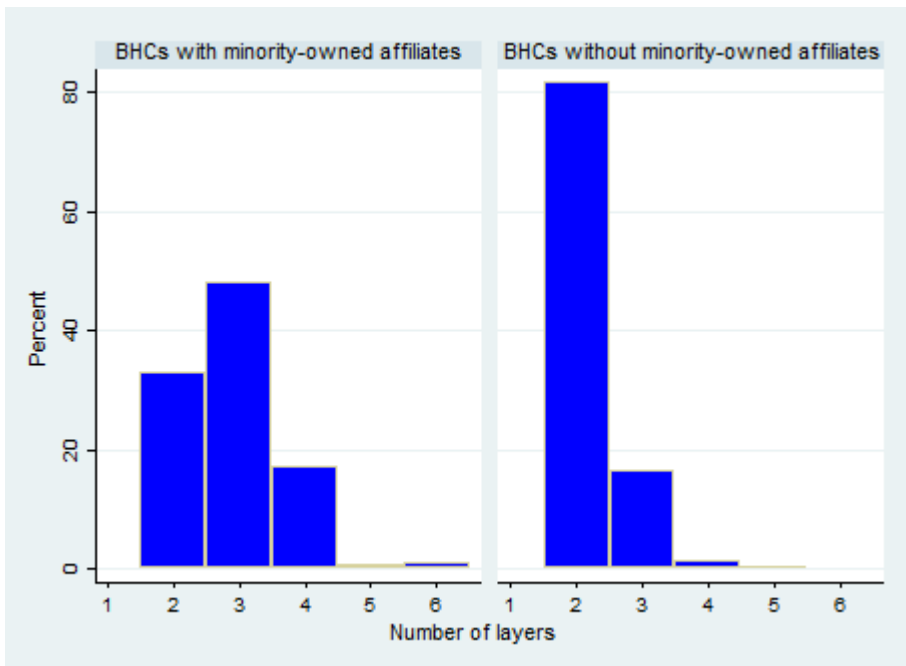
Part B. Balance sheet of the subsidiary

Subsidiary	
A_s	L_s
	E_s

Part C. Balance sheet of the parent after decompression

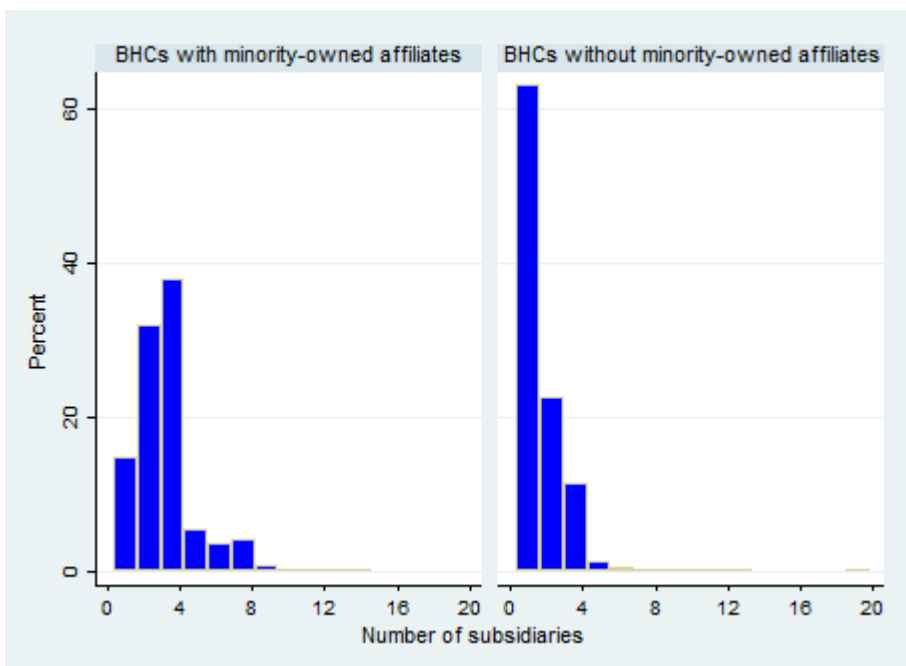
Parent after decompression	
A_p^o	L_p
	$\alpha(A_s - E_s)$
αA_s	E_p

Figure 2. The number of layers of banks with and without minority ownership



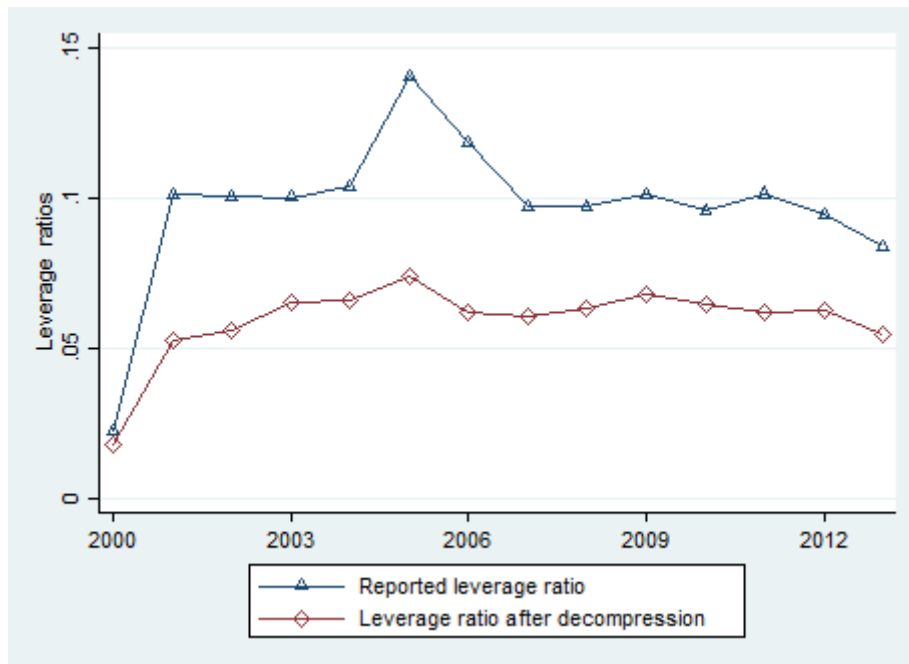
Note: Only reporting affiliates are taken into account.

Figure 3. The number of affiliates of banks with and without minority ownership



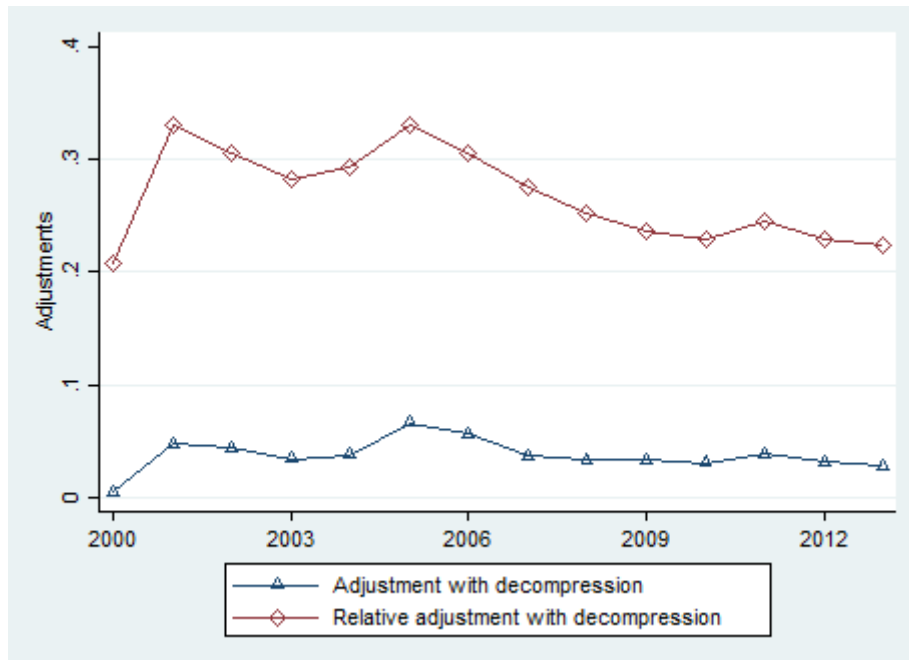
Note: Only reporting affiliates are taken into account.

Figure 4. Reported leverage ratio and leverage ratio after decompression, 2000-2013



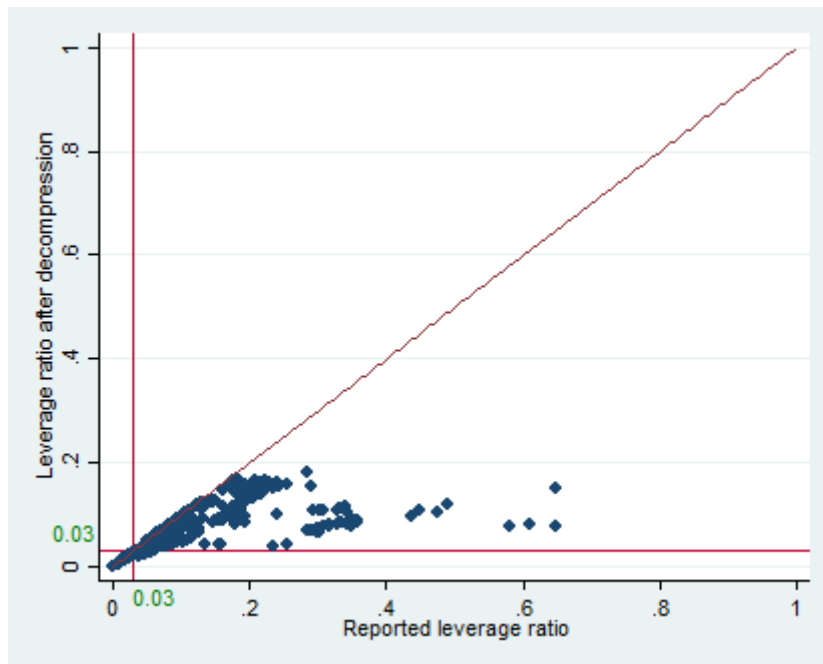
Notes: The reported leverage ratio is ratio of equity to assets. The leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. The leverage ratios are annual means based on biannual data.

Figure 5. Absolute and relative adjustments with decompression, 2000-2013



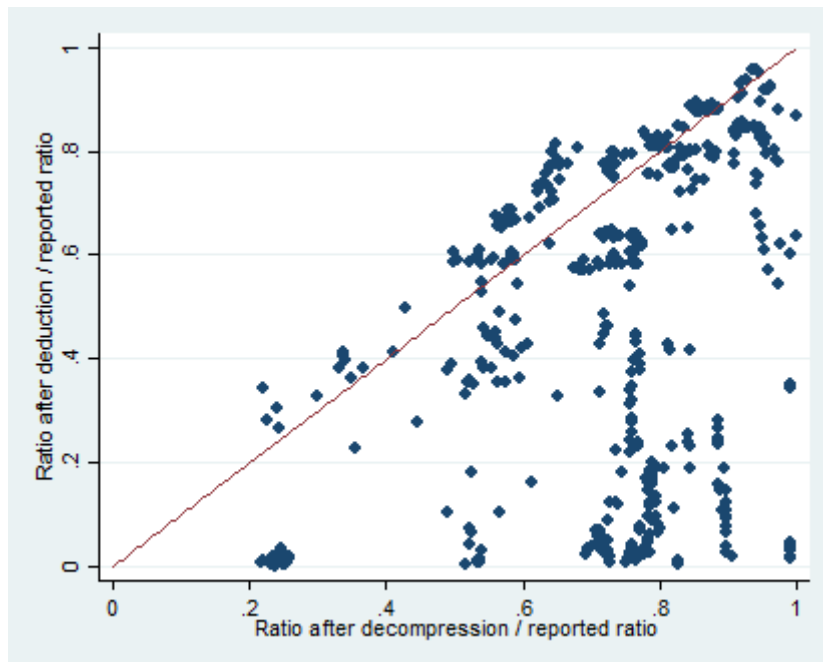
Notes: The absolute adjustment with decompression is the difference of the ratio of equity to assets and the ratio of equity to assets after consolidation of minority-owned affiliates. The relative adjustment with decompression is the difference of the ratio of equity to assets and the ratio of equity to assets after consolidation of minority-owned divided by the ratio of equity to assets. The figure shows annual means based on biannual data.

Figure 6. Leverage ratio after decompression plotted against reported leverage ratio



Notes: The reported leverage ratio is the ratio of equity to assets. The leverage ratio after decompression is the ratio of equity to assets after consolidation of minority-owned affiliates. The sample consists of BHCs for which decompression is possible.

Figure 7. A comparison of leverage ratio reductions through decompression and deduction



Notes: The reported leverage ratio is the ratio of equity to assets. The leverage ratio after decompression is the ratio of equity to assets after consolidation of minority-owned affiliates. The leverage ratio after deduction is ratio of equity net of equity investments in minority-owned affiliates to assets. The figure does not show observations where the leverage ratio after deduction is negative. The sample consists of BHCs for which capital adjustments through both decompression and deduction are possible.

Table 1. A numerical example of decompression and deduction

Consider a parent bank with total assets, A_p , of 1000 dollars that owns 40 % of the equity of a subsidiary bank with assets, A_s , of 500 dollars. The equity of the subsidiary, E_s is 40. The parent's ownership share, α , of the subsidiary's equity is 40%. The parent's ownership of the subsidiary' equity, αE_s , thus is 16. The parent's other assets, A_p^o , amount to 984. The parent's equity, E_p , is 80, while its liabilities, L_p , are 920. The balance sheets of the parent and the subsidiary are given by

Parent	
$A_p^o=984$	$L_p=920$
$\alpha E_s=16$	$E_p=80$

Subsidiary	
$A_s=500$	$L_s=460$
	$E_s=40$

The parent's leverage ratio, $\lambda_p = \frac{E_p}{A_p}$, is 0.08. The leverage ratio after decompression, $\lambda_{p,c} = \frac{\lambda_p}{1+\alpha\rho(1-\lambda_s)}$ is 0.068. The absolute adjustment with decompression, $\delta_{c,a} = \lambda_p - \lambda_{p,c}$, is 0.012, while the relative adjustment with decompression, $\delta_{c,r} = \frac{\lambda_p - \lambda_{p,c}}{\lambda_p}$, is 0.15. The leverage ratio after deduction, $\lambda_{p,d} = \lambda_p - \alpha\rho\lambda_s$, is 0.064. The absolute adjustment with deduction, $\delta_{d,a} = \lambda_p - \lambda_{p,d}$, is 0.16, while the relative adjustment under deduction, $\delta_{d,r} = \frac{\lambda_p - \lambda_{p,d}}{\lambda_p}$, is 0.2. The bias is the leverage ratio under deduction relative to the one under decompression, $\Delta = \lambda_{p,d} - \lambda_{p,c}$, is -0.004.

Table 2. Descriptive statistics

Z-score is index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window. Earnings volatility is standard deviation of return on equity calculated over a one-and-half-year rolling window. Reported leverage ratio is ratio of equity to assets. Leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. Absolute adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression. Relative adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression divided by the reported leverage ratio. Leverage ratio after deduction is ratio of equity net of equity investments in minority-owned affiliates to assets. Absolute adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction. Relative adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction divided by the reported leverage ratio. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. Panel A considers sample of banks for which decompression is possible. Panel B considers sample of BHCs for which deduction is possible.

Panel A: Decompression sample	Obs	Mean	Std.Dev.	Min	Max
Z-score	536	3.5615	0.8621	0.4082	5.7079
Earnings volatility	542	0.0479	0.0743	0.0016	0.5352
Reported leverage ratio	542	0.1004	0.0858	0.0001	0.3565
Leverage ratio after decompression	542	0.0637	0.0459	0.0001	0.1638
Absolute adjustment with decompression	542	0.0367	0.0564	0.0000	0.2733
Relative adjustment with decompression	542	0.2646	0.1765	0.0091	0.7756
Size	542	11.2210	1.0196	8.1286	12.9945
Asset growth	542	0.0351	0.1074	-0.4492	0.4800
Concentration	542	0.0222	0.0786	0.0000	0.4918
Number of offspring	542	3.3801	1.6650	2.0000	10.0000
Panel B: Deduction sample	Obs	Mean	Std.Dev.	Min	Max
Z-score	812	3.5477	0.8726	0.4082	5.7079
Earnings volatility	824	0.0493	0.0759	0.0016	0.5352
Reported leverage ratio	824	0.0940	0.0864	0.0001	0.3565
Leverage ratio after deduction	824	0.0432	0.0631	-0.0515	0.2149
Absolute adjustment with deduction	824	0.0513	0.0636	0.0005	0.3490
Relative adjustment with deduction	824	0.8068	0.7597	0.0451	5.4226
Size	824	11.3482	0.9753	8.1286	12.9945
Asset growth	824	0.0343	0.1056	-0.4492	0.4800
Concentration	824	0.0188	0.0666	0.0000	0.4918
Number of offspring	824	3.8434	1.8448	2.0000	12.0000

Table 3. Correlation matrix

Z-score is index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window. Earnings volatility is standard deviation of return on equity calculated over a one-and-half-year rolling window. Reported leverage ratio is ratio of equity to assets. Leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. Absolute adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression. Relative adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression divided by the reported leverage ratio. Leverage ratio after deduction is ratio of equity net of equity investments in minority-owned affiliates to assets. Absolute adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction. Relative adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction divided by the reported leverage ratio. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. Panel A considers sample of banks for which decompression is possible. Panel B considers sample of banks for which deduction is possible. All variables apart from Z-score, earnings volatility and number of offspring are lagged one period. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

Panel A. Sample of banks for which decompression is possible

Panel A	Z-score	Earnings volatility	Reported leverage ratio	Leverage ratio after decompression	Absolute adjustment with decompression	Relative adjustment with decompression	Size	Asset growth	Concentration	Number of offspring
Z-score	1									
Earnings volatility	-0.7519***	1								
Reported leverage ratio	0.1252***	-0.1438***	1							
Leverage ratio after decompression	0.1779***	-0.1638***	0.8020***	1						
Absolute adjustment with decompression	0.0440	-0.0845**	0.8716***	0.4067***	1					
Relative adjustment with decompression	-0.0554	0.0008	0.6698***	0.2343***	0.8322***	1				
Size	-0.0633	0.1186***	-0.6761***	-0.3100***	-0.7808***	-0.7143***	1			
Asset growth	0.0799*	-0.1038**	-0.1008**	-0.0730*	-0.0923**	-0.1194***	0.1105***	1		
Concentration	-0.1682***	0.1585***	-0.1408***	-0.1014**	-0.1313***	-0.2012***	0.2778***	0.0149	1	
Number of offspring	0.0574	-0.0482	0.1476***	0.3611***	-0.0562	-0.1123***	0.2447***	0.0396	-0.0066	1

Panel B. Sample of banks for which deduction is possible

Panel B	Z-score	Earnings volatility	Reported leverage ratio	Leverage ratio after deduction	Absolute adjustment with deduction	Relative adjustment with deduction	Size	Asset growth	Concentration	Number of offspring
Z-score	1									
Earnings volatility	-0.7735***	1								
Reported leverage ratio	0.0506	-0.1065***	1							
Leverage ratio after deduction	0.0883**	-0.1320***	0.6961***	1						
Absolute adjustment with deduction	-0.0245	-0.0089	0.6731***	-0.0530	1					
Relative adjustment with deduction	-0.0773**	0.0771**	-0.3319***	-0.5603***	0.1127***	1				
Size	0.0209	0.0389	-0.6191***	-0.2288***	-0.6301***	0.0568	1			
Asset growth	0.0863**	-0.1011***	-0.1005***	-0.0334	-0.1143***	0.0597*	0.0927***	1		
Concentration	-0.1811***	0.1542***	-0.1012***	-0.0356	-0.1038***	-0.0797**	0.2211***	0.0413	1	
Number of offspring	0.0368	-0.0349	0.0995***	0.2130***	-0.0831**	-0.1314***	0.2286***	0.0693**	-0.0397	1

Table 4. The propensity of BHCs to have minority-owned affiliates

This table displays correlations. Minority ownership is a dummy variable indicating whether a BHC has a minority-owned subsidiary in its hierarchical structure. Minority ownership share is the number of minority-owned affiliates divided by the number offspring at various levels. Reported leverage ratio is ratio of equity to assets. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	Minority ownership	Minority ownership share
Minority ownership	1	
Minority ownership share	0.7610***	1
Reported leverage ratio	-0.0039	0.0104***
Size	0.0062*	-0.0270***
Asset growth	-0.0000	-0.0066*
Concentration	-0.0061*	-0.0013
Number of offspring	0.2056***	0.0845***

Table 5. Bank risk and capital following decompression method

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a one-and-half-year rolling window. Reported leverage ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported leverage ratio and leverage ratio after decompression divided by the reported leverage ratio where leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. Absolute adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. All independent variables except number of offspring are lagged one period. Time fixed effects are included. Robust standard errors are clustered at the bank level. Sample includes banks with minority ownership for which decompression is possible. The pre-crisis period is 2000q1-2007q2, while the crisis and aftermath period is 2007q3-2013q4. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	Z score						Earnings volatility					
	Full sample		Pre-crisis		Crisis and aftermath		Full sample		Pre-crisis		Crisis and aftermath	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reported leverage ratio	3.315** (1.489)	3.711 (2.280)	3.054** (1.521)	2.873 (2.439)	3.519* (1.835)	4.029 (2.505)	-0.206** (0.087)	-0.245* (0.128)	-0.179** (0.080)	-0.201 (0.129)	-0.220* (0.119)	-0.239 (0.157)
Relative adjustment with decompression	-1.570*** (0.534)		-1.736** (0.689)		-1.428** (0.616)		0.107*** (0.038)		0.081** (0.031)		0.118** (0.053)	
Absolute adjustment with decompression		-3.926 (2.378)		-2.097 (3.200)		-4.415* (2.316)		0.295* (0.164)		0.168 (0.150)		0.312 (0.214)
Size	0.022 (0.104)	0.054 (0.105)	0.035 (0.176)	0.141 (0.173)	0.016 (0.125)	0.023 (0.124)	0.006 (0.009)	0.004 (0.010)	-0.001 (0.007)	-0.004 (0.008)	0.009 (0.013)	0.007 (0.014)
Asset growth	0.538 (0.420)	0.669 (0.428)	0.251 (0.787)	0.405 (0.766)	0.621 (0.417)	0.715 (0.428)	-0.075** (0.033)	-0.084** (0.034)	0.010 (0.027)	0.001 (0.027)	-0.134** (0.053)	-0.142** (0.055)
Concentration	-2.186*** (0.704)	-1.894** (0.900)	-0.971 (0.609)	-0.707 (0.756)	-2.952*** (0.946)	-2.687** (1.115)	0.148*** (0.050)	0.127* (0.066)	0.017 (0.030)	0.002 (0.044)	0.216*** (0.071)	0.197** (0.087)
Number of offspring	-0.013 (0.057)	-0.011 (0.060)	-0.002 (0.066)	0.004 (0.075)	-0.018 (0.057)	-0.017 (0.058)	-0.000 (0.003)	-0.000 (0.003)	-0.000 (0.003)	-0.000 (0.003)	-0.000 (0.004)	-0.000 (0.004)
Number of observations	536	536	231	231	305	305	542	542	233	233	309	309

R-squared	0.131	0.099	0.123	0.073	0.141	0.118	0.140	0.121	0.087	0.068	0.178	0.158
Number of banks	78	78	61	61	40	40	79	79	62	62	40	40
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of clustering	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 6. Bank risk and capital following decompression method including banks without minority ownership

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a one-and-half-year rolling window. Reported leverage ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported leverage ratio and leverage ratio after decompression divided by the reported leverage ratio where leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. Absolute adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. All independent variables except number of offspring are lagged one period. Time fixed effects are included. Robust standard errors are clustered at the bank level. Sample includes banks with minority ownership for which decompression is possible and banks without minority ownership. The pre-crisis period is 2000q1-2007q2, while the crisis and aftermath period is 2007q3-2013q4. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	Z score						Earnings volatility					
	Full sample		Pre-crisis		Crisis and aftermath		Full sample		Pre-crisis		Crisis and aftermath	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reported leverage ratio	5.944***	5.982***	4.214***	4.249***	7.110***	7.151***	-0.447***	-0.449***	-0.238***	-0.240***	-0.586***	-0.588***
	(0.205)	(0.205)	(0.223)	(0.223)	(0.274)	(0.275)	(0.017)	(0.017)	(0.015)	(0.015)	(0.025)	(0.026)
Relative adjustment with decompression	-0.425		-0.199		-0.650*		0.040**		0.023*		0.056*	
	(0.272)		(0.251)		(0.387)		(0.018)		(0.013)		(0.030)	
Absolute adjustment with decompression		-3.155***		-2.001***		-4.607***		0.225***		0.115***		0.346***
		(0.648)		(0.763)		(0.807)		(0.036)		(0.024)		(0.074)
Size	-0.015	-0.016	-0.016	-0.017	-0.014	-0.014	-0.001*	-0.001*	-0.002***	-0.002***	-0.001	-0.001
	(0.010)	(0.010)	(0.013)	(0.013)	(0.012)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Asset growth	-0.064	-0.064	-0.610***	-0.610***	0.368***	0.367***	-0.055***	-0.055***	0.003	0.003	-0.097***	-0.097***
	(0.063)	(0.063)	(0.080)	(0.080)	(0.092)	(0.092)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)
Concentration	-0.039	-0.039	-0.096	-0.097	-0.010	-0.010	-0.000	-0.000	0.010*	0.010*	-0.006	-0.006
	(0.051)	(0.051)	(0.065)	(0.065)	(0.057)	(0.057)	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
Number of offspring	-0.009	-0.009	-0.015**	-0.015*	-0.002	-0.002	0.001*	0.001*	0.001**	0.001**	0.000	0.000
	(0.006)	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Number of observations	76447	76447	31258	31258	45189	45189	76889	76889	31296	31296	45593	45593

R-squared	0.100	0.100	0.079	0.080	0.118	0.118	0.107	0.107	0.065	0.065	0.127	0.127
Number of banks	4834	4834	4092	4092	4304	4304	4837	4837	4094	4094	4308	4308
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of clustering	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 7. Means of the samples including banks where decompression is possible with and without matching

Reported leverage ratio is ratio of equity to assets. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. Columns 1-3 refer to a sample including all banks where decompression is possible and all banks without minority ownership. Columns 4-6 refer to a sample of banks where decompression is possible and banks without minority ownership constructed by way of propensity score matching on the basis of the five variables in the table. T-test concerns test of equal means. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	No matching			Matching		
	Banks after decompression (1)	Banks with no minority ownership (2)	T-test of equal means (3)	Banks after decompression (4)	Banks with no minority ownership (5)	T-test of equal means (6)
Reported leverage ratio	0.1022	0.1019	0.0003	0.0985	0.0930	0.0055
Size	11.2001	11.4818	-0.2817***	11.2267	11.1694	0.0573
Asset growth	0.0390	0.0458	-0.0068	0.0360	0.0472	-0.0112
Concentration	0.0222	0.0316	-0.0094*	0.0223	0.0273	-0.0050
Number of offspring	3.3385	1.6382	1.7003***	3.2326	3.0640	0.1686

Table 8. Bank risk and capital following decompression method for the matched sample

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window (3 observations). The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a one-and-half-year rolling window (3 observations). Reported leverage ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported leverage ratio and leverage ratio after decompression divided by the reported leverage ratio where leverage ratio after decompression is ratio of equity to assets after consolidation of minority-owned affiliates. Absolute adjustment with decompression is difference between the reported leverage ratio and the leverage ratio after decompression. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. All independent variables except number of offspring are lagged one period. Time fixed effects are included. Robust standard errors are clustered at the bank level. Sample includes banks with minority ownership for which decompression is possible and banks without minority ownership selected by propensity score matching. The pre-crisis period is 2000q1-2007q2, while the crisis and aftermath period is 2007q3-2013q4. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	Z score						Earnings volatility					
	Full sample		Pre-crisis		Crisis and aftermath		Full sample		Pre-crisis		Crisis and aftermath	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reported leverage ratio	3.464*** (1.208)	4.421*** (1.503)	2.387* (1.243)	2.722* (1.515)	4.253*** (1.457)	5.554*** (1.732)	-0.210*** (0.061)	-0.253*** (0.073)	-0.154** (0.064)	-0.179** (0.081)	-0.245*** (0.075)	-0.295*** (0.085)
Relative adjustment with decompression	-0.427 (0.298)		-0.191 (0.311)		-0.675 (0.417)		0.022 (0.017)		0.016 (0.017)		0.031 (0.025)	
Absolute adjustment with decompression		-3.354** (1.437)		-1.194 (1.819)		-5.037*** (1.588)		0.157** (0.064)		0.093 (0.079)		0.206** (0.081)
Size	0.059 (0.056)	0.038 (0.055)	0.085 (0.081)	0.077 (0.081)	0.040 (0.067)	0.013 (0.066)	-0.004 (0.003)	-0.003 (0.003)	-0.005 (0.003)	-0.005 (0.004)	-0.003 (0.004)	-0.002 (0.004)
Asset growth	-0.162 (0.368)	-0.157 (0.377)	-0.865 (0.525)	-0.844 (0.526)	0.448 (0.504)	0.423 (0.510)	-0.032 (0.020)	-0.033 (0.021)	0.031 (0.027)	0.029 (0.028)	-0.088*** (0.030)	-0.087*** (0.030)
Concentration	-0.579 (0.965)	-0.502 (0.986)	0.317 (0.801)	0.353 (0.813)	-1.166 (1.154)	-1.063 (1.185)	0.031 (0.053)	0.027 (0.055)	-0.009 (0.028)	-0.012 (0.029)	0.056 (0.074)	0.052 (0.076)
Number of offspring	-0.049 (0.045)	-0.043 (0.044)	-0.074 (0.048)	-0.072 (0.048)	-0.032 (0.048)	-0.026 (0.047)	0.003 (0.002)	0.002 (0.002)	0.004* (0.002)	0.003 (0.002)	0.002 (0.002)	0.002 (0.002)

Number of observations	1034	1034	443	443	591	591	1034	1034	443	443	591	591
R-squared	0.074	0.080	0.078	0.078	0.088	0.097	0.074	0.077	0.066	0.066	0.089	0.092
Number of banks	462	462	290	290	227	227	462	462	290	290	227	227
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of clustering	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 9. Bank risk and capital following deduction method

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as $(ROA+CAR)/\sigma(ROA)$, where ROA is return on assets, CAR is ratio of equity to assets, and $\sigma(ROA)$ is the standard deviation of return on assets calculated over a one-and-half-year rolling window (3 observations). The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a one-and-half-year rolling window (3 observations). Reported leverage ratio is ratio of equity to assets. Relative adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction divided by the reported leverage ratio where leverage ratio after deduction is ratio of equity net of equity investments in minority-owned affiliates to assets. Absolute adjustment with deduction is difference between the reported leverage ratio and the leverage ratio after deduction. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Number of offspring is the total number of offspring at various levels. All independent variables except number of offspring are lagged one period. Time fixed effects are included. Robust standard errors are clustered at the bank level. Sample includes banks with minority ownership for which deduction is possible. The pre-crisis period is 2000q1-2007q2, while the crisis and aftermath period is 2007q3-2013q4. ***, **, * denote significance at 1%, 5% and 10% levels, respectively.

	Z score						Earnings volatility					
	Full sample		Pre-crisis		Crises and aftermath		Full sample		Pre-crisis		Crises and aftermath	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Reported leverage ratio	1.196 (1.239)	1.841 (1.182)	0.687 (1.426)	1.773 (1.246)	1.290 (1.469)	1.926 (1.404)	-0.136* (0.081)	-0.196** (0.086)	-0.076 (0.066)	-0.142** (0.071)	-0.168 (0.106)	-0.231* (0.118)
Relative adjustment with deduction			-0.238* (0.123)		-0.039 (0.069)		0.006 (0.006)		0.011** (0.005)		0.002 (0.007)	
Absolute adjustment with deduction		-0.915 (0.855)		-0.386 (1.396)		-1.250 (0.988)		0.115* (0.062)		0.089 (0.061)		0.139* (0.083)
Size	0.149 (0.102)	0.140 (0.104)	0.103 (0.162)	0.162 (0.165)	0.156 (0.113)	0.133 (0.114)	-0.010 (0.009)	-0.008 (0.009)	-0.007 (0.008)	-0.007 (0.007)	-0.011 (0.011)	-0.008 (0.012)
Asset growth	0.758* (0.427)	0.712 (0.439)	0.775 (0.697)	0.517 (0.751)	0.859* (0.488)	0.844* (0.478)	-0.074** (0.030)	-0.070** (0.030)	0.008 (0.034)	0.022 (0.035)	-0.152*** (0.042)	-0.150*** (0.041)
Concentration	-2.860*** (0.749)	-2.751*** (0.740)	-2.175 (1.406)	-2.071 (1.464)	-3.324*** (0.817)	-3.238*** (0.813)	0.200*** (0.049)	0.192*** (0.048)	0.113 (0.088)	0.106 (0.089)	0.241*** (0.070)	0.235*** (0.071)
Number of offspring	-0.016 (0.034)	-0.015 (0.034)	-0.022 (0.033)	-0.020 (0.033)	-0.011 (0.043)	-0.011 (0.042)	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)	-0.000 (0.003)	-0.000 (0.003)

Number of observations	812	812	340	340	472	472	824	824	344	344	480	480
R-squared	0.088	0.085	0.090	0.065	0.096	0.098	0.111	0.112	0.063	0.056	0.138	0.142
Number of banks	113	113	91	91	60	60	115	115	94	94	60	60
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of clustering	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
