Lending and Risk Controls for BHCs after the Dodd-Frank Act*

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Abstract

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JEL classification: G21, G18, G28
Keywords: Dodd–Frank Act, Credit Risk, Lending, Syndicate Loans, Risk Management

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* We thank Murali Jagannathan (the editor) and two anonymous referees for valuable comments and suggestions. All the authors contributed equally to this paper. We are solely responsible for all remaining errors and omissions.

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[†]The authors are not aware of any interests that are directly or indirectly related to the work submitted for publication, that includes both interests within/outside the last 3 years of beginning the work.

1. Introduction

Large and complex banks have attracted significant attention from policy makers and scholars. Yet researchers are continuing to learn how banks can improve their resilience to actual adverse conditions or financial turmoil. Indeed, banks that are complex and opaque are more willing to engage in excessive risk-taking activities (Morgan, 2002) as they experience limited disciplining from insured depositors (Merton, 1977), and receive implicit and explicit government guarantees (Gandhi and Lustig, 2015).

While the wave of financial deregulation reforms in the 1990s has removed restrictions on banks' non-traditional activities[1], since the onset of the Global Financial Crisis (GFC) regulators have become more concerned with limiting the drivers of complexity dynamics. Indeed, regulators in the United States (US) and around the world have introduced a set of regulations to tackle the negative costs and externalities associated with large banks' failure. Among them, the Dodd-Frank Wall Street Reform and Consumer Protection Act, commonly referred to as the Dodd-Frank Act (DFA hereafter), was passed into law on 21 July 2010 to address the theme of systemic financial institutions' resolvability and to end 'too-big-to-fail' doctrine (Correa and Goldberg, 2022). As a result, the DFA has increased several costs for some forms of banking complexity by imposing capital requirements more sensitive to the risks in off-balance sheet activities and, in some instances, directly targeting banks' organizational structures. The DFA specifically intended to reduce the riskiness associated with the size and complexity of bank holding companies (BHCs hereafter), which control almost all US banking assets, by fixing for example limits on their non-

[1] The deregulation process of the 1990s was a fundamental force for changes in the business model of US banks. It also fostered increases in bank size and complexity. The Riegle-Neal Act of 1994 allowed banks to expand across US states by acquiring new branches or establishing new ones. Gradual deregulation and eventual repeal of the Glass Steagall Act via the 1999 Financial Modernization Act allowed banks to enter non-traditional banking sectors.

traditional banking activities (Avraham et al., 2012) or risky activities.[2] Complex BHCs embed a large network of non-bank legal entities (see, for example, Adrian and Ashcraft, 2012; Cetorelli et al., 2014) with more of them located overseas (see Cetorelli and Goldberg, 2014; Cetorelli et al., 2014; Carmassi and Herring, 2016; Goldberg and Meehl, 2020). This makes them very difficult to monitor from a regulatory perspective. In fact, while non-bank subsidiaries and entities are allowed to engage in traditional banking functions, they are, however, not subject to the same regulatory requirements of parent bank and bank subsidiaries—i.e. capital requirements, failure procedure, and distribution of dividends (Pogach and Unal, 2018). Furthermore, organizational complexity can exacerbate the agency problems within the organization as managers might undertake value-destroying diversification by redeploying resources from profitable entities to low-quality ones. This agency theory approach is however challenged by the view that broader business and geographic diversification can also allow banks to reduce default risk and liquidity risk (Cetorelli and Goldberg, 2016; Luciano and Wihlborg, 2018) and dependency on a country's economic and demand characteristics (Correa and Golderg, 2022).

Our paper sets out new evidence to the literature focusing on complex banks by examining whether the DFA may have improved complex BHCs' credit risk management. Different from previous papers (e.g., Correa and Goldberg, 2022) that focus, for example, on the roles of regulation and corporate governance as drivers of bank organizational complexity, we explore whether the DFA was successful or not in reducing credit risk for complex BHCs. This issue is important because the DFA aims to end implicit guarantees, such as the too-big-to-fail (TBTF) policy, and to restore market discipline which consists of the market belief that uninsured creditors

[2] Since the passage of the Gramm-Leach-Bliley Act (GLBA) of 1999, which enabled a BHC to register as a financial holding company (FHC) and thereby to engage in a broad range of financial activities, including securities underwriting and dealing, insurance underwriting, and merchant banking activities, today, virtually all large BHCs are registered as FHCs.

and shareholders will bear the losses in the event of failure (Balasubramnian and Cyree, 2014). Specifically, we argue that, on the one hand, the introduction of DFA could have encouraged BHCs to undertake less risky activities and exert greater monitoring effort. On the other hand, we maintain that BHCs could have engaged in reaching-for-yield behavior, resulting in increased credit to riskier of credit borrowers as they carry higher loan yield spreads (e.g., Acharya et al., 2018). To this end, we formulate two hypotheses to account for opposing views on the effects of DFA on the risk behavior of BHCs: (i) the *Risk Monitoring Hypothesis*, under which the DFA decreased the riskiness of complex BHCs and their contribution to credit risk; and (ii) the *Moral Hazard Hypothesis*, under which the DFA increased the riskiness of complex BHCs and their contribution to credit risk.

To this purpose, in this paper we examine how complex BHCs' credit risk changes under the effect of the DFA compared to non-complex-BHCs. Following prior studies (e.g., Acharya et al., 2018; Goetz et al., 2018), we measure credit risk by non-performing loans (*NPLs*) and loan loss reserves (*LLRs*). We also examine the net charge-offs for loan portfolios. For our analysis we focus on BHCs which are affected by DFA; that is, banks with assets over US$10 billion before the enactment of DFA. To detect complex BHCs, we retain the definition of complexity provided by FR Y-9C Consolidated Financial Statements for BHCs that mainly refers to BHCs engaging in credit-extending activities of either the parent bank holding company or its non-bank subsidiaries or debt outstanding to the public; significant non-banking activity with an inherently high-risk profile; and extensive inter-company transactions. These are key areas that generate major concerns for supervisory and monitoring purposes. Data on BHC characteristics have been retrieved from FR Y-9C. Our final sample consists of 60 unique BHCs for a total of 2,285 observations over the period 2001-2016.

In general, our findings show that the passage of DFA was not successful in its goal of reinforcing the financial system by reducing the credit risk of complex BHCs. Specifically, complex BHCs have experienced a significant *increase* of NPLs and LLRs compared to non-complex BHCs after the DFA. Such results are also economically significant. For example, complex BHCs' NPLs increase by 48 basis points following DFA, which accounts for 39% with respect to the sample mean. Our findings appear to be in line with the *Moral Hazard Hypothesis* as complex BHCs may not have reduced moral hazard incentives to engage in excessive risk-taking behavior after the DFA's passage.

We further explore whether complex BHCs have increased their net charge-offs for various loan portfolios as an increase in LLRs does not necessarily indicate an increase in credit risk. We complement this analysis by considering whether complex BHCs may incur increased credit risk by granting more credit access to relatively risky borrowers to overcome the regulatory costs. Our findings confirm this view as we show that complex BHCs' lending quality portfolio has deteriorated compared to that of non-complex BHCs after the implementation of the DFA. In fact, complex BHCs appear to have increased their supply of credit cards loans and mortgage-backed securities which are typically risky bank asset categories because they are strongly associated with bank failure or very high charge-off rates (e.g., Cole and White, 2012; Harris et al., 2018). However, we also find that complex BHCs have increased commercial and industrial loans (C&I loans) in their loan portfolio, which appears to be of less concern in terms of credit losses. This could indicate a more thoughtful recognition of forecasted loss in the future from complex BHCs after the DFA. All together the results suggest that regulatory enforcement has been effective in detecting some areas of credit risks. However, there is still evidence of an increase of aggressive credit risk policies for certain types of loan by complex BHCs after the DFA's implementation.

We also underpin possible mechanisms to explain the increase in BHCs' credit risk. *First*, we identify some key channels regarding portfolio lending quality—i.e., asset quality and monitoring of loans. By taking a closer look at the external flows between a BHC and its non-bank clients and between a BHC and its non-bank affiliates, we find that complex BHCs have rebalanced their balance sheets through a reduction in the relative importance of their credit extending and borrowing activities both inside and outside the group.

In further analysis, we explore whether complex BHCs have reduced their monitoring effort, which is costly, for the syndicate loans after the passage of the DFA. This, in turn, could have resulted in a deterioration of BHCs' credit risk. Indeed, the improvement of the credit risk management function and an adequate monitoring effort are crucial to prevent the adoption of excessive risk-seeking corporate policies which may, in turn, also result in an increased systemic risk contribution by BHCs (Chava and Purnanandam, 2010). Nonetheless, complex organizations are more difficult to monitor due to agency problems and moral hazard issues (Penas and Unal, 2004; Dam and Koetter, 2012; Duchin and Sosyura, 2014). For the scope, we run two tests: (1) we consider whether complex BHCs have decreased their covenant-based monitoring requirements which, according to Gustafson et al. (2021), represent a substitute form for monitoring in lending contracts. (2) We also assess whether complex BHCs' loan share has changed following the DFA. As explicated by Sufi (2007), the structure of syndicated loans reflects the monitoring efforts exerted by lenders.[3] Our results show that complex BHCs set fewer financial, capital, performance, and general covenants and, in general, apply fewer covenants after the DFA, in this way reducing restrictions to borrowers' behavior. Consistent with this view, we also find that complex BHCs retain a smaller portion of the syndicate loans as lead agent share,

[3] The lead agent is responsible for due diligence and monitoring activities of borrowers in the syndicate market. Thus, a lower loan share indicates less monitoring effort as the lead agent bank is less exposed to credit losses.

thereby suggesting that they are less willing to exert due diligence and monitoring efforts. Additionally, we find that complex BHCs charge higher loan prices after the DFA regardless of borrowers' risk profile. Altogether, our findings indicate that complex BHCs have lessened their monitoring role, and thus related monitoring costs, in the lending market after the DFA's implementation.

As an alternative channel, we also explore whether complex BHCs may exhibit differences in the organizational structure of their risk management functions compared to non-complex BHCs after the DFA passage. For this analysis, we proxy the BHCs' risk management function by using the risk management index (RMI) developed by Ellul and Yerramilli (2013). The RMI index measures the strength and independence of the risk management function and is built as the principal component of various risk management variables.[4] Our findings show that complex BHCs experienced a lower RMI compared to non-complex BHCs after the DFA, thereby suggesting that they have decreased the strength and independence of the risk management function compared to the case of non-complex BHCs.

Our results are robust to a variety of tests for sample selection criteria, endogeneity concerns, different variables, and model specifications. To address potential selection bias, we employ a matching technique to construct suitable control/treatment samples for the comparison of credit risk between complex and non-complex BHCs. We also check the robustness of our results by running a set of placebo tests to corroborate the interpretation of the baseline results as evidence of the introduction of the DFA on complex BHCs' credit risk. We further perform a dynamic treatment analysis that examines the timing of a firm's credit risk relative to the DFA's implementation. Then, we control for the possibilities that our results could also be driven by

[4] It specifically includes information on six variables: CRO Present, CRO Executive, CRO Top5, CRO Centrality, Risk Committee Experience, and Active Risk Committee. See Ellul and Yerramilli (2013) for further details.

complex BHCs' size by excluding from the sample Global Systemically Important Banks (GSIB), BHCs with total assets >$75 Billion and <$125 Billion. We run additional robustness tests, such as controlling for macro-variables, adding loan portfolios measures as control variables, and dropping BHCs that changed their complexity status over the sample period. Furthermore, we explore whether our findings are driven by specific dimensions of complexity such as business, geographic, or organizational complexity. Our main findings remain robust to all these alternative specifications and tests.

This paper contributes to the existing studies in several way. *First*, it offers new evidence to the literature on the DFA's implications for the financial sectors. Prior studies find mixed results after the passage of the DFA for banks. For example, Balasubramnian and Cyree (2014) find that the DFA has been effective in reducing, but not in eliminating, the discounts on yield spreads on the too-big-to-fail (TBTF) banks. Akhigbe et al. (2016) show that total and unsystematic risk measures have significantly declined following the DFA, particularly in the case of institutions engaged in more risk-taking activities. Gao et al. (2018) find that the effect of different proposals and events in the legislative process leading up to the adoption of the DFA had an individual and systemic risk-reducing effect on the "systemically important financial firms" in their sample. Andriosopoulos et al. (2017), however, find mixed results in terms of risk for financial institutions during the various stages of the Act's legislative process. In the case of the DFA, Bouwman et al. (2018) show that near-below-threshold banks alter their behavior to attempt to avoid or delay the regulatory costs. In fact, these banks appear to slow their growth to avoid crossing the threshold and increased loan prices by exploiting borrowers more than needed given their risk profile or by seeking out riskier borrowers. Differently from these prior studies, we explore how and to what extent the DFA has impacted on credit risk and managerial risk controls of complex BHCs

compared to non-complex BHCs. *Second*, our paper sheds new light on complex financial institutions. Prior studies have focused on the resolutions of bank complexity in case of failure (Carmassi and Herring, 2016; Goldberg and Meehl, 2020) or governance that plays an important role in balancing trade-offs between the agency problems that increase risk and the diversification benefits (Correa and Goldberg, 2021). Other studies focus on the benefits in terms of income and return diversification and costs associated with agency problems (e.g., Santomero and Eckles, 2000, Acharya, 2009; Cetorelli and Goldberg, 2016; Luciano and Wihlborg, 2018). *Third*, our paper adds new evidence to the literature focusing on the effect of regulatory changes on lending (e.g., Acharya et al., 2018; Kovner and Van Tassel, 2021).

This paper is organized as follows. Section 2 develops the hypotheses; Section 3 discusses data and the empirical strategy; Section 4 presents the main results and robustness checks, while Section 5 discusses possible mechanisms for our findings. Section 6 concludes and discusses policy implications.

2. Hypotheses Development

Although the DFA intended to promote market discipline as one of its main objectives (DFA §112(a)(1)(B)), there is still an ongoing debate in the literature on whether these regulations are effective in inducing BHCs to reduce their riskiness or whether they only serve to increase moral hazard and BHCs' riskiness. On the one hand, an increase of regulatory monitoring can bring benefit to the stability of the banking system and reduce banks' credit risk taking behavior. On this matter, several recent studies argue that strict regulatory requirements, such as higher capital provisions, could decrease moral hazard with a consequent reduction of risk-taking behavior and related losses (e.g., Hart and Zingales, 2011; Berger and Bouwman, 2013; Acharya et al., 2016;

Berger et al., 2017b). Indeed, banks subject to stricter regulatory enforcement are likely to bear less credit risk. Therefore, as pointed out by Acharya et al. (2018), it could be that stricter regulatory requirements can result in banks reducing credit risk by contracting credit supply, particularly to the riskiest borrowers. Banks could also be more prudent in managing their risks by, for example, exerting more monitoring activities and applying stricter contractual conditions, particularly to riskier borrowers. Furthermore, regulatory enforcement could encourage banks to improve their ability to predict future net loan charge-offs by increasing their loan loss provisions (Bhat et al., 2019).

On the other hand, it also possible that tightening regulatory monitoring for market discipline can also produce unforeseen and unintended results. For example, banks experiencing regulatory costs could therefore seek to increase their credit supply to the riskiest borrowers to compensate for the decrease in leverage risk (Calem and Rob, 1999). They could also have the incentive to exploit borrowers by charging higher loan rates (Bouwman et al., 2018) and reducing small loans (Bordo and Duca, 2018) to offset the regulatory costs. This could lead to a reduction in costly monitoring activities which, in turn, may translate into the riskiness of the loans held by banks.

As a new angle to this discussion, we posit that the consequences of regulatory tightening on bank risk may vary with organizational complexity. Complex BHCs are, in fact, difficult to monitor given their configuration of multiple various entities with broader spans of business activities, or wider geographic locations of BHC affiliates. As a result, they tend to experience serious agency problems and moral hazard (Penas and Unal, 2004; Dam and Koetter, 2012; Duchin and Sosyura, 2014). Some of these complex entities may, in fact, attempt to engage in regulatory arbitrage by increasing opacity through affiliate placement (Goldberg and Meehl, 2020). They

could, for example, also relocate their activities to less regulated geographical locations which, in turn, can help them to circumvent rules (Andriosopoulos et al., 2017).

Thus, although the DFA intended to tackle the high-risk activities of complex BHCs, its effectiveness is not assured. The more complex a BHC is, the more opportunities it has to neutralize and/or evade the most onerous provisions of the DFA and the more difficult it is to monitor and regulate. [5] However, supervisory attention is particularly directed toward large banks, and, in turn, this could prevent them from misbehaving (Eisenback et al., 2022). Therefore, it is not clear *a priori* whether the DFA would be effective in addressing these issues particularly when it comes to tackling BHCs' issues of complexity.

Drawing on the previous arguments, we conjecture that the provisions of the DFA could have either increased or decreased the lending risk behavior of BHCs; and particularly of complex BHCs that extensively deal with high-risk activities in non-banking areas. Therefore, we formulate the following two compelling hypotheses:

H1. DFA decreases the credit riskiness of complex BHCs (The Risk Monitoring Hypothesis)

H2. DFA increases the credit riskiness of complex BHCs (The Moral Hazard Hypothesis)

3. Sample and Methodology

3.1 Data Description

To assess the effect of the DFA on the credit risk profile of complex BHCs, we used detailed information on quarterly accounting characteristics retrieved from the Reporting Form

[5] The literature is rather inconclusive on the impact of banks' diversification into non-banking activities on their riskiness. On the one hand, bank diversification can bring benefits in terms of costs and profits to large institutions and reduce individual risk (Baele et al., 2007; Elyasiani et al., 2016). On the other hand, it can also bear negative implications in terms of lending risk due to the increased interconnectedness among financial institutions (Acharya, 2009), inefficiencies, and concentration of power (Santomero and Eckles, 2000). Other recent studies show that banks diversifying into non-banking activities experience higher probability of default (e.g., Vallascas and Hagendorff, 2011; Weiß et al., 2014; Casu et al., 2016).

Consolidated Financial Statements for Holding Companies-FR Y-9C and the bank accounting and market characteristics from the Federal Reserve Bank of Chicago website and CRSP. By merging all available data from years 2001 to 2016 we find 226,381 observations for 8,395 BHCs. After dropping 2007-2010 observations and retaining banks existing before 2006 and after 2010, we are left with 155,916 observations for 6,349 BHCs. Finally, by removing observations with missing values and banks not affected by Dodd-Frank Action (with total assets below $10 Billion), we end up with a final sample of 2,285 observations for 60 BHCs. Specifically, following Bouwman et al. (2018) we focus solely on the provisions that impose new rules on banks according to their bank asset sizes [6], and we have the data sample span from 2001 to 2016. We also exclude the financial crisis period (2007-2009) and the year in which the DFA was first implemented in 2010.

Table A.1 shows the list of complex and non-complex BHCs included in the analysis. We extract bank loan contract information from LPC-Dealscan and link the loan-level data to Compustat to get the borrower-level characteristics following the procedure from Chava and Jarrow (2004), and then use the Dealscan-Compustat Link provided by Michael Roberts.[7] We also use the DealScan Lender ID and Call Report BHC ID Link-File provided by Andrew MacKinlay[8] to link the lender identifier-years from databases from FR Y-9C and company ID lender identifier-years from the Thomson Reuters DealScan Facilities file. Finally, we use the risk management index (RMI) developed by Ellul and Yerramilli (2013) to proxy for BHCs' risk management function over the period 1995–2013.[9] Details on the RMI are included in Ellul and Yerramilli (2013).

[6] We consider the BHCs' size before the implementation of the DFA and avoiding the years of the global financial crisis in 2007-2009.

[7] Links are accessed through the following: http://finance.wharton.upenn.edu/~mrrobert/styled-9/styled-12/index.html

[8] https://sites.google.com/site/acmackinlay/data

[9] We thank Professor Ellul for having kindly shared data on the risk management index (RMI) with us.

3.2 Model specification

Our model explores whether complex BHCs have changed their credit risk after the passage of the DFA compared to non-complex ones. For this analysis we focus on BHCs affected by the DFA. To this purpose, we consider BHCs with total assets above the $10 billion threshold in 2006 following a similar logic to Bouwman et al. (2018). This allows us to account for the fact that BHCs near the threshold could have intentionally grown assets, risk-weighted assets, and total loans more slowly to not comply with the law's requirements. We consider the following model specification,

$$\text{Risk}_{i,t} = \beta_0 + \beta_1 \text{Complex-BHC}_i \times \text{Post-DFA}_t + \beta_2 \text{Bank-Characteristics}_{\text{i,t-1}} + \gamma_i + \delta_t + \varepsilon_{i,t,} \quad (1)$$

where *Risk* proxies for the risk measure for bank *i* at time *t*. Following previous studies (e.g., Bushman and Williams, 2012; Bouwman and Malmendier, 2015; Goetz et al., 2016; Abedifar et al., 2018), we include two variables as measures of the quality of lending portfolios: i) the ratio of nonperforming loans to gross total assets (*NPLs*), defined as the ratio of the sum of past due 30 days or more loans and nonaccrual loans to total assets; and ii) the ratio of loan loss reserve to total assets (*LLRs*), which is the ratio of the sum of loan loss reserve to gross total assets. Higher values of these variables indicates that BHCs' loan quality is decreased. However, higher LLRs may also be associated with an improved ability of BHCs to predict future loan charge-offs, and thus to better predict banks' credit risk modeling. To account for this, we also run a granular analysis on the net charge-offs for loans portfolios.

Our main variable of interest is *Complex BHC* which is a dummy variable that equals to one if a BHC is complex according to the definition of complexity provided by the code RSSD9057

retrieved the FR Y-9C in 2006, and zero otherwise.[10] In the robustness test, we restrict our sample by excluding BHCs changing their complexity status after the DFA. Complex BHCs are BHCs engaging in credit-extending activities either of the parent bank holding company or its non-bank subsidiaries or debt outstanding to the public; significant non-banking activity with an inherently high-risk profile; and extensive inter-company transactions. These are key areas that generate major concerns for supervisory and monitoring purposes. *Post-DFA* is a dummy variable that equals to one after 2010. The coefficient β_1 captures the effect of the DFA after implementation on complex BHCs. A negative β_1 would indicate a decrease of risk for complex BHCs resulting from the DFA, and vice-versa for positive coefficients. The model also encompasses quarter fixed effects (FE) and BHCs' FE, respectively, indicated by δ_t and γ_i. Following Berger et al. (2017a,b) and Acharya et al. (2018), we include in our model a broad set of bank characteristics to mitigate potential omitted variable concerns. All control variables are lagged by one quarter. Consistent with the existing literature (see, for example, Berger et al., 2017a,b; Duchin and Sosyura, 2014; Acharya et al., 2018), we include *Equity to Assets,* calculated as the ratio of equity capital divided by total assets that takes into consideration the BHC's ability to absorb potential losses; *Total*

[10] Consistent with the Federal Reserve classification, values from 3 to 8 of the code RSSD9057 indicate complex institutions, while values of 2 and 9 indicate non-complex institutions. Specifically, *2 = Noncomplex*; *3 = Complex: Nonbank Financial Factors*. Nature and scale of non-bank activities warrant designation as complex for supervisory purposes; *4 = Complex: High Risk Activities*. Company engages, either directly or through its subsidiaries, in significant non-banking activity having an inherently high-risk profile; *5 = Complex: Public Debt*. Company issues significant debt to the public such that unsophisticated investors may be at risk of loss; *6 = Complex: Management Factors*. Management practices such as the nature of inter-company transactions or centralized risk management policies and procedures warrant designation as complex for supervisory purposes*; 7 = Complex: Multiple Factors*. Company meets two or more criteria for the complex designation, more than one of which are material in the judgment of the supervisory Reserve Bank. While the intensity of the supervisory approach may not differ from other complex companies, this designation alerts examiners to the presence of more than one factor; *8 = Complex: Supervisory Judgment*. Company does not appear to be complex as described in SR 02-01, however, at the discretion of the supervisory Reserve Bank, it is designated a complex organization for supervisory purposes; *9 = Noncomplex: Supervisory Judgment*. Company appears to be complex as described in SR 02-01; however, at the discretion of the supervisory Reserve Bank, it is designated a non-complex organization for supervisory purposes. RSSD9057=1 is only valid before 2001-12-31 which is before our sample period of analysis.

Assets that is the logarithm of total assets; *Net Income to Assets* proxied by annualized net income to total assets; and *Liquid Asset to Assets* — that is, liquid assets divided by total assets; and finally *Non-interest Income to Assets*. We also add *Loan to Assets* and *Deposits to Assets* to account for lending and deposit activities. For the baseline analysis we consider quarterly fixed effects (FEs) and bank FEs.

The description of the variables is reported in Table A.2, in the Appendix. Table 1 reports the descriptive statistics for all variables employed in the baseline model and the univariate analysis between complex and non-complex BHCs. Overall, complex BHCs appear to have more non-performing loans although they have a lower proportion of loans to total assets and perform better.

[Please insert Table 1 here]

Finally, Table A.3 in the Appendix presents the correlation matrix among the key variables. We can see that correlation coefficients are not large across the control variables (below 0.5), which allows us to include them simultaneously in the models.

4. Empirical Results

4.1 Baseline results

Table 2 shows the main regression estimation results for Eq. (1). Columns (1) and (2) present results where the dependent variable is, respectively, *NPLs* and *LLRs.* Table 2 shows that the coefficient of *Post-DFA×Complex-BHC* is both positively and significantly related to *NPLs* and *LLRs*. This suggests that the DFA has contributed to the increase of complex BHCs' credit risk, thus supporting *H2 (The Moral Hazard Hypothesis)*. Such results are also economically

significant. For example, on average, complex BHCs' *NPLs* increases by 48 basis points after the DFA's implementation, which accounts for 39% of the sample mean.[11]

[Please insert Table 2 here]

Prior studies point out that macroeconomic forces also affect credit quality (Bath et al., 2019; Bhat and Desai, 2020; Correa and Goldberg, 2022). For example, in their model, Correa and Goldberg (2022) include VIX which captures the general risk appetite in the economy and the GDP growth. Thus, in Columns (3) and (4) we further control for macroeconomic conditions such as *GDP growth*, *Credit to GDP gap*, and the *VIX* after removing quarterly fixed effects. The results remain robust to this test.

Turning to bank characteristics, our results show that Loan to Assets, Deposits to Assets, Liquid Assets to Assets, and Non-interest Income to Assets affect NPLs negatively and significantly. Conversely, we find that Net Income to Assets impacts positively on NPLs. Our findings suggest that banks performing well and operating in a favorable economic environment could benefit from higher marker power and assume greater risk. This evidence echoes Boyd and De Nicoló's (2005) "concentration-fragility" prediction which states that banks with market power and higher expected rate of return on bank assets are also riskier. Finally, we also highlight that empirical evidence shows that performance may have mixed effects on risky activities (Delis and Kouretas, 2011).

As a further analysis, we split complex BHCs according to their type of complexity. Specifically, we consider two major types of complexity identified according to the category indicated by RSSD9057—namely, "Risky Activities" and "Management Factors and Supervisory Judgment". Thus, in the category "Risky Activities", we consider all the BHCs engaging in

[11] 39% is calculated as the ratio between the coefficient 0.0048 and the mean value of *NPLs* that is 0.0122.

material credit-extending activities either of the parent bank holding company or its non-bank subsidiaries or debt outstanding to the public (Complex Type RSSD9057= 3, 4, 5). Instead, in the category "Management Factors and Supervisory Judgment", we include all the complex BHCs that i) exhibit management practices complex or complex organization for supervisory purposes and ii) meet two or more criteria for the complex designation, more than one of which are material in the judgment of the supervisory reserve (Complex Type RSSD9057=6, 7 or 8).

Columns (1) and (2) consider as complex BHCs only the BHCs engaging in Risky Activities (RSSD9057= 3, 4, 5). We instead drop from the sample BHCs with complex Management Factors (RSSD9057=6, 7, 8). Conversely, Columns (3) and (4) consider as complex only those BHCs with complex Management Factors (RSSD9057=6, 7, 8) while we dropped the BHCs engaging in Risky Activities (RSSD9057= 3, 4, 5). Specifically, we find 43 BHCs engaging in Risky Activities, while only three BHCs are complex for Management Factors. The control sample includes 14 non-complex BHCs in all the columns.

As expected, results given in Table 3 shows that those BHCs engaging in material credit-extending activities either of the parent BHC or its non-bank subsidiaries or debt outstanding to the public have seen an increase of credit risk after the DFA. We also find that BHCs that are complex due to the category of "Management Factors and Supervisory Judgment" experience an increase of credit risk following the DFA introduction compared to non-complex ones.

[Please insert Table 3 here]

4.2 Net charge-offs and composition of loan portfolios

In this section, we explore whether complex BHCs have increased their net charge-offs in the post-DFA period. This analysis is further motivated by the fact that an increase in LLRs does not

necessarily indicate an increase in credit risk. Indeed, as suggested by Bhat et al. (2019), this could also reflect banks' ability to predict future loan charge-offs. As a result, banks could accumulate more reserves to deal with loan origination during downturns. We are specifically interested in exploring whether complex BHCs have decreased their net charge-offs after the DFA's implementation. This would indicate that an increase of LLRs could be driven by an improvement in credit management if not associated with a relative enhancement of net charge-offs.

To address this issue, we follow Jones et al. (2012) and Acharya et al. (2018) and consider various categories of loan portfolios such as: commercial and industrial loans (*C&I*); Real Estate *(Residential);* Real Estate *(Commercial);* credit card lending (*Credit card*); and other loans (*Others*). Then we examine the dynamics of net charge-offs for these loan portfolios. This analysis is motivated by the fact that certain categories of credit can increase BHCs' exposure to bankruptcy risk and/or credit losses (Acharya et al., 2018). Existing literature highlights, for example, that real estate credit, mortgage-backed securities, and credit card loans are more likely to lead to higher probability of bank failure (e.g., Cole and White, 2012; Berger and Bouwman, 2013; Berger et al., 2016; Acharya et al., 2018; Harris et al., 2018). We also maintain that certain credit categories tend to be more opaque and thus more difficult to monitor. In turn, this can worsen the market discipline as an effective mechanism of risk control (Levine, 2004; Mehran et al., 2011; Jones et al., 2013).

Table 4 shows that *Post-DFA×Complex-BHC* is both positively and significantly related to net charge-offs of residential real estate loans, commercial real estate loans, and credit card loans. This suggests that complex BHCs exhibit an increase of credit losses for these loans which are relatively risky, as pointed out by Acharya et al. (2018). The increasing charge-offs on commercial and residential real estate loans is of great concern to BHCs as these loans appear to strongly predict bank failure (e.g., Cole and White, 2012; Berger and Bouwman, 2013; Berger et al., 2016).

However, *Post-DFA×Complex-BHC* is negatively related to net charge-offs of C&I loans. This indicates that BHCs do not exhibit an increase of credit losses for C&I loans which represent a large portion of loan portfolios. Overall, as indicated by Column (6), complex BHCs exhibit an increase of total net charge-offs for the overall loan portfolios after DFA.

[Please insert Table 4 here]

To fully comprehend the dynamics of BHCs' loan portfolio we also investigate whether the DFA's passage may alter the credit supply to risky borrowers. Specifically, we argue that the decrease in asset quality could be triggered by the increase of credit access to relatively risky borrowers. For this investigation, we employ the same loan portfolios as before plus *mortgage-backed securities (MBS)*. We rerun our regression analysis as in Eq. (1) by using these credit categories as the main dependent variables. The estimation results are presented in Table 5.[12] Our findings show that complex BHCs have reduced their credit transparency, as the coefficient estimates of *Post-DFA×Complex-BHC* are positively and statistically significant at the 1% level with *Credit card*, *Others*, and *MBS*. Conversely, *Post-DFA×Complex-BHC* is negatively and statistically significant at the 1% level related to both *Real Estate (Residential)*, and *Real Estate (Commercial)*. Overall, these findings suggest that BHCs have increased all categories of loans to relatively risky borrowers except for *Real estate loans*.

[Please insert Table 5 here]

Taken together, the results show that complex BHCs have reduced *Real estate loans* where they experience an increased amount of net charge-offs. This could indicate a more thoughtful recognition of forecasted loss in the future from complex BHCs after the DFA. In the same vein, complex BHCs have increased C&I loans in their loan portfolio which appear to be of less concern

[12] In an alternative specification, we added the loan portfolios measures to the baseline model as control variables. Results remain robust to this test. The table is available upon request.

in terms of credit losses. However, complex BHCs also have more credit card loans which, as highlighted by prior studies (e.g., Harris et al., 2018), exhibit very high charge-off rates. This evidence constitutes a warning sign for credit risk's deterioration. Overall, the results suggest that regulatory enforcement has been effective in detecting some areas of credit risks. However, there is still evidence of an increase of aggressive credit risk policies for certain types of loans by complex BHCs after the DFA's implementation. To further explore this issue, we focus on the syndicate lending market, and we examine potential changes to the risk management control' system.

4.3 Robustness checks for baseline results

We run several tests to corroborate the validity of our baseline results. First, we perform a dynamic analysis to exclude a trend indicating that an increased credit risk pre-dates DFA. Then, we employ a matching procedure and a placebo test to exclude that our results are driven by banks' fundamental characteristics or by sample variation. Next, we verify whether our results are driven by BHCs' size and alternative measures of complexity such as business, geographic, and organizational complexity.

4.3.1 Dynamic analysis, matching procedure, placebo test

We perform a dynamic treatment analysis to examine the timing of BHCs' credit risk around the passage of the DFA for complex and non-complex BHCs. This investigation enables us to assess whether observed changes to risk credit already occur prior to the DFA's passage. In this case our results could be capturing a pre-existing trend. For the scope, we decompose the DFA dummy into 10 dummy variables: for the years 2001-2005 before the DFA's implementation and years 2011-

2015 after the DFA's implementation. We report the results of our dynamic treatment analysis in Table 6.

[Insert Table 6 about here]

Table 6 shows that complex BHCs start to exhibit a positive and significant increase of *NPLs* and *LLRs* starting from 2011, and thus after the DFA's implementation. Conversely, before the DFA's passage, there was not a significant difference (at least consistent over time) between complex and non-complex BHCs with respect to credit risk. This indicates that the baseline findings cannot easily be attributed to reverse causality.

Then, we run a matching procedure to rule out the possibility that complex BHCs' credit risk may be driven by certain bank characteristics. To address this potential selection bias, we employ a PSM matching technique to construct suitable control/treatment samples for complex and non-complex BHCs subject to the DFA and, thus, above the $10 billion size threshold. We first estimate a probit model to predict the probability of being a complex BHC in quarter *t* based on a series of BHC characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposits to Assets, Net Income to Assets, Liquid Asset to Assets*, and *Non-interest Income to Assets*. We then match each complex BHC to a benchmark non-complex BHC, using the propensity score matching within 0.01 caliper. The matching procedure allows us to identify the control unit that is closest to each treated unit according to the above banks' characteristics. As a result of this procedure, we have a subsample of 35 complex BHC (with 1056 observations) and 14 non-complex BHCs (with 516 observations). For this analysis we drop 11 complex BHCs due to unsatisfying matching. Panel A of Table 7 compares the characteristics of complex and non-complex BHCs for the PSM sample. Compared to the baseline sample, the matched sample shows smaller differences between complex and non-complex BHCs in terms of the bank-level characteristics. We rerun the baseline

regression by using the PSM sample and report the results in Panel B. The baseline results still hold.

[Insert Table 7 about here]

To ensure that our baseline results are not driven by sample variation, we also perform a placebo test by randomizing the assignment of treatment (with no replacement) for the passage of the DFA. We estimate the effect of pseudo-treatment with the full set of control variables as presented in the baseline model. We store the estimated coefficient of the interaction term *Post-DFA× Complex-BHC* and repeat the simulation 1000 times to generate the distribution of the placebo estimates as plotted in Figure 1. The true estimate of the interaction term *Post-DFA×Complex- BHC* as reported in Table 2 is shown as a dashed red line for comparison. From Figure 1, we can see that the true estimates are significantly larger in magnitude than any of the placebo estimates, and the distribution of the placebo estimation is centered around zero. This evidence suggests that the baseline findings are not driven by chance or by other omitted bank-level characteristics.

[Insert Figure 1 about here]

4.3.2 BHC size and complexity measures

In this section, we rule out the possibilities that our results could also be driven by BHCs' size. For this scope, we rerun the analysis by excluding Global Systemically Important Banks in Panel A of Table 8. Furthermore, consistent with Acharya et al. (2018), we also remove BHCs with total assets >$75 Billion and <$125 Billion in Panel B of Table 8. We find that the results for these two subsamples remain consistent with our main findings.

[Insert Table 8 about here]

Next, we account for the possibility that BHCs do not stay in one class (complex class and non-complex class) all the time. We detect 15 BHCs that move from the complex (non-complex) class to the non-complex (complex) class in the post-DFA period. We rerun the analysis by excluding them from the baseline mode. Panel C of Table 8 shows that the baseline results remain robust to this test.

Further, we explore whether our findings are driven by specific dimensions of complexity. For this analysis, we follow prior studies (e.g., Cetorelli and Goldberg, 2014; Correa and Goldberg, 2021) and consider business, geographic, and organizational complexity as alternative measures of BHCs' complexity. To build these alternative measures of complexity, we manually collect the information on BHCs' affiliates from the FFIEC National Information Center (NIC) on a yearly basis. These data are available for 57 BHCs included in our sample for a total of 684 observations. We then construct the following variables to capture the organizational, business, and geographical complexity: 1) *Organizational complexity* calculated by the number of business types spanned by BHC affiliates; 2) *Business complexity* measured by the number of non-financial entities relative to the total number of affiliated entities; and 3) *Geographical complexity* measured by the number of affiliated entities located abroad relative to the total number of affiliated entities. Then, for each alternative complex measure, we recalculated the Complex-BHC indicator by assigning one to all the observations above its sample median value in year 2006, and zero otherwise. Panel A of Table 9 reports the univariate analysis of bank complexity level before and after the DFA by using different complex measures. In general, there is no significant difference before and after DFA in terms of different complex measures. In other words, BHCs do not change their complexity after the DFA implementation. Then, we explore whether BHCs with organizational, business, or geographical complexity have decreased their credit risk after the DFA. For this analysis we have

matched the complexity measures retrieved from the FFIEC National Information Center (NIC) with the quarterly accounting data employed for our baseline model. For this exercise, our sample thus encompasses 57 BHCs for a total of 2220 observations (an unbalanced panel dataset due to financial data availability). Complex BHC is a dummy variable if the alternative complex measure is above the median value of the sample in the year 2006. Panels B-D of Table 9 show that *Post-DFA*×*Complex-BHC* is positively and significantly related to *NPLs* and *LLRs* in all the estimations regardless of whether BHCs are organizationally, operationally, or geographically complex. All findings are still robust.

[Insert Table 9 about here]

5. Detecting possible mechanisms

In this section, we further provide possible mechanisms to explain the decrease in BHCs' credit risk. First, we examine how and to what extent the DFA's introduction may have affected lending and borrowing activities between the parent BHC and its non-bank subsidiaries. Then, we explore whether the passage of the DFA may alter the monitoring effort exerted by complex BHCs in the syndicate loan market. Adequate monitoring activities are indeed crucial to prevent the adoption of excessive risk-seeking by banks. For this analysis, we specifically focus on the covenants embedded in loan contracts and loan share retained by BHCs in the syndicate loan markets. We also examine loan pricing according to borrowers' risk profile. Finally, as an alternative channel, we also examine the effect of the DFA on BHCs' strength and independence of the risk management function.

5.1. Lending and borrowing activities between the parent BHC and its non-bank subsidiaries

In this section, we examine how and to what extent the DFA's introduction may have affected lending and borrowing activities between the parent BHC and its non-bank subsidiaries. For this analysis we specifically consider the following dependent variables: 1) the total amount of borrowings guaranteed by the parent to non-bank subsidiaries divided by total consolidated assets (*Total amount of borrowings to non-bank subsidiaries*); 2) the sum of loans, advances, notes, bonds, and debentures in non-bank subsidiaries and associated non-bank companies divided by to total consolidated assets (*Extension of credit to nonbank subsidiaries and associated nonbank companies);* and 3) the total amount of loans and advances to the reporting bank holding company made by subsidiary nonbanks and associated nonbanks divided by total consolidated assets (*Subsidiary nonbanks and associated nonbanks loans and advances to the parent).*[13] These activities contribute to the complexity level of BHCs and expose them to an additional source of risk, which is difficult for regulators to detect and monitor. This is driven by the fact that large and complex BHCs exhibit a conglomerate structure where multiple but different subsidiaries coexist subject to different regulatory requirements and regulatory filings (Avraham et al., 2012; Pogach and Unal, 2018). Thus, complex BHCs may use internal resources via non-bank subsidiaries and entities to ease the credit constraints on their subsidiaries or transfer resources within the group by overcoming regulatory constraints. Table 10 shows that *Post-DFA×Complex-BHC* is negatively and significantly related to both *Total amount of borrowings to non-bank subsidiaries* and *Subsidiary nonbanks and associated nonbanks loans and advances to the parent*.

[13] We use the following codes from Y-9LP Parent Company: i) bhcp0541for *total amount of borrowings to non-bank subsidiaries*; ii) bhcp0537 for *loans, advances, bonds, and debentures investments in non-bank subsidiaries and associated non-bank companies*; iii) bhcp1274 for *the total amount of loans and advances to the reporting bank holding company made by subsidiary nonbanks and associated nonbanks.*

Columns (4)-(6) of Table 10 verify whether our findings are driven by BHCs changing their complexity status during the period of analysis. To this end, we have removed from the sample all the BHCs that have changed their status in the post-DFA period based on the RSSD9057 indicator. The main findings of Columns (4)-(6) reflect those of Columns (1)-(3). This indicates that complex BHCs have significantly decreased their borrowing guarantees with respect to non-bank subsidiaries and *subsidiary nonbanks and associated nonbanks loans and advances to the parent*. Therefore, the passage of the DFA appears to be effective in reducing, at least, transactions within the parent BHCs and their non-bank subsidiaries. While previous results suggest that banks extend riskier credits, possibly to overcome the regulatory costs associated with the DFA, this set of findings, however, indicates that BHCs have reduced risks associated with intra-group borrowing and lending. In the next session, we thus explore whether BHCs exert an adequate monitoring effort in the lending market and at the organization level which is crucial to prevent the adoption of excessive risk-seeking corporate policies.

[Please insert Table 10 here]

5.2 Syndicate Loans

Existing studies have largely argued that lenders may resort to debt covenants to monitor and limit borrowers' opportunistic managerial behaviors (e.g., Myers, 1977; Smith and Warner, 1979). Gustafson et al. (2021) point out that a higher covenant intensity and higher number of covenants embedded in lending contracts indicate that lenders are exerting more monitoring effort. Consistently, empirical papers show that banks that employ fewer/looser covenants in their loan contracts are riskier (e.g., Berger et al., 2017a; Nguyen et al., 2019). Drawing on this line of research, we therefore explore whether complex BHCs incur higher credit risk because of less

strict monitoring activities on borrowing firms following the enactment of the DFA. Data on syndicate loans come from LPC-Dealscan, which encompasses the most comprehensive and historical loan-deal information available on US syndicate loans.[14]

Following Deng et al. (2020), we introduce several measures of debt covenants, including variables for general covenants (*general covenant*), financial covenants (*financial covenant*), capital covenants (*capital covenant*), and performance covenants (*performance covenant*). We also construct a measure of covenant intensity (*covenant intensity*) developed by Bradley and Roberts (2015). The *covenant intensity* is measured as the logarithm value of one plus the index value ranging from 0 to 6, which is based on six different covenants as described in Bradley and Roberts (2015). We follow Bradley and Roberts (2015), Bozanic et al. (2018), and Deng et al. (2020) to control for firm-level characteristics of borrowing firms, such as *ROA, Tobin's q, Total Assets, Capex, Tangibility,* and *Sales*. All control variables are lagged on an annual basis (data are reported on annual frequency). We also account for loan- and bank-level characteristics, including the number of facilities (*Facility Amount*), maturity of loans (*Maturity*), and the banks' characteristics included in the baseline model. All specifications include bank and loan purpose FEs. Table 10 shows the relationship between the enactment of the DFA for complex BHCs and debt covenants included in loan contracts. We find that the coefficients of *Post-DFA* are negative and significant in Columns (1)-(5). These results indicate that complex BHCs decrease the covenant-based monitoring of their borrowing firms following the DFA.

[Please insert Table 11 here]

As a further test to corroborate this evidence, we also consider whether the DFA's passage may have altered the loan share retained by the lead BHC in the syndicate loan. This matters

[14] The lead bank in each syndicate loan is identified by using the 10-part ranking hierarchy proposed by Chakraborty et al. (2018).

because the lead agent's potential loss is relative to the fraction of the loan it retains (Sufi, 2007; Gustafson et al., 2020; Croci et al., 2021; Degl'Innocenti et al., 2022). Consequently, holding a large loan fraction represents a mechanism to spur the lead agent to exert the optimal level of monitoring (e.g., Holmstrom and Tirole, 1997; Lin et al., 2012; Gustafson et al., 2021). Column (6) in Table 11 shows that *Post-DFA* is negatively and significantly related to *Lender Share*, thereby suggesting that complex BHCs retain a smaller fraction of the loans after the DFA's implementation. Consistent with the results on covenants, this finding also indicates that complex BHCs are less willing to undertake monitoring of costly activities after the DFA.

We next investigate whether the enactment of the DFA may alter corporate loan pricing, particularly for risky borrowers. This analysis is motivated by the fact that banks apply stricter loan terms for borrowers experiencing more information asymmetry (e.g., Sufi, 2007; Ertugrul et al., 2017). Like He and Hu (2016), and Croci et al. (2021), we consider two pricing variables—the all-in spread down (*All in Spread*) and the total borrowing cost (*Total borrowing cost*). A higher *All in Spread* or *Total borrowing cost* is associated with a higher loan price. For this analysis we use the same borrowers', loans' and banks' characteristics as in Table 12.

[Please insert Table 12 here]

Following Acharya et al. (2018), we construct a subsample analysis for firms with high (above-median) and low (below-median) levels of leverage (*leverage*) for the borrowers included in our sample. Columns (1) and (3) show the results for *Post-DFA* for *All in Spread* and *Total borrowing cost*, respectively, while Columns (2) and (4) report the findings for the interaction term *Post-DFA*×*Leverage* relative to *All in Spread* and *Total borrowing cost*.

As shown in Columns (1) and (3), *Post-DFA* is positively and significantly related at the 1% level to both *All in Spread* and *Total borrowing cost*, suggesting that complex BHCs have charged

higher prices for loans. When we consider the borrowers' risk profile, we do not find any significant results for the interaction term of *Post-DFA×Leverage*. This means that complex BHCs have increased the loan pricing regardless of the borrowers' risk profile. All these findings support the view that complex BHCs require less stringent covenant-based monitoring requirements and set less strict contractual conditions for riskier borrowers.

5.3. Risk Management Index (RMI)

It could also be that one of the reasons why complex BHCs exhibit a high credit risk can be attributed to a deterioration of their risk management function. To test this issue, we employ the *RMI* developed by Ellul and Yerramilli (2013) which measures the strength and independence of the risk management function and is built as a principal component of a range of risk management variables.[15]

Table 13 shows the results of *RMI* for the baseline model and alternative samples. Specifically, Column (1) reports the results for the baseline model, and Column (2) reports the results of using the PSM sample. In Columns (3) and (4) we remove GSIB and banks with total assets >$75 billion and <$125 billion, respectively. In Column (5), we exclude BHCs which change their complex class in the post-DFA period. In Columns (6) to (8) we report results by using alternative complex measures: namely, *Organizational complexity*, *Business complexity,* and *Geographical complexity*. In all the specifications we find that *Post-DFA×Complex-BHC* is negatively and significantly related to *RMI* at the 1% level (at the 5% level in the case of *Organizational complexity*). Only in the case of BHCs with geographical complexity do we find that *Post-DFA×Complex BHC* is insignificantly related to *RMI*. Overall, this finding suggests that

[15]It specifically includes information on six variables: *CRO Present*, *CRO Executive*, *CRO Top5*, *CRO Centrality*, *Risk Committee Experience*, and *Active Risk Committee*. See Ellul and Yerramilli (2013) for further details.

complex BHCs have curbed the strength and independence of the risk management function. Given the fact that complex BHCs have experienced an increased credit risk after the DFA, it is thus possible that some of them may have elected to undertake high risks coupled with a weak risk management function.

[Please insert Table 13 here]

6. Conclusions

This paper explores whether the DFA was successful or not in reducing BHCs' credit risk and supply of credit to risky borrowers. This issue is of great concern to policy makers as the DFA aims to end implicit guarantees, such as the too-big-to-fail (TBTF) policy, and to restore market discipline which consists of market belief that uninsured creditors and shareholders will bear the losses in the event of failure (Balasubramnian and Cyree, 2014). To this end, we formulate two compelling hypotheses: (1) the *Risk Monitoring Hypothesis*, under which the DFA decreased the riskiness of complex BHCs and their contribution to credit risk; and (2) the *Moral Hazard Hypothesis*, under which the DFA increased the riskiness of complex BHCs and their contribution to credit risk. Our results show that complex BHCs have experienced a significant increase of credit risk, measured in terms of non-performing loans, loan loss reserve and net charge-offs, compared to non-complex BHCs. Such results are also economically significant. For example, complex BHCs' non-performing loans increased by 48 basis points, which accounts for 39% with respect to the sample mean after the DFA's implementation. By splitting complex BHCs according to their type of complexity we find that, particularly, BHCs engaging in material credit-extending activities either of the parent bank holding company or its non-bank subsidiaries or debt outstanding to the public have seen an increase of credit risk after the DFA's passage. Results are

also robust to a variety of tests for sample selection criteria, endogeneity concerns, and alternative complexities' specifications.

From a policy standpoint, this paper offers some important implications. We show that the DFA has not been fully effective in reducing the credit risk of complex BHCs. This is important because one of the aims of the DFA was to tackle the riskiness associated with the complexity of BHCs. This finding could be valuable to regulators in designing possible future regulatory interventions to reduce credit risk for different types of institutions with different organizational structures. Furthermore, we provide evidence that quality of lending, monitoring efforts in the syndicate lending market, and the risk management function have declined since the DFA's passage compared to non-complex-BHCs.

References

Abedifar, P., Molyneux, P., Tarazi, A., 2018. Non-interest income and bank lending. *Journal of Banking and Finance* 87, 411–426.

Acharya, V.V., 2009. A theory of systemic risk and design of prudential bank regulation. *Journal of Financial Stability*, 5, 224–255.

Acharya, V.V., Berger, A.N., Roman, R.A., 2018. Lending Implications of U.S. Bank Stress Tests: Costs or Benefits? *Journal of Financial Intermediation*, 34, 58–90.

Adrian, T., Ashcraft, A.B., 2012. Shadow banking: A review of the literature. *Federal Reserve Bank of New York, Staff Reports*, no. 580. October, 1-36. Available at: https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr580.pdf

Akhigbe, A., Martin, A.D., Whyte, A.M., 2016. Dodd–Frank and risk in the financial services industry. *Review of Quantitative Finance and Accounting*, 47(2), 395–415.

Andriosopoulos, K., Chan, K.K., Dontis-Charitos, P., Staikouras, S.K., 2017. Wealth and risk implications of the Dodd-Frank Act on the U.S. financial intermediaries. *Journal of Financial Stability*, 33, 366–379.

Avraham, D., Selvaggi, P., Vickrey, J.I., 2012. A structural view of U.S. bank holding companies. *Economic Policy Review*, 18, 65–81.

Baele, L., De Jonghe, O., Vander Vennet, R., 2007. Does the stock market value bank diversification? *Journal of Banking and Finance*, 31, 1999–2023.

Balasubramnian, B., Cyree, K.B., 2014. Has market discipline on banks improved after the Dodd–Frank Act? *Journal of Banking and Finance*, 41, 155–166.

Bhat, G., Desai, H. 2020. Bank Capital and Loan Monitoring, *The Accounting Review* 95(3), 85-114.

Bhat, G., Ryan, S.G., Dushyantkumar, V. 2019. The implications of credit risk modelling for banks' loan loss provisions and loan-origination procyclicality. *Management Science* 65(5), 2116-2141.

Berger, A.N., Bouwman, C. H. S., 2013. How does capital affect bank performance during financial crises? *Journal of Financial Economics* 109, 146–176.

Berger, A.N., Roman, R.A., 2017b. Did saving wall street really save main street? The real effects of TARP on local economic conditions. *Journal of Financial Quantitative Analysis*, 52, 1827–1867.

Berger, A.N., Bouwman, C.H.S., Kick, T., Schaeck, K., 2016. Bank liquidity creation following regulatory interventions and capital support. *Journal of Financial Intermediation*, 26, 115–141.

Berger, A.N., El Ghoul, S., Gue consolidated mi, O., Roman, R.A., 2017a. Internationalization and bank risk. *Management Science*, 63(7), 2049–2395.

Bordo, M., Duca, J., 2018. The impact of the Dodd-Frank Act on small businesses, NBER Working Paper 24501.

Bouwman, C.H., Malmendier, U., 2015. Does a bank's history affect its risk-taking? *American Economic Review* 105 (5), 321–325.

Bouwman, C.H.S., Hu, S.S., Johnson, S.A., 2018. Differential bank behaviors around the Dodd–Frank Act size thresholds. *Journal of Financial Intermediation*, 34, 47–57.

Bozanic, Z., Loumioti, M., Vasvari, F.P., 2018. Corporate loan securitization and the standardization of financial covenants. *Journal of Accounting Research* 56(1), 45-83.

Bushman, R., Williams, C., 2012. Accounting Discretion, Loan Loss Provisioning, and Discipline of Banks' Risk-Taking. *Journal of Accounting and Economics* 54, 1–18.

Bradley, M., Roberts, M.R., 2015. The structure and pricing of corporate debt covenants. The *Quarterly Journal of Finance* 5(2), 1-37.

Calem, P., Rob, R., 1999. The Impact of Capital-Based Regulation on Bank Risk-Taking. *Journal of Financial Intermediation*, 8(4), 317–352.

Carmassi, J., Herring, R., 2016. The corporate complexity of global systemically important banks. *Journal of Financial Service Research* 49 (2), 175–201.

Casu, B., Dontis-Charitos, P., Staikouras, S.K., Williams, J., 2016. Diversification, size and risk: the case of bank acquisitions of nonbank financial firms. *European Financial Management*, 22, 235–275.

Cetorelli, N., Goldberg, L.S., 2014. Measures of global bank complexity. *Federal Reserve Bank of New York Economic Policy Review,* December, 107–126. Available at: https://www.newyorkfed.org/medialibrary/media/research/epr/2014/1412ceto.pdf.

Cetorelli, N., Mcandrews, J., Traina, J., 2014. Evolution in bank complexity. *Federal Reserve Bank of New York Economic Policy Review,* December, 85–106. Available at: https://www.newyorkfed.org/medialibrary/media/research/epr/2014/1412cet2.pdf.

Chakraborty, I., Goldstein, I., MacKinlay, A. 2018. Housing price booms and crowdingout effects in bank lending. *The Review of Financial Studies* 31(7), 2806-2853.

Chava, S., Jarrow, R.A., 2004. Bankruptcy prediction with industry effects. *Review of Finance* 8, 537–569.

Chava, S., Roberts, M.R., 2008. How does financing impact investment? The role of debt covenants. *Journal of Finance* 63, 2085-2121.

Chava, S., Purnanandam, A., 2010. CEOs vs. CFOs: incentives and corporate policies. *Journal of Financial Economics* 97, 263–278

Cole, R.A., White, L.J., 2012. Deja vu all over again: the causes of US commercial bank failures this time around. *Journal of Financial Service Research* 42, 5–29.

Correa, R., Goldberg, L., 2022. Bank Complexity, Governance, and Risk. Journal of Banking and Finance 134. 106013.

Croci, E., Degl'Innocenti, M., Zhou, S., 2021. Large consumer-supplier links and syndicated loan structure. *Journal of Corporate Finance* 66, 101844.

Dam, L., Koetter, M., 2012. Bank bailouts and moral hazard: evidence from Germany. *Review of Financial Studies* 25 (8), 2343–2380.

Degl'Innocenti, M., Frigerio, M., Zhou, S., 2022. Development banks and the syndicate structure: Evidence from a world sample. *Journal of Empirical Finance* 66, 99-120.

Delis, M.D., Kouretas, G.P., 2011. Interest rates and bank risk-taking. *Journal of Banking & Finance* 35, 840–855.

Deng, S., Mao, C.X., Xia, C., 2020. Bank geographic diversification and corporate innovation: Evidence from the lending channel. *Journal of Financial and Quantitative Analysis*, forthcoming.

Dick-Nielsen, J., Rossi, M., 2019.The Cost of Immediacy for Corporate Bonds. *The Review of Financial Studies*, 32(1) 1–41.

Disyatat, P., 2011. The bank lending channel revisited. *Journal of Money, Credit and Banking* 43(4), 711-734.

Duchin, R., Sosyura, D., 2014. Safer ratios, riskier portfolios: Banks' response to government aid. *Journal of Financial Economics*, 113, 1–28.

Eisenbach, T. M., Lucca, D.O., Townsend, R.M. (2022) Resource Allocation in Bank Supervision: Trade-Offs and Outcomes. *Journal of Finance* 77(3), 1685-1736.

Ellul, A., Yerramilli, V., 2013. Stronger risk controls, lower risk: evidence from US bank holding companies. *Journal of Finance* 68, 1757–1803.

Elyasiani, E., Staikouras, S.K., Dontis-Charitos, P., 2016. Cross-industry product diversification and contagion in risk and return: the case of bank-insurance and insurance-bank takeovers. *Journal of Risk and Insurance*, 83, 681–718.

Ertugrul, M., Lei, J., Qiu, J., Wan, C., 2017. Annual report readability, tone ambiguity, and the cost of borrowing. *Journal of Financial and Quantitative Analysis* 52(2), 811-836.

Gandhi, P., Lustig, H. 2015. Size anomalies in US bank stock returns. *Journal of Finance* 70, 733–68.

Gao, Y., Liao, S., Wang, X., 2018. Capital markets' assessment of the economic impact of the Dodd-Frank Act on systematically important financial firms. *Journal of Banking and finance*, 86, 204–223.

Goetz M, Laeven L, Levine R (2016) Does the geographic expansion of banks reduce risk? *Journal Financial Economics* 120, 346–362.

Goldberg, L., Meehl, A., 2020. Complexity in large U.S. banks. Fed. Reserve Bank New York Econ. Policy Review 26 (2), 1–28.

Gustafson, M.T., Ivanov, I.T., Meisenzahl, R. R. 2021. Bank Monitoring: Evidence from Syndicated Loans. *Journal of Financial Economics* 139(2), 452-477.

Harris, T.S., Khan, U., Nissim, D., 2018. The expected rate of credit losses on banks' loan portfolios. *The Accounting Review* 93(5), 245–271.

Hart, O., Zingales, L., 2011. A new capital regulation for large financial institutions. *American Law and Economics Review*, 13, 453–490.

He, W., Hu, M., 2016. Religion and bank loan terms. *Journal of Banking & Finance* 64, 205-215.

Holmstrom, B., Tirole, J., 1997. Financial intermediation, loanable funds, and the real sector. *Quarterly Journal of Economics,* 112, 663-691.

Jones, J. S., Lee, W. Y., Yeager, T. J., 2012. Opaque banks, price discovery, and financial instability. *Journal of Financial Intermediation* 21(3), 383-408.

Jones, J. S., Lee, W. Y., Yeager, T. J., 2013. Valuation and systemic risk consequences of bank opacity. *Journal of Banking and Finance* 37(3), 693-706.

Kovner, A., Van Tassel, P. 2020. Evaluating regulatory reform: Banks' cost of capital and lending. *Journal of Money, Credit and Banking*.

Lin, C., Ma, Y., Malatesta, P., Xuan, Y., 2012. Corporate ownership structure and bank loan syndicate structure. *Journal of Financial Economics,* 104, 1–22.

Leung, W.S., Song, W., Chen, J., 2019. Does bank stakeholder orientation enhance financial stability? *Journal of Corporate Finance* 56, 38-63.

Levine, R., 2004. The corporate governance of banks: A concise discussion of concepts and evidence. *The World Bank Working Paper*.

Luciano, E., Wihlborg, C., 2018. Financial synergies and the organization of bank affiliates: a theoretical perspective on risk and efficiency. *Journal of Banking and Finance* 88 (C), 208–224.

Mehran, H., Morrison, A., and Shapiro, J., 2011. Corporate governance and banks: What have we learned from the financial crisis? Federal Reserve Bank of New York, NY.

Merton, R. C. 1977. An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees: An Application of Modern Option Pricing Theory. *Journal of Banking and Finance* 1, 3-11.

Myers, S.C., 1977. Determinants of corporate borrowing. *Journal of Financial Economics* 5(2), 147- 175.

Morgan, D. P. 2002. Rating banks: risk and uncertainty in an opaque industry. *American Economic Review* 92(4), 874–88.

Nguyen, D.D., Nguyen, L., Sila, V., 2019. Does corporate culture affect bank risk-taking? Evidence from loan-level data. *British Journal of Management* 30(1), 106-133.

Penas, M., Unal, H., 2004. Gains in bank mergers: evidence from the bond markets. *Journal of Financial Economics* 74 (1), 149–179.

Pogach, J., Unal, H., 2018. The Dark-Side of Banks' Nonbank Business: Internal Dividends in Bank Holding Companies. *FDIC Center for Financial Research Paper*, No. 2018-01. Available at: https://www.fdic.gov/bank/analytical/cfr/2018/wp2018/cfr-wp2018-01.pdf.

Santomero, A.M., Eckles, D.L., 2000. The determinants of success in the new financial services environment: now that firms can do everything, what should they do and why should regulators care? *Federal Reserve Bank of New York, Economic Policy Review*. 6, 11–23. Available at: https://pdfs.semanticscholar.org/bbdd/78a5e059cc1abfa6cd35864efa28679339bf.pdf

Smith, C., Warner, J. 1979. On financial contracting: An analysis of bond covenants. *Journal of Financial Economics* 7(2), 117-161.

Sufi, A. (2007). Information asymmetry and financing arrangements: Evidence from syndicated loans. *Journal of Finance*, 62(2), 629-6.

Vallascas, F., Hagendorff, J., 2011. The impact of European bank mergers on bidder default risk. *Journal of Banking and Finance*, 35, 902–915.

Weiß, G.N.F., Neumann, S., Bostandzic, D., 2014. Systemic risk and bank consolidation: international evidence. *Journal of Banking and Finance*, 40, 165–181.

Figure 1: Placebo estimation

Figure 1 plots the histogram of the coefficient estimates on *Post_DFA*Complex BHC* from 1000 placebo tests of Eq.1. To create each placebo estimate, we randomly assign a pseudo-complex BHC indicator to the baseline sample (with no replacement). We then estimate the baseline regressions in Table 2 based on these pseudo-complex BHC indicators. We save the coefficient estimates on *Post_DFA*Complex BHC* and repeat this procedure 1000 times. The graphs show the distribution of the coefficient estimates when the dependent variables are *NPLs and LLRs*. The vertically dashed red line shows the true estimation reported in Table 2. Table A.2 includes definitions of all variables.

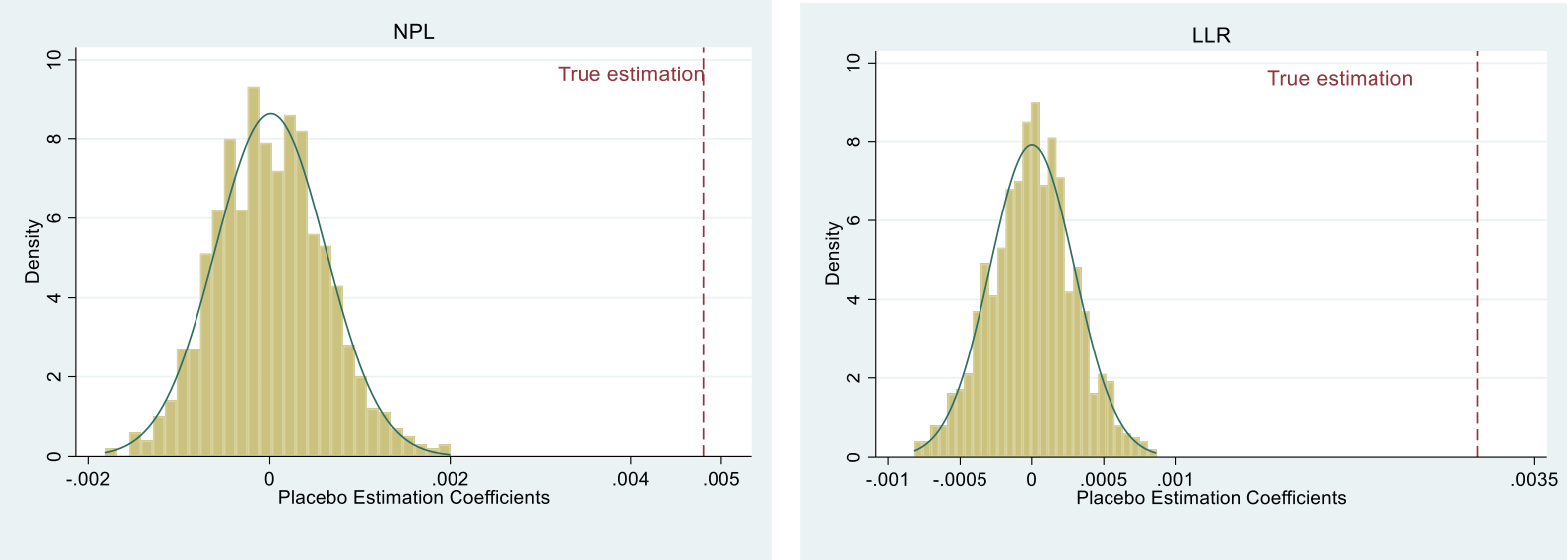

Table 1: Summary statistics

This table reports summary statistics of variables used in this study. The sample ranges from 2001 to 2006, and 2011 to 2016 (dropped financial crisis year and DFA implementation year). Table A.2 includes definitions of all variables.

Variable	N	Mean	p50	SD	p25	P75	Non-Complex	Complex	Non-complex-Complex
Baseline model							Obs: 516	Obs: 1,769	
NPLs	2285	0.0122	0.0087	0.0129	0.0050	0.0152	0.009	0.013	-0.004***
LLRs	2285	0.0143	0.0138	0.0063	0.0111	0.0168	0.002	0.003	-0.001***
Complex BHC	2285	0.7742	1.0000	0.4182	1.0000	1.0000			
Risk Management Index	1564	0.7775	0.7584	0.3090	0.5263	1.0219	0.700	0.801	-0.102***
Total Assets	2285	17.6057	17.2290	1.4637	16.4655	18.3910	16.576	17.933	-1.357***
(Total Assets in $ Billion)	2285	178.9281	31.1199	438.3417	14.4087	98.3794			
Loan to Assets	2285	0.5961	0.6471	0.1668	0.5254	0.7056	0.613	0.592	0.022***
Equity to Assets	2285	0.0983	0.0960	0.0233	0.0815	0.1106	0.099	0.099	0.001
Deposits to Assets	2285	0.6892	0.7060	0.1309	0.6338	0.7805	0.748	0.673	0.074***
Net Income to Assets	2285	0.0128	0.0097	0.0122	0.0052	0.0163	0.007	0.015	-0.007***
Liquid Asset to Assets	2285	0.2681	0.2308	0.1413	0.1737	0.3276	0.279	0.265	0.014**
Non-interest Income to Assets	2285	0.0123	0.0093	0.0117	0.0050	0.0157	0.008	0.014	-0.006***
GDP growth (Quarterly)	48	4.3708	4.6000	2.1899	2.6500	5.5500			
Credit to GDP gap (Quarterly)	48	-3.1104	-2.8000	10.8791	-14.4500	7.4000			
VIX (Quarterly)	48	18.2508	16.3880	5.9109	13.6958	20.9235			
Lending Portfolio									
C&I Loan	2285	0.1245	0.1202	0.0740	0.0714	0.1722	0.115	0.128	-0.013***
Real Estate Loan (Commercial)	2285	0.0591	0.0000	0.0938	0.0000	0.1038	0.085	0.052	0.033***
Real Estate Loan (Residential)	2285	0.1964	0.1898	0.1077	0.1254	0.2431	0.211	0.192	0.018***
Credit Card	2285	0.0249	0.0000	0.0527	0.0000	0.0192	0.015	0.028	-0.013***
Other Loans	2285	0.0227	0.0000	0.0379	0.0000	0.0331	0.010	0.026	-0.016***
MBS	2285	0.0011	0.0000	0.0041	0.0000	0.0000	0.000	0.002	-0.002***
C&I NCO	2285	0.0037	0.0019	0.0057	0.0004	0.0048	0.003	0.004	-0.001**
Real Estate NCO (Commercial)	2285	0.0011	0.0000	0.0037	0.0000	0.0001	0.001	0.001	-0.001***
Real Estate NCO (Residential)	2285	0.0016	0.0005	0.0032	0.0000	0.0015	0.001	0.002	-0.001***
Credit Card NCO	2285	0.0032	0.0000	0.0064	0.0000	0.0039	0.002	0.004	-0.002***
Others NCO	2285	0.0017	0.0000	0.0063	0.0000	0.0003	0.003	0.002	0.001**
Total NCO	2285	0.0015	0.0000	0.0034	0.0000	0.0014	0.001	0.002	-0.001***
Total amount of borrowings to non-bank subsidiaries	2285	0.0203	0.0000	0.0912	0.0000	0.0000	0.000	0.026	-0.026***

Extension of credit to nonbank subsidiaries and associated nonbank companies	2285	0.0285	0.0005	0.0622	0.0000	0.0288	0.005	0.036	-0.032***
Subsidiary nonbanks and associated nonbanks loans and advances to the parent	2284	0.3270	0.1972	0.3353	0.0199	0.5491	0.577	0.255	0.322***
Loan Characters									
General Covenant	2347	1.2992	1.3863	0.6401	1.0986	1.6094			
Financial Covenant	2347	0.8679	1.0986	0.4901	0.6931	1.0986			
Capital Covenant	2347	0.1906	0.0000	0.3151	0.0000	0.6931			
Performance Covenant	2347	0.6975	0.6931	0.5161	0.0000	1.0986			
Covenant Intensity	2347	0.9279	1.0986	0.6555	0.0000	1.3863			
Lender Share	2347	17.5307	17.6222	1.4239	16.9936	18.1975			
Facility Amount	2347	19.2775	19.3370	1.4269	18.4207	20.2124			
Facility Maturity	2347	3.7402	4.1109	0.6015	3.6109	4.1109			
All in Spread	1841	1.5003	1.3750	0.9734	0.7500	2.0000			
Total borrowing cost	1509	1.1207	0.8861	0.8666	0.5389	1.4263			

Table 2: Baseline regression

This table reports the regression estimates for Eq.1, where $y_{i,t}$ is the credit risk, measured by *NPLs* and *LLRs* for BHC *i* in time *t*. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets.* In Columns (3) and (4) we further control for macroeconomic conditions and include controls for *GDP growth*, *Credit to GDP gap*, and the *VIX*. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	NPLs	LLRs	NPLs	LLRs
Post_DFA×Complex BHC	0.0048***	0.0031***	0.0072***	0.0041***
	(0.0008)	(0.0004)	(0.0012)	(0.0005)
Total Assets	0.0016	-0.0011***	-0.0004	-0.0026***
	(0.0015)	(0.0003)	(0.0013)	(0.0003)
Loan to Assets	-0.0493**	-0.0054	-0.0662***	-0.0167***
	(0.0201)	(0.0040)	(0.0200)	(0.0048)
Equity to Assets	0.0011	0.0005	-0.0182	-0.0125
	(0.0231)	(0.0074)	(0.0255)	(0.0091)
Deposits to Assets	-0.0283***	-0.0011	-0.0422***	-0.0097***
	(0.0048)	(0.0014)	(0.0047)	(0.0019)
Net Income to Assets	0.6579**	0.0954	0.9156**	0.1740
	(0.2970)	(0.0930)	(0.3553)	(0.1269)
Liquid Asset to Assets	-0.0449***	-0.0131***	-0.0564***	-0.0196***
	(0.0159)	(0.0043)	(0.0172)	(0.0052)
Non-interest Income to Assets	-0.7286**	-0.1047	-0.9580***	-0.1826
	(0.3106)	(0.0973)	(0.3616)	(0.1300)
GDP growth			0.0002**	0.0003***
			(0.0001)	(0.0000)
Credit to GDP gap			-0.0004***	-0.0001***
			(0.0000)	(0.0000)
VIX			0.0004***	0.0003***
			(0.0000)	(0.0000)
Quarter FE	Yes	Yes	No	No
Bank FE	Yes	Yes	Yes	Yes
Number of BHCs	60	60	60	60
N	2285	2285	2285	2285
adj. R-sq	0.659	0.795	0.540	0.656

Table 3: Different types of complexity

This table reports the regression estimates for Eq.1, where the dependent variables are the credit risk, measured by NPLs and LLRs for BHC *i* in time *t*. Post_DFA is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Columns (1) and (2) consider as complex BHCs only the BHCs engaging in Risky Activities (RSSD9057= 3, 4, 5), while BHCs with complex Management Factors (RSSD9057=6, 7, 8) are dropped from the sample. Columns (3) and (4) consider as complex only those BHCs with complex Management Factors (RSSD9057=6, 7, 8) while BHCs engaging in Risky Activities (RSSD9057= 3, 4, 5) are dropped from the sample. The control sample includes 14 non-complex BHCs in all the columns, Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets*. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Complex Type	Risky Activities (RSSD9057= 3, 4, 5)		Management Factors (RSSD9057=6, 7, 8)	
	(1)	(2)	(3)	(4)
	NPLs	LLRs	NPLs	LLRs
Post_DFA×Complex BHC	0.0049***	0.0030***	0.0027***	0.0028***
	(0.0009)	(0.0004)	(0.0006)	(0.0005)
Total Assets	0.0019	-0.0006**	0.0049***	-0.0019***
	(0.0016)	(0.0003)	(0.0007)	(0.0005)
Loan to Assets	-0.0502**	-0.0060	-0.0283***	-0.0153**
	(0.0206)	(0.0040)	(0.0101)	(0.0059)
Equity to Assets	-0.0050	-0.0043	-0.0408***	-0.0278***
	(0.0242)	(0.0076)	(0.0133)	(0.0087)
Deposits to Assets	-0.0280***	-0.0000	-0.0036	-0.0143***
	(0.0049)	(0.0014)	(0.0039)	(0.0024)
Net Income to Assets	0.7920**	0.1964**	0.3982**	0.2461*
	(0.3246)	(0.0978)	(0.2006)	(0.1406)
Liquid Asset to Assets	-0.0470***	-0.0146***	-0.0431***	-0.0135**
	(0.0163)	(0.0044)	(0.0097)	(0.0056)
Non-interest Income to Assets	-0.9007***	-0.2471**	-0.2493	-0.1269
	(0.3383)	(0.0995)	(0.1899)	(0.1295)
Quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Number of BHCs	57	57	17	17
N	2159	2159	642	642
adj. R-sq	0.658	0.793	0.802	0.830

Table 4: Net charge-offs of loan portfolio

This table reports the regression estimates for Eq.1 where $y_{i,t}$ is the net charge-offs (NCO) of different types of loans including Commercial, Real Estate (Commercial), Real Estate (Residential), Credit Card and Others for BHC *i* in time *t* from Columns (1)-(5). In Column (6), we report the regression estimation on total NCO for all loan portfolios. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets*. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	C&I NCO	Real Estate NCO (Residential)	Real Estate NCO (Commercial)	Credit Card NCO	Others NCO	Total NCO
Post_DFA×Complex BHC	-0.0023***	0.0009**	0.0017***	0.0032***	-0.0012	0.0011***
	(0.0005)	(0.0004)	(0.0003)	(0.0004)	(0.0007)	(0.0003)
Total Assets	0.0013***	-0.0009***	-0.0008***	-0.0008**	-0.0021***	-0.0005***
	(0.0005)	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0002)
Loan to Assets	0.0013	-0.0013	-0.0013	0.0066**	0.0042	-0.0038**
	(0.0036)	(0.0033)	(0.0017)	(0.0032)	(0.0040)	(0.0019)
Equity to Assets	-0.0090	0.0007	0.0019	0.0153**	0.0231**	-0.0018
	(0.0092)	(0.0060)	(0.0031)	(0.0060)	(0.0113)	(0.0034)
Deposits to Assets	-0.0006	0.0006	-0.0012	-0.0094***	0.0052***	-0.0004
	(0.0020)	(0.0008)	(0.0008)	(0.0017)	(0.0019)	(0.0008)
Net Income to Assets	0.0264	0.0699*	0.0807**	0.1168	-0.2284	0.1585***
	(0.0922)	(0.0421)	(0.0363)	(0.0768)	(0.1704)	(0.0406)
Liquid Asset to Assets	-0.0094***	-0.0048	-0.0040**	0.0085***	0.0045	-0.0056***
	(0.0033)	(0.0035)	(0.0016)	(0.0032)	(0.0039)	(0.0018)
Non-interest Income to Assets	-0.0379	-0.0925**	-0.1002***	-0.1947**	0.2814	-0.2117***
	(0.0939)	(0.0448)	(0.0386)	(0.0807)	(0.1863)	(0.0438)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of BHCs	60	60	60	60	60	60
N	2285	2285	2285	2285	2285	2285
adj. R-sq	0.467	0.601	0.676	0.694	0.332	0.706

Table 5: Asset composition

This table reports the regression estimates for Eq.1 where $y_{i,t}$ is the different type of loans, including *C&I Loan, Real Estate (Commercial) Loan, Real Estate (Residential) Loan, Credit Card, Other Loans,* and *MBS* for BHC *i* in time *t* from Columns (1)-(5). *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets*, and *Non-interest Income to Assets.* All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	C&I Loan	Real Estate Loan (Commercial)	Real Estate Loan (Residential)	Credit Card	Other Loans	MBS
Post_DFA×Complex BHC	0.0062**	-0.0768***	-0.0125***	0.0191***	0.0336***	0.0035***
	(0.0027)	(0.0043)	(0.0028)	(0.0029)	(0.0016)	(0.0002)
Total Assets	-0.0007	-0.0339***	0.0088**	0.0154***	0.0051***	-0.0005*
	(0.0022)	(0.0032)	(0.0038)	(0.0034)	(0.0017)	(0.0003)
Loan to Assets	0.2014***	0.0871**	0.2992***	0.0850***	-0.1368***	0.0012
	(0.0192)	(0.0385)	(0.0307)	(0.0237)	(0.0256)	(0.0023)
Equity to Assets	0.1855***	-0.3014***	-0.2124***	-0.0518	-0.0163	0.0173***
	(0.0366)	(0.0718)	(0.0640)	(0.0558)	(0.0373)	(0.0040)
Deposits to Assets	0.0720***	-0.2271***	0.0377**	0.0266*	0.0717***	-0.0084***
	(0.0101)	(0.0167)	(0.0163)	(0.0140)	(0.0090)	(0.0023)
Net Income to Assets	0.7280*	2.4574**	1.0107	3.4019***	-2.3455***	0.0523
	(0.4380)	(1.0208)	(0.8722)	(1.2079)	(0.5326)	(0.1123)
Liquid Asset to Assets	-0.0055	-0.1260***	-0.0429*	0.0469**	-0.1216***	0.0058**
	(0.0179)	(0.0413)	(0.0224)	(0.0232)	(0.0296)	(0.0024)
Non-interest Income to Assets	-0.8010*	-2.9723***	-1.0348	-3.9277***	2.7036***	-0.0728
	(0.4297)	(1.1067)	(0.8867)	(1.3428)	(0.5566)	(0.1115)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of BHCs	60	60	60	60	60	60
N	2285	2285	2285	2285	2285	2285
adj. R-sq	0.925	0.838	0.921	0.755	0.757	0.520

Table 6: Dynamic estimation

This table reports the regression estimates for Eq.1. *Year 2001* to *Year 2015* are a series of dummy variables that equals to one if year equals to year t, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets.* All regressions include year fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)
	NPLs	LLRs
Year2001×Complex BHC	-0.0000	0.0011*
	(0.0013)	(0.0006)
Year2002×Complex BHC	0.0021	0.0009*
	(0.0013)	(0.0005)
Year2003×Complex BHC	-0.0007	0.0001
	(0.0010)	(0.0004)
Year2004×Complex BHC	-0.0015	0.0001
	(0.0009)	(0.0004)
Year2005×Complex BHC	-0.0013	-0.0002
	(0.0008)	(0.0004)
Year2011×Complex BHC	0.0078***	0.0072***
	(0.0021)	(0.0010)
Year2012×Complex BHC	0.0055***	0.0044***
	(0.0015)	(0.0006)
Year2013×Complex BHC	0.0030**	0.0028***
	(0.0013)	(0.0005)
Year2014×Complex BHC	0.0028***	0.0016***
	(0.0010)	(0.0004)
Year2015×Complex BHC	0.0020***	0.0010***
	(0.0008)	(0.0004)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	60	60
N	2285	2285
adj. R-sq	0.660	0.804

Table 7: Effects of DFA on bank loan risks: PSM estimation

This table reports the regression estimates for Eq.1. The sample is derived from propensity score matching. In Panel A, we compare the mean statistics for the PSM samples between complex BHCs and non-complex BHCs. In Panel B, we estimate the Eq. (1) where $y_{i,t}$is the credit risk, measured by *NPLs* and *LLRs* for BHC *i* in time *t*. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets.* All regressions include year fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: t-test of the PSM sample

Variable	Non-Complex (Obs.) Number of BHC: 14	Complex (Obs.) Number of BHC: 35	Non-Complex (mean)	Complex (mean)	Diff (Non-complex – Complex)
NPLs	516	1056	0.009	0.011	-0.001**
LLRs	516	1056	0.013	0.014	-0.001***
Total Assets	516	1056	16.549	17.139	-0.590***
Loan to Assets	516	1056	0.613	0.625	-0.012
Equity to Assets	516	1056	0.099	0.10	-0.001
Deposits to Assets	516	1056	0.748	0.726	0.022***
Net Income to Assets	516	1056	0.007	0.009	-0.002***
Liquid Asset to Assets	516	1056	0.279	0.253	0.026***
Non-interest Income to Assets	516	1056	0.007	0.009	-0.002***

Table 7: Effects of DFA on bank loan risks: PSM estimation (continued)

Panel B: PSM sample estimation

	(1)	(2)
	NPLs	LLRs
Post_DFA*Complex BHC	0.0024**	0.0021***
	(0.0011)	(0.0004)
Total Assets	0.0027***	-0.0014***
	(0.0009)	(0.0004)
Loan to Assets	-0.0368*	-0.0177***
	(0.0208)	(0.0065)
Equity to Assets	-0.0491*	-0.0024
	(0.0283)	(0.0090)
Deposits to Assets	0.0038	0.0046**
	(0.0031)	(0.0019)
Net Income to Assets	0.6094	0.0970
	(0.6325)	(0.2626)
Liquid Asset to Assets	-0.0597***	-0.0230***
	(0.0224)	(0.0068)
Non-interest Income to Assets	-0.5140	-0.0599
	(0.5428)	(0.2463)
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHC	49	49
N	1572	1572
adj. R-sq	0.720	0.775

Table 8: Robustness test

This table reports the regression estimates for Eq.1 where $y_{i,t}$is the credit risk, measured by *NPLs* and *LLRs* for BHC *i* in time *t*. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets.* In Panel A, we exclude Global Systematically Important Banks; in Panel B, we exclude banks with total assets between $75 Billion to $125 Billion; In Panel C, we drop 15 BHCs which change complex status in the post-DFA period (i.e. from year 2011 to 2016) based on RSSD9057 indicator. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Exclude GSIB		
	(1)	(2)
	NPLs	LLRs
Post_DFA×Complex BHC	0.0032***	0.0026***
	(0.0009)	(0.0004)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	55	55
N	2050	2050
adj. R-sq	0.628	0.792
Panel B: Exclude Bank with total assets >$75 Billion and <$125 Billion		
	(1)	(2)
	NPLs	LLRs
Post_DFA×Complex BHC	0.0094***	0.0038***
	(0.0010)	(0.0004)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	43	43
N	1586	1586
adj. R-sq	0.768	0.783
Panel C: drop BHCs which change complex status in the post-DFA period		
	(1)	(2)
	NPLs	LLRs
Post_DFA×Complex BHC	0.0031***	0.0028***
	(0.0012)	(0.0004)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	45	45
N	1620	1620
adj. R-sq	0.648	0.788

Table 9: Alternative complex measure

Panel A reports the univariate analysis of bank complexity level before and after DFA by using different complex measures available on yearly basis. Panels B-D report the regression estimates for Eq.1, where $y_{i,t}$ is the credit risk, measured by *NPLs* and *LLRs* for BHC *i* in time *t*. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. We collect the bank affiliation information from the FFIEC National Information Center (NIC) for 57 BHCs on yearly basis. We construct three measures of complexity: a) *Organizational complexity* which is measured by the number of business types spanned by BHC affiliates; b) *Business complexity* which is measured by the number of non-financial affiliations relative to total affiliation number; and c) *Geographical complexity* which is measured by the number of affiliations located aboard relative to the total affiliation number. In Panel B we match the information retrieved from the FFIEC National Information Center (NIC) with the quarterly accounting data employed in the baseline model for 57 BHCs. the Complex BHC is a dummy variable if the alternative complex measure is above the median value of the sample in the year 2006. Control variables include bank-level characteristics, including *Total Assets*, *Loan to Assets*, *Equity to Assets*, *Deposit to Assets*, *Net Income to Assets*, *Liquid Asset to Assets* and *Non-interest Income to Assets*. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A	Observations[18]	Before DFA	After DFA	Diff.	
		Mean	Mean	(Before Mean - After Mean)	p-value
Complex BHC (RSSD9057)	720	0.7605	0.7365	0.0240	0.399
Organizational complexity	684	7.3980	7.0495	0.3485	0.412
Business complexity	684	0.084	0.0865	-0.0025	0.912
Geographical complexity	684	0.1665	0.1965	-0.0300	0.309
Number of Subsidiaries	684	469.1575	619.8345	-150.6775	0.292

[18] Data on Complex BHC (RSSD9057) is available for 60 BHCs for twelve years, while data on other complexity measures is available for 57 BHCs for the same years.

Table 9: Alternative complex measure (continued)

Panel B: Organizational complexity

	(1)	(2)
	NPLs	LLRs
Post_DFA*Complex BHC	0.0038***	0.0035***
	(0.0008)	(0.0003)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	57	57
N	2220	2220
adj. R-sq	0.655	0.799

Panel C: Business complexity

	(1)	(2)
	NPLs	LLRs
Post_DFA*Complex BHC	0.0040***	0.0030***
	(0.0008)	(0.0003)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	57	57
N	2220	2220
adj. R-sq	0.656	0.797

Panel D: Geographical complexity

	(1)	(2)
	NPLs	LLRs
Post_DFA*Complex BHC	0.0038***	0.0028***
	(0.0007)	(0.0003)
Controls	Yes	Yes
Quarter FE	Yes	Yes
Bank FE	Yes	Yes
Number of BHCs	57	57
N	2220	2220
adj. R-sq	0.655	0.796

Table 10: Lending and Borrowing between Parent BHC and its non-bank affiliates

This table reports regression estimates for Eq.1, where $y_{i,t}$ is the measure of lending and debt activities of the parent BHC and non-bank subsidiaries i in time t. *Total amount of borrowings to non-bank subsidiaries* is the total amount of borrowings guaranteed by the parent to non-bank subsidiaries divided by total consolidated assets; *Extension of credit to nonbank subsidiaries and associated nonbank companies* is the sum of loans, advances, notes, bonds, and debentures in non-bank subsidiaries and associated non-bank companies divided by to total consolidated assets; *Subsidiary nonbanks and associated nonbanks loans and advances to the parent* is the total amount of loans and advances to the reporting bank holding company made by subsidiary nonbanks and associated nonbanks divided by total consolidated assets. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets*. Column (1) to (3) report the results by using the full sample. Column (4) to (6) report the results by excluding BHCs which change complex status in the post-DFA period (i.e. from year 2011 to 2016) based on RSSD9057 indicator. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Full Sample			Drop BHCs which change complex status in the post-DFA period		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total amount of borrowings to non-bank subsidiaries	Extension of credit to nonbank subsidiaries and associated nonbank companies	Subsidiary nonbanks and associated nonbanks loans and advances to the parent	Total amount of borrowings to non-bank subsidiaries	Extension of credit to nonbank subsidiaries and associated nonbank companies	Subsidiary nonbanks and associated nonbanks loans and advances to the parent
Post_DFA×Complex BHC	-0.0178***	-0.0032	-0.0575**	-0.0223***	-0.0024	-0.2434***
	(0.0032)	(0.0020)	(0.0238)	(0.0043)	(0.0031)	(0.0413)
Total Assets	-0.0001	-0.0143**	0.0461**	0.0043	-0.0133	-0.0715***
	(0.0055)	(0.0066)	(0.0197)	(0.0075)	(0.0095)	(0.0065)
Loan to Assets	0.1469***	-0.0164	0.3974***	0.2021***	-0.0086	-0.0839
	(0.0546)	(0.0765)	(0.1472)	(0.0695)	(0.1037)	(0.1051)
Equity to Assets	-0.4308***	-0.1117**	-2.1499***	-0.7024***	-0.1450*	-1.1305***
	(0.0691)	(0.0541)	(0.3897)	(0.1155)	(0.0838)	(0.4014)
Deposits to Assets	0.0677***	0.0090	-0.0416	0.1050***	0.0427	-0.0749
	(0.0238)	(0.0236)	(0.0895)	(0.0394)	(0.0444)	(0.0824)
Net Income to Assets	2.3655	1.2502	0.8201	3.2749	0.8856	-9.3386
	(1.7162)	(1.1585)	(2.2732)	(2.4907)	(1.7245)	(8.5186)
Liquid Asset to Assets	0.0834**	-0.0382	-0.1238	0.0823	-0.0381	0.1934
	(0.0418)	(0.0446)	(0.1247)	(0.0517)	(0.0537)	(0.1359)
Non-interest Income to Assets	-1.8824	-1.4395	-0.3592	-2.3464	-0.4873	8.0300
	(1.6852)	(1.2453)	(2.3116)	(2.4114)	(1.7968)	(8.2710)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of BHC	60	60	60	45	45	45
N	2285	2285	2284	1620	1620	1620
adj. R-sq	0.725	0.692	0.740	0.725	0.692	0.785

Table 11: Impact of DFA on loan terms of complex BHCs

This table reports the estimation of the impact of the Dodd-Frank Act on syndicate loan terms. The dependent variables are as follows: Columns (1) General Covenant, (2) Financial Covenant, (3) Capital Covenant, (4) Performance Covenant, (5) Covenant Intensity, and (6) Lender Share. We restrict observations where leader banks are those complex BHCs identified in the baseline sample. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Bank controls include control variables applied in the baseline regression. Borrower controls are borrower characteristics, including *ROA, Tobin's q, Total Assets, Capex, Tangibility,* and *Sales*. Loan controls include the *Facility Amount* and *Facility Maturity*. All regressions include BHC fixed effects and loan purpose fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	General Covenant	Financial Covenant	Capital Covenant	Performance Covenant	Covenant Intensity	Lender Share
Post_DFA	-0.1696**	-0.0881*	-0.0918***	-0.1036*	-0.1934***	-0.3802***
	(0.0688)	(0.0489)	(0.0332)	(0.0533)	(0.0632)	(0.1369)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Controls	Yes	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	No	No	No	No	No
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Loan purpose FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of BHC	21	21	21	21	21	21
N	2347	2347	2347	2347	2347	2347
adj. R-sq	0.222	0.281	0.150	0.299	0.367	0.472

Table 12: Impact of DFA on loan pricing of complex BHCs

This table reports the estimation of the impact of the Dodd-Frank Act on syndicate loan pricing. The dependent variables are *All in Spread* (Columns (1) and (2)) and *Total borrowing cost* (Columns (3) and (4)). For this analysis, we consider as leader banks only complex BHCs. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Leverage is a dummy variable that equals to one if borrower's leverage ratio is above the mean of the sample observations, and zero otherwise. Bank controls include control variables applied in the baseline regression. Borrower controls are borrower characteristics, including *ROA, Tobin's q, Total Assets, Capex, Tangibility*, and *Sales*. Loan controls include the log value of Facility Amount and the log value of Facility Maturity. All regressions include BHC fixed effects and loan purpose fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	All in Spread	All in Spread	Total borrowing cost	Total borrowing cost
Post_DFA	0.9217***	0.8317***	0.5864***	0.5571***
	(0.1051)	(0.1415)	(0.1096)	(0.1176)
Leverage		0.9850***		1.2260***
		(0.1588)		(0.1668)
Post_DFA*Leverage		0.2452		-0.0230
		(0.3080)		(0.2300)
Bank Controls	Yes	Yes	Yes	Yes
Borrower Controls	Yes	Yes	Yes	Yes
Loan Character Controls	Yes	Yes	Yes	Yes
Quarter FE	No	No	No	No
Bank FE	Yes	Yes	Yes	Yes
Loan Purpose FE	Yes	Yes	Yes	Yes
Number of BHCs	19	19	19	19
N	1841	1841	1509	1509
adj. R-sq	0.392	0.435	0.368	0.435

Table 13: Risk management

This table reports the regression estimates for Eq.1, where $y_{i,t}$ is the Risk Management Index for BHC *i* in time *t*. *Post_DFA* is a dummy variable that equals to one if year 2010 and afterwards, and zero otherwise. Complex BHC is a dummy variable that equals to one if the BHC is defined as a complex BHC based on the RSSD9057 indicator, and zero otherwise. Control variables include bank-level characteristics, including *Total Assets, Loan to Assets, Equity to Assets, Deposit to Assets, Net Income to Assets, Liquid Asset to Assets* and *Non-interest Income to Assets*. Column (1) reports the results for the baseline model, and Column (2) reports the results of using PSM sample. In Columns (3) and (4) we remove GSIB and banks with total assets >$75 Billion and <$125 Billion, respectively. In Column (5) we exclude BHCs change complex class (e.g., from complex bank to non-complex bank) in the post-DFA period. In Columns (6) to (7) we report results by using alternative complex measures: namely, *Organizational complexity*, *Business complexity*, and *Geographical complexity*. All regressions include quarter fixed effects and BHC fixed effects. Standard errors are adjusted for heteroskedasticity and reported in parentheses. Table A.2 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline Model	*PSM*	*Drop GSIBs*	*Banks with total assets >$75 Billion and <$125 Billion*	*Drop BHC change complex class in post-DFA period*	*Organizational complexity*	*Business complexity*	*Geographical complexity*
Post_DFA	-0.0496***	-0.0783***	-0.0710***	-0.0513***	-0.0461***	-0.0202**	-0.0292***	0.0171
×Complex BHC	(0.0103)	(0.0108)	(0.0103)	(0.0117)	(0.0123)	(0.0101)	(0.0102)	(0.0120)
Total Assets	-0.0067	-0.0255**	-0.0066	0.0313***	-0.0527***	-0.0032	-0.0024	-0.0061
	(0.0102)	(0.0106)	(0.0105)	(0.0115)	(0.0096)	(0.0104)	(0.0104)	(0.0102)
Loan to Assets	-0.0613	0.3816***	0.1729	-0.3846***	0.2006*	-0.0783	-0.0767	-0.0755
	(0.1131)	(0.1377)	(0.1195)	(0.1373)	(0.1153)	(0.1140)	(0.1133)	(0.1138)
Equity to Assets	0.5768***	0.6048***	0.5183***	0.3857*	0.5176**	0.6106***	0.6593***	0.5018***
	(0.1875)	(0.2093)	(0.1961)	(0.2292)	(0.2214)	(0.1889)	(0.1922)	(0.1920)
Deposits to Assets	0.2164***	0.0853	0.1255**	0.5597***	-0.0006	0.2007***	0.2040***	0.1513***
	(0.0600)	(0.0643)	(0.0610)	(0.0732)	(0.0622)	(0.0612)	(0.0606)	(0.0585)
Net Income to Assets	-3.4395	-2.3318	-3.9746	-6.7346**	0.2872	-3.5167	-3.5345	-3.4977
	(2.4915)	(3.7926)	(2.7517)	(3.3706)	(1.7450)	(2.4908)	(2.4784)	(2.4745)
Liquid Asset to Assets	0.1109	0.5669***	0.3611***	-0.1348	0.3730***	0.0604	0.0725	0.0652
	(0.1053)	(0.1290)	(0.1165)	(0.1294)	(0.1081)	(0.1044)	(0.1045)	(0.1047)
Non-interest Income to Assets	4.2019*	1.0692	5.1108*	7.7439**	-0.5874	4.3685*	4.3797*	4.4462*
	(2.5153)	(3.5683)	(2.7843)	(3.4528)	(1.7631)	(2.5164)	(2.5037)	(2.5018)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of BHCs	53	40	48	38	40	52	52	52
N	1564	999	1389	1140	1146	1542	1542	1542
adj. R-sq	0.941	0.958	0.949	0.943	0.950	0.940	0.941	0.940

Appendix

Table A.1: BHC used in the baseline regression

RSSDID	BHC Name	Complex BHC
1025309	BANK OF HAWAII CORPORATION	Yes
1025608	FIRST HAWAIIAN, INC.	Yes
1026632	CHARLES SCHWAB CORPORATION, THE	Yes
1027004	ZIONS BANCORPORATION	Yes
1027518	CITY NATIONAL CORPORATION	Yes
1033470	BANK OF NEW YORK COMPANY, INC., THE	Yes
1039502	JPMORGAN CHASE & CO.	Yes
1068025	KEYCORP	Yes
1068191	HUNTINGTON BANCSHARES INCORPORATED	Yes
1068762	MELLON FINANCIAL CORPORATION	Yes
1069125	NATIONAL CITY CORPORATION	Yes
1069778	PNC FINANCIAL SERVICES GROUP, INC., THE	Yes
1070345	FIFTH THIRD BANCORP	Yes
1070804	FIRSTMERIT CORPORATION	Yes
1071203	SKY FINANCIAL GROUP, INC.	Yes
1072442	MERCANTILE BANKSHARES CORPORATION	Yes
1073551	WACHOVIA CORPORATION	Yes
1073757	BANK OF AMERICA CORPORATION	Yes
1074156	BB&T CORPORATION	Yes
1075612	FIRST CITIZENS BANCSHARES, INC.	Yes
1078529	BBVA USA BANCSHARES, INC.	Yes
1078604	AMSOUTH BANCORPORATION	Yes
1078846	SYNOVUS FINANCIAL CORP.	Yes
1080465	COLONIAL BANCGROUP, INC., THE	Yes
1094640	FIRST HORIZON NATIONAL CORPORATION	Yes
1111435	STATE STREET CORPORATION	Yes
1117129	FULTON FINANCIAL CORPORATION	Yes
1119794	U.S. BANCORP	Yes
1120754	WELLS FARGO & COMPANY	Yes
1131787	SUNTRUST BANKS, INC.	Yes
1141599	SOUTH FINANCIAL GROUP, INC., THE	Yes
1145476	WEBSTER FINANCIAL CORPORATION	Yes
1199563	ASSOCIATED BANC-CORP	Yes
1199611	NORTHERN TRUST CORPORATION	Yes
1199844	COMERICA INCORPORATED	Yes
1249196	TD BANK US HOLDING COMPANY	Yes
1378434	UNIONBANCAL CORPORATION	Yes
1826056	RBC CENTURA BANKS, INC.	Yes
1883693	BOK FINANCIAL CORPORATION	Yes
1888193	WILMINGTON TRUST CORPORATION	Yes
1951350	CITIGROUP INC.	Yes
2277860	CAPITAL ONE FINANCIAL CORPORATION	Yes
2337045	INVESTORS FINANCIAL SERVICES CORP.	Yes
2389941	TCF FINANCIAL CORPORATION	Yes
2549857	COUNTRYWIDE FINANCIAL CORPORATION	Yes
2694814	UCBH HOLDINGS, INC.	Yes
1037003	M&T BANK CORPORATION	No
1048429	NORTH FORK BANCORPORATION, INC.	No
1048773	VALLEY NATIONAL BANCORP	No
1049341	COMMERCE BANCSHARES, INC.	No
1079740	WHITNEY HOLDING CORPORATION	No

1097614	BANCORPSOUTH, INC.	No
1102367	CULLEN/FROST BANKERS, INC.	No
1104231	INTERNATIONAL BANCSHARES CORPORATION	No
1117679	COMMERCE BANCORP, INC.	No
1200393	CORUS BANKSHARES, INC.	No
1205688	CITIZENS REPUBLIC BANCORP, INC.	No
1246702	PEOPLE'S MUTUAL HOLDINGS	No
2132932	NEW YORK COMMUNITY BANCORP, INC.	No
2734233	EAST WEST BANCORP, INC.	No

Table A.2: Variable definitions

Variables	Definition	Mnemonic Construction & Data Source
	BHC Risk	
NPLs	Non-performing loan ratio, measured by total non-performing loans scaled by total loans and lease.	((BHCK5525- BHCK3506) +(BHCK5526- BHCK3507))/BHCK2122. Source: FR Y-9C
LLRs	Loan loss reserve, measured by the allowance for loan and lease losses scaled by total loans and lease.	BHCK3123/ BHCK2122. Source: FR Y-9C
Risk Management Index	A risk management index (RMI) to measure the strength and independence of the risk management function at bank holding companies (BHCs).	Ellul and Yerramilli (2013)
Complex BHC	A dummy variable that equals to one if the BHC is a complex institution based on the BHC's complexity indicator code RSSD9057.	The indicator equal to one if RSSD9057=3, to 8, and zero otherwise. Source: FR Y-9C
	BHC Characteristics	
Total Assets	The logarithm value of bank total assets.	Logarithm value of BHCK2170 Source: FR Y-9C
Total Assets (in $ Billion)	The dollar value of bank total assets in billion.	Source: FR Y-9C
Loan to Assets	The loan ratio measured by total loans to total assets.	(BHCKB528+BHCK5369)/BHCK2170 Source: FR Y-9C
Equity to Assets	The equity ratio measured by total equity capital scaled by total assets.	BHCK3210/BHCK2170 Source: FR Y-9C
Deposits to Assets	The deposition ratio measure by total deposit scaled by total assets.	(BHDM6631+BHDM6636+BHFN6631+BHFN6636)/BHCK2170 Source: FR Y-9C
Net Income to Assets	Net income ratio measure by net income scale total assets.	BHCK4079/BHCK2170 Source: FR Y-9C
Liquid Asset to Assets	The ratio of liquid assets to total assets.	(BHCK1754+BHCK1773+BHCK3545+BHDMB987+BHCKB989)/BHCK2170 Source: FR Y-9C
Non-interest Income to Assets	The ratio of non-interest income to total assets	(BHCK4079- BHCKA220)/BHCK2170
	Quarterly Macro Control	
GDP growth	The difference between the credit-to-GDP ratio and its long-term trend in percentage points.	Bureau of Economic Analysis Source: Bank for International Settlements
Credit to GDP gap		
VIX	CBOE Volatility Index.	Source: Chicago Board Operations Exchange
	Loans and NCO Categories	
C&I Loan	Ratio of bank total commercial and industrial loans to total assets.	Source: FR Y-9C
Real Estate Loan (Residential)	Ratio of bank total residential loans and unused commitments to total assets.	Source: FR Y-9C
Real Estate Loan (Commercial)	Ratio of bank total commercial real estate loans and unused commitments to total assets.	Source: FR Y-9C
Credit Card	Ratio of bank credit card and consumer loans and unused commitments to total assets.	Source: FR Y-9C
Other Loans	Ratio of bank other loans and unused commitments to total assets.	Source: FR Y-9C

MBS	Ratio of total mortgage-backed securities to total assets.	Source: FR Y-9C
C&I NCO	Ratio of net charge-offs of commercial and industrial loans to the type of loans.	Source: FR Y-9C
Real Estate NCO (Residential)	Ratio of net charge-offs of residential real estate loans to the type of loans.	Source: FR Y-9C
Real Estate NCO (Commercial)	Ratio of net charge-offs of commercial real estate loans to the type of loans	Source: FR Y-9C
Credit Card NCO	Ratio of net charge-offs of credit card and consumer loans to the type of loans.	Source: FR Y-9C
Others NCO	Ratio of net charge-offs of other loans to the type of loans.	Source: FR Y-9C
Total NCO	Ratio of the net charge-offs of the five types of loan to the total loans.	Source: FR Y-9C
	Borrowing and Lending of Parent BHC	
Total amount of borrowings to non-bank subsidiaries	It is the total amount of borrowings guaranteed by the parent to non-bank subsidiaries divided by total consolidated assets.	Source: FR Y-9C
Extension of credit to nonbank subsidiaries and associated nonbank companies	It is the sum of loans, advances, notes, bonds, and debentures in non-bank subsidiaries and associated non-bank companies divided by to total consolidated assets	Source: FR Y-9C
Subsidiary nonbanks and associated nonbanks loans and advances to the parent	It is the total amount of loans and advances to the reporting bank holding company made by subsidiary nonbanks and associated nonbanks divided by total consolidated assets	Source: FR Y-9C
	Facility characters	
Leader_Share	The ratio of leader amount to total amount of the package.	Source: FR Y-9C
General Covenant	The logarithm value of one plus the number of general covenant included in the debt agreement.	Source: Deal Scan
Financial Covenant	The logarithm value of one plus the number of financial covenant included in the debt agreement.	Source: Deal Scan
Capital Covenant	The logarithm value of one plus the number of capital covenant included in the debt agreement.	Source: Deal Scan
Performance Covenant	The logarithm value of one plus the number of performance covenant included in the debt agreement.	Source: Deal Scan
Covenant Intensity	It is an index value ranging from 0 to 6, which is based on six different covenants as described in Bradley and Roberts (2015). We take the logarithm value of the index.	Source: Deal Scan
Facility Amount	The logarithm value of facility amount.	Source: Deal Scan
Facility Maturity	The logarithm value of facility maturity.	Source: Deal Scan
All in Spread	All-in-spread-drawn is the sum of the annual spread paid over LIBOR for each dollar drawn down from the loan and annual fee.	Source: Deal Scan
Total borrowing cost	The total cost of borrowing accounts for fees, spreads, and the likelihood that they will have to be paid. The construction of the variable follows Berg, Saunders and Steffen (2016).	Source: Deal Scan
	Borrower Firm Characters	
ROA	The return on assets ratio measured by earnings before interest and tax scaled by total assets.	Compustat

Tobin's q	Tobin's q measured by the market value of equity plus the book value of short- and long-term debt scaled by total assets.	Compustat
Total Assets	Logarithm value of borrower's total assets.	Compustat
Capex	Capital expenditure to total assets.	Compustat
Tangibility	Firm tangibility measured by net property, plant and equipment scaled by total assets.	Compustat
Sales	Logarithm value of firm sales.	Compustat
	Alternative Complex measure	
Organizational complexity	The total count of business types of BHC affiliates.	FFIEC NIC database
Business Complexity	The ratio of non-financial affiliates to total number of affiliates.	FFIEC NIC database
Geographical Complexity	The ratio of foreign located affiliates to total number of affiliates.	FFIEC NIC database
Number of Subsidiaries	The total number of affiliates.	FFIEC NIC database

Table A.3: Correlation Matrix

This table report the Pearson Correlations for variables used in the baseline model. Appendix A.3 includes definitions of all variables. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	NPLs	1.000													
2	LLRs	0.505***	1.000												
3	Risk Management Index	0.222***	0.254***	1.000											
4	Complex BHC	0.120***	0.093***	0.140***	1.000										
5	Total Assets	0.358***	0.198***	0.460***	0.390***	1.000									
6	Loan to Assets	0.026	0.172***	0.014	-0.053**	-0.277***	1.000								
7	Equity to Assets	0.205***	0.173***	0.193***	-0.012	0.104***	0.249***	1.000							
8	Deposits to Assets	-0.162***	0.113***	-0.020	-0.242***	-0.394***	0.331***	0.060***	1.000						
9	Net Income to Assets	-0.020	-0.085***	0.104***	0.230***	0.145***	-0.303***	-0.113***	-0.326***	1.000					
10	Liquid Asset to Assets	-0.089***	-0.155***	-0.162***	-0.042**	0.120***	-0.913***	-0.312***	-0.297***	0.170***	1.000				
11	Non-interest Income to Assets	-0.046**	-0.103***	0.094***	0.215***	0.114***	-0.286***	-0.099***	-0.302***	0.992***	0.162***	1.000			
12	GDP growth	-0.188***	-0.113***	-0.053**	-0.010	-0.061***	0.001	-0.100***	-0.093***	0.060***	0.024	0.066***	1.000		
13	Credit to GDP gap	-0.409***	-0.195***	-0.281***	-0.028	-0.288***	0.042**	-0.409***	-0.281***	0.209***	0.028	0.221***	0.340***	1.000	
14	VIX	0.123***	0.216***	-0.021	-0.015	-0.135***	-0.010	-0.156***	-0.077***	0.079***	0.025	0.077***	-0.410***	0.153***	1.000