Bank response to higher capital requirements when banks gain private information about their asset values

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Abstract

We show that the extent to which a bank expects to acquire private information over its assets is a key determinant of its response to a change in capital requirements. Our novel finding is that opaque banks rely on reducing risk-weights to de-lever more so than transparent banks. We use the FAS 166/167 reforms for identification and explain our findings in a model in which opaque banks face an adverse selection discount when selling assets. We provide an explanation for why banks respond to an increase in capital requirements, even when the requirements do not immediately bind.

Keywords: Securitization, Off-balance sheet activities, Variable Interest Entity, Capital requirements.

JEL Classifications: G21, G28

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1. Introduction

Capital requirements are the most prominent macro-prudential instrument in the arsenal of bank regulators. Since the global financial crisis of 2007-2009, the requirements have been further tightened under Basel III, and especially so for the banks which are the most systemically important, to curb excessive risk-taking. An important question which arises here is how banks respond to changes in capital requirements. Several existing empirical papers have considered this question (e.g., Gropp et al. 2019) but they do not capture how two important bank features affect banks' response to the change in capital requirements. These features, which have been discussed widely in the last three decades, are: First, banks often keep large capital buffers in excess of the minimum capital requirements (e.g., Berger et al. 1995). Second, it has been argued that banks gain private information about the true value of (some of) their assets over time (e.g., Parlour and Plantin, 2008, Dang et al., 2017). In this context, the contribution of this paper is to argue theoretically and present supporting empirical evidence that information asymmetry associated with bank assets is a key determinant of the bank response to a change in capital requirements.

Model preview. We present a model which predicts that the banks' response to higher capital requirements depends critically on the transparency of their assets. Suppose that there are two types of banks: one type owns informationally opaque assets (e.g., relationship loans) and the other type owns more marketable assets (arm's length loans and other tradeable assets). Would the two types of banks respond differently to an increase in capital requirements?

In the model, when the increase in capital requirements is imposed banks do not have superior information about the quality of their assets; they only know the expected quality, which is also known to the outside investors. Following the increase in capital requirements, banks learn the true quality of their loans over time. The opaque banks observe privately if their tradeable assets are of good or poor quality, while the transparent banks' tradeable asset quality is publicly observed. Additionally, at a future date, there may be a negative shock to banks' untraded assets with some positive probability; the realization of the shock is privately observed by each bank. We assume that banks hold sufficient excess capital buffer such that the increase in capital requirements does not immediately lead to the violation of the requirements. However, if the negative shock to the untraded assets realizes at the future date, a bank falls short of the regulatory capital requirements and needs to sell risky assets. Banks can sell risky assets either before or after they learn the quality of their tradeable assets.

If the opaque banks sell their loans after they privately observe their loan quality, the proportion of bad loans sold will be higher than if they sell the loans before quality is observed. This is because even banks which are not hit by the negative shock to the untraded assets will sell their bad loans to benefit from the pooling price. Hence, the market applies an adverse selection discount to the loans sold by opaque banks after they have observed the loan type.

Because of this adverse selection discount, the opaque banks may breach the regulatory requirements if the negative shock hits and they sell their assets after they have gained private information about their true value. If they sell before they learn the true value of their loans, the opaque banks will avoid the adverse selection discount and will meet the higher capital requirements even if the negative shock hits. Thus, the opaque banks will sell the assets on which they gain private information over time immediately after the increase in the capital requirements. In contrast, the banks with the transparent assets do not face the adverse selection discount since their loan quality is observed publicly; so, in response to the increase in capital requirements they need not sell risky assets, unless the negative shock to their untraded assets realizes. Beatty and Liao (2011) argue that it is difficult for banks to replenish equity capital in crisis periods (see also Beatty and Liao, 2014); our theory suggests that it is relatively more difficult to do so for banks which have mostly non-marketable assets.

Our model bears similarities with models in banking and corporate finance in which new information arrives and the information is private to some agents (e.g., Parlour and Plantin, 2008, Greenwood et al., 2015, Dang et al., 2017). In these models, informed and uninformed agents are allowed to trade only after the arrival of private information, and inefficiencies (from the ex-ante perspective) arise due to this private information. In contrast to the existing models, we allow for trade to occur both prior to and after the arrival of the private information, and do not exogenously impose the timing of the trade. In equilibrium, parties can engage in trade prior to the arrival of the private information to avoid the adverse selection discount. This observation allows us to derive a new empirical prediction which is that banks with informationally opaque assets reduce risk-weighted assets more aggressively when there is an increase in capital requirements compared to banks which own more marketable assets.

Empirical setting. The ideal scenario to assess the impact of capital requirements would be if the regulators impose higher capital requirements on some randomly chosen banks, and not on others. By randomly chosen banks, we mean that the regulator does not consider bank size or systemic importance in choosing which banks are subjected to the higher capital requirements. In Basel II, changes in capital requirements are uniform across all banks in a jurisdiction and implemented at the same time for all banks, which means that there is no comparable group of banks against who the effects can be benchmarked. The various buffers introduced in Basel III give rise to some heterogeneity which may potentially be exploited for benchmarking. However, the buffers are imposed systematically, e.g., the largest banks are subject to higher requirements. The systematic nature of the regulation renders the benchmarking imperfect. In some cases (e.g., in the UK), the regulator imposes bank-specific requirements, but these correlate with potentially unobserved bank-specific characteristics.

Gropp et al. (2019) address some of these identification challenges by exploiting the institutional set-up of the 2011 capital exercise, conducted by the European Banking Authority (EBA) (see also Bostandzic et al., 2021). The exercise targeted the largest banks in each EU member country. Since the largest banks in some EU member countries are smaller than some of the smaller banks in some other EU member countries, there is a size overlap between the banks chosen to be in the capital exercise and those that are left out. However, their set-up still suffers from the issue that the largest banks in any country are systemically more important from the perspective of that country, which makes them systematically different from the similar-sized banks from the other countries which are left out of the capital exercise. In support of this argument, Gropp et al. (2022) show that the individual governments of the EU member countries protected their largest banks from the new capital charges.

Our identification relies on the implementation of the FAS 166/167 in 2010. Under the previous relevant standard, FIN 46 (R), banks kept Variable Interest Entities (VIEs) mostly off the balance sheet. Following the implementation of the FAS 166/167, banks were required to consolidate the VIEs onto their balance sheets. Consolidation of the VIEs led to a mechanical fall in the level of the risk-weighted capital ratio, since the VIEs were included in the calculation of the risk-weighted assets. Important for our identification, the consolidation itself did not directly affect bank risk, since the banks were already exposed to most of the risk coming from these assets even before consolidation. As with Gropp et al. (2019), there is a considerable overlap between the size distributions of the treated and control banks. Additionally, since all our banks belong to the same jurisdiction, the United States, size is a reasonable proxy for the bank's systemic importance. Thus, our identification is not subject to the shortcoming in Gropp et al. (2019) that the treated banks are likely to be more systemically important than the control banks.

Our setting has another advantage which is that capital requirements vary at the bank-level. Imbierowicz et al. (2018), Fraisse et al. (2019), De Jonghe et al. (2020) and Eckley et al. (2021), also consider settings in which capital requirements vary at the bank-level. In these settings the regulator exercises discretion in imposing the bank-level requirements, and hence, the requirements may be correlated with potentially unobserved bank-level factors. In our setting the requirements are correlated with observed bank-level factors and can be controlled for in the regressions.

Our sample consists of annual bank-level data for US Bank Holding Companies for the time-period between 2005 and 2015. To be included in our sample, we require that a bank has non-zero securitized assets in at least one year during the sample. This gives us an initial sample of 163 banks, of which 33 form the treated group since they consolidate VIE assets. Figure 1 shows the size distribution (in terms of the average total assets over the sample period) of the treated and control groups. Although the treated banks are larger on average, there is a considerable overlap in the size distributions of the treated and the control groups: the largest control bank in the sample is larger than 30 treated banks, and there are 60 control banks which are larger than the smallest treated bank. These 60 banks make up the control group in the final sample.

Empirical results. In response to the increase in capital requirements induced by the FAS 166/167 regulation, the treated banks rely on reducing risk-weighted assets (the denominator) to reduce leverage, rather than increasing their Tier 1 capital (the numerator). The result is striking since the mechanical impact of the reforms would be to increase the treated banks' risk-weighted assets if banks did not respond. That the treated banks' risk-weighted assets are lower relative to the control banks', suggests that the treated banks' response to the reforms was strong enough to overturn the mechanical impact of the reforms. Overall, the treated banks increase their risk-weighted capital ratio following the reforms, relative to the control banks by around 1.2%. In terms of the risk of their loan portfolio, the treated banks reduce *Net Charge-offs* by 0.19%, after controlling for bank-specific factors. The magnitude of the drop is 23% of the sample mean for this variable. The overall bank risk, reflected in the *Z-Score*, is also lower. We show that our findings are not driven by the differential impact of the global financial crisis on the treated banks vis-à-vis the control banks.

Our model predicts that the impact of reforms differs across transparent and opaque banks. We classify the treated banks in our sample as transparent if their trading assets are above the 75$^{\text{th}}$ percentile (more than 4.7% of their assets in trading assets), and opaque otherwise. On average, a transparent bank has around a fifth of its assets in trading assets. It may be the case that some trading assets are complex in nature, but transparency in our model is not related complexity. When we say an asset is transparent, we mean that market participants have symmetric information about the state of nature, and it is opaque when there is information asymmetry. Since trading assets are held as short-term investments and marked to market, banks which own these assets are unlikely to know more about these assets than outsider investors.

We find that both transparent and opaque banks increase the risk-weighted capital ratios following the reforms, although to a different extent and, most importantly, through different means. To achieve higher risk-weighted capital ratio, the opaque banks rely heavily on adjusting the denominator, i.e., reducing risk-weighted assets, while the transparent banks do not. Consistent with our model predictions, we find that for both our risk proxies, the effect is statistically significant only for the opaque banks and it becomes statistically insignificant for the transparent banks (while retaining the same sign). Our findings highlight that it is crucial to consider the asset side of banks in evaluating banks' response to higher capital requirements.

Our findings complement the findings in Bushman and Williams (2012) who show that bank transparency is associated with more prudent risk-taking due to enhanced outside monitoring.

Regulators often increase capital requirements even when the higher requirements do not appear to bind given existing buffers. E.g., in January 2022, the German bank regulators, BaFin, raised capital requirements, but said in a statement,

"Banks will be able to meet this requirement almost entirely from existing excess capital".

Existing papers suggest that banks build up excess buffers to avoid accidentally breaching regulatory requirements due to negative shocks (Berger et al. 1995, Lindquist, 2004, Jokipii and Milne, 2008, and Stolz and Wedow, 2011); thus, raising capital requirements can be effective, even if the increased requirements are not binding, because banks may wish to protect a certain level of buffer. However, it is not clear why banks do not sell risky assets to increase their risk-weighted capital ratio when they are arbitrarily close to breaching requirements.

We provide a new explanation for why banks may respond to an increase in capital requirements even though the requirements are currently not binding and our explanation accounts for the possibility of risky asset sales. In our model, even if the increased requirements are currently slack, the opaque banks anticipate that at a future date they may have to sell their assets at an adverse selection discount which may lead to a breach of the regulatory requirements. As a result, they sell assets immediately to avoid this adverse selection discount.

Related literature. Our paper contributes to the literature which studies the impact of bank capital requirements (e.g., Laeven and Levine, 2009, Behr et al. 2010, Berger and Udell, 1994). In contrast to these studies, we exploit the across-bank heterogeneity in changes in capital requirements, which allows us to make more reliable inferences. In this regard, our paper is closest to Gropp et al. (2019), who we have discussed in detail above. To summarize our novel contribution, we show that there are differences in how transparent and opaque banks deleverage; the latter are more reliant on reducing risk-weighted assets in increasing the risk-weighted capital ratio.

Our paper also adds to a small set of papers which studies the impact of the FAS 166/167 reforms (e.g., Dou et al., 2018, Tian and Zhang, 2016, Dou, 2021, and Tang, 2019). These papers focus on the credit supply impacts of the FAS 166/167 reforms, with the general finding that the affected banks cut their credit supply. In contrast, we investigate how the affected banks respond to these reforms in terms of their overall risk-taking and the liability structure.

2. Model

We present a stylized model of banking which predicts that banks' response to higher capital requirements differs depending on the transparency of their assets. The model has four dates, $t = \{0, 1, 2, 3\}$. There are two types of banks: opaque banks and transparent banks.[2] At $t = 0$, both types of banks have tradeable legacy loans, which can be either relationship or arm's length, and some non-tradeable assets. The relationship loans are owned by the opaque banks. The transparent banks own the arm's length loans and do not have private information regarding their loans. A secondary market for loans operates at $t = 0$ and $t = 2$. All agents are risk-neutral and protected by limited liability. The risk-free rate is normalized to 0, so there is no discounting.

It has been argued that bank equity capital is costlier than deposits, which leads to the

[2] In our stylized model, we assume that some banks are transparent, and others are opaque. This assumption may be micro-founded in the framework of Biswas and Koufopoulos (2022), as follows. There are skilled and unskilled banks, and both can divert resources which puts an upper bound on bank leverage. The skilled banks will manage complex (opaque) projects such as relationship loans since they add value to these projects. The unskilled banks manage simpler (transparent) projects. If we assume that more can be diverted from the opaque projects then the diversion constraint is more binding for the skilled bankers, and the equilibrium outcome is that the opaque banks will be smaller and less levered compared to the transparent banks. The details are available upon request.

unregulated bank leverage to be higher than the socially optimal level (see e.g., Allen et al., 2015, and Biswas and Koufopoulos, 2022). The regulator imposes risk-based capital requirements, i.e., Tier 1 equity capital divided by risk-weighted assets. In addition, breaching the regulatory minimum is assumed to be costly. The cost of breaching the regulatory requirements may be interpreted as higher compliance costs (e.g., an increase in capital charge or restrictions on payout). This implies that a bank will hold a buffer in excess of the capital requirements at $t = 0$. With capital requirement, $k\%$, a bank brings forward a buffer, $b\%$, to $t = 0$, so the risk-weighted capital ratio at this date is $(k + b)$. Banks can sell risky assets which reduces risk-weights and leads to an increase in the risk-weighted capital ratio (similar to Corona et al., 2015, Davila and Hebert, 2020; see Shleifer and Vishny, 2011, for supporting empirical evidence).

For an opaque bank, the entrepreneur's project has a positive NPV at the time of the loan issuance; the gross interest rate, R, is set such that the bank makes non-negative expected profits, and it is paid at $t = 3$ only if the entrepreneur succeeds, which happens with probability, $p \in (0,1)$. With the complementary probability, $(1 - p)$, the entrepreneur's project fails, and the loan is not repaid. At $t = 1$ the opaque bank privately learns with certainty whether the loan will be repaid or not. For a transparent bank, its loan will repay R at $t = 3$ with probability p and 0 with probability $(1 - p)$; the difference with the opaque banks is that the transparent bank does not learn anything about its loans at $t = 1$.

At $t = 2$ both types of banks face a purely idiosyncratic shock with probability $\lambda \in (0,1)$; there is no aggregate uncertainty and λ is assumed to be distributed independently of p.[3] The shock reduces the value of the non-tradeable assets of the bank which impairs a fraction, $\alpha \in$

[3] To simplify the analysis, we assume that the idiosyncratic shock hits the banks' untraded assets (this being the only purpose of the untraded assets in our model). However, it should be noted that if the shock hit the traded assets (e.g., lowering the success probability of the legacy assets), the main results go through qualitatively.

$(0,1)$ of the banks' risk-weighted equity capital, i.e., if a shock hits a bank, its risk-weighted capital ratio falls from $(k+b)$ to $(1-\alpha)(k+b)$. The realization of the shock is privately observed by the banks. We summarize the timeline of model below:

t=0: Banks own legacy loans with expected value, pR. The bank capital ratio is $k+b$.

t=1: The opaque banks privately learn if the legacy loans will be repaid, whereas the transparent banks do not gain any private information.

t=2: Banks face a negative shock to the untraded assets with probability, λ, which impairs a fraction, α, of the bank's risk-weighted capital ratio.

t=3: All returns are realized. Loans are repaid only if entrepreneurs succeed.

We look for the subgame perfect Nash equilibrium of the game and solve it using backward induction. Suppose that at $t=0$ the risk-weighted capital requirements go up by Δ%. The increase in requirements is such that the requirements do not bind due to the existing excess buffer, i.e., $b>\Delta$. However, if the negative shock hits a bank's untraded assets at $t=2$, the bank will need to sell risky assets in order not to breach the regulatory requirements. Similar to Greenwood et al. (2015), we assume that banks sell risky assets to adjust the risk-weighted capital ratio (see empirical evidence in Adrian and Shin (2010), for empirical evidence in support of the assumption). Banks can sell risky assets at $t=0$ or $t=2$. Given the increase in risk-weighted capital requirements, if the negative shock hits a bank, the bank will sell risky assets worth:

$$(k+\Delta)-(1-\alpha)(k+b)=\Delta+\alpha(k+b)-b \tag{1}$$

By selling the amount of risky asset described in Equation (1) the bank will ensure that it will not breach the regulatory minimum. How would the opaque and transparent banks respond to an increase in risk-based capital requirements at $t=0$? Consider an opaque bank's problem at $t = 2$. When an opaque bank sells its loans, it is either due to the negative shock to the untraded assets or because it learns at $t = 1$ that the entrepreneur has failed and will not make the loan repayments. The potential buyers of the opaque banks' loans do not know the loan quality, although the banks themselves know the loan quality. Therefore, the opaque banks sell their bad loans even if they do not experience the negative shock, which leads to an increase in probability of selling loans by opaque banks from λ (the symmetric information prior) to $\lambda + (1 - \lambda)(1 - p)$. Asymmetric information leads to a higher probability that the loans being sold by the opaque bank are bad, compared to the symmetric information prior. If the opaque bank attempts to sell, the fair price of the loan at $t = 2$ will be:

$$\Pi = \frac{\lambda\, pR}{\lambda + (1-\lambda)(1-p)} < pR \tag{2}$$

In contrast, at $t = 0$ the price of the opaque banks' loans is given by pR, which is the fair price of the loan given that the bank does not have superior information about the quality of the loan relative to the outside investors. Note that $pR > \Pi$ for any $\lambda < 1$. This implies that for any feasible parameters, an opaque bank faces an adverse selection discount in selling its loans at $t = 2$, relative to the price at $t = 0$. Lemma 1 summarizes the above discussion.

Lemma 1: *The opaque banks receive a higher price if selling the loan at $t = 0$ than if selling at $t = 2$. Specifically, the adverse selection discount is $\frac{(1-\lambda)(1-p)}{\lambda + (1-\lambda)(1-p)} pR$.*

Suppose that the shock hits at $t = 2$. Consider the following set of parameters:

$$pR > \Delta + \alpha(k + b) - b > \Pi > \alpha(k + b) - b \tag{3}$$

For these parameters, an opaque bank avoids breaching the higher capital requirements if it sells its loans at $t = 0$ (first inequality), but not if it sells its loans at $t = 2$ (second inequality). The third inequality ensures that if there is no increase in capital requirements at

$t = 0$, the opaque bank can meet the regulatory requirements by selling the assets at $t = 2$ implying that if there is no increase in capital requirements the opaque bank is indifferent between selling the loan at $t = 0$ or $t = 2$. If the magnitude of the shock to the untraded assets, α, is more severe (the first inequality flips), selling loans never avoids breaching the regulatory requirements. If the magnitude of the negative shock is less severe (the second inequality flips), the bank avoids breaching regulatory requirements by selling its loans $t = 2$.

Supposing that α is in the intermediate range, the opaque bank always sells its loans at $t = 0$. Waiting to sell till $t = 2$ is never an optimal strategy for the bank since with a positive probability there will be a negative shock leading to a breach of the regulatory capital requirements, which is to be avoided in all states given the cost it entails. To ensure that the bank does not fall short of the regulatory requirements in all future states, the opaque bank responds to an increase in capital requirements by selling its loans, even though the requirements do not bind at $t = 0$.

Lemma 2: *For intermediate values of* α *(given by Equation 3), the opaque banks sell assets at* $t = 0$ *in response to an increase in capital requirements at* $t = 0$*, even if the increase in requirements is not immediately binding.*

Next, consider a transparent bank's problem. It does not face the adverse selection problem like the opaque banks. If it sells its assets at $t = 2$, it is clearly because of the shock, and not because it is attempting to hide the sale of bad assets behind the shock. Therefore, its loans are sold at the same price at $t = 2$ as at $t = 0$.

Lemma 3: *The transparent banks are indifferent between selling their assets at* $t = 0$ *or* $t = 2$*, in response to an increase in capital requirements at* $t = 0$*.*

To summarize, the key friction in the model is that the opaque banks privately learn at the intermediate date whether the loan will be repaid, but the transparent bank do not gain any private information. In the presence of this friction, the opaque banks, but not the transparent banks, sell assets in response to an increase in capital requirements, even if the requirements are not binding. The reason is that in the event of a crisis, an opaque bank will face an adverse selection discount in selling its assets such that the proceeds from the sale may not be sufficient to cover the shortfall in equity capital. In contrast, a transparent bank is able to sell its assets at a fair price at any given point in time. In reality, both types of banks are likely to face some discounts in selling their assets during crisis times (e.g., due to a temporary lower demand for riskier securities during the crisis, as in Shleifer and Vishny, 1992, Allen and Carletti, 2008, and Shleifer and Vishny, 2011); the model's predictions are qualitatively unchanged as long as the discount for the opaque assets is larger than the discount for the transparent assets.

The main predictions from the model are stated below:

Empirical Prediction 1: *On average, banks respond to an increase in capital requirements even if the increased requirements are not immediately binding.*

Although, an increase in capital requirements may not lead to a breach in the regulatory requirements due to the presence of excess capital buffers, still it increases the probability that the capital requirements will become binding when a negative shock hits in the future. Because opaque banks acquire private information about their asset quality over time, selling risky assets sooner rather than later reduces the adverse selection cost. For this reason, opaque banks may respond immediately to an increase in capital requirement, even if at this point in time the requirements are not binding. Existing papers suggest that banks build up excess capital buffers to insure against negative shocks leading to a breach of the regulatory requirements (Berger et al. 1995, Lindquist, 2004, Jokipii and Milne, 2008, and Stolz and Wedow, 2011).

But these papers cannot explain why banks would want to sell risky assets immediately following the increase in capital requirements rather than later, after the negative shock realizes. Our model provides micro-foundations for why selling risky assets following negative shocks can be costly for banks which is that it imposes an adverse selection cost on the bank due to the arrival of private information over time. Thus, banks may sell risky assets following an increase in capital requirements, even though the higher requirements are not immediately binding. The key distinguishing feature of our paper is that it shows whether a bank responds immediately or not to an increase in capital requirements depending on its asset transparency. This allows us to derive a novel empirical prediction, which is the following:

Empirical Prediction 2: *Following an increase in capital requirements, the opaque banks will reduce risk-weights to de-lever, while the transparent banks may not.*

The opaque banks are more reliant on reducing risk-weighted assets to de-lever, compared to transparent banks. Opaque banks acquire private information over time which imposes an adverse selection cost on them when they sell risky assets in the event that a negative shock hits the bank. Thus, the opaque banks sell risky assets immediately following an increase in capital requirements rather than after the realization of the negative shock. In contrast, the transparent banks do not suffer from the adverse selection cost if selling after the negative shock realizes, which makes them indifferent between selling before or after the arrival of information regarding the loan quality since this information is not private.

It is important to note that the predictions rely on an *anticipated* negative shock, which implies that it is not necessary to observe a shock in the data to test the prediction. As long as there is a positive probability of a future shock, the transparent and opaque banks respond differentially to an increase in capital requirements. Therefore, to test the predictions, we need an exogenous shock to banks' capital requirements; the FAS 166/167 reforms precisely offer this empirical setting.

3. Data and Methodology

3.1 Institutional background

Our identification comes from the FAS 166/167 reforms, effective from 2010. Prior to the reforms, banks kept most of the Variable Interest Entities (the VIEs) off their balance sheets, even if retaining exposure to potential losses coming from these assets. Due to being off the balance sheet, the VIEs did not carry a capital charge. The previous standards which governed accounting for securitization, FAS 140 and FIN 46(R), were quantitative in nature, allowing banks to meet the necessary requirements for them to just avoid consolidation (and pay the associated capital charge). Following the FAS 166/167 reforms, banks are required to consolidate all VIEs over which they have significant control, and they retain an obligation to absorb their losses. The new requirements, being qualitative, are less prone to being abused by accounting manipulations.

Starting in 2011, banks disclose the data on the size of assets in consolidated VIEs on Schedule RC-V of the Call Reports (in 2010 disclosure of this information was not required). We identify 33 banks which reported the consolidation of at least one VIE asset under the FAS 166/167 between 2011-2015; these 33 banks make up the treatment group. The consolidation of VIE assets lead to an increase in the affected banks' capital charge, which we interpret as a de facto increase in capital requirements.

3.2 Data

We use annual bank balance sheet data collected from the FR Y-9C reports of US bank holding companies in the SNL Financial database. Our sample covers 2005–2015, with the implementation of the FAS 166/167 reforms at the beginning of 2010, which falls roughly in the middle of the sample period. To construct the sample, we begin with all 3920 US bank holding companies. We only keep the banks that have non-zero off-balance sheet securitized assets in at least one year during our sample to ensure comparability between the banks affected by the FAS 166/167 and those which were not (see e.g., Casu et al., 2013, who show that securitizing banks differ from non-securitizing banks across several dimensions). We end up with a total of 163 banks in our sample, including the 33 treated banks identified using the VIE consolidation data. Of the 130 control banks, we identify a sub-sample of 60 banks (see Figure 1), the smallest of which is larger than the smallest treated bank. We use this set of banks as the final control group. Thus, in the final sample we have 33 treated banks, 60 control banks, and 869 bank-year observations. Including control variables in the regressions reduces the number of observations. To retain the largest sample size possible, we report regressions both with and without including the control variables. We define the main variables in our analysis below, and the summary statistics are in Table 1. All continuous variables are winsorized at the 1st and 99th percentiles to avoid the effects of outliers in the regressions.

Under Basel capital adequacy standards, riskier asset categories entail higher risk-weights, implying a higher associated capital charge for them. Therefore, banks may de-leverage by reducing risk-weighted assets (RWA) by tilting the asset portfolio away from the riskier assets to the safer ones (e.g., reduce lending and hold cash) and/or by issuing Tier 1 capital (*CET1*), which is composed of core capital including common equity and retained earnings. Unrealized gains and losses on available-for-sale (AFS) securities and loan loss reserves are excluded from Tier 1 capital. We examine how banks deleverage following the implementation of the FAS 166/167 reforms. We hypothesize that banks deleverage primarily through reducing risk-weights, due to costs associated with issuing capital. Therefore, our main dependent variable is RWA, scaled by total assets. We also test to what extent deleveraging occurs through the numerator, i.e., *CET1*, scaled by total assets. Finally, what is the overall impact of the FAS 166/167 on the risk-weighted capital ratio, *CET1/RWA.*

When a bank re-balances its portfolio from assets with high capital charges to assets with lower capital charges, we will detect a change in the *RWA/Assets* variable. If the imposition of the capital charges is imperfect, banks may engage in regulatory arbitrage which reduces capital charge without necessarily lowering risk exposure. For this reason, we examine the impact of the reforms in two direct measures of risk-taking: *Net Charge-offs* and *Z-score. Net Charge-offs* is the ratio of net charge-off to average gross loans. Higher values of *Net Charge-offs* indicate higher risk-taking. Our second risk proxy is the *Z-Score* which measures the distance to default. The *Z-Score* is calculated as follows:

$$Z - Score_{i,t} = \frac{ROA_{i,t} + Equity_{i,t}/Assets_{i,t}}{\sigma(ROA)_{i,t}} \tag{4}$$

$\sigma(ROA)$ is the volatility of *ROA*. We use the quarterly *ROA* to construct the volatility variable, so it is time-varying at the annual frequency. A higher *Z-Score* signals that a bank has a lower insolvency risk. It may be interpreted as the number of standard deviations that a bank's profits have to fall for the bank to just deplete its equity capital and become insolvent (Roy, 1952). Since the distribution of *Z-Score* is known to be highly skewed, we use the natural logarithm of *Z-Score* in the regressions, as is the standard practice (e.g., Laeven and Levine, 2009, and Beck et al., 2013). Unlike *Net Charge-offs*, which measure the risk in banks' loan portfolios, the *Z-Score* measure captures the overall bank risk. From Table 1, the average *Net Charge-offs* in our sample is 0.827, and the average *Z-Score* is 3.879.

We control for various bank characteristics in our regressions. Bank size is proxied using the natural logarithm of the total assets, *Size. GrowthTA* is the growth rate in *Size*. The return on assets, *ROA*, reflects bank profitability. The average bank in the sample has a *ROA* of

0.879%. *Loan* and *Cash*, which are the ratio of gross loans to the total assets and the ratio of total cash to total assets, reflect the bank's business model and liquidity, respectively. The average bank's loan portfolio makes up 64.14% of its total assets, and it holds 1.98% of the total assets in cash. *Deposit* is the total deposits scaled by the total assets, and *Equity* is the total equity divided by the total assets; together, they reflect the bank's funding structure. The ratio of overheads to the total assets, *Overheads,* captures the bank's operating costs. Finally, we control for the size of the off-balance sheet activities, *OFBS*, by using the total assets securitized divided by the total assets. Off-balance sheet activities make up 4.468% of the bank's total assets.

Transparent banks. A key prediction of our model is that the impact of reforms should differ by bank asset transparency. To test the cross-sectional differences across transparent and opaque banks, we use the pre-treatment data to construct an indicator variable, *Transparent,* which equals 1 if a treated bank has trading assets above the 75th percentile (among the treated banks), while it equals 0, otherwise.[4] The idea is that the banks with a high fraction of trading assets can sell these assets at the market price at any given point in time. It may be the case that some trading assets are complex in nature. Transparency in our model is not related complexity, but to the distribution of information about the state of nature which affects the value of the asset. When we say an asset is transparent, we mean that market participants have symmetric information about the state of nature, and it is opaque when there is information asymmetry. What is important is not the complexity of the asset as such, but whether banks have private information about their assets. If banks do not have private information about their assets, it is easier for them to sell the assets in the event of a

[4] The 50th percentile Trading assets value is roughly 1%, and hence, not a significant proportion of bank's assets. For this reason, we pick the 75th percentile as the cut-off which is 4.7%.

negative shock because they will not face an adverse selection discount. Since trading assets are held as short-term investments, banks which own these assets are unlikely to know more about these assets than outsider investors.

On average, the transparent banks in our sample have close to a fifth of their assets in trading assets (19%), pre-treatment. Additionally, these banks have much smaller fraction of their assets in loans (39%), compared to the opaque banks (61%). Since loans are opaque assets, due to the screening and monitoring functions of banks, smaller loan portfolios make the banks which we classify as transparent, even more transparent compared to the banks which we classify as opaque.

3.3 Methodology

We identify the impact of the higher capital requirements on bank deleveraging using a difference-in-differences research design. We estimate the following regression:

$$Y_{i,t} = \beta_1 * Post_t * Consolidation_i + \alpha X_{i,t-1} + \gamma_i + \gamma_t + \varepsilon_{i,t} \tag{5}$$

where Y_{it} is the outcome variable (e.g., *RWA/Assets*) for bank i in year t. $Consolidation$ is an indicator variable that equals one if a bank consolidated VIEs under the FAS166/167 and zero otherwise. $Post$ is an indicator variable, which equals one if the year is 2010 or later and zero otherwise. We include the bank fixed effects, γ_i, to control for time-invariant bank characteristics and the year fixed effects, γ_t, to control for time-varying shocks. We cannot estimate the coefficients on *Post* and *Consolidation* because these are subsumed by the included fixed effects. The variable of interest is the interaction term, *Post** *Consolidation*, which captures the banks in the treated group in the post-reform period. The vector, X_{it-1}, is the set of bank characteristics (e.g., *Size, OFBS,* and others discussed in Section 3.2); the controls are lagged by one period to mitigate endogeneity concerns. We estimate Equation (5) using OLS, and the standard errors are clustered at the bank level.

4. Results

4.1 Parallel Trends

The validity of our difference-in-differences set-up requires that the parallel trend assumption is not violated, i.e., the change in the treated and control banks' outcome variables would have followed a similar trend in the absence of the FAS 166/167 implementation (Angrist and Krueger, 1991). In Table 2, we look at the evolution of changes in the primary outcome variables, *RWA/Assets* and *CET1/Assets,* prior to the reforms. Panel (a) reports the results for *RWA/Assets*. The difference between the treated and control banks in the change in *RWA/Assets* is not statistically different from zero for two of the most recent pre-reform horizons, although the difference becomes positive statistically significant at the 10% level for the longest horizon. This observation suggests that although prior to the global financial crisis, *RWA* evolved differently for our treated and control banks, the trends became parallel over the crisis years, 2007 - 2009, leading up to the FAS 166/167 reforms. In Panel (b), we consider *CET1/Assets*; for this variable, the difference is statistically significant in the most recent horizon. These observations suggest that the parallel trends assumption is likely to be satisfied for *RWA/Assets,* although not necessarily for *CET1/Assets*.

4.2 Baseline Results

We examine how banks deleverage following the de facto increase in capital requirements induced by the reforms. Regulatory capital requirements under Basel II are in terms of Tier 1 capital over risk-weighted assets. Higher capital requirements may be met either through increasing Tier 1 capital on the liability side (the numerator) or reducing risk-weights of assets (the denominator).

We begin by visually inspecting how each element of bank leverage evolves around the reforms in Figure 2. We plot the means of the primary outcome variables, $RWA/Assets$ and $CET1/Assets$, separately for the treated and control banks. Panel (a) shows that prior to the reforms, i.e., over the crisis years, the mean $RWA/Assets$ is similar for the two groups. There is an immediate differential impact following the FAS 166/167 reforms, with a much sharper fall for the treated banks compared to the control banks. The visuals in panel (a) are striking: the mechanical impact (i.e., if the treated banks did not respond to the reforms), of consolidating the VIEs on the balance sheet would be higher risk-weighted assets for the treated banks. That we observe the opposite in the data is indicative of a strong response by the treated banks. In panel (b), we plot the mean $CET1/Assets$ around the reforms for the treated and control groups. In the most recent pre-reform year, the $CET1/Assets$ variable climbs for both groups, but sharper for the treated banks. Post-reform, there is no discernible differential impact detected in the $CET1/Assets$ variable. The raw data plots suggest that bank deleverage primarily by reducing the risk-weighted assets following the reforms.

In Table 3, we present the regression results. In columns 1 and 2, the dependent variable is RWA scaled by total assets, and the regressions are without and with controls included, respectively. The coefficient on the interaction term is negative and statistically significant at the 1% level in both columns. This result suggests that in response to the higher requirements, banks re-balance their portfolio towards assets which have lower risk-weights attached to them. The response is sufficiently strong to overturn the mechanical impact of the reforms which is to increase the amount of risk-weighted assets. The finding is consistent with Dou et al. (2018) who find that the banks affected by the FAS 166/167 reforms reduce mortgage origination and increase the sale of existing mortgages. In columns 3 and 4, the dependent variable is $CET1$ scaled by total assets, and the regressions are without and with controls included, respectively.

The coefficient on the interaction term is statistically insignificant at the conventional levels in both columns, consistent with what we observe in the raw data plots.

In Figure 3, we trace out the dynamic effects of bank de-leveraging by plotting the coefficients obtained from estimating a version of Equation (5), replacing the interaction term, *Post*Consolidation*, with interactions of *Consolidation* with each year, and the year before the reforms, 2009, serves as the excluded category. In panel (a), we plot $RWA/Assets$. The pre-reform coefficients are insignificant, confirming that there are no significant pre-trends, and the post-reform coefficients are negative and statistically significant for several of the years. In contrast, for *CET1/Assets* which is plotted in panel (b), the plotted coefficients suggest that in 2009 there is a positive adjustment, but the post-reform coefficients are statistically insignificant.

Overall, these results indicate that the average bank meets the increased requirements through adjusting the denominator rather than numerator. Our results are consistent with the findings of Gropp et al. (2019) who also find evidence for bad deleveraging being the predominant response of the average bank to an increase in capital requirements, using a different empirical setting (the EBA capital exercise).

In columns 5 and 6, we estimate Equation (5) using $CET1/RWA$ as the dependent variable, and the regressions are without and with controls included, respectively. The coefficient on the interaction term, *Post*Consolidation*, is positive and statistically significant in both columns. The magnitude of the effect is economically important. The treated banks increase their risk-weighted capital ratio by 1.2% (in the specification which includes the controls), which is roughly 10.6% of the sample average for this variable. This result confirms that the treated banks deleverage in response to the higher capital requirements. In terms of the control variables, the coefficient on *Size* is negative and statistically, while the coefficient on ROA is positive and statistically significant.

In Table 4, we present the results of estimating Equation (5) with the risk-taking variables as the dependent variables. In columns 1 and 2, the dependent variable is *Net Charge-offs*, without and with the control variables, respectively. The coefficient on the interaction term, *Post*Consolidation*, is negative and statistically significant at the 5% level in both columns. The estimated coefficients suggest that the magnitude of the effect is sizable. Following the implementation of the FAS 166/167, the treated banks reduce *Net Charge-offs* by 0.21% or 0.19%, depending on the specification. Taking the coefficient in full specification, *Net Charge-offs* for the treated banks fall by 23% $(0.190/0.827)$ relative to the mean. In columns 3 and 4, the dependent variable is the *Z-Score*, which captures the overall risk-taking of the bank. The *Z-Score* provides a slightly different information than *Net Charge-offs*, since loans in our sample make up 64.14 % of the total assets for the average banks. Consistent with lower risk-taking following the treatment, the coefficient on the interaction term is positive and statistically significant, whether we include the controls or not. When we include the controls, the coefficient is 0.377 and significant at the 5% level, which implies that the reforms lead to a 45.8% $(e^{\wedge}0.377-1)$ average increase in the *Z-Score*.

In terms of the set of control variables, the coefficient on *Size* is positive in the *Net Charge-offs* regression and negative in the *Z-Score* regression, indicating that larger banks are riskier, consistent with a 'too-big-to-fail' hypothesis. The coefficient on *ROA* is negative in the *Net Charge-offs* regressions, implying that the profitable banks take less risk. The coefficient on *OFBS* is insignificant in both regressions, implying that conditional on being a securitizing bank (which makes up our sample), the intensity of the securitization is not significantly associated with risk-taking.

4.3 Robustness

Since the post-reform period begins in 2010, one possibility is that global financial crisis of 2007-2009 drives our results. Alternatively, it may be the case that banks anticipate the reforms (see e.g., Hendricks et al., 2022). Additionally, motivated by the crisis, this period also experienced other major reforms, such as the Dodd-Frank Act and the Basel III (although, the implementation of Basel III did not start till much after the FAS 166/167 reforms and is still not completed in 2022). Our choice of control banks mitigates these concerns to some extent since they are also securitizing banks and similar in size. We perform two additional tests to further address these concerns and report the results in Table 5 and Table 6.

In Table 5, we use the year before the crisis, 2006, as the placebo treatment year (with the sample from 2003-2009): if the crisis is driving our original findings, then the placebo effect should be significant in the treated banks. We do not find this to be the case for any of our dependent variables, which suggests that the crisis is not driving our findings.

Each of the eight globally systemically important banks, G-SIBs, in the sample is a treated bank. Given that the crisis and the ensuing regulations may have affected the G-SIBs asymmetrically compared to the non G-SIBs, it is possible that the treatment effect is a G-SIB effect, rather than coming from the FAS 166/167 reforms. In order to investigate this possibility, we re-do the original regressions, but drop the G-SIBs from the sample (in Table 6). The coefficients of interest are identical in sign to the full-sample regressions and remain statistically significant for *RWA/Assets*, *Charge-offs*, and *Z-Score*, while insignificant for *CET1/Assets*, suggesting that the G-SIBs do not drive our findings.

4.4 Cross-sectional heterogeneity

Our model generates a new prediction that the effects of an increase in capital requirements should be stronger for the opaque banks. To test the hypothesis, we construct an indicator variable, *Transparent,* which equals 1 if a treated bank has trading assets above the 75th percentile (among the treated banks), while it equals 0, otherwise. We estimate an augmented version of Equation (5) as follows:

$$Y_{i,t} = \beta_1 * Post_t * Consolidation_i + \lambda_1 * Post_t * Consolidation_i * Transparent_i + \alpha X_{i,t-1} + \gamma_i + \gamma_t + \varepsilon_{i,t} \quad (6)$$

Since only the treated banks can take the value 1 for the variable, *Transparent*, the interaction, *Post*Transparent*, and *Consolidation*Transparent* are subsumed due to perfect multicollinearity. The coefficient, λ_1, captures the heterogenous effect. By itself, the coefficient, β_1, reflects the treatment effect for the opaque banks, while the sum, $\beta_1 + \lambda_1$, represents the treatment effect for the transparent banks. The main prediction from the model is that λ_1 will take the opposite sign to β_1, when the dependent variable is *RWA/Assets*.

In Table 7, we estimate Equation (6), with *RWA/Assets*, *CET1/Assets,* and *CET1/RWA* as the dependent variables. In column 1, the dependent variable is *RWA/Assets*. The coefficient on the interaction term, *Post*Consolidation,* is negative, while the coefficient, λ_1, is positive. The sum, $\beta_1 + \lambda_1$, is also negative but statistically insignificant. This suggests that only the opaque banks reduce risk-weighted assets sufficiently to overturn the mechanical impact of the reforms, consistent with the opaque banks selling riskier assets in order to avoid the adverse selection costs in the potential event of a crisis. The transparent banks reduce risk-weighted assets as well, but the response only offsets the mechanical impact of the reforms. In column 2, the dependent variable is *CET1/Assets*. Both β_1 and λ_1 are positive, although the effects are statistically insignificant. In column 3, the dependent variable is the risk-weighted capital ratio, *CET1/RWA*. The coefficient on the interaction term, *Post*Consolidation*, is positive and statistically significant, and the coefficient, λ_1, is positive. This suggests that in response to the increased capital requirements, both transparent and opaque banks increase their risk-weighted capital ratio.

Therefore, we find some evidence that although both transparent and opaque banks deleverage following the reforms, they do so in different ways, with the opaque banks mainly reducing risk-weights, while the transparent banks being relatively less reliant on reducing risk-weights to deleverage. In terms of absolute change in the risk-weighted assets, the difference between transparent and opaque banks (denoted by λ) is not statistically significant. However, it should be noted that the transparent banks increase their risk-weighted capital ratio by roughly 3.7 times the increase of the opaque banks following the reforms. Therefore, if both types of banks were to increase the risk-weighted capital ratio by the same magnitude, the transparent banks would reduce risk-weighted assets by a smaller magnitude compared to the opaque banks. The findings are consistent with Empirical Prediction 2 which states that the opaque banks are more reliant on reducing risk-weighted assets to de-lever compared to transparent banks.

One possibility is that the transparent banks are systematically differently affected by the reforms, which then leads to a different treatment effect for the transparent banks relative to the opaque banks. However, we find that transparent banks are no more or less likely to be more intensely treated; half of the transparent banks were treated with above median intensity and the other half were treated with below median intensity (the treatment intensity is reflected by and increasing in the amount of VIE assets consolidated following the reforms).

We report the findings for the two risk proxies in Table 8. In column 1 the dependent variable is *Net Charge-Offs*. As before, the coefficient on the interaction term, *Post*Consolidation*, is negative and statistically significant. The coefficient, λ_1, is positive, although statistically insignificant. The sum, $\beta_1 + \lambda_1$, becomes statistically insignificant. These findings suggest that the treated banks with smaller amounts of trading assets reduced their risk more aggressively post-treatment, which is consistent with our hypothesis. In column 2 the dependent variable is *Z-Score*. The coefficient on the interaction term, *Post*Consolidation*, is positive, and statistically significant at 10% level. The sum, $\beta_1 + \lambda_1$, becomes statistically insignificant. Overall, consistent with Prediction 2, we infer that the risk-curbing effects are relatively muted for the transparent banks, compared to the opaque banks.

5. Conclusion

We examine how banks deleverage. After the implementation of the FAS 166/167 in 2010, banks were required to consolidate the securitized VIEs onto their balance sheets. The consolidation itself did not directly affect the banks' risk exposures. Since the consolidated assets were included in the risk-weighted assets, the treated banks experience a (de facto) increase in capital requirements. We identify 33 banks which consolidated at least one VIE asset during 2011-15, which make up the treated group, and 60 securitizing banks which are comparable in size to the treated banks make up the control group.

We find that, on average, banks de-lever by reducing risk-weights. It is important to note that banks de-lever differently based on their opacity. The opaque banks rely on adjusting the denominator, i.e., reducing risk-weighted assets, while the transparent banks are less reliant on adjusting the denominator. We argue that this is the case since the banks with opaque assets suffer adverse selection discounts in selling their assets in the event of a crisis. Our findings provide a rationale for why banks respond to an increase in capital requirements, even when the requirements do not immediately bind.

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Figure 1: Bank size distribution.

This graph shows the size distribution of the control and treated groups. The Y-axis is the log of size. The value, 0, on the X-axis denotes the controls banks, while the value, 1, denotes the treated banks.

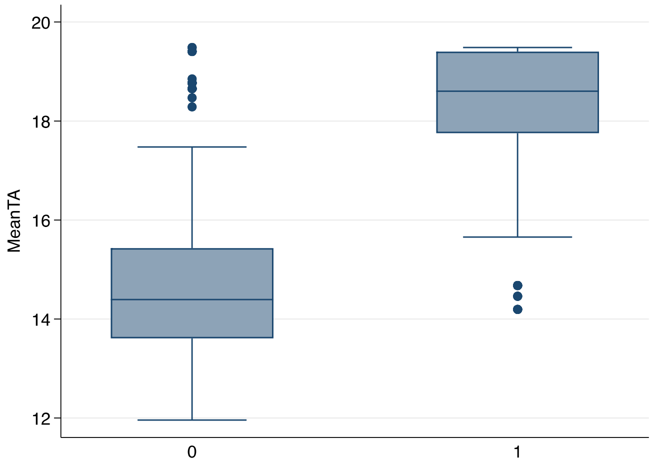
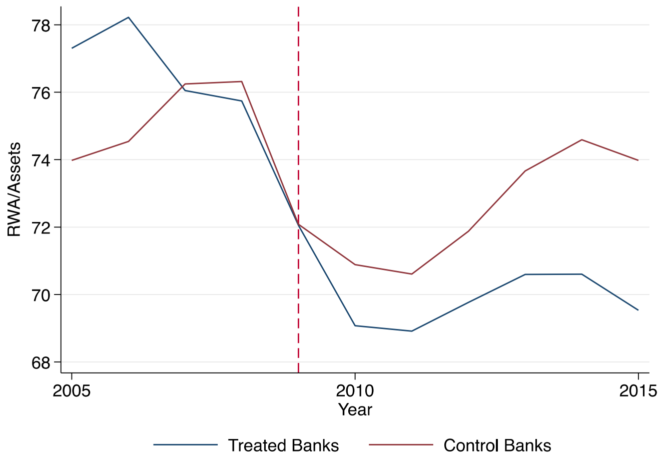
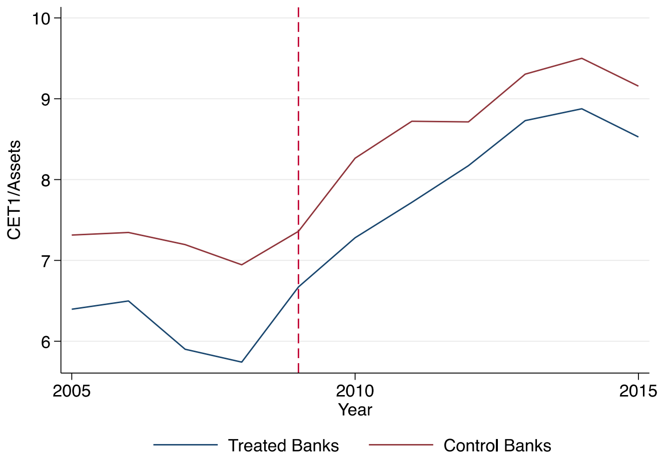


Figure 2: Unconditional average effects.

This figure plots the means of the outcome variables, *RWA/Assets* and *CET1/Assets*, separately for the treated and control groups over the sample period. The treatment date is the start of 2010.



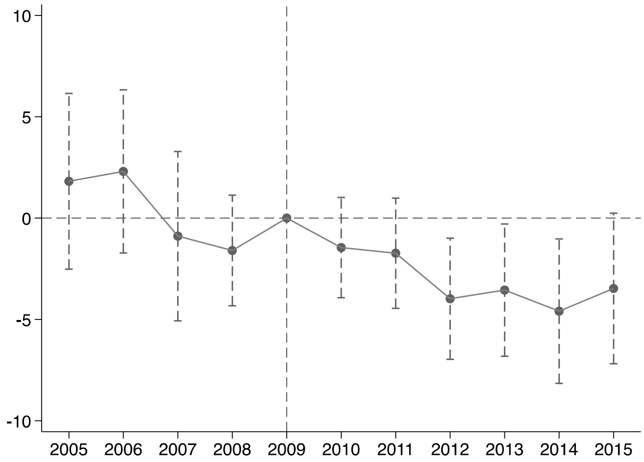
Panel (a): *RWA/Assets*



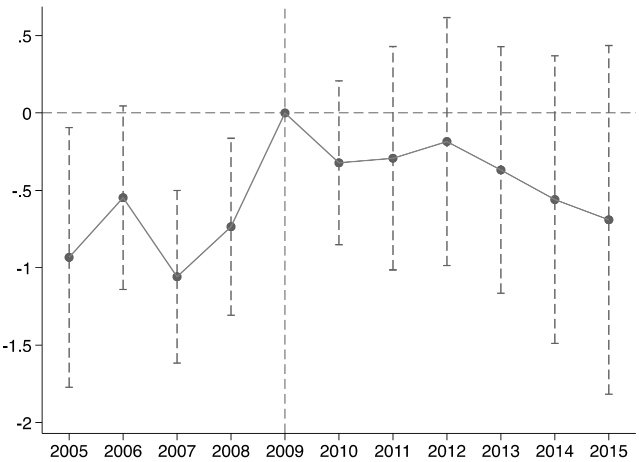
Panel (b): *CET1/Assets*

Figure 3: Dynamic effects of bank de-leveraging.

This figure plots the dynamic effects of bank de-leveraging. In particular, this figure plots the coefficient estimates of an augmented version of Equation (5), replacing the interaction term, *Post*Consolidation*, with the interactions of *Consolidation* with a set of year dummy variables. We exclude the year before the reforms, 2009, thus estimating the dynamic effect of the reforms relative to that year. Vertical bars indicate 95% confidence intervals based on standard errors clustered at the bank level.



Panel (a): *RWA/Assets*



Panel (b): *CET1/Assets*

Table 1: Descriptive statistics.
The table shows the summary statistics of the key variables used in the analysis (see Section 3.2). All variables are winsorized at the 1st and 99th percentiles to minimize the effects of outliers.

Variable	N.	Mean	SD	p10	p25	P50	p75	p90
RWA/Assets	853	73.056	13.974	54.030	66.342	74.972	82.022	88.014
CET1/Assets	844	7.907	4.592	4.212	5.589	7.479	8.967	10.537
CET1/RWA	844	11.115	5.548	6.210	7.980	10.475	12.490	15.500
Charge-Offs	869	0.827	1.018	0.050	0.160	0.420	1.090	2.310
Z-Score	869	3.879	1.400	1.880	3.005	4.119	4.840	5.512
Size	869	16.492	1.806	14.420	14.857	16.074	18.241	19.485
GrowthTA	851	6.977	14.177	-3.910	-2.41e-06	4.354	9.953	18.023
ROA	869	0.879	0.860	0.010	0.600	0.960	1.230	1.550
Loan	869	64.143	14.968	40.840	59.690	67.550	73.920	78.750
Cash	869	1.982	1.083	0.870	1.260	1.770	2.440	3.370
Deposits	869	70.370	13.683	46.140	65.170	74.410	80.030	83.770
Equity	869	10.506	3.349	6.890	8.450	10.100	12.070	14.400
Overheads	869	3.347	1.313	2.250	2.660	3.030	3.590	4.750
OFBS	869	4.468	22.005	0	0	0	2.653	10.971

Table 2: The evolution of changes in the primary outcome variables for the pre-treatment years.

The table reports the changes in the primary outcome variables, *RWA/Assets* and *CET1/Assets* for different horizons prior to the reforms. Columns 1 and 2 show the evolution of changes in the treated and control groups, respectively. Column 3 reports the differences in the changes between the two groups, and the t-statistic testing the equality of means is reported in column 4.

	(1) Treated	(2) Control	(3) Differences	(4) T-Statistic
Panel a. *RWA/Assets*				
2009-2008	-2.218	-3.893	-1.675	-1.112
2009-2007	-4.123	-3.821	0.303	0.141
2009-2006	-6.295	-2.160	4.135*	1.799
Panel b. *CET1/Assets*				
2009-2008	0.833	0.281	-0.553**	-2.324
2009-2007	0.454	0.002	-0.452	-1.377
2009-2006	-0.143	-0.138	0.005	0.015

Table 3: Higher capital requirements and regulatory capital.

The dependent variables are the risk-weighted capital ratio, and its components. In column 1 and 2, the dependent variable is *RWA/Assets*, in column 3 and 4, it is *CET1/Assets*, and in column 5 and 6, it is *CET1/RWA*. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after the implementation of the FAS 166/167. Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	RWA/Assets		*CET1/Assets*		*CET1/RWA*	
*Post*Consolidation*	-5.086***	-3.365***	-0.109	0.256	0.959*	1.181**
	(-3.15)	(-2.82)	(-0.28)	(0.85)	(1.79)	(2.48)
Size		1.490		-1.867***		-2.637***
		(0.94)		(-4.35)		(-3.37)
GrowthTA		-0.038***		-0.006		-0.002
		(-2.76)		(-1.62)		(-0.26)
ROA		-0.126		0.365***		0.563***
		(-0.24)		(2.84)		(2.78)
Loan		0.596***		0.021		-0.057
		(12.88)		(1.12)		(-1.55)
Cash		0.341		-0.022		-0.158
		(1.17)		(-0.19)		(-0.72)
Deposit		-0.063		0.011		0.019
		(-1.18)		(0.48)		(0.42)
Equity		-0.099				
		(-0.51)				
Overheads		0.064		0.193*		0.187
		(0.23)		(1.72)		(1.14)
OFBS		0.147*		0.049***		0.027
		(1.83)		(2.99)		(1.23)
Observations	853	824	844	815	844	815
R^2	0.204	0.478	0.301	0.430	0.344	0.442
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Higher capital requirements and bank risk-taking.

The dependent variables are bank risk-taking proxies. In columns 1 and 2, the dependent variable is *Net Charge-Offs*, and in columns 3 and 4, the dependent variable is the *Z-Score*. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after the implementation of the FAS 166/167. Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	Net Charge-Offs		*Z-Score*	
*Post*Consolidation*	-0.208**	-0.190**	0.339*	0.377**
	(-2.19)	(-2.27)	(1.93)	(2.03)
Size		0.229**		-0.124
		(2.31)		(-0.63)
GrowthTA		-0.004***		0.004
		(-3.27)		(1.27)
ROA		-0.289***		
		(-5.04)		
Loan		0.010**		0.007
		(2.53)		(0.81)
Cash		0.078*		-0.043
		(1.85)		(-0.75)
Deposit		0.002		0.003
		(0.27)		(0.25)
Equity		0.048***		
		(2.95)		
Overheads		-0.149***		0.038
		(-3.57)		(0.49)
OFBS		0.009		0.008
		(1.61)		(1.12)
Observations	869	832	869	832
R^2	0.477	0.583	0.270	0.283
Bank FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 5: Robustness tests by using the placebo treatment year, 2006.

The dependent variables are the primary outcome variables, *RWA/Assets*, *CET1/Assets*, *Net Charge-Offs*, and *Z-Score*. In this table, we report the results of placebo tests using the sample period as 2003-2009. In the first two columns, the dependent variables are the components of the risk-weighted capital ratio. In the last two columns, the dependent variables are bank risk-taking proxies. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after 2006 (i.e. the year preceding the crisis). Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	RWA/Assets	*CET1/Assets*	*Charge-Offs*	*Z-Score*
*Post*Consolidation*	-1.081	0.230	-0.002	-0.251
	(-0.97)	(0.71)	(-0.02)	(-0.98)
Controls	Yes	Yes	Yes	Yes
Observations	501	497	515	515
R^2	0.335	0.138	0.613	0.357
Bank FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 6: Robustness tests after dropping the G-SIBs.

The dependent variables are the primary outcome variables, *RWA/Assets*, *CET1/Assets*, *Net Charge-Offs*, and *Z-Score*. In this table, we report the results without the 8 G-SIBs. In the first two columns, the dependent variables are the components of the risk-weighted capital ratio. In the last two columns, the dependent variables are bank risk-taking proxies. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after the implementation of the FAS 166/167. Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
	RWA/Assets	*CET1/Assets*	*Charge-Offs*	*Z-Score*
*Post*Consolidation*	-2.816***	0.375	-0.208**	0.404*
	(-2.85)	(1.06)	(-2.03)	(1.84)
Controls	Yes	Yes	Yes	Yes
Observations	743	734	751	751
R^2	0.464	0.427	0.582	0.282
Bank FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 7: Higher capital requirements, regulatory capital, and trading assets.

The dependent variables are the risk-weighted capital ratio and its components, scaled by assets. In column 1 the dependent variable is *RWA/Assets*, in column 2 it is *CET1/Assets*, and in column 3 it is *CET1/RWA*. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after the implementation of the FAS 166/167. *Transparent* is an indicator variable that equals one if a treated bank's trading assets is above the 75^{th} percentile. Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1) *RWA/Assets*	(2) *CET1/Assets*	(3) *CET1/RWA*
*Post*Consolidation*	-3.436**	0.113	0.775*
	(-2.64)	(0.38)	(1.83)
*Post*Consolidation*Transparent*	0.370	0.731	2.083
	(0.15)	(1.16)	(1.37)
Size	1.534	-1.779***	-2.385***
	(0.97)	(-4.09)	(-3.14)
GrowthTA	-0.038***	-0.007*	-0.004
	(-2.76)	(-1.92)	(-0.73)
ROA	-0.124	0.367***	0.570***
	(-0.24)	(2.86)	(2.81)
Loan	0.597***	0.022	-0.054
	(12.77)	(1.18)	(-1.48)
Cash	0.341	-0.022	-0.159
	(1.17)	(-0.20)	(-0.76)
Deposit	-0.062	0.013	0.023
	(-1.12)	(0.55)	(0.52)
Equity	-0.099		
	(-0.51)		
Overheads	0.064	0.191*	0.181
	(0.23)	(1.69)	(1.09)
OFBS	0.145*	0.046***	0.021
	(1.81)	(3.00)	(0.93)
*Post*Consolidation + Post*	-3.067	0.844	2.858*
**Consolidation*Transparent*	(-1.37)	(1.30)	(1.89)
Observations	824	815	815
R^2	0.478	0.433	0.450
Bank FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Table 8: Higher capital requirements, bank risk-taking, and trading assets.

The dependent variables are risk-taking proxies. In column 1, the dependent variable is *Net Charge-offs*, and in column 2, the dependent variable is the *Z-Score*. *Consolidation* is an indicator variable that equals one if banks consolidated VIEs under the FAS 166/167. *Post* is an indicator variable that equals one after the FAS 166/167. *Transparent* is an indicator variable that equals one if a treated bank's trading assets is above the 75th percentile. Control variables are lagged by one year. Bank fixed effects and year fixed effects are included in all regressions. The standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

	(1) *Charge-Offs*	(2) *Z-Score*
*Post*Consolidation*	-0.217**	0.374*
	(-2.25)	(1.89)
*Post*Consolidation*Transparent*	0.142	0.017
	(1.12)	(0.04)
Size	0.245**	-0.121
	(2.40)	(-0.60)
GrowthTA	-0.005***	0.004
	(-3.36)	(1.24)
ROA	-0.289***	
	(-5.04)	
Loan	0.010**	0.007
	(2.56)	(0.81)
Cash	0.077*	-0.043
	(1.84)	(-0.75)
Deposit	0.002	0.003
	(0.31)	(0.25)
Equity	0.048***	
	(2.93)	
Overheads	-0.149***	0.038
	(-3.55)	(0.49)
OFBS	0.009	0.008
	(1.57)	(1.11)
*Post*Consolidation + Post*	-0.075	0.391
**Consolidation*Transparent*	(-0.77)	(1.01)
Observations	832	832
R^2	0.583	0.283
Bank FE	Yes	Yes
Year FE	Yes	Yes