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BANK CAPITALIZATION AND RISK TAKING**

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***MACROECONOMICS AND GROWTH***



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## Abstract

Bank holding companies may be effectively undercapitalized as a result of incomplete consolidation of minority ownership. Using two approaches -- consolidating the minority-owned subsidiaries into the parent or deducting equity investments in minority ownership from the parent's capital -- we find that the effective capital ratios of US bank holding companies are substantially lower than the reported ratios. Empirical evidence suggests that the undercapitalization is associated with higher risk taking at the bank holding company level. These findings indicate that incomplete consolidation of minority-owned financial institutions constitutes a loophole in capital regulation.

JEL Classification: G21 and G32

Keywords: bank leverage, capital regulation, organizational structure, risk taking and undercapitalization

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## 1. Introduction<sup>1</sup>

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 crisis has rekindled the debate on capital adequacy rules for banks. The Basle III framework implies generally higher required bank capital levels, and it makes attempts to increase the quality of required bank capital and to measure it better. A measurement issue addressed by Basle III concerns how a bank's regulatory capital should reflect a parent's bank exposure to asset risk associated with its nonconsolidated banking subsidiaries. Before Basle III, a parent bank's asset exposure was taken to be limited to its equity investment in a nonconsolidated subsidiary. This was an understatement of the actual risk exposure, as the parent bank's implicit guarantees of the liabilities of its nonconsolidated subsidiaries meant that a parent bank's actual losses stemming from the subsidiary bank could exceed its equity investment in the subsidiary bank. To remedy this, Basle III requires banks to budget additional regulatory capital against this risk. Over the period 2014-2017, US regulators are phasing in a requirement of this kind for US banks.

The lack of proper regulatory capital budgeting for the asset risk stemming from

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nonconsolidated subsidiaries provided US banks with an incentive to place assets in such subsidiaries to reduce their effective capitalization rate. In this paper, we document the prevalence of minority-owned banking subsidiaries of US banks, that generally do not need to be consolidated according to US GAAP, over the 2000-2013 period, and we examine the implications of minority-owned subsidiaries for bank risk. To assess the risk implications, we need to counterfactually consolidate minority-owned subsidiaries with their parent banks. This exercise yields a ‘decompressed’ parent bank with larger, ‘decompressed’ assets than the actually reported assets, but with equal equity. We can also calculate a ‘decompressed’ capital ratio as the ratio of equity to ‘decompressed’ assets, which will be lower than the reported capital ratio. A bank’s risk is expected to reflect its larger, ‘decompressed’ assets rather than the reported assets. In line with this, we find that a bank’s Z-score is negatively related to the gap between the reported capital ratio and the capital ratio after decompression, while the standard deviation of its return on equity is positively related to this gap.

To be able to consolidate a bank’s minority-owned subsidiaries, we use information on the parent bank’s 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 parent banks where we can complete the decompression exercise, we find that decompression reduces the capital ratio by 26% on average. Banks that have a reported capital ratio above 3% but a capital ratio after decompression below this figure are effectively not meeting the US leverage ratio requirement of 3%. We also find that banks have a smaller gap between the reported capital ratio and the capital ratio after decompression during the crisis years 2007-2009 than before, as banks scaled back their use of minority-owned subsidiaries.

The US and broader Basle III policy response to the risks posed by minority-owned subsidiaries has been to introduce requirements for parent banks to deduct part of the equity investment in these subsidiaries from their regulatory Tier1 capital on the premise that the deducted capital is required to absorb losses stemming from the subsidiary, and hence is not available to absorb losses related to the parent bank's outside assets (Basel Committee on Banking Supervision, 2010).

Theoretically, we show that this 'deduction method' of adjusting the parent bank's reported capital ratio for the asset risk associated with minority-owned subsidiaries is less accurate than the full consolidation of these subsidiaries by way of the 'decompression method'. For the benchmark case of a parent firm that has a single minority-owned subsidiary with equal reported capital 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 capital ratio that is too low relative to the 'decompressed' capital ratio. For our sample of banks, we find empirically that the parent bank's capital ratio after adjustment through deduction on average is lower than the 'decompressed' capital ratio. A negative empirical relationship between the bank's Z-score and the gap between the parent's reported capital ratio and the adjusted capital ratio using the deduction method, however, suggests that adjusting a bank's regulatory capital using the deduction method would be effective in reducing bank risk stemming from minority-owned subsidiaries.

Several papers examine how banks have used off-balance-sheet structures to arbitrage capital regulations.<sup>2</sup> Acharya, Schnabl and Suarez (2013) analyze how banks have used asset-backed commercial paper conduits enhanced with liquidity

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<sup>2</sup>See Acharya and Ryan (2015, pp. 63-69) for a discussion of channels by which banks' financial reporting for securitizations related to the consolidation decision affect financial stability.

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) 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 capital ratios, 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.<sup>3</sup>

Mian and Smith (1990) examine whether Fortune 500 US firms report their

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<sup>3</sup> Foley and Hines (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.

financial subsidiaries on a consolidated or unconsolidated basis in 1985.<sup>4</sup> 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 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 reported leverage. 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 banks were able to use nonconsolidated financial institutions to increase their effective leverage beyond limits imposed by capital adequacy requirements, resulting in additional bank risk.

The remainder of the paper is organized as follows. Section 2 discusses the accounting and regulatory treatment of minority-owned subsidiaries in the US. Section 3 compares the 'decompression' and 'deduction' methods of adjusting a bank's reported capital for its minority-owned subsidiaries, and it describes our algorithms for applying these methods to US bank data. Section 4 presents the data. Section 5 presents the empirical evidence. First, we consider how a parent bank's minority ownership of financial institutions varies with the reported capital ratio and other bank characteristics. Second, we relate bank risk variables to computed gaps

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<sup>4</sup> Before the adoption of Financial Accounting Standard 94 in 1987, US firms had discretion regarding the consolidation of majority-owned financial subsidiaries.

between reported and adjusted parent bank capital ratios as indices of the minority ownership of financial 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.<sup>5</sup> As traditionally interpreted, majority ownership of a subsidiary, defined as an ownership share of common stock exceeding 50%, is taken to imply control.<sup>6</sup>

Whether or not a subsidiary is consolidated into the parent's balance sheet may have little impact on the parent firm's or firms' requirement to stand behind their subsidiary. According to the Federal Reserve Board's 'source of strength' principle, bank holding companies (BHCs) are expected to support their distressed banking affiliates and to effectively guarantee their liabilities with their own capital.<sup>7</sup>

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<sup>5</sup> We call an affiliate of a parent a subsidiary regardless of the ownership share.

<sup>6</sup> Specifically, ARB 51 states that consolidated financial statements are 'usually necessary for a fair representation when one of the companies in the group directly or indirectly has a controlling interest in the other companies'. Over time it has been recognized that the more than 50% voting interest rule is not always effective at identifying who really controls and should thus consolidate an entity (see Holzmann and Ramnath, 2012). In response to the Enron scandal and the use of nonconsolidated Special Purpose Entities (SPEs) by banks in the period leading up to the financial crisis, several refinements of ARB 51 have been issued by the Financial Accounting Standards Board (FASB), including FIN 46 and its revision FIN 46(R), to ensure the consolidation of so-called Variable Interest Entities (VIEs), defined as entities where a parent company has a controlling interest based on economic risks and rewards rather than on voting power. These new rules were a means to close loopholes regarding the nonconsolidation of SPEs used by banks. Financial institutions such as commercial banks and bank holding companies, however, are taken to be 'voting entities' rather than VIEs. Loopholes related to the nonconsolidation of financial subsidiaries have been approached through required deductions of equity investments in minority-owned financial institutions from parent bank regulatory capital rather than through applying the VIE concept.

<sup>7</sup> 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

Gilbert (1991) finds that very large BHCs tend to inject more capital into their distressed subsidiaries than other bank owners inject into their bank 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 subsidiaries, but there is no reason why the source of strength principle should not apply to nonconsolidated banking affiliates.<sup>8</sup> There thus is little, if any, scope for BHCs to use nonconsolidated, majority-owned affiliates to offload asset risk.

Nonconsolidated subsidiaries, however, have been useful as a means to arbitrage capital adequacy rules that are based on accounting entries on a BHC's consolidated balance sheet. In particular, let us consider the leverage ratio requirement, which states that the ratio of a BHC's Tier1 capital to its consolidated assets has to be at least 3%. Non-consolidation of a subsidiary keeps the BHC's consolidated assets relatively low, and hence makes it easier for a BHC to meet the leverage ratio requirement. A BHC can maintain non-consolidated subsidiaries by operating them as joint ventures with other banks, resulting in ownership shares that do not exceed 50%.

The regulatory response to the capital arbitrage opportunities offered by nonconsolidated subsidiaries has been to require a BHC to deduct part of its equity investment in its nonconsolidated subsidiaries from its Tier1 capital (as used to compute the regulatory leverage ratio) in recognition of the fact that a BHC's Tier1 capital serves as a buffer to absorb losses stemming from nonconsolidated

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source of financial strength for such institution.”

<sup>8</sup> According to the Bank Holding Company Act, “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.”

subsidiaries' investments as well as from the parent bank's outside investments. Specifically, the US Bank Holding Company Act stipulates that one-half of the aggregate investments in unconsolidated subsidiaries will be deducted from Tier1 capital (and one-half from Tier2 capital).<sup>9</sup> The partial deduction of the BHC's equity investment in nonconsolidated subsidiaries from its Tier1 capital suggests that the incentive to use nonconsolidated subsidiaries to arbitrage the leverage ratio requirement has been reduced, but not eliminated.<sup>10</sup>

The Federal Reserve Board has been phasing in these deductions since 2014 (Federal Reserve System, 2013). During our sample period of 2000-2013, no deductions from Tier1 capital or Tier 2 capital as used to compute the regulatory leverage and capital ratios were required. Data from this period thus is well-suited to study whether the riskiness of a parent bank with nonconsolidated subsidiaries reflected that it effectively operated with lower capital ratios than were reported.

### **3. Adjusting the capital ratio for minority-owned subsidiaries**

In this section, we examine the 'decompression' and 'deduction' methods of adjusting a parent bank's reported capital ratio for its minority-owned subsidiaries. First, we outline and compare the two methods for the case of a parent bank that is a minority owner of a single subsidiary. Second, we describe algorithms for computing adjusted capital ratios for banks with more complex corporate structures.

#### **3.1 Adjustment methods**

Let us consider a parent that has a minority ownership in a single subsidiary. The

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<sup>9</sup> See <https://www.fdic.gov/regulations/laws/rules/7500-4200.html#fdictail> for the relevant regulations.

<sup>10</sup> The Bank Company Holding Act implies that the investments in unconsolidated subsidiaries are fully deducted from regulatory capital, being the sum of Tier1 and Tier2 capital. The regulatory capital ratio is regulatory capital after the deduction divided by the BHC's consolidated assets. The full deduction implies that the regulatory capital requirement cannot be arbitrated through nonconsolidated subsidiaries.

subsidiary is not consolidated in the balance sheet of the parent bank. Instead, the parent reports the equity ownership in the minority as an investment among other assets. The parent bank is assumed to 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 (proportional to the parent's ownership share of the subsidiary) as well as on the parent's outside assets.

The parent has assets,  $A_p$ , liabilities,  $L_p$ , and equity,  $E_p$ . The reported capital ratio of the parent,  $\lambda_p$ , is given by  $E_p/A_p$ . Similarly, the subsidiary has assets,  $A_s$ , liabilities,  $L_s$ , and equity,  $E_s$ , with a reported capital ratio,  $\lambda_s$ , given by  $E_s/A_s$ .

The parent owns a share  $\alpha$  of the equity of the subsidiary, implying an equity investment of  $\alpha E_s$  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  $\alpha E_s$  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 capital ratio for its minority-owned subsidiary essentially consolidates the minority-owned subsidiary with the parent bank proportionally to the parent bank's ownership share,  $\alpha$ . Consolidation of the subsidiary's assets on the parent bank's balance in proportion to the ownership share  $\alpha$  provides a more accurate picture of the asset exposure of the parent bank's equity holders than full consolidation.<sup>11</sup>

Specifically, on the parent's balance sheet we replace the equity investment,

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<sup>11</sup> 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.

$\alpha E_s$ , by the proportionally owned subsidiary assets,  $\alpha A_s$ , given rise to assets for the decompressed parent equal to  $A_p + \alpha(A_s - E_s)$ . The capital 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  $\rho$  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 capital ratio after decompression is less than the parent's reported capital ratio, i.e.  $\lambda_{p,c} < \lambda_p$ .<sup>12</sup>

In the empirical work, we will use two measures of the reduction in the capital ratio brought about by decompression. First, we consider the absolute adjustment of the reported capital 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,  $\alpha E_s$ , from the parent's reported capital,  $E_p$ , yielding an adjusted capital,  $E_p - \alpha E_s$ . The capital 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 capital ratio than the parent's reported capital ratio,

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<sup>12</sup> The capital ratio after decompression,  $\lambda_{p,c}$ , declines with the subsidiary's relative size,  $\rho$ , but increases with its reported capital ratio,  $\lambda_s$ .

i. e.  $\lambda_{p,d} < \lambda_p$ .<sup>13</sup> We can again construct two measures of the reduction in the parent's reported capital ratio brought about by deduction. First, the absolute adjustment  $\lambda_p - \lambda_{p,d}$ , denoted,  $\delta_{d,a}$ , 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 relevant to study because US banks since 2014 have to make adjustments to their Tier1 capital by way of a deduction method. 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 US regulation requires 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, which essentially consolidates the subsidiary into the parent's balance sheet, 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.

Given the actual use of the deduction method, it is interesting to compare the two methods, and specifically to consider the 'error' the deduction method introduces in the adjusted capital ratio after deduction relative to the 'correct' capital ratio after

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<sup>13</sup> The capital ratio after deduction,  $\lambda_{p,d}$ , declines with the subsidiary's relative size,  $\rho$ , and with its reported capital ratio,  $\lambda_s$ .

decompression. Specifically, we define this ‘error’,  $\Delta$ , as the difference between the capital 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,  $\Delta$ , can be either positive or negative, depending on the parameters  $\alpha$ ,  $\lambda_s$ ,  $\lambda_p$ , and  $\rho$ . For the benchmark case of equal reported capital ratios of the parent and the subsidiary, i.e.  $\lambda_s = \lambda_p$ , we have  $\Delta < 0$ , indicating that the capital ratio resulting from deduction is less than the capital ratio resulting from decompression. This suggests that the deduction method on average will yield an adjusted capital ratio that is too low. Our calculations in the empirical section confirm that the leverage ratio with deduction on average is lower than the capital ratio after decompression.

Differentiating the difference  $\Delta$  with respect to the subsidiary’s and the parent’s reported capital ratios yields

$$\frac{\partial\Delta}{\partial\lambda_s} = -\alpha\rho \left\{ 1 + \frac{\lambda_p}{[1 + \alpha\rho(1 - \lambda_s)]^2} \right\} < 0 \quad (4)$$

$$\frac{\partial\Delta}{\partial\lambda_p} = 1 - \frac{1}{1 + \alpha\rho(1 - \lambda_s)} > 0 \quad (5)$$

A higher reported capital ratio for the subsidiary,  $\lambda_s$ , thus reduces the adjusted capital ratio under deduction relative to the capital ratio after decompression, tending towards a downward adjustment by the deduction method that is too large. A higher

reported capital ratio of the parent,  $\lambda_p$ , works in the opposite direction.<sup>14</sup>

In Box A1 in the Appendix, we present a numerical example where we calculate the capital ratio adjustments under decompression and deduction for a parent bank with a single minority-owned subsidiary bank.

A shortcoming of our capital 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.<sup>15</sup>

### 3.2 Algorithms to compute adjusted capital ratios for complex banks

The structure of the bank considered in section 2.2 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 subsidiaries that are connected to the parent by multi-layered ownership structures. In this subsection, we describe our algorithms for adjusting the reported capital ratio of a more complex bank using the

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<sup>14</sup> The derivatives  $\frac{\partial \Delta}{\partial \alpha}$  and  $\frac{\partial \Delta}{\partial \rho}$  are given by

$$\frac{\partial \Delta}{\partial \alpha} = \lambda_p \left\{ \frac{\rho(1 - \lambda_s)}{[1 + \alpha\rho(1 - \lambda_s)]^2} - \rho \frac{\lambda_s}{\lambda_p} \right\}$$

$$\frac{\partial \Delta}{\partial \rho} = \lambda_p \left\{ \frac{\alpha(1 - \lambda_s)}{[1 + \alpha\rho(1 - \lambda_s)]^2} - \alpha \frac{\lambda_s}{\lambda_p} \right\}$$

The signs of these derivatives are indeterminate. For the special case of  $\Delta = 0$ , we can establish

$$\frac{\partial \Delta}{\partial \alpha} = -\frac{1}{\alpha} \frac{\lambda_p [\alpha\rho(1 - \lambda_s)]^2}{[1 + \alpha\rho(1 - \lambda_s)]^2} < 0$$

$$\frac{\partial \Delta}{\partial \rho} = -\frac{1}{\rho} \frac{\lambda_p [\alpha\rho(1 - \lambda_s)]^2}{[1 + \alpha\rho(1 - \lambda_s)]^2} < 0$$

<sup>15</sup> After consolidation or decompression, the parent bank's balance sheet should only reflect outside assets. These will be smaller to the extent that some of the assets of the parent bank or the subsidiary before consolidation consist of internal debts. Hence, consolidation or decompression leads to smaller calculated parent bank capital adjustments if there are internal debts. This shows that internal debt financing mitigates the effectiveness of minority-owned subsidiaries as a means to reduce effective parent bank capitalization below reported capitalization.

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  $n-1$ <sup>th</sup> layer, etc. Generally, let  $m \leq n$  be the lowest layer where any minority-owned subsidiary is located. This implies that the  $m-1$ <sup>th</sup> 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  $m-1$ <sup>th</sup> layer has  $K$  subsidiaries that are minority-owned. The decompressed assets of the owning bank  $A_{m-1,c}$  are then calculated as

$$A_{m-1,c} = A_{m-1} + \sum_{k=1}^K \alpha_k \times (A_{m,k} - E_{m,k}) \quad (6)$$

where  $A_{m-1}$  are the owning bank's reported assets,  $\alpha_k$  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 (6).

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

$$A_{m-2,c} = A_{m-2} + \sum_{k=1}^K \alpha_k \times (A_{m-1,k,c} - E_{m-1,k}) + \sum_{l=1}^L \alpha_l \times (A_{m-1,l,c} - A_{m-1,l}) \quad (7)$$

where  $A_{m-1,k,c}$  and  $A_{m-1,l,c}$  are the assets of subsidiaries  $k$  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 (7) reflects a generalization of the decompression of minority-owned subsidiaries in (6) to take into account that the assets of these subsidiaries may have been decompressed themselves. The second summation in (7) 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 subsidiaries' assets.<sup>16</sup> The asset adjustment algorithm in (7) 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 capital ratio of the parent after decompression,  $\lambda_{p,c}$ , as given by

$$\lambda_{p,c} = \frac{E_1}{A_{1,c}} \tag{8}$$

which generalizes equation (1). The capital ratio after decompression,  $\lambda_{p,c}$ , is generally less than the reported capital ratio given by  $\frac{E_1}{A_1}$ .

Next, we describe how the deduction method of adjusting the capital 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 subsidiaries 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

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<sup>16</sup> According to (7), we increase the assets of the majority-owned subsidiary on the balance sheet of the directly owning bank in proportion to the relevant ownership share. Thus we ignore the accounting convention whereby after consolidation the assets of a majority-owned subsidiary are fully reflected on the balance sheet of the owning bank even if the ownership rate is less than 100%. This distinction vanishes in the case of fully owned subsidiaries.

parent to subsidiary  $q$ .<sup>17</sup>

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

$$\lambda_{p,d} = \frac{E_1 - \sum_{q=1}^Q D_q}{A_1} \quad (8)$$

which generalizes (2).

In Table A1 in the Appendix, 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 capital ratio for Middle Georgia Corporation using both the decompression and deduction algorithms. In this example, the deduction algorithm yields a slightly lower adjusted capital ratio.

#### 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 since the implementation of the Bank Holding Company Act of 1956. 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.

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<sup>17</sup> Implementation of the deduction method in the US only requires parent banks to deduct a measure of their equity investments in directly held subsidiaries. Multiplicative ownership shares, however, are relevant if the equity investment numbers used in the calculations at each level are adjusted to reflect prior deductions.

Information on ownerships 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 parent bank's equity for investments in minority-owned financial institutions in the first quarter of 2014.

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 11 layers including the top-tier BHC. The hierarchies can harbor a range of financial institutions, including BHCs, national banks, non-member banks, and foreign banks.<sup>18</sup> Table A2 in the Appendix 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 Table A2 in the Appendix).

Our capital ratio adjustments only take into account minority-owned subsidiaries that are required to file regulatory reports providing accounting data, as we need basic accounting data for the subsidiary to adjust the parent's capital ratio through either decompression or deduction.<sup>19</sup> Based on only reporting subsidiary financial

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<sup>18</sup> 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.

<sup>19</sup> Our adjustments of the parent's reported capital 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.

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 1,061 top parents with minority ownership, and 7,118 top banks without such ownership. Figure 2 shows that banks with minority-owned subsidiaries 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 3.4 and 2.3 layers.<sup>20</sup> Similarly, Figure 3 shows that banks with minority-owned subsidiaries have a distribution of the number of subsidiaries implying relatively many subsidiaries. Banks with and without minority-owned subsidiaries have on average 14.6 and 2.5 subsidiaries.

For banks with minority ownership, we aim to adjust the reported capital ratio through applying the decompression and deduction methods. To do the decompression, we need to have information on the equity and assets of pertinent subsidiaries 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 subsidiaries, calculated as the ownership share of a subsidiary by the parent times the equity of a subsidiary. Accounting data is matched to all reporting financial institutions in the hierarchies using information from the Call Reports, and the Y9-C and Y9-SP forms.<sup>21</sup>

We consider our attempt to adjust a bank's reported capital ratio through decompression successful only if we can complete the effective consolidation for all reporting minority-owned financial subsidiaries located anywhere in the bank's

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<sup>20</sup> Previously Avraham, Selvaggi, and Vickery (2012) have presented statistics on the complexity of US bank holding companies without making a distinction between majority-owned and minority-owned subsidiaries.

<sup>21</sup> For small BHCs, consolidated assets are available from form Y-9SP, while for large BHCs consolidated assets are available from form Y9-C.

hierarchical structure.<sup>22</sup> 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 subsidiaries in practice means that we can only complete the decompression for relatively small banking hierarchies.

In fact, we are able to complete the decompression for a sample of 94 top-tier banks, yielding 650 bank-quarter observations.<sup>23</sup> These banks on average report a capital ratio of 0.1004, while the average capital ratio after decompression is 0.0647 as shown in Panel A of Table 1 (see Table A3 in the Appendix for variable descriptions and data sources).

Figure 4 shows time plots of the average yearly reported capital ratio and the capital 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 capital ratio after decompression appears to be more stable over time than the reported capital ratio, which suggests that some of the time variation of the reported capital ratio materializes on account of varying ownership of minority-owned financial institutions. The average difference between the reported capital ratio and the capital ratio after decompression is 0.0357, or 26.1% of the reported capital ratio.

Figure 5 plots the time trends of the absolute and relative adjustments of the capital ratio following decompression. These adjustments are seen to have peaked in 2005, and to have declined subsequently as evidence of reduced use of minority-

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<sup>22</sup> We also disregard top banks where a financial institution anywhere in the hierarchy shows asset growth higher than 200%, and cases where the top bank’s reported equity to assets ratio exceeds 70%.

<sup>23</sup> The largest BHC which can be fully decompressed is Community First Bancshare, Inc., which has total assets of US\$ 570 million in 2008Q2.

owned financial subsidiaries driving a wedge between the two capital ratios.

Figure 6 plots the capital ratio after decompression against the reported capital ratio using quarterly data. Interestingly, there are 61 observations in the figure (out of 650) where the reported capital ratio exceeds 0.03 but where the capital ratio after decompression is less than 0.03. These banks are problematic from a regulatory point of view as they meet the leverage requirement of 0.03 on the basis of the reported capital ratio, but not on the basis of the capital ratio after decompression.<sup>24</sup>

The sample of banks 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 subsidiaries. We can apply the deduction method to 167 top banks with minority-owned financial institutions, providing a sample of 1614 quarterly observations. The average calculated deduction from the capital ratio is 0.0431 as seen in Panel B of Table 1, somewhat larger than the average reduction in the capital ratio of 0.0357 if decompression is applied. In specific cases, however, the deduction method gives rise to a smaller downward adjustment of the capital ratio than the decompression method, as suggested by the theoretical analysis of section 3.1. To illustrate this, Figure 7 plots the capital ratio after deduction (relative to the reported capital ratio) against the capital ratio after decompression (relative to the reported capital 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 capital 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 capital ratio.

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<sup>24</sup> The regulatory leverage ratio is defined as Tier1 capital divided by assets. We illustrate that some banks appear to have been effectively circumventing the regulatory leverage ratio requirement over the 2000-2013 period by considering the ratio of equity to assets before and after consolidating minority-owned financial institutions.

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 (calculated using a four-quarter rolling window). Second, earnings volatility is calculated as the standard deviation of the return on equity, calculated using a four-quarter rolling window.

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 subsidiaries 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 bank's overall risk (which stems from the bank's overall outside assets) relative to the parent bank's equity. A bank with minority-owned subsidiaries, 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 capital 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 capital ratio.

The regressions include three additional bank level control variables. First, size is calculated as the logarithm of total assets.<sup>25</sup> A larger bank may be less risky due to greater asset diversification. Second, asset growth is the growth rate of assets. Faster growing banks 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 bank's assets in the aggregate assets of all banks in a county. Banks with a larger market share may be either less or more risky.<sup>26</sup>

Panels A and B of Table 2 provide correlations among the variables in the samples of banks to which we have been able to apply the decompression and deduction methods, respectively. In either panel, the Z-score is positively related to the reported capital ratio as well as to the respective adjusted capital ratio, reflecting that better capitalized banks tend to be less risky. Further, the correlation between the Z-score and either absolute capital adjustment is positive and significant, suggesting that the average bank with nonconsolidated financial subsidiaries augments the consolidated bank's capital enough to compensate for the nonconsolidated subsidiary-firm assets.<sup>27</sup> Conversely, earnings volatility is positively and significantly correlated

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<sup>25</sup> A large fraction of banks in our analysis are small BHCs that file form Y-9SP with few reported items which limits our choice of control variables.

<sup>26</sup> 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.

<sup>27</sup> The average bank may not use minority-owned financial institutions to arbitrage capital adequacy rules perhaps because it has other preferred methods at its disposal to reach this objective such as the conduits resulting from securitization studied by Acharya et al. (2013). Non-consolidation of minority-owned subsidiaries, however, is an important issue nonetheless if a significant number of banks use this

with the relative capital adjustment following deduction in Panel B, suggesting that banks that require a relatively large capital adjustment are more risky.

## **5. Empirical results**

In this section, we first investigate how parent bank characteristics are associated with the minority ownership of financial institutions. Second, we examine the relationship between bank risk and the non-consolidation of minority-owned financial institutions as reflected in calculated capital adjustments following the decompression and deductions methods.

### **5.1 Which banks have minority-owned financial institutions?**

To start, we consider how bank characteristics are correlated with the use of minority-owned financial institutions. For the overall universe of top banks, we create the minority ownership variable which is a dummy variable that equals 1 if the bank has any minority-owned financial institutions among all reporting subsidiaries. As seen in Panel C of Table 1, 8.3% of banks have at least one minority-owned financial institution.

In Table 3, regression 1 is a Probit regression of the minority ownership variable on a set of bank variables. The regression includes quarter fixed effects, and standard errors are adjusted for clustering at the bank level. The coefficient for the reported capital ratio is estimated to be positive but insignificant. Size enters with a positive and significant coefficient, indicating that larger banks are more likely to have a minority-owned subsidiary. Further, concentration is estimated with a positive and significant coefficient, suggesting that market power increases the likelihood of minority ownership of financial institutions.

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method of capital arbitrage which appears to be the case based on Figure 6.

Next, we consider the share of a parent bank's reporting subsidiaries that is minority-owned represented by the minority ownership share variable. As seen in Panel C of Table 1, this variable has a mean of 0.73%, indicating that slightly less than 1% of subsidiaries are minority-owned. Column 2 of Table 3 reports the results of a Tobit regression of this share variable on the four bank characteristics. Now the reported capital ratio receives a positive and significant coefficient, suggesting that banks with substantial minority ownership of financial institutions tend to compensate for the additional risks by reporting higher capitalization. Size receives a positive and significant coefficient, suggesting that larger banks maintain relatively many minority-owned financial institutions. The positive and significant coefficient for concentration indicates that banks with significant market share tend to hold relatively more minority-owned subsidiaries.

## **5.2 Minority-owned subsidiaries and bank risk**

Next, we relate the Z-score and earnings volatility, as measures of bank risk, to calculated capital adjustments obtained through either decompression or deduction, as indices of the use of minority-owned subsidiaries. The regressions include the reported capital ratio and other bank variables as control variables. Further, quarter fixed effects are included, and standard errors are clustered at the bank level.

We start with considering regressions that include capital adjustments following decompression for the sample of banks to which decompression can be applied in Table 4. In regressions 1-6 of this table, the Z-score is the dependent variable.<sup>28</sup> In regression 1, the reported capital ratio obtains a positive coefficient of 3.503 that is significant at 10%, while the relative reduction following decompression obtains a

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<sup>28</sup> All variables except absolute and relative capital adjustments are winsorized at the 1% and 99% levels to reduce the influence of outliers.

negative coefficient of -1.539 that is significant at 1%. The negative coefficient for the relative capital adjustment variable suggests that the use of minority-owned subsidiaries 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 0.173, which reduces the Z-score by 0.266 ( $=0.173*1.539$ ) amounting to 32% of the standard deviation of the Z-score of 0.819. 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 capital ratio following decompression, yielding a negative coefficient of -4.216 that is significant at 10%.

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 crisis and subsequent periods, 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 banks that make use of nonconsolidated financial subsidiaries 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 0.173 implies an increase in earnings volatility of 0.019 ( $= 0.173 \times 0.109$ ), which is 27% of the standard deviation of earnings volatility of 0.070 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 unreported regressions analogous to Table 4, we enlarge the sample to include all banks that do not have reporting minority-owned financial subsidiaries. In these regressions, the Z-score and earnings volatility are strongly related to the relative and absolute reductions in the capital ratio after decompression. Banks to which decompression can be applied and banks without minority ownership, however, differ significantly in their size and other bank characteristics, as evident in columns 1-3 of Table 5. 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 logit 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 capital ratio, size, asset growth and concentration. 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 51 decompressed bank and 501 banks without minority ownership.<sup>29</sup> Columns 4-6 of Table 5 shows that decompressed and non-decompressed banks in the PSM sample have average bank characteristics that do not differ significantly.

Table 6 shows the results of bank risk regressions analogous to Table 4 for the PSM sample. In the earnings volatility regression 9 for the pre-crisis sample, the relative capital adjustment variable obtains a positive and significant coefficient consistent with nonconsolidated financial institutions augmenting overall bank risk. Similarly, the absolute capital adjustment variable is estimated with significant coefficients in the six regressions where it is included except regression 4. Overall, the evidence of Table 6 suggests that bank risk is positively related to our calculated capital adjustment variables after we control for differences in observed bank characteristics between the groups of decompressed bank and banks without minority ownership.

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 subsidiaries. Table 7 presents the results of bank risk regressions including capital adjustment variables following the deduction method that are analogous to Table 4. In the theoretical section 3.2, 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 bank risk variables and capital adjustment variables if decompression rather than deduction is applied. Comparing Tables 4 and 7, this seems to be the case. The absolute capital adjustment variable is negative and

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<sup>29</sup> We have 528 bank-year observations for the group of 51 decompressed banks. Note that a decompressed bank may be matched with a number of different banks in different years.

significant in Z-score regression 2, while the absolute (relative) capital adjustment variable is positive and significant in regressions 8, 10, 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 4. The relative capital adjustment variable, for instance, fails to be significant in the Z-score regression 1 of Table 7, while it is significant in the corresponding regression in Table 4.

Columns 1-3 of Table 8 show that banks to which deduction has been applied have observable bank characteristics that are not significantly different from the sample of banks without minority ownership. All the same, we construct a PSM sample consisting of banks to which deduction has been applied and banks without minority ownership to mitigate any within-sample relationship between the existence of minority ownership and other bank characteristics. As seen in columns 4-6 of Table 8, banks with and without deduction in the resulting PSM sample have average banks characteristics that are very similar.

Table 9 shows results of bank risk regressions including capital adjustment variables after deduction for the PSM sample. In these regressions, the Z-score is throughout negatively and significantly related to the absolute capital adjustment following deduction, while earnings volatility is in all instances positively and significantly related to this adjustment variable. Similarly, we found that the absolute capital adjustment under decompression is relatively important in explaining bank risk in regressions for an analogous PSM sample in Table 6.

A shortcoming in comparing Table 4 based on capital adjustments following decompression with Table 7 based on capital adjustments following deduction is that the samples of banks differ. This follows from the fact that the deduction method can be applied to relatively more banks, as it requires less information. To remedy this,

Table 10 presents bank risk regressions including capital adjustment variables following the deduction method, but based on the sample of banks in Table 4 for which decompression as well as deduction are possible. In the earnings volatility regressions 8 and 9 in Table 10, the absolute and relative capital adjustment variables obtain positive and significant coefficients. This provides some evidence that capital adjustment following deduction is related to bank risk taking. This evidence, however, is rather weak compared to the evidence of Table 4. This confirms that capital adjustments following decompression more accurately explain bank risk than the corresponding adjustments following deduction as motivated in section 3.1.

## **6. Conclusion**

US banks do not need to consolidate their minority-owned financial subsidiaries. As a result, their effective rate of capitalization is lower than the reported one. In this paper, we approximate effective capitalization rates for US banks with minority-owned financial institutions using two methods. First, we calculate the effective capitalization rate that results, if we also consolidate minority-owned financial institutions. Second, we adjust the reported capitalization rate by deducting a bank's equity investments in minority-owned financial institutions. Both methods lead to downward adjustments in capitalization as a reflection of a bank's use of minority-owned financial institutions.

We argue that effective consolidation of minority-owned financial subsidiaries is the preferred method of adjusting reported capital ratios. In fact, relative to this consolidation method, the deduction method produces errors in the adjustment that can be either positive or negative, depending on the exact structure of the overall bank. 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 capital ratio that is too large.

For a sample of US banks for the 2000-2013 period, we calculate the downward adjustment in the capital ratio using the two methods, showing that the downward adjustment using the deduction method on average is larger.

Empirically we find that bank 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 bank risk as generated by minority-owned subsidiaries, and that BHCs can use such subsidiaries to arbitrage capital regulation. Banks that have reported leverage ratios above the regulatory requirement, but adjusted leverage ratios below this requirement seem to have been using this loophole in the regulation.

However, this loophole has not gone unnoticed by regulators, and steps have been taken towards eliminating it as part of Basel III and of its US implementation. Specifically, the U.S. Federal Reserve Board issued proposals for new deductions from capital consistent with Basel III on June 7, 2012. The final rule implementing Basel III was approved by the Board of Governors of the Federal Reserve System on July 2, 2013 (Federal Reserve Board, 2013).<sup>30</sup>

The newly adopted required capital deductions for investments in nonconsolidated financial institutions in the US vary by the degree of parent ownership of the subsidiary. In particular, a distinction is made between nonsignificant investments (if the banking organization owns 10% or less of the subsidiary's common stock), and

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<sup>30</sup> The European Union correspondingly adopted a new regulation on prudential requirements for credit institutions in 2013 including required deductions from common equity Tier1 for investments in nonconsolidated financial sector entities (see European Commission, 2013, section 3).

significant investments (if the banking organization owns more than 10% of the subsidiary's common stock). Aggregate nonsignificant investments in common stock have to be deducted from the banking organization's Tier1 capital the extent that they exceed 10% of this capital. Significant investments in common shares instead are subject to 10% and 15% Tier1 capital deduction limits that apply to individual significant investments and to aggregate significant investments, respectively.<sup>31</sup>

These newly defined required deductions are phased in as follows: the regulatory adjustments will initially be 20% of the required adjustments on 1 January 2014, 40% on 1 January 2015, 60% on 1 January 2016, 80% on 1 January 2017, and reach 100% on 1 January 2018. Hence, the capitalization loopholes identified in this paper are gradually phased out over time. This paper provides a basis and rationale for this phasing out.

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<sup>31</sup> See Federal Reserve System (2013, pp. 62066-62069)

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## Appendix

### Box A1. 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,  $\alpha$ , of the subsidiary's equity is 40%. The parent's ownership of the subsidiary's equity,  $\alpha E_s$ , 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

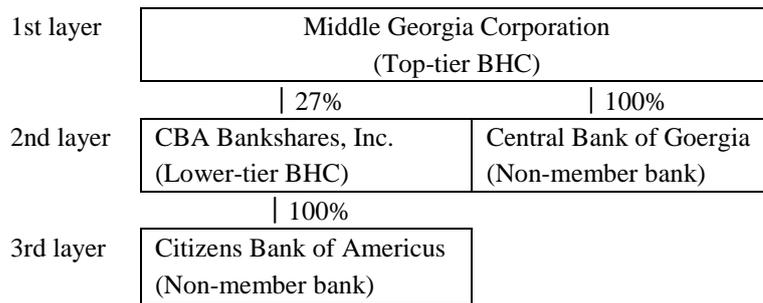
Parent	
$A_p^o=984$	$L_p=920$
$\alpha E_s=16$	$E_p=80$

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

The parent's capital ratio,  $\lambda_p = \frac{E_p}{A_p}$ , is 0.08. The capital 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 capital 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 error is the capital ratio under deduction relative to the one under decompression,  $\Delta = \lambda_{p,d} - \lambda_{p,c}$ , is -0.004.

Table A1. 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 capital ratio adjustment by way of decompression starts at the second layer. The reported capital ratio is 0.076; the capital ratio after decompression is 0.064; and the capital ratio after deduction is 0.061.

Table A2. Financial institution classification

This table 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).

Table A3. Variable descriptions and data sources

Variable	Description	Source
Z-score	Index of bank solvency constructed as $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and $stddev(ROA)$ is the standard deviation of return on assets calculated over a 4-quarter rolling window. ROA is defined as net income to total assets.	Y9-C, Y9-SP
Earnings volatility	Standard deviation of return on equity calculated over a 4-quarter rolling window. Return on equity is defined as net income to equity.	Y9-C, Y9-SP
Minority ownership	Dummy variable that equals one if a bank has minority ownership of at least one subsidiary	Y9-C, Y9-SP, NIC
Minority ownership share	Share of a bank's subsidiaries that is minority-owned	Y9-C, Y9-SP, NIC
Reported capital ratio	Ratio of equity to assets	Y9-C, Y9-SP
Capital ratio after decompression	Ratio of equity to assets after consolidation of minority-owned subsidiaries	Call reports, Y9-C, Y9-SP
Capital ratio after deduction	Ratio of equity net of equity investments in minority-owned subsidiaries to assets	Call reports, Y9-C, Y9-SP
Absolute adjustment with decompression	Difference between the reported capital ratio and the capital ratio after decompression	Call reports, Y9-C, Y9-SP
Relative adjustment with decompression	Difference between the reported capital ratio and the capital ratio after decompression divided by the reported capital ratio	Call reports, Y9-C, Y9-SP
Absolute adjustment with deduction	Difference between the reported capital ratio and the capital ratio after deduction	Call reports, Y9-C, Y9-SP
Relative adjustment with deduction	Difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio	Call reports, Y9-C, Y9-SP
Size	Natural logarithm of assets	Y9-C, Y9-SP
Asset growth	Growth rate of assets	Y9-C, Y9-SP
Concentration	Share of bank assets in county of location	Y9-C, Y9-SP

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

Part A. Balance sheet of the parent

Parent	
$A_p^o$	$L_p$
$\alpha E_s$	$E_p$

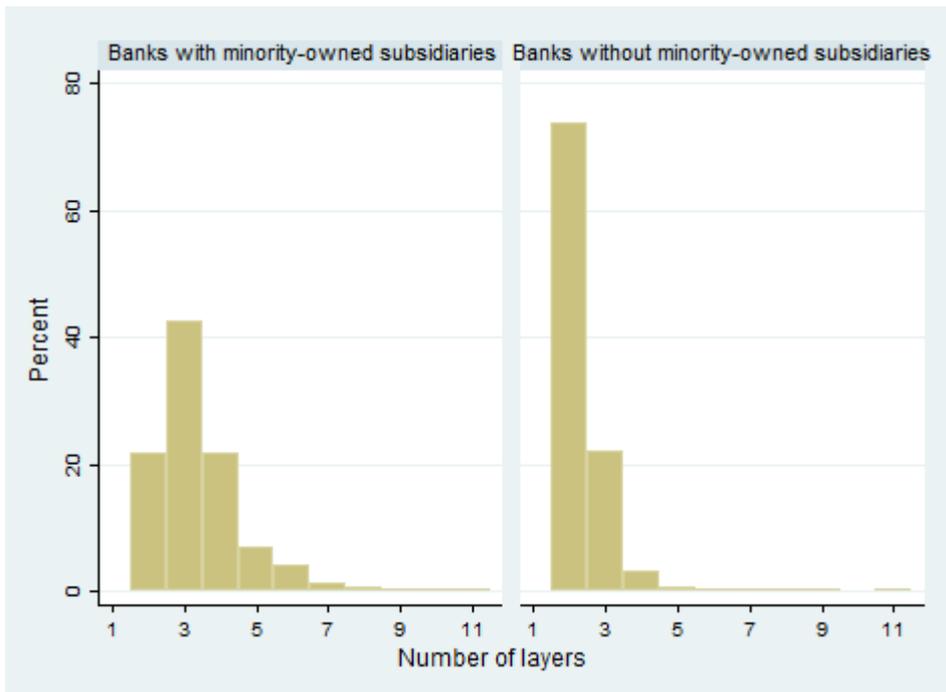
Part B. Balance sheet of the subsidiary

Subsidiary	
$A_s$	$L_s$
	$E_s$

Part C. Balance sheet of the parent after decompression

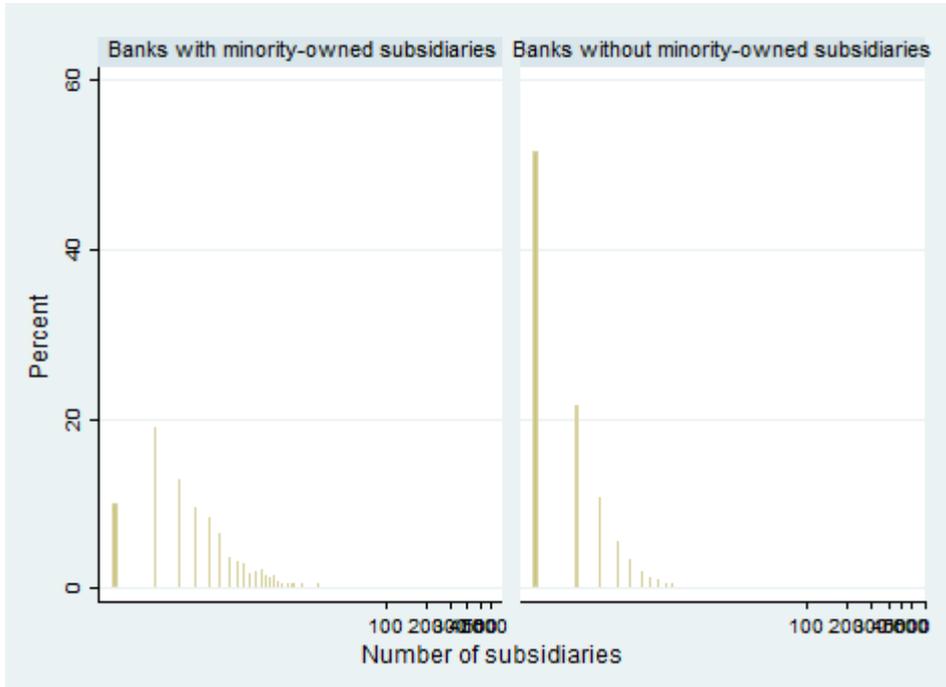
Parent after decompression	
$A_p^o$	$L_p$
	$\alpha(A_s - E_s)$
$\alpha A_s$	$E_p$

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



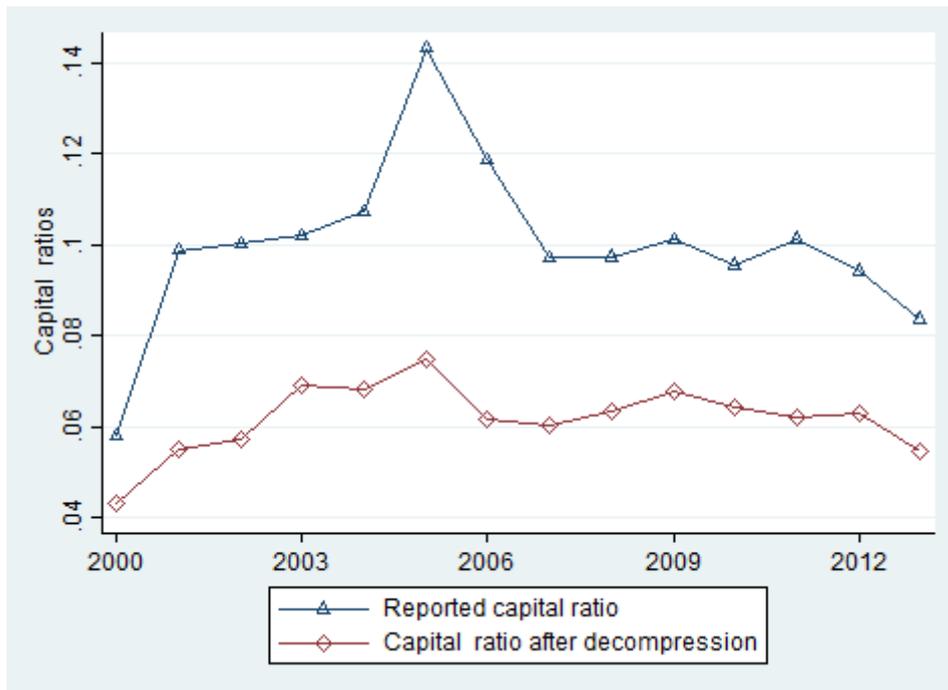
Only reporting subsidiaries are taken into account.

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



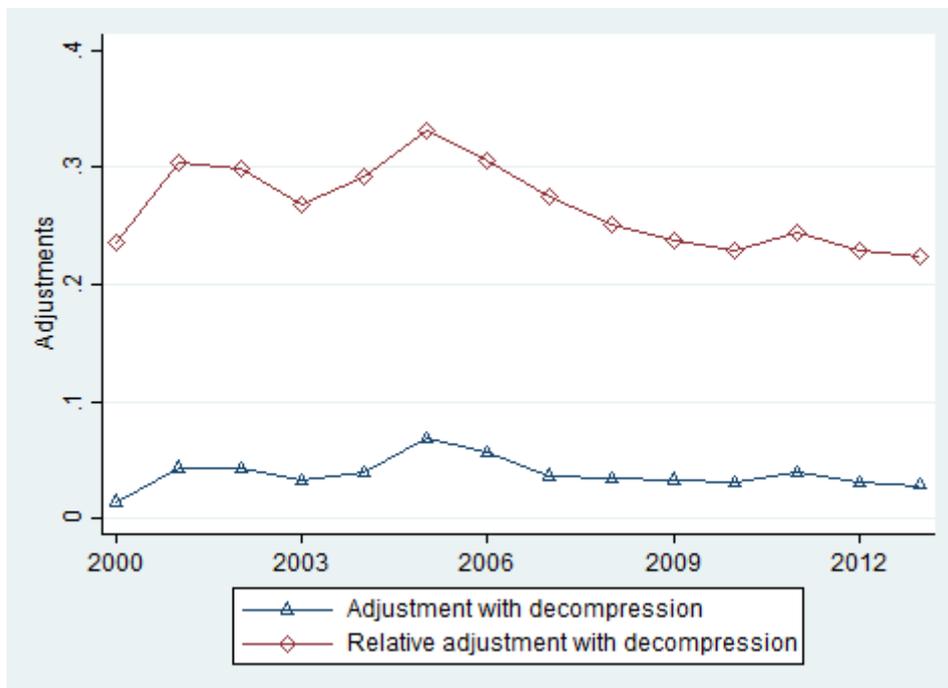
The number of subsidiaries is reported on a logarithmic scale. Only reporting subsidiaries are taken into account.

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



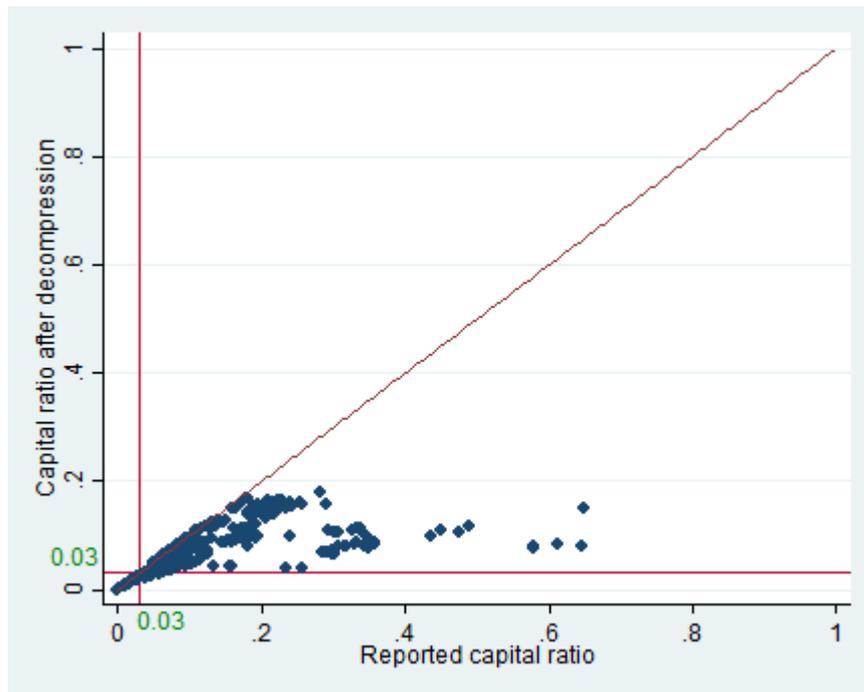
The reported capital ratio is ratio of equity to assets. The capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. The capital ratios are annual means averaged over four quarters.

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



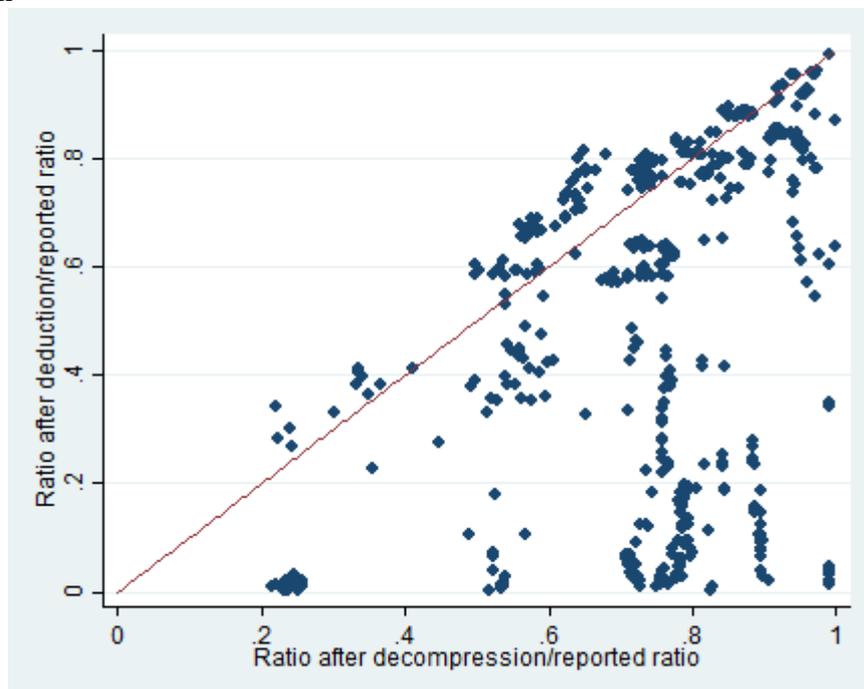
The absolute adjustment with decompression is the difference of the ratio of equity to assets and the ratio of equity to assets after consolidation of minority-owned subsidiaries. The relative adjustment with decompression is the difference of the ratio of equity to assets and the ratio of equity to assets after consolidation of minority-owned divided by the ratio of equity to assets. The figure shows annual means averaged over four quarters.

Figure 6. Capital ratio after decompression plotted against reported capital ratio



The reported capital ratio is the ratio of equity to assets. The capital ratio after decompression is the ratio of equity to assets after consolidation of minority-owned subsidiaries. The sample consists of banks for which decompression is possible.

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



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

possible.

Table 1. Descriptive statistics

Z-score is index of bank solvency constructed as  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. Earnings volatility is standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. Absolute adjustment with decompression is difference between the reported capital ratio and the capital ratio after decompression. Relative adjustment with decompression is difference between the reported capital ratio and the capital ratio after decompression divided by the reported capital ratio. Capital ratio after deduction is ratio of equity net of equity investments in minority-owned subsidiaries to assets. Absolute adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction. Relative adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. Minority ownership is dummy variable that equals one if a bank has minority ownership of at least one subsidiary. Minority ownership share is share of a bank's subsidiaries that is minority-owned. Panel A considers sample of banks for which decompression is possible. Panel B considers sample of banks for which deduction is possible. Panel C considers sample of banks for which decompression is possible and banks without minority ownership.

	Obs	Mean	Std.dev.	Min	Max
<b>Panel A. Decompression sample</b>					
Z-score	494	3.4730	0.8190	0.7665	5.1793
Earnings volatility	539	0.0497	0.0698	0.0049	0.4670
Reported capital ratio	539	0.1004	0.0835	0.0007	0.3568
Capital ratio after decompression	539	0.0647	0.0454	0.0001	0.1638
Absolute adjustment with decompression	539	0.0357	0.0545	0.0000	0.2733
Relative adjustment with decompression	539	0.2606	0.1733	0.0091	0.7756
Size	539	11.2645	1.0203	8.2569	13.2411
Asset growth	539	0.0251	0.0934	-0.3139	0.4386
Concentration	539	0.0225	0.0784	0.0000	0.5501
<b>Panel B. Deduction sample</b>					
Z-score	1329	3.4609	0.6992	0.7665	5.1793
Earnings volatility	1405	0.0471	0.0626	0.0049	0.4670
Reported capital ratio	1405	0.0980	0.0800	0.0007	0.3568
Capital ratio after deduction	1405	0.0550	0.0535	-0.0342	0.2065
Absolute adjustment with deduction	1405	0.0431	0.0623	0.0005	0.3271
Relative adjustment with deduction	1405	0.5499	0.5313	0.0193	3.4124
Size	1405	12.4819	1.9777	8.2569	20.2044
Asset growth	1405	0.0252	0.0814	-0.3139	0.4386
Concentration	1405	0.0643	0.1633	0.0000	0.8856
<b>Panel C: Pooled sample</b>					
Minority ownership	149240	0.0834	0.2765	0	1
Minority ownership share	149240	0.0073	0.0543	0	1

Table 2. Correlation matrices

Z-score is index of bank solvency constructed as  $(ROA+CAR)/\text{stddev}(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $\text{stddev}(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. Earnings volatility is standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. Absolute adjustment with decompression is difference between the reported capital ratio and the capital ratio after decompression. Relative adjustment with decompression is difference between the reported capital ratio and the capital ratio after decompression divided by the reported capital ratio. Capital ratio after deduction is ratio of equity net of equity investments in minority-owned subsidiaries to assets. Absolute adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction. Relative adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio. Size is natural logarithm of assets. Asset growth is growth rate of assets. Concentration is share of bank assets in county of location. 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 and earnings volatility are lagged one period.

Panel A. Sample of banks for which decompression is possible.

Panel A	Z-score	Earnings volatility	Reported capital ratio	Capital ratio after decompression	Absolute adjustment with decompression	Relative adjustment with decompression	Size	Asset growth	Concentration
Z-score	1								
Earnings volatility	-0.7782***	1							
Reported capital ratio	0.1722***	-0.1707***	1						
Capital ratio after decompression	0.2267***	-0.1946***	0.7999***	1					
Absolute adjustment with decompression	0.0784*	-0.098**	0.8708***	0.4020***	1				
Relative adjustment with decompression	-0.0311	0.0017	0.6692***	0.2304***	0.8324***	1			
Size	-0.0900**	0.1072**	-0.6572***	-0.2924***	-0.7676***	-0.7055***	1		
Asset growth	0.0418	-0.0634	-0.0975**	-0.0776*	-0.0827*	-0.1066**	0.1001**	1	
Concentration	-0.1743***	0.1371***	-0.1418***	-0.1059**	-0.1332***	-0.2061***	0.2897***	0.0199	1

Panel B. Sample of banks for which deduction is possible.

Panel B	Z-score	Earnings volatility	Reported capital ratio	Capital ratio after deduction	Absolute adjustment with deduction	Relative adjustment with deduction	Size	Asset growth	Concentration
Z-score	1.0000								
Earnings volatility	-0.7918***	1.0000							
Reported capital ratio	0.1317***	-0.1498***	1.0000						
Capital ratio after deduction	0.1305***	-0.1785***	0.6290***	1.0000					
Absolute adjustment with deduction	0.0570**	-0.0363	0.7353***	-0.0566**	1				
Relative adjustment with deduction	-0.0411	0.1138***	-0.2191***	-0.6647***	0.2947***	1			
Size	-0.0849***	0.0043	-0.1340***	0.0969***	-0.2551***	-0.3200***	1		
Asset growth	0.0350	-0.0896***	-0.0946***	-0.0461*	-0.0865***	0.0399	0.0385	1	
Concentration	-0.1519***	0.0938***	-0.0665**	0.0501*	-0.1281***	-0.1947***	0.7054***	0.0324	1

Table 3: Which banks have minority-owned subsidiaries?

We use all reporting subsidiaries. The dependent variable in regression in column 1 is minority ownership which is dummy variable that equals one if a bank has minority ownership of at least one subsidiary. The dependent variable in the regression in column 2 is minority ownership share which is share of a bank's subsidiaries that is minority-owned. Reported capital 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. All independent variables are lagged one period. The regression in columns 1 is a Probit regression. The regression in column 2 is a Tobit regression. Time fixed effects are included. Robust standard errors are clustered at the bank level. \*\*\*, \*\*, \* denote significance at 1%, 5% and 10% levels, respectively.

	Minority ownership Probit (1)	Minority ownership share Tobit (2)
Reported capital ratio	1.324	0.836*
	-0.852	-0.496
Size	0.365***	0.101***
	-0.022	-0.007
Asset growth	-0.008	-0.09
	-0.148	-0.071
Concentration	0.337**	0.176***
	-0.149	-0.067
Constant	-6.054***	-2.132***
	-0.299	-0.137
Number of obs	149240	149240
Pseudo R-sq	0.164	0.099
Number of banks	6287	6287
Time effects	Yes	Yes
Level of clustering	Bank	Bank

Table 4. 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  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported capital ratio and capital ratio after decompression divided by the reported capital ratio where capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. Absolute adjustment with decompression is difference between the reported capital ratio and the capital 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. All independent variables 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 capital ratio	3.503*	4.002*	3.749**	4.233*	3.303	3.761	-0.237***	-0.274**	-0.247**	-0.290*	-0.210**	-0.231*
	(1.750)	(2.318)	(1.631)	(2.375)	(2.070)	(2.540)	(0.080)	(0.114)	(0.105)	(0.152)	(0.097)	(0.127)
Relative adjustment with decompression	-1.539***		-1.734**		-1.355**		0.109***		0.099***		0.106**	
	(0.555)		(0.698)		(0.633)		(0.038)		(0.037)		(0.051)	
Absolute adjustment with decompression		-4.216*		-3.737		-4.168*		0.290*		0.239		0.288
		(2.443)		(4.081)		(2.280)		(0.151)		(0.167)		(0.196)
Size	0.012	0.037	0.045	0.112	-0.005	0.002	0.004	0.001	-0.001	-0.005	0.008	0.006
	(0.106)	(0.102)	(0.146)	(0.146)	(0.127)	(0.123)	(0.007)	(0.008)	(0.006)	(0.007)	(0.011)	(0.011)
Asset growth	0.213	0.365	-0.239	-0.087	0.423	0.554	-0.050	-0.060	0.050	0.042	-0.124**	-0.134**
	(0.471)	(0.468)	(0.943)	(0.897)	(0.506)	(0.513)	(0.042)	(0.043)	(0.049)	(0.050)	(0.060)	(0.062)
Concentration	-2.183***	-1.864**	-0.875	-0.340	-2.689***	-2.460**	0.130***	0.110*	-0.007	-0.032	0.188***	0.173**
	(0.670)	(0.872)	(0.672)	(0.915)	(0.775)	(0.903)	(0.048)	(0.066)	(0.040)	(0.063)	(0.058)	(0.071)
Constant	3.263**	2.591*	2.861	1.618	3.783**	3.427**	-0.017	0.035	0.050	0.116	-0.058	-0.022
	(1.421)	(1.379)	(1.867)	(1.859)	(1.592)	(1.541)	(0.095)	(0.098)	(0.085)	(0.085)	(0.128)	(0.130)
Number of obs	494	494	199	199	295	295	539	539	240	240	299	299
R-sq	0.155	0.122	0.160	0.114	0.158	0.134	0.135	0.113	0.119	0.097	0.176	0.157
Number of banks	51	51	37	37	36	36	76	76	61	61	37	37

Time effects	Yes											
Level of clustering	Bank											

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Table 5. Means of the samples including banks where decompression is possible with and without matching

Reported capital 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. 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 four 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	Banks with no minority ownership	T-test of equal means	Banks after decompression	Banks with no minority ownership	T-test of equal means
	(1)	(2)	(3)	(4)	(5)	(6)
Reported capital ratio	0.1021	0.0977	0.0044**	0.0974	0.0972	0.0002
Size	11.2638	12.4532	-1.1993***	11.3781	11.4052	-0.0272
Asset growth	0.0313	0.0294	0.0019	0.0259	0.0315	0.0055
Concentration	0.0235	0.0604	-0.0369***	0.0242	0.0222	-0.0020

Table 6. 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  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported capital ratio and capital ratio after decompression divided by the reported capital ratio where capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. Absolute adjustment with decompression is difference between the reported capital ratio and the capital 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. All independent variables 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 capital ratio	3.404** (1.375)	4.109*** (1.516)	2.973** (1.315)	3.302** (1.383)	3.668** (1.629)	4.636** (1.862)	-0.237*** (0.071)	-0.284*** (0.084)	-0.191** (0.087)	-0.219** (0.102)	-0.258*** (0.082)	-0.319*** (0.099)
Relative adjustment with decompression	-0.428 (0.308)		-0.354 (0.336)		-0.478 (0.403)		0.030 (0.019)		0.035* (0.021)		0.025 (0.025)	
Absolute adjustment with decompression		-3.105** (1.360)		-1.846 (2.063)		-3.837** (1.624)		0.209*** (0.075)		0.167* (0.097)		0.230** (0.095)
Size	0.029 (0.057)	0.013 (0.055)	0.069 (0.070)	0.066 (0.071)	0.019 (0.069)	-0.003 (0.067)	-0.002 (0.003)	-0.001 (0.003)	-0.002 (0.003)	-0.002 (0.003)	-0.002 (0.004)	-0.001 (0.004)
Asset growth	-0.008 (0.447)	0.003 (0.455)	-0.578 (0.544)	-0.543 (0.547)	0.300 (0.664)	0.272 (0.670)	-0.060** (0.027)	-0.061** (0.027)	0.020 (0.024)	0.017 (0.024)	-0.106** (0.047)	-0.104** (0.047)
Concentration	-0.958 (0.820)	-0.885 (0.852)	-0.137 (0.443)	-0.077 (0.470)	-1.467 (1.057)	-1.383 (1.085)	0.043 (0.050)	0.038 (0.052)	-0.009 (0.026)	-0.015 (0.030)	0.078 (0.062)	0.073 (0.064)
Constant	2.742*** (0.812)	2.800*** (0.802)	2.363** (0.912)	2.338** (0.911)	1.718* (0.930)	1.877** (0.906)	0.086** (0.040)	0.083** (0.041)	0.083** (0.040)	0.087** (0.041)	0.163*** (0.054)	0.152*** (0.053)

Number of obs	1002	1002	408	408	594	594	1002	1002	408	408	594	594
R-sq	0.113	0.115	0.142	0.139	0.102	0.108	0.145	0.147	0.128	0.119	0.156	0.162
Number of banks	521	521	239	239	323	323	521	521	239	239	323	323
Time effects	Yes											
Level of clustering	Bank											

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Table 7. 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  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Relative adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio where capital ratio after deduction is ratio of equity net of equity investments in minority-owned subsidiaries to assets. Absolute adjustment with deduction is difference between the reported capital ratio and the capital 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. All independent variables 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 capital ratio	1.016*	1.858**	1.104*	1.751**	0.994	2.113*	-0.114***	-0.207***	-0.055**	-0.151***	-0.158**	-0.269***
	(0.573)	(0.826)	(0.566)	(0.805)	(0.811)	(1.139)	(0.038)	(0.055)	(0.027)	(0.051)	(0.070)	(0.085)
Relative adjustment with deduction	-0.063		-0.143		-0.048		0.009		0.021***		0.002	
	(0.076)		(0.113)		(0.094)		(0.008)		(0.008)		(0.011)	
Absolute adjustment with deduction		-1.320*		-0.941		-1.662		0.141**		0.131**		0.173*
		(0.795)		(0.987)		(1.087)		(0.056)		(0.051)		(0.093)
Size	0.025	0.024	-0.034	-0.023	0.109**	0.105**	-0.004**	-0.004**	0.001	-0.000	-0.010**	-0.010**
	(0.029)	(0.028)	(0.025)	(0.025)	(0.046)	(0.045)	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)	(0.004)
Asset growth	0.448	0.433	0.197	0.175	0.735	0.714	-0.073***	-0.070**	0.008	0.014	-0.174***	-0.171***
	(0.308)	(0.307)	(0.423)	(0.433)	(0.478)	(0.473)	(0.027)	(0.028)	(0.021)	(0.027)	(0.053)	(0.052)
Concentration	-0.816**	-0.805**	-0.353	-0.402	-1.408**	-1.381**	0.071**	0.069**	0.014	0.020	0.127**	0.125**
	(0.359)	(0.354)	(0.293)	(0.302)	(0.537)	(0.535)	(0.031)	(0.030)	(0.014)	(0.015)	(0.053)	(0.053)
Constant	2.924***	2.867***	3.720***	3.502***	2.013***	2.003***	0.109***	0.117***	0.030	0.062***	0.182***	0.180***
	(0.410)	(0.401)	(0.362)	(0.366)	(0.610)	(0.590)	(0.029)	(0.027)	(0.019)	(0.021)	(0.064)	(0.061)
Number of obs	1329	1329	709	709	620	620	1405	1405	772	772	633	633
R-sq	0.071	0.075	0.088	0.082	0.086	0.093	0.107	0.111	0.091	0.063	0.140	0.148
Number of banks	106	106	81	81	69	69	143	143	119	119	70	70

Time effects	Yes											
Level of clustering	Bank											

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Table 8. Means of the samples including banks where deduction is possible with and without matching

Reported capital 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. 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 deduction is possible and banks without minority ownership constructed by way of propensity score matching on the basis of the four 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 deduction	Banks with no minority ownership	T-test of equal means	Banks after deduction	Banks with no minority ownership	T-test of equal means
Reported capital ratio	0.0987	0.0977	0.0011	0.0988	0.1013	-0.0025
Size	12.4622	12.4484	-0.0138	12.5800	12.4942	0.0858
Asset growth	0.0291	0.0295	-0.0003	0.0255	0.0288	-0.0033
Concentration	0.0650	0.0602	-0.0048	0.0669	0.0726	-0.0058

Table 9. Bank risk and capital following deduction method for the matched sample

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Relative adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio where capital ratio after deduction is ratio of equity net of equity investments in minority-owned subsidiaries to assets. Absolute adjustment with deduction is difference between the reported capital ratio and the capital 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. All independent variables 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 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 capital ratio	2.376*** (0.571)	2.736*** (0.529)	2.358*** (0.553)	2.654*** (0.525)	2.384*** (0.778)	3.202*** (0.852)	-0.164*** (0.034)	-0.181*** (0.031)	-0.142*** (0.030)	-0.159*** (0.032)	-0.179*** (0.047)	-0.218*** (0.048)
Relative adjustment with deduction	0.036 (0.052)		0.035 (0.110)		0.034 (0.049)		-0.003 (0.003)		0.001 (0.006)		-0.005 (0.003)	
Absolute adjustment with deduction		-0.854*** (0.251)		-0.618*** (0.175)		-1.959** (0.779)		0.045** (0.018)		0.029*** (0.009)		0.109** (0.048)
Size	-0.011 (0.014)	-0.013 (0.013)	-0.023* (0.013)	-0.026** (0.012)	0.013 (0.028)	0.018 (0.027)	-0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	-0.001 (0.002)	-0.001 (0.002)
Asset growth	0.429 (0.273)	0.425 (0.274)	-0.073 (0.335)	-0.059 (0.336)	1.176** (0.462)	1.107** (0.459)	-0.071*** (0.019)	-0.071*** (0.019)	-0.020 (0.020)	-0.020 (0.020)	-0.146*** (0.034)	-0.142*** (0.034)
Concentration	-0.152 (0.133)	-0.166 (0.131)	-0.107 (0.099)	-0.109 (0.097)	-0.270 (0.282)	-0.347 (0.272)	0.005 (0.008)	0.006 (0.008)	0.003 (0.005)	0.003 (0.005)	0.009 (0.018)	0.014 (0.017)
Constant	3.200*** (0.225)	3.206*** (0.212)	3.380*** (0.213)	3.405*** (0.202)	2.990*** (0.411)	2.892*** (0.393)	0.064*** (0.014)	0.063*** (0.013)	0.056*** (0.012)	0.057*** (0.012)	0.068** (0.029)	0.072*** (0.027)
Number of obs	2684	2684	1449	1449	1235	1235	2684	2684	1449	1449	1235	1235
R-sq	0.079	0.085	0.075	0.081	0.087	0.096	0.081	0.084	0.061	0.065	0.103	0.107
Number of banks	1233	1233	723	723	640	640	1233	1233	723	723	640	640

Time effects	Yes											
Level of clustering	Bank											

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Table 10. Bank risk and capital following deduction method for the sample where decompression is possible

The dependent variable in regressions 1-6 is Z-score, which is an index of bank solvency constructed as  $(ROA+CAR)/stddev(ROA)$ , where ROA is return on assets, CAR is ratio of equity to assets, and  $stddev(ROA)$  is the standard deviation of return on assets calculated over a 4-quarter rolling window. The dependent variable in regressions 7-12 is earnings volatility which is the standard deviation of return on equity calculated over a 4-quarter rolling window. Reported capital ratio is ratio of equity to assets. Relative adjustment with decompression is difference between the reported capital ratio and capital ratio after decompression divided by the reported capital ratio where capital ratio after decompression is ratio of equity to assets after consolidation of minority-owned subsidiaries. Absolute adjustment with decompression is difference between the reported capital ratio and the capital ratio after decompression. Relative adjustment with deduction is difference between the reported capital ratio and the capital ratio after deduction divided by the reported capital ratio where capital ratio after deduction is ratio of equity net of equity investments in minority-owned subsidiaries to assets. Absolute adjustment with deduction is difference between the reported capital ratio and the capital 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. All independent variables are lagged one period. Time fixed effects are included. Robust standard errors are clustered at the bank level. 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	2.045 (1.953)	2.725 (1.803)	1.906 (1.932)	2.804 (1.871)	2.207 (2.221)	2.752 (2.002)	-0.116 (0.091)	-0.217** (0.088)	-0.080 (0.093)	-0.229** (0.114)	-0.133 (0.109)	-0.191* (0.098)
Relative adjustment with deduction	-0.079 (0.101)		-0.249 (0.180)		0.016 (0.104)		0.010 (0.010)		0.029** (0.012)		-0.003 (0.006)	
Absolute adjustment with deduction		-1.201 (1.447)		-0.165 (2.142)		-1.791 (1.566)		0.189* (0.097)		0.138 (0.092)		0.210 (0.141)
Size	0.116 (0.129)	0.094 (0.138)	0.131 (0.178)	0.204 (0.177)	0.090 (0.141)	0.035 (0.155)	-0.003 (0.007)	0.001 (0.008)	-0.001 (0.007)	-0.006 (0.007)	0.000 (0.009)	0.007 (0.012)
Asset growth	0.326 (0.475)	0.314 (0.479)	-0.005 (0.847)	-0.161 (0.915)	0.543 (0.528)	0.522 (0.527)	-0.059 (0.041)	-0.056 (0.042)	0.021 (0.033)	0.045 (0.048)	-0.134** (0.063)	-0.130** (0.061)
Concentration	-2.143** (0.854)	-2.049** (0.852)	-0.635 (0.891)	-0.572 (0.876)	-2.634*** (0.893)	-2.596*** (0.894)	0.132** (0.060)	0.120* (0.062)	-0.009 (0.057)	-0.021 (0.056)	0.182*** (0.067)	0.180** (0.068)
Constant	1.734 (1.744)	1.936 (1.823)	1.571 (2.312)	0.544 (2.240)	2.433 (1.804)	3.109 (1.903)	0.075 (0.094)	0.039 (0.102)	0.051 (0.087)	0.126 (0.091)	0.052 (0.113)	-0.030 (0.139)
Number of obs	493	493	198	198	295	295	538	538	239	239	299	299

R-sq	0.113	0.113	0.129	0.107	0.121	0.127	0.111	0.116	0.139	0.099	0.150	0.160
Number of banks	51	51	37	37	36	36	76	76	61	61	37	37
Time effects	Yes											
Level of clustering	Bank											

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