1.Introduction and Related Literature

Given their unique characteristics and importance to the health of the financial system and real economy, banks have traditionally been subject to intense regulation and supervision. The global financial crisis and subsequent bailouts of large too-big-to-fail banks highlighted the dangers for the financial system (and real economy) arising from the increased size and complexity of large banks.[1] Subsequent regulatory reforms, including the US Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act hereafter) focused on enhancing the regulation and supervision of large banks (above a defined asset size threshold) in order to ensure the future stability of the financial system. Such changes ushered in a period of so-called tiered bank regulation and appear to have reduced the risks posed by large banks. However, they have also increased the regulatory compliance costs facing banks, as well as increasing the oversight costs of government agencies tasked with supervising the financial system.[2] This led many stakeholders (particularly lobbyists and executives at large banks) to call for a loosening and removal of many of the post-global financial crisis regulatory reforms. In response to such calls, in 2018, US congress passed the Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA). The EGRRCPA removed many of the regulations imposed under the terms of the Dodd-Frank Act, which resulted in a decline in regulatory requirements and oversight of some large banks. [3] In this paper, we investigate how this decline in regulatory oversight impacted the risk of the large banks.

The effectiveness of bank regulation in curbing risk is open to some debate. One strand of literature views external bank regulation as necessary to containing agency problems, promoting better corporate governance and curbing excessive risk-taking at banks by aligning the interests of managers, shareholders, depositors, creditors and other stakeholders (Alexander, 2006; Hagendorff et al., 2010; Adams and Ferreira, 2012). The public interest view of

[1] Large banks with a wide scope of business activities require significant supervision (Anginer et al., 2019), especially given that such entities can engage in a wider array of activities (including securitization, off-balance sheet transactions and issuance of subordinated debt) to manage, shift or conceal risk.

[2] Hogan and Burns (2019) find that the Dodd-Frank Act increased non-interest expenses, while Cetorelli and Traina (2021) note an increase in bank funding costs.

[3] The Dodd-Frank Act is regarded as the most detailed regulatory overhaul of the financial system in recent history (Krainer, 2012; Acharya and Richardson, 2012; McLaughlin et al., 2021). Title I of the Dodd-Frank Act devised a new inter-agency entity (Financial Stability Oversight Council-FSOC) to design enhanced supervision and prudential standards for bank holding companies (BHCs) with large, interconnected, highly levered and complex operations in order to promote financial stability. In this context, BHCs with asset size larger than $50 billion were defined as systemically important financial institutions (SIFIs), which were subject to stricter risk-based and contingent capital requirements, both in-company run, and Federal Reserve administered stress tests, advanced reporting requirements (living wills, credit exposure reports and other disclosures), orderly liquidation procedures, risk management requirements, concentration and short-term debt limits.

regulation asserts that official regulators and supervisors have resources and incentives to mitigate market failures, prevent lending corruption and improve welfare by promoting the efficient allocation of funds and disciplining excessive risk-taking behavior (Barth et al., 2008). Prior cross-country and US-based evidence suggests that strict regulation and supervisory oversight lead to a decline in idiosyncratic and systemic risk, and subsequent improvements in financial stability (Laeven and Levine, 2009; Hoque et al., 2015; Kandrac and Schlusche, 2021). An alternative view suggests that the relationship between bank regulation and risk is less certain (Barth et al., 2004; Demirgüç-Kunt and Detragiache, 2011). Bank regulation may encourage managerial risk-taking and exacerbate moral hazard (Koehn and Santomero, 1980; González, 2005).[4] Moreover, regulatory capture and lobbying could impede the effectiveness of bank regulation (Shleifer and Vishny 1998; Agoraki et al., 2011; Laeven, 2013; Lambert, 2019). Financial deepening and innovation coupled with increasing opportunities for activity diversification (and the fragmented institutional structure for regulation) creates further threats to financial stability by allowing banks to exploit regulatory arbitrage (Kroszner and Strahan, 2011; Omarova, 2011).[5]

We assess the validity of these aforementioned competing views by utilizing the EGRRCPA as a quasi-experimental design to investigate the impact of a reduction in regulatory oversight on large bank risk. As a setting, we use a specific provision of the EGRRCPA, which raised the asset size threshold for enhanced supervision of large banks from $50 billion to $250 billion. This provision led to a reduction in regulatory oversight for a small group of large banks via relief from in-house stress testing, chief risk officer requirements, resolution plans, capital planning, credit exposure reports, certain liquidity requirements and counterparty credit limits.[6] Advocates of the changes contend that the EGRRCPA provides much needed regulatory relief to banks. By reducing compliance costs, the EGRRCPA frees up valuable resources that can be used by banks to better serve customers.[7] Opponents argue that the removal of many of

[4] Nichols et al. (2011) suggest that unless the underlying driver of financial disturbances are adequately identified, regulation is doomed to fail, and likely to contribute to the next financial crisis.

[5] As an example of regulatory arbitrage, Boyson et al. (2016) show that constrained banks tend to satisfy capital requirements by issuing trust-preferred securities in order to operate with desired level of risk. These securities are issued by subsidiaries of BHCs and essentially would not be qualified as Tier-1 regulatory capital if they were issued by BHCs themselves. Besides this, trust-preferred securities are hybrid instruments combining debt and equity characteristics which allows banks to increase leverage without being bounded by capital requirements.

[6] Title IV of the EGRRCPA exempts banks with asset size ranging between $50 billion to $100 billion unconditionally. For banks remaining within the range of $100-$250 billion, the EGRRCPA provides the Federal Reserve with discretion to apply enhanced rules on a case-by-case basis.

[7] The necessity to revise previously defined asset size thresholds (for enhanced regulatory requirements for large financial institutions) had already been acknowledged by policymakers. For example, former member of Federal Reserve Board of Governors Daniel Tarullo stated that the $50 billion asset threshold established for enhanced regulation was too low (https://www.bis.org/review/r170407c.htm).

regulations introduced via the Dodd-Frank Act in the aftermath of the global financial crisis will lead to an increase in bank risk-taking.[8] Against this background, the present study investigates the impact of a reduction in regulatory oversight facing certain large banks (via the EGRRCPA) on large bank risk.

The setting used for the current study allows us to identify large BHCs affected by the enactment of the EGRRCPA versus counterparts that were unaffected by the new legislation.[9] This provides a robust research design as a basis to test our overarching research hypothesis that large banks are likely to increase risk following a decline in the regulatory oversight. Our dataset (which straddles the introduction of the EGRRCPA in 2018Q2), comprises quarterly financial accounting information on BHCs over the period from 2015Q1-2020Q1. In order to assess the impact of a reduction in regulatory oversight on ex-ante bank risk, measured by the change in risk-weighted assets, we use a difference-in-differences (DiD) approach to compare the difference in the risk of affected large banks (BHCs with asset size of $50 to $250 billion) before and after the EGRRCPA with the same difference in risk of unaffected counterparts (BHCs with asset size between $10 and $50 billion).

By way of preview, the results of our empirical analysis suggest that following the enactment of the EGRRCPA, affected banks that experience a decline in regulatory oversight increased risk relative to unaffected counterparts. As such, these findings support our hypothesis that a reduction in regulatory oversight leads banks to assume additional risk via an increase in risk-weighted assets. We assess the internal validity of our findings via placebo and temporal dynamics tests of treatment effects. The results of these tests support the causal interpretation of our main findings. Our baseline findings also remain intact when we consider alternative bank risk indicators. In addition to an increase in standalone risk, the exogenous change in regulatory oversight also leads to increasing systemic risk. Our findings are maintained following a myriad of robustness tests including: alternative model specifications; data handling; different sub-samples; varied event intervals; propensity score matching; and entropy balancing. Increased risk is observed for both on- and off-balance sheet activities, and

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[8] On behalf of the Systemic Risk Council, in his letter to US Senate, former BoE deputy governor Paul Tucker emphasized the financial stability concerns of revising regulatory threshold for large banks. (https://www.systemicriskcouncil.org/2018/10/systemic-risk-council-comments-on-jobs-act-3-0-bill/)

[9] Drawing inferences from a single country setting also abates concerns regarding cross-country confounders that could impact the relationship between regulation and risk. These include differences in legal enforcement, income, bank competition, cross-border banking activities, macroeconomic fundamentals, institutional quality, degree of economic development and monetary policy (Buch and DeLong, 2008; Behr et al., 2010; Delis and Staikouras, 2011; Delis et al., 2012; Anginer et al., 2016).

is driven via an adjustment in bank asset portfolios toward riskier assets. Finally, we observe that less regulatory oversight is translated into increased bank profitability, increased market valuation and reduced compliance costs at affected banks.

The contribution of our study to prior literature is manifold. First, we provide insights regarding the impact of tiered regulation and supervision on large bank risk. Existing evidence suggests that the tiered provisions of the Dodd-Frank Act led to: increased merger and acquisitions (Bindal et al., 2020); reduced small business lending (Bordo and Duca, 2018); increased shareholder wealth (Leledakis and Pyrgiotakis, 2019); and improved bank disclosure and financial reporting quality (Kleymenova and Zhang, 2019; Chronopoulos et al., 2022). A recent group of studies investigates the direct impact of the Dodd-Frank Act on bank risk. Balasubramnian and Cyree (2014) suggest that market discipline improves following the passing of the Dodd-Frank Act, evidenced by reduced yield spreads of subordinated debt transactions. Gao et al. (2018) emphasize the market perception monitored by negative abnormal stock returns and positive abnormal bond returns for large financial institutions such that provisions of Dodd-Frank Act are expected to be effective in reducing bank risk. Calluzzo and Dong (2015) show that US financial institutions became less risky in the post-crisis period in large part to legislative changes. Akhigbe et al. (2016) find that the largest banks reduced discretionary risk-taking, while Clark et al. (2020) conclude that complex BHCs have a larger distance to default following the enactment of the Dodd-Frank Act. Jiang (2020) documents that the establishment of risk committees (after Dodd-Frank Act) reduced the tail, residual and asset risk of banks.[10] We extend this evidence base by considering the impact of adjusting asset size thresholds in the tiered provisions of the Dodd-Frank Act (via the provisions of the EGRRCPA leading to the lessening of regulatory oversight of a group of large banks) on bank risk. We find that a reduction in regulatory oversight following changes to bank regulation contributes to an increase in bank risk. As such our results have relevance for government agencies tasked with supervising large banks and safeguarding the stability of the financial system.

Second, we contribute to the literature analyzing the consequences of US banking industry deregulation. Prior literature investigates the impact of state-level and federal deregulation (such as the 1994 Riegle-Neal Interstate Banking and Branching Efficiency Act, IBBEA and the 1999 Gramm-Leach-Bliley Act, GLBA) on banks and the real economy. Prior

[10] In a related study, Luu and Vo (2021) find that large US banks reduced risk following the introduction of external stress tests.

evidence suggests that the enhanced bank competition following the IBBEA: improved bank efficiency (Jayaratne and Strahan, 1997); generated abnormal stock returns for banks (Brooks et al., 1998); altered credit allocation (Keil and Müller, 2020); increased voluntary disclosure (Burks et al., 2018); boosted bank profitability (Zou et al., 2011); and exacerbated bank risk (Jiang et al., 2017). Berger, Molyneux and Wilson (2020) provide a discussion of the impact of the IBBEA on households, SMEs and corporates. Moreover, the increased product freedoms and diversification opportunities brought about following the enactment of the GLBA led to: increased bank risk (Akhigbe and Whyte, 2004; Zhao and He, 2014); improved efficiency (Stiroh and Strahan, 2003); and enhanced profitability (Chronopoulos et al, 2015). As the first study using the EGRRCPA as a significant deregulatory event, we demonstrate the impact of reduced regulatory oversight and attention on financial stability.

Third, we advance the literature on how external bank regulation influences bank efficiency through compliance expenses. Bank profitability and efficiency might come under pressure as a reaction to changes in the institutional environment (Demirguç-Kunt et al., 2003; Chortareas et al., 2012; Teixeira et al., 2020). In addition to considerable direct costs, banks are likely to face compliance expenses to satisfy the supervisory requirements progressively (Franks et al., 1997; Elliehausen, 1998; Cull et al., 2011; Barth et al., 2013). Banks are required to: create internal and external reporting mechanisms; gather and process necessary data; train and develop human capital; maintain and improve the technological infrastructure; revise organizational structure; and curtail customer outreach in order to comply regulatory requirements. Due to the breadth and complexity of its provisions, the Dodd-Frank Act has generated large compliance costs for US banks (Cyree, 2016; Hogan and Burns, 2019). In this study, we complement this literature to present evidence which suggests that the removal of certain provisions of the Dodd-Frank Act reduces the compliance expense burden at US banks.

The rest of the paper is structured as follows. Section 2 provides: a background to the EGRRCPA (Section 2.1); information regarding data (Section 2.2); and the methodology adopted (Section 2.3). Section 3 presents the empirical findings. Section 4 provides a summary and concluding remarks.

2. Research Setting, Data and Methods

2.1.Research Setting

The Dodd-Frank Act was passed by US Congress in response to the financial and economic instability caused by the global financial crisis of 2007-2009. This legislation is credited with providing a basis for a subsequent raft of regulatory and supervisory reforms, which have reduced systemic risk and enhanced the safety and soundness of the US banking industry. However, critics argue that the Dodd-Frank Act imposes a significant additional regulatory burden and associated costs on banks seeking to comply with the raft of new regulations. Such concerns combined with extensive lobbying activities by banks led to the introduction of the EGRRCPA, which softens many of the enhanced regulatory provisions introduced under the Dodd-Frank Act. Sponsored by Senator Mike Crapo, the EGRRCPA (initially known as the Crapo Bill) enjoyed bipartisan political support, passing the Senate in March 2018, and receiving presidential ascent in May of the same year.

Of particular relevance to the present study, Title IV, Section 401 of the EGRRCPA revised the applicability of enhanced prudential regulatory standards for large BHCs (previously determined by Dodd-Frank Act) by increasing the asset size threshold for enhanced oversight from $50 to $250 billion.[11] This change had the immediate effect of exempting BHCs with an asset size between $50 billion and $100 billion from enhanced supervisory requirements including in-company stress tests, capital planning, living wills, reporting and liquidity requirements among others. In the case of BHCs with an asset size between $100 billion and $250 billion, similar regulatory relief is provided, with discretion allocated to the Federal Reserve for re-implementation of enhanced regulatory oversight if deemed necessary.

For the purposes of our empirical design, we combine the aforementioned two sub-classes of BHCs (with asset size ranging from $50 billion to $250 billion) together in order to form a group of treated banks. Our rationale is as follows. First, the EGRRCPA removed the "systemically important" classification for both groups banks—a key component of prudential bank regulation following the global financial crisis. Second, the enactment of the EGRRCPA lifted the compulsory feature of enhanced regulatory oversight for banks in the asset range $50 billion to $250 billion, thus establishing exogenous variation. Third, in our empirical specification, we investigate the ex-ante risk exposure of banks in order to capture current perceptions of expected future bank risk (rather than realized risk). Thus, we aim to alleviate

[11] The content of the EGRRCPA was not limited to supervision of large BHCs, but also brought revisions to financial intermediation activities across the size distribution of banks. Title I aims to improve access to mortgage credits by providing regulatory relief to commercial banks and credit unions concerning lending standards. Title II has the goal of enhancing consumer access to credit via rule changes regarding capital and reporting requirements of community banks alongside different revisions for regulatory aspects of smaller BHCs, federal savings associations and public housing agencies. Title III deals with promoting protections for veterans, consumers and homeowners in terms of reporting processes and information sharing. Title V is designed to implement measures for existing SEC regulations to encourage capital formation, whereas Title VI enhances consumer protection arrangement for student borrowers.

concerns regarding applicability of legislative change on some banks, which is driven by the discretion for re-implementation (of enhanced prudential provisions) delegated to Federal Reserve. Finally, by using banks in the asset range from $50 billion to $250 billion, we have sufficient treated units to draw sensible inferences regarding the impact of changes in regulatory oversight on bank risk.

2.2.Data

Our data collection process commences by identifying organizations covered by the large BHC list published by the National Information Center (NIC).[12] In order to mitigate possible issues related to selection into treatment, we download this aforementioned list one quarter (2018Q1) prior to the signing of the EGRRCPA into law. The treated BHC group is formed from entities with consolidated total assets ranging between $50 billion and $250 billion. BHCs with total assets in the interval $10 billion to $50 billion constitute the control group. We exclude BHCs with assets exceeding the $250 billion threshold, given that the enactment of the EGRRCPA did not alter the regulatory arrangements for these banks.[13] Smaller BHCs below the $10 billion threshold are also discarded given that their organizational structure, managerial motives and business practices are distinct from larger counterparts.

We merge the sample bank list with financial statement data of BHCs presented under FRY-9C forms through unique identifiers (RSSD ID). Balance sheet and income statement information of BHCs are retrieved from the Federal Reserve Bank of Chicago.[14] The sample period is confined to the interval 2015Q1-2020Q1 in order to exclude any possible impact of prior regulations including the Dodd-Frank Act, and more recent distortions caused by the Covid-19 pandemic (Berger and Demirgüç-Kunt, 2021).[15] The post-treatment period covers the interval from 2018Q2 onwards following the official signing of the EGRRCPA into law. After obtaining the financial statement data of sample BHCs, we delete any entities with missing observations for key items including total assets, equity, loans, net income and risk-weighted assets. We also eliminate BHCs that do not satisfy the requirement of a balanced data structure

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[12] This data is accessed at: https://www.ffiec.gov/npw/Institution/TopHoldings

[13] Besides, we aim to drop any global systemically important banks (G-SIBs) which remained to be subject to advanced oversight after the enactment of the law.

[14] This data is accessed at: https://www.chicagofed.org/banking/financial-institution-reports/bhc-data

[15] Large BHCs with more than $50 billion in total consolidated assets were required to comply with the final rules based on Dodd-Frank Act mandates by January 2015 (Fritsch and Siedlarek, 2022).

to account for M&A activities. Our final sample comprises 91 BHCs with 1911 bank-quarter observations. The treated group comprises 20 BHCs with 420 bank-quarter observations.

2.3.Methodology

In order to investigate the impact of a change in regulatory oversight on bank risk, we follow prior literature, which evaluates the impact of tiered bank regulation on various bank-level outcome variables (Bouwman et al., 2018; Leledakis and Pyrgiotakis. 2019; Bindal et al., 2020) using a DiD framework as follows:[16]

$$\Delta RWA_{it} = \beta(Post_t \, x \, Treated_i) + \gamma X_{it} + f_i + \delta_t + \varepsilon_{it} \quad (1)$$

The dependent variable (ΔRWA) is the change in bank risk measured as the quarterly logarithmic change in risk-weighted assets of bank i from time $t-1$ to t. We prefer this accounting-based standardized risk indicator in our baseline case given that risk-weighted assets capture the overall risk faced by banks via exposure to a variety of liquidity, market, credit and maturity risks. Indeed, other accounting-based measures may not fully capture the multidimensional nature of bank activities, particularly for larger banks (Klomp and De Haan, 2012). Risk-weighted assets are also relevant to prudential regulation, given that the indicator continues to serve as an input to capital adequacy calculations and stress-testing worldwide (Lesle and Avramova, 2012; Berger et al., 2014; Anginer et al., 2019). Consequently, with this choice, we aim to utilize ex-ante variation in risk considering the relatively shorter post-treatment phase of our empirical design (Casu et al., 2011; Luu and Vo, 2021).[17]

$Post$ takes a value of one after 2018Q1 following the enactment of the EGRRCPA, and zero otherwise. $Treated$ defines the treatment group by assigning a value of one to BHCs with assets exceeding $50 billion prior to the enactment of the EGRRCPA, and zero otherwise. The main coefficient of interest (β) is assigned to the $Post \, x \, Treated$ interaction term. This coefficient captures the change in risk of treated BHCs (relative to control BHCs) from pre- to post-treatment period. The baseline specification is saturated with bank (f_i) and time (quarter-

[16] We opt for a DiD research design in preference to a sharp regression discontinuity approach given the low number of observations surrounding the size threshold defined by the EGGRRCPA.

[17] A potential criticism of the risk-weighted assets measure is the comparability problem, which arises due to distinctive business and risk management practices across banks (Ferri and Pesic, 2017; Santos et al., 2020). We expect that the aforementioned issue has negligible implications for our analysis, given that our sample comprises large BHCs from the same geographic jurisdiction. However, within the scope of our robustness testing, we also analyze alternative proxies for bank risk with narrower definitions and ex-post features. These comprise insolvency risk ($Z - Score$) and asset quality ($NPA \, Ratio$).

by-year) (δ_t) fixed effects in order to absorb bank-level persistent characteristics and time-varying aggregate economic and political forces, respectively. ε_{it} is the error term. Given that treatment status is determined based upon bank asset size, standard errors are clustered at the BHC level.

Equation (1) incorporates other control variables (X_{it}) used typically in prior empirical investigations of bank risk. $Deposit\ Funding$ denotes the ratio of interest-bearing deposits to total assets (Ellul and Yerramilli, 2013; DeYoung and Torna, 2013; Ly et al., 2018). A priori, the relationship between a reliance on deposit funding and bank risk is unclear. On the one hand, deposit financing is likely to limit bank risk by providing a stable source of funding. Banks with a higher deposit base tend to avoid risky activities in order to preserve charter values (González, 2005).[18] On the other hand, banks with a heavy dependence on (retail) deposits may assume more risk in the presence of safety-net guarantees such as deposit-insurance (Lambert et al., 2017).[19]

$Provisions$ are defined as the ratio of loan loss provisions to total loans (Jokipii and Milne, 2011; Goetz et al., 2016). Provisions allow banks to engage in earnings management. However, excessive provisioning is likely to amplify bank complexity and opacity, which in turn are important predictors of bank risk (Beatty and Liao, 2014; Cohen et al., 2014). Increased complexity along with a lower level of transparency may reduce the effectiveness of bank supervision and market monitoring designed to contain information asymmetry (Adams and Mehran, 2012; Laeven, 2013).

$Operating\ Efficiency$ is the ratio of non-interest expenses to total income. Higher values are interpreted as lower efficiency. Prominent operational risks, excessive overhead costs and organizational inefficiency at banks are expected to increase risk (Chortareas et al., 2012). $Liquidity$ is measured as the ratio of cash and equivalent balances to total assets. This variable represents the extent to which highly liquid assets are available to meet immediate liquidity demands and avoid bank runs in the face of maturity mismatches and unexpected withdrawals (Curry et al., 2008; Jokipii and Milne, 2011).

[18] Deposit market competition may also encourage banks with lower charter values to increase risk, yielding a negative correlation between bank deposits and risk (Agoraki et al., 2011).
[19] Additionally, while depositors perform monitoring by demanding higher savings rates, the existence of a deposit insurance scheme decreases monitoring incentives by exacerbating moral hazard (Demirgüç-Kunt and Huizinga, 2004; Anginer et al., 2014; Calomiris and Jaremski, 2016; Anginer and Demirgüç-Kunt, 2019).

$Dividends$ are defined as the ratio of dividends declared on common stock to total assets. On the one hand, payout policy could be positively related to risk if dividends are used to transfer wealth from other stakeholders to owners via risk-shifting (Srivastav et al., 2014; Acharya et al., 2017a).[20] On the other hand, payout policy might be negatively correlated with risk if dividends are used as a signaling devise to convey a reduction in risk to outside stakeholders (Michaely et al., 2021). Banks with riskier loan portfolios and lower capital may also choose to retain earnings rather than pay dividends in order to sustain a certain level of capital, reinforcing the negative association between payouts and risk (Forti and Schiozer, 2015; Tripathy et al., 2021).

$Derivatives$ is defined as the ratio of off-balance sheet derivative items held for trading to total assets. Although the use of derivatives for hedging purposes could mitigate bank risk by lowering cash flow volatility, the speculative positions taken in derivative contracts could propagate overall bank risk, given that these instruments are used to build leverage and accumulate systemic risk (Li and Marinč, 2014).

Details of variable definitions and summary statistics are provided in Table 1 (and Table A1 of the Appendix). All continuous variables are winsorized at 1st and 99th percentiles to remove the possible impact of outliers. The correlation matrix of control variables is presented in the Appendix (Table A2) confirming no severe multicollinearity problem.[21]

[**Insert Table 1 Here**]

3.Empirical Results

3.1.Baseline Findings

Main Results

In this section, we present baseline empirical results derived from estimating Equation (1). Two-way fixed effects (TWFE) estimations utilizing time-varying controls may induce bias to DiD estimates. Therefore, in column (1) of Table 2, we use a parsimonious version of Equation (1) excluding other controls. $Post\ x\ Treated$ is positive and significant, suggesting that the risk exposure of treated banks increases relative to control group counterparts in the

[20] Payouts can also increase bank risk by depleting the higher-quality assets and leaving riskier ones on the balance sheet (Kanas, 2013; Onali, 2014).

[21] In an unreported analysis, we produce variance inflation factor (VIF) values, which stay lower than the commonly referred threshold of 5. This analysis further supports the non-existence of multicollinearity in the set of covariates.

post-EGRRCPA period. In column (2), this relationship remains the same when other control variables are added. The effect is also economically significant given that the point estimate for β in column (2) implies that, upon the passage of the EGRRCPA, affected banks experience an annual growth rate in risk-weighted assets, which is 8% (=1.96% x 4) higher than unaffected counterparts. Overall, our baseline findings support the hypothesis that a reduction in regulatory oversight leads banks to assume additional risk. Therefore, we highlight the implications for financial stability of altering tiered regulatory provisions (initially designed to better monitor and scrutinize operations of large banks).

In terms of other covariates, the coefficient estimates are in line with prior expectations based upon insights provided by prior literature. Statistical significance is evident for $Operating\ Efficiency$, $Liquidity$ and $Dividends$. Operational inefficiencies increase bank risk (Chortareas et al., 2012), while liquidity buffers (Jokipii and Milne, 2011; Hogan and Meredith, 2016), and dividend payouts reduce risk (Tripathy et al., 2021).

[**Insert Table 2 Here**]

Alternative Bank Risk Proxies

We extend our empirical investigation by considering a variety of alternative indicators measuring different definitions of bank risk (Table 3). In column (1), we replace our preferred ex-ante risk-weighted assets measure with an ex-post bank $Z - Score$ measure, which captures the leverage and portfolio risk jointly (Lepetit and Strobel, 2013). This measure defines the required decline in profitability necessary for a bank to deplete its equity and become insolvent. Under the assumption that bank profits are shaped by a normal distribution, the $Z - Score$ has a probabilistic interpretation reversely and monotonically analogous to the likelihood of insolvency (Lepetit and Strobel, 2015). Higher values of the indicator convey a greater distance to default. We apply a logarithmic transformation in order to avoid highly skewed distributions (Delis and Staikouras, 2011; Delis et al., 2012).[22] When the $Z - Score$ is taken as the dependent variable in DiD estimations, we find that following the enactment of the EGRRCPA, treated BHCs face higher default risk relative to control group counterparts.

In columns (2) and (3), we adopt narrower definitions of bank risk to concentrate on ex-post asset quality. A deterioration in asset quality is likely to have an adverse impact on the profitability, liquidity and pricing of banks (Fernández et al., 2016). The risk of bank borrowers

[22] We also follow the approach of Laeven and Levine (2009) and Lepetit and Strobel (2013) to retrieve the bank-level fixed (time-invariant) standard deviation of return on assets (ROA) by employing all sample observations.

also serves as an integral input to the regulatory oversight process including stress-testing (Acharya et al., 2018). Therefore, we expand our analysis to cover alternative indicators such as the ratio of non-performing assets to total assets. The data source for BHC financial statements (FRY-9C forms) is granular enough to construct various credit risk measures. $NPA\ Ratio$ 1 denotes the portion of total contractual assets (loans, lease financing receivables, debt securities and other assets) past due 30-89 days, while $NPA\ Ratio$ 2 denotes the portion past due 90 days (or more) and non-accruing items. Given the observed positive coefficients, treated banks appear to face elevated credit risk, albeit the statistical significance is marginally retained for the initial ratio definition only

In column (4), we use another dependent variable $\Delta(Tier - 1\ Capital/RWA)$ (Hoque et al., 2015; Abdelbadie and Salama, 2019). In recognition of the post-global financial crisis regulatory emphasis on narrow equity standards and quality of capital in containing bank risk, we employ a Tier-1 core capital measure (Anginer et al., 2021). We validate the existence of higher risk-taking among treated banks compared to control banks following the passage of the EGRRCPA, manifested in negative and significant coefficient predicting the change in capital adequacy.

To complement our bank risk analysis using financial statement data, we use a market-based bank risk measure. We first identify publicly quoted BHCs within our sample by matching our data with the Federal Reserve Bank of New York link table via RSSD ID identifiers.[23] Our sample is dominated by publicly traded large BHCs (78 out of 91 sample BHCs). We retrieve daily stock price and the number of shares outstanding data from CRSP for the revised bank list throughout the sample interval. In line with prior literature bank risk ($Market\ Risk$) is measured as the standard deviation of daily stock return for a given bank in each quarter (Konishi and Yashuda, 2004; Jiang, 2020). The results presented in column (5) suggest that treated banks experience increased market risk following the enactment of the EGRRCPA.

Our discussion thus far investigates how deregulation impacts individual bank risk. However, this ignores the possibility that an increase in individual bank risk can be propagated across the entire industry given the size, interconnectedness and common exposures of large banks (Bisias et al., 2012; Meuleman and Vander Vennet, 2020). Relative to smaller

[23] This table is accessed at the following link:
https://www.newyorkfed.org/research/banking_research/datasets.html

counterparts, larger banks are more prone to create systemic risk given their too-big-to-fail status and more volatile funding sources and market-based activities (Laeven et al., 2016). Prior evidence suggests that extensive securitization and derivative use and balance sheet interconnections led to an unprecedented increase in systemic risk in the US banking industry following the onset of the global financial crisis (Straetmans and Chaudhry, 2015; Huang et al., 2020). Subsequent post-crisis reforms including the Dodd-Frank Act amended regulatory and supervisory frameworks (incorporating macroprudential provisions) to monitor and manage systemic risk. Thus, in the current empirical setting, it would seem timely to investigate how the reversal of selected prudential requirements introduced under the Dodd-Frank Act impacts systemic risk.

In order to investigate this issue, we follow established practice and create $Systemic\ Risk$ indicator based on marginal expected shortfall (Acharya et al., 2017b). This measure is conceptualized as the marginal contribution of an individual bank to the expected shortfall of the entire financial system (Brownless and Engle, 2012). In practice, this is calculated as the expected stock return of a specific bank, contingent on the fact that the market return performs worse than a certain threshold in the same period. More formally:

$$Marginal\ Expected\ Shortfall_{it}^{q} = E\left(r_{it} | r_{mt} \leq VaR_{r_{mt}}^{q}\right) \quad (2)$$

In Equation (2), r_{it} denotes the daily stock return of bank i at time t. r_{mt} denotes market return. $VaR_{r_{mt}}^{q}$ represents the threshold specified by the pre-determined q-percent quantile of the empirical distribution of market return.[24]. We choose the value of the parameter q as 10%, so that the expression $r_{mt} \leq VaR_{r_{mt}}^{q}$ corresponds to the trading days during which market return is lower than 10% tail outcomes in each quarter. We reverse the sign of daily returns to retrieve $Systemic\ Risk$ indicator in a way that larger values describe the higher level of systemic risk. The results present in column (6), treated banks also experience increasing systemic risk following the adoption of the EGRRCPA.

[**Insert Table 3 Here**]

[24] We use the S&P 500 index returns as the proxy for market return. The findings are robust to the use of alternative market indices.

3.2.Robustness Checks

We undertake a myriad of robustness checks in order to ensure the validity of our baseline findings with respect to: standard error construction; unique features of US BHCs influencing risk-taking; data processing; endogeneity concerns; and placebo test procedures. For these robustness checks, we estimate variants of the model specification used in column (2) of Table 2. Results are presented in summary format as rows in Table 4 (for the sake of brevity and space considerations).

[**Insert Table 4 Here**]

Standard Errors Clustering and Local Factors

Given equivalent competitive pressures and pool of existing and potential customers, banks located in the same states could follow similar strategies and exhibit similar risk-taking propensities (Craig and Dinger, 2013; Kick and Prieto, 2015). Rather than clustering at the BHC level, we cluster the standard errors at the state of BHC headquarters level (in row (1)) to capture correlations within localities.

Prior evidence suggests that region-specific banking industry conditions, economic activity, competition, cultural factors, policy uncertainty and legal and political forces are influential determinants of bank risk and financial stability (Ghosh, 2015; Kick and Prieto, 2015; Jin et al., 2017; Goetz, 2018; Ashraf and Shen, 2019). Therefore, in order to control such state-level time-varying forces explicitly in the regressions, we add state-by-time fixed effects to the baseline model. The results presented in row (2) show that the significance of the increase in bank risk is robust to the inclusion of higher degree fixed effects.

Bank Ownership and Complexity

Ownership

The relationship between regulatory oversight and bank risk could also be contingent on ownership status. Recent regulatory discussions and reforms emphasize the importance of information disclosure and transparency in ensuring adequate market discipline in the banking industry (Flannery and Bliss, 2019; Godspower-Akpomiemie and Ojah, 2021). In this context, prior literature argues that in the absence of outside monitoring by financial market participants, private banks assume more risk (Kwan, 2004; Barry et al., 2011). Therefore, a potential criticism is that our baseline results are driven by the behavior of privately held banks. To alleviate this concern, after retrieving ownership status, we discard private banks and repeat the estimations. Our results (presented in row (3)) continue to show increased risk at treated banks following the enactment of the EGRRCPA.

Complexity

A particular mechanism transmitting from the reduction in regulatory oversight to risk is bank complexity. The post-global financial crisis period has seen an increase in the complexity of banks and more supervisory resources allocated to ensure bank soundness (Anginer et al., 2019). Growing bank complexity and aggravated informational asymmetries and free-riding problems could also erode incentives for small and uninformed investors (and depositors) to monitor bank risk (De Ceuster and Masschelein, 2003; Mehran et al., 2011). Although complex organizational structure could improve cost-efficiency thanks to operational diversification, prior studies suggest that increased bank complexity may exacerbate default probabilities (Casu et al., 2016). In the US banking industry, BHCs are inherently complex umbrella organizations consisting of a network of subsidiaries that have varied business lines and geographical scope. Thus, the post-global financial crisis reform agenda manifested in the implementation of Dodd-Frank Act has aimed to tackle bank complexity by constraining the range of banking activities (Avraham et al., 2012). This is confirmed by Clark et al. (2020) who show that the regulatory framework introduced by Dodd-Frank Act reduces the market and default risk of complex BHCs.

We pursue a similar strategy and measure BHC complexity by evaluating FRY-9C form indicator RSSD9057. This series is created with supervisory purpose and analyzes the complexity of BHC organization concerning: credit-extending activities (either of the parent BHC or its nonbank subsidiaries); the nature and scale of non-bank activities; high-risk business areas (such as securities broker/dealer activities, insurance underwriting, and merchant banking); the issuance of public debt to unsophisticated investors; management practices (such as the nature of intercompany transactions or centralized risk management policies); and supervisory judgment. When the sample is restricted only to complex BHCs based on this regulatory definition, our results (presented in row (4)) continue to suggest increased risk of treated BHCs in the post- EGRRCPA period.

Indirect Treatment Effects

Investigating the impact of regulation on bank outcome variables (such as risk) based upon pre-determined asset size thresholds with DiD methods may be biased if organizations slightly above or below the regulatory threshold alter their behavior, leading to indirect treatment effects, and reduced reliability of treated and counterfactual BHCs (Holder et al., 2013). Prior studies examining the impact of regulatory thresholds on bank behavior acknowledge this possibility (Bouwman et al., 2018; Bindal et al., 2020). In line prior practice, we adjust our empirical design to exclude observations belonging to 30% band around the asset size regulatory threshold. Specifically, we eliminate treated (and control) banks with asset size in the intervals $50 billion to $65 billion and $35 billion to $50 billion, respectively. Our results, presented in rows (5) and (6) suggest that our baseline findings are not distorted by indirect treatment effects.

Data Handling, Serial Correlation and Shortened Event Window

There are multiple statistical issues that could threaten the validity of our baseline findings. These include simultaneity, winsorization, serial correlation and the choice of sample interval. In the case of potential simultaneity concerns due to the utilization of contemporaneous control variables, we use one-quarter lagged values of control variables in row (7) and show that the sign and significance of the baseline effect do not change. For data handling choice, unlike baseline strategy, we use raw versions of variables without winsorization in row (8) and ensure that the main findings are not altered. In terms of serial correlation problems potentially leading to flawed DiD estimations (due to highly persistent banking outcomes with high-frequency quarterly data) (Bertrand et al., 2004; Goddard et al., 2011), we collapse the sample at the BHC level before and after the legislative change and repeat the estimations with collapsed data. The findings presented in row (9) continue to indicate a positive and significant coefficient. Regarding the potential impact of events occurring before and after the enactment of EGRRCPA, in row (10), we perform the estimations with an event interval shortened to four-quarters over the pre- and post-treatment phase and document that the main results continue to hold.

Comparability Concerns: Propensity Score Matching & Entropy Balancing

The EGRRCPA reduces enhanced regulatory oversight of banks with assets exceeding $50 billion. Thus, the assignment of banks to the treatment group raises concerns regarding comparability with respect to banks assigned to the control group (Pierret and Steri, 2020). Moreover, the number of banks included in the treatment group is disproportionately small relative to the banks in the control group. Therefore, the control group banks may not necessarily be good matches for banks in the treated group. We address endogeneity concerns (due to treatment assignment) and potential covariate imbalance via propensity score matching and entropy balancing.

Propensity Score Matching

We use a propensity score matching approach to create a sub-sample of control banks that more closely resemble (match) our treatment group (Rosenbaum and Rubin, 1983; Lambert, 2019). In order to so, we retain cross-sectional bank observations one period before the enactment of the EGRRCPA (2018Q1) and estimate a probit regression model to predict binary treatment status variable through the set of control variables included in Equation (1). In order to assign a specific control bank to each treated bank, we derive propensity scores to implement one-to-one matching without replacement. The estimation is repeated using the matched sample of banks. The results presented in row (11) validate our baseline results.

Entropy Balancing

As an alternative to propensity score matching, we also employ an entropy balancing procedure as a remedy to latent confounding factors (Hainmueller, 2012). This method has certain advantages over traditional matching techniques employed to alleviate systematic observable differences between treatment and control observations (Zhao and Percival, 2017).[25] Entropy balancing is essentially a re-weighting scheme applied to the pre-processing of units in a binary treatment observational study, with the intent that the moments of covariate distributions are identical across treatment and re-weighted control groups (Hainmueller and Xu, 2013). The technique integrates the balance of control variables directly into the weight function applicable to units in the control group. The assigned weights are chosen by minimizing the entropy distance subject to balance and normalizing constraints imposed on the moments of transformed control units distributional properties. As seen in row (12), the impact of the EGRRCPA on bank risk holds when a balanced sample is utilized for the estimations.

Alternative DiD Estimator

Recent econometrics literature suggests that traditionally utilized TWFE techniques could be biased in DiD designs with staggered exogenous shocks (Callaway and Sant'Anna,

[25] Entropy balancing does not trim individual observations. Consequently, it can retain valuable information about the entire sample. By design, the technique also inherently ensures perfect covariate balance by using the distributional properties. Moreover, this procedure is not influenced by discretionary choices in choosing the auxiliary empirical model to predict the assignment of observations to the treatment group. The entropy balancing framework is flexible, and its superiority over other matching methods has been confirmed via simulation studies (Paris et al., 2018; Amusa et al., 2019; McMullin and Schonberger, 2020).

2021; Goodman-Bacon, 2021). Even considering DiD settings with single shock timing and multiple time periods (similar to our case), the existence of heterogeneous dynamic treatment effects and other controls are likely to cast doubt on the TWFE method due to identification problems (De Chaisemartin and d'Haultfoeuille, 2020; Sun and Abraham, 2021). As a remedy to this issue in calculating treatment effects, we utilize the robust and efficient estimator outlined by the imputation approach of Borusyak et al. (2021). We use this method to overcome the bias potentially induced by heterogeneous treatment effects. The results present in row (13) continue to find an increase in the risk of treated banks using this alternative DiD estimator.

Placebo Tests and Parallel Trends Assumption

The validity of DiD estimation also relies on the parallel trends assumption requiring that the outcome variable of interest for treated and control BHCs should adhere to similar trends in the absence of the policy change (Roberts and Whited, 2013). Although this assumption is not directly testable, we attempt to provide indirect evidence by showing that our design is compatible with parallel trends assumption via placebo tests and dynamic treatment effects.

Initially, we employ multi-step placebo testing procedure. The first test entails the exclusion of the post-treatment period and the introduction of a pseudo shock date. Here, we assume falsely that the EGRRCPA was passed in 2016Q4. The placebo test coefficient estimate presented in row (14) is negligible and insignificant. By means of the second placebo test, we retain the sample period and shock timing, but randomize the assignment of treatment status across BHCs. The results presented in row (15) suggest that the pseudo interaction coefficient obtained from this placebo test is insignificant.

Figure 1 plots an augmented version of Equation (1) involving the interaction of policy variable with relative time indicators. We observe that the coefficient on DiD term is insignificant in pre-treatment periods, while the increased risk of treated BHCs is evident following the enactment of the EGRRCPA. The positive and significant coefficients demonstrate both instantaneous and lead effects in the post-treatment interval. These findings together with placebo tests hint that the parallel trends assumption is supported in our empirical setting.

[**Insert Figure 1 Here**]

3.3. Underlying Mechanisms

3.3.1. The Impact of a Reduction in Regulatory Oversight on Risk Exposure and Portfolio Adjustment

In this section, we extend our analysis to investigate the underlying mechanisms driving the change in bank risk following the enactment of the EGRRCPA. Prior literature suggests that banks tend to increase the scope of operations in order to pursue risky strategies (Boyd et al., 1998). Regulations that restrict the range of activities tend to improve financial stability by containing bank risk (Hovakimian and Kane, 2000; Laeven and Levine, 2009; Agoraki et al., 2011). In this context, the source of risk may not be confined to on-balance sheet activities, given that off-balance sheet activities also externalize risky strategies through leverage reduction (via derivative positions) and excessive liquidity creation (via credit commitments), (Berger and Bouwman, 2017). In fact, post-global financial crisis regulations require comprehensive disclosures of detailed bank transactions to ensure financial stability (Krainer, 2012; Anginer et al., 2019). Prior literature also suggests that regulation can prompt banks to revise portfolio risk by altering exposure to different asset risk categories (Berger and Udell, 1994; Luu and Vo, 2021). Therefore, how the additional risk assumed by treated BHCs following the enactment of the EGRRCPA is distributed across a broader range of bank activities contains important information value regarding the underlying mechanisms driving the link between regulatory oversight and bank risk.

In order to assess whether on- or off-balance sheet items facilitate the increase of bank risk, we use data collected from Schedule HC-R of FRY-9C form. These data filings provide detailed information on the distribution of bank exposures across different asset classes. We create the dependent variables ΔOBS and $\Delta OFBS$ by aggregating the individual on- and off-balance sheet financial statement items (listed on Schedule HC-R) subject to risk-weight categorizations. We re-estimate Equation (1) with these alternative dependent variables. The results presented in columns (1) and (2) of Table 5 measure the source of the growth in risk exposure following the enactment of the EGRRCPA. We find that an increase in bank risk in the post-treatment period is driven by both on- and off-balance sheet activities. By using the Schedule HC-R reporting, we also derive the dependent variables $\Delta 20\%RW$, $\Delta 50\%RW$ and $\Delta 100\%RW$ which monitor the growth of exposure to low, medium and high-risk asset balances (serving as inputs to risk weight calculations), respectively. The results presented in columns

(3) to (5) of Table 5 suggest that high-risk assets held at treated banks increases following the enactment of the EGRRCPA.

[**Insert Table 5 Here**]

3.3.2.The Impact of a Reduction in Regulatory Oversight on Bank Profitability

Regulations designed to curb bank risk could impose a hurdle to bank efficiency and profitability by hampering economies of scale and scope (Barth et al., 2013).[26] Prior evidence suggests that the Dodd-Frank Act led to higher loan rates to borrowers and increased funding costs for banks (Balasubramanian and Cyree, 2014; Bouwman et al., 2018). In this context, we assume that the removal of systemically important status and a reduction in enhanced regulatory oversight for treated banks improves profitability in the post-EGRRCPA period. In order to investigate this possibility, we construct the dependent variable ROE (measured as the ratio of net income to total equity) and re-estimate Equation (1) including additional control variables. The results presented in column (1) of Table 6 suggest that the reduction in regulatory oversight leads to improved bank profitability.

[**Insert Table 6 Here**]

The Dodd-Frank Act is generally acknowledged as the most comprehensive and detailed financial regulation in recent history. Aligning bank practices in order to meet the enhanced requirements brought about by the Dodd-Frank Act is expected to bring about higher monitoring expenditures and compliance costs. Cyree (2016) identifies that the compliance burden for smaller banks increases considerably following the passage of Dodd-Frank Act. Bouwman et al. (2018) document that Dodd-Frank Act resulted in increased regulatory costs for affected banks. Conversely, given that the EGRRCPA exempted treated BHCs from several regulatory requirements (including company-run stress tests, resolution plans and capital planning), we expect that treated banks would experience a decline in compliance costs. Following prior literature, we select specific non-interest expense items to create an alternative $Compliance\ Expenses$ dependent variable (Hogan and Burns, 2019). In order to do so, we aggregate data processing, accounting and auditing, consulting and advisory expenses, and normalize by total non-interest expenses. We re-estimate Equation (1) with additional control

[26] Drawing on a cross-country sample, Demirgüç-Kunt et al. (2003) find that regulatory impediments increase the costs of financial intermediation. Chortareas et al. (2012) study a group of European commercial banks and find that interventionist bank policies exacerbate bank inefficiency. Hirtle et al. (2020) examine the relevance of regulatory scrutiny to profitability for US banks.

variables. The results presented in column (2) of Table 6, suggest that compliance costs are lower in the post-treatment period for BHCs subject to a reduction in regulatory oversight.

3.3.3. The Impact of a Reduction in Regulatory Oversight on Bank Valuation

Given the limited liability structure prevalent in the modern corporations, bank shareholders are reluctant to internalize the externalities of bank operations (Jensen and Meckling, 1976; Laeven and Levine, 2009; Laeven, 2013). Given a limited liability ownership structure, shareholders have convex claims over bank assets and earnings and face a payoff schedule that has an unbounded upside and bounded downside potential. Debtholders have concave claims. Due to the modern corporate structure, shareholders can be classified as risk-seeking, while other stakeholders are likely to be risk-averse. The existence of financial safety nets could also exacerbate moral hazard and induce shareholder risk-seeking behaviour via risk-shifting. The guarantees provided under financial safety nets can be modeled as a put option written on the bank assets embedding a premium whose value is increased through asset volatility and bank leverage (Merton, 1977; Hovakimian et al., 2003). Therefore, bank owners are incentivized to inflate bank risk in order to exploit such guarantees (Bolton et al., 2015). However, the extent to which shareholders harness financial safety nets by increasing bank risk is limited by constraints imposed by external bank regulation (Buser et al., 1981; Mehran et al., 2011). Unless regulated properly, banks given their highly levered capital structure are inherently encouraged (by shareholders) to risk-taking in order to maximize profits and shareholder value.

Prior empirical evidence is compatible with the notion that shareholders channel banks toward riskier activities. Saunders et al. (1990) find that shareholder-controlled US banks are riskier than management-controlled counterparts, particularly during the period of deregulation. Pathan (2009) suggests that stronger shareholder rights reflected in the governance of BHCs coincide with higher bank risk-taking. Laeven and Levine (2009) demonstrate that large bank shareholders with greater cash flow rights exhibit more risk. Beltratti and Stulz (2012) present cross-country evidence (prior to the global financial crisis) which suggests that banks with more shareholder-friendly boards carry more risk. Anginer et al. (2018) find that US banks with shareholder-orientated governance tend to have larger individual and systemic risk.

In this context, we investigate whether shareholders have a favorable reaction to the increased risk and profitability of BHCs following the EGRRCPA. We analyze the evolution of conventional market valuation measures before and after the shift in regulatory oversight.

Focusing on the publicly traded BHCs in our sample, we construct the ratio of market value to book value of equity ($Market - to - Book\ Ratio$), the sum of market value of equity and book value of liabilities normalized by the book value of assets ($Tobin's\ Q$), and price-to-earnings ratio ($P/E\ Ratio$). The findings of estimations predicting these outcome variables are provided in Table 7. We observe that treated BHCs achieve stronger valuation in the post-treatment period, which suggests that bank shareholders have a favorable perception of enhanced risk and increased profitability.

[**Insert Table 7 Here**]

4.Conclusion

The regulation of the US banking industry was subject to a complete overhaul following the taxpayer-funded bailout of banks during global financial crisis of 2007-2009. Under the terms of the Dodd-Frank Act, the regulation of BHCs was tiered by asset size thresholds with very large entities subject to enhanced regulatory oversight (including stress tests, resolution plans and capital planning) in order to limit risks posed to the financial system. Despite a general consensus that these changes have been successful in improving the safety and soundness of the financial system, many commentators, lobbyists, banks and industry stakeholders argue that an undue regulatory burden was being placed on large (as well as small) banks. Consequently, in response to industry pressure and bi-partisan political support, the enhanced prudential regulatory oversight of a certain asset size class of large banks was reduced following the enactment of the EGRRCPA in 2018.

In this paper, we exploit the exogenous variation in the regulatory oversight of large BHCs following the enactment of the EGRRCPA (which removed many of the regulations imposed under the terms of the Dodd-Frank Act, including raising the asset size threshold for enhanced supervision of large banks from $50 billion to $250 billion for a small group of large banks) to analyze the relationship between bank regulation and risk. Using a DiD framework, we find that relative to other large BHCs, banks affected by EGRRCPA requirements respond to a reduction in regulatory oversight by increasing risk. This finding is robust to a myriad of additional checks, alternative bank risk indicators, modeling choices, sample composition, endogeneity concerns and placebo tests. Financial stability concerns are not limited to standalone bank risk. Systemic risk also increases. The results from a further empirical analysis suggest that increased bank risk is driven by adjustments to both on- and off-balance sheet asset portfolios. Moreover, banks subject to less regulatory oversight improve profitability and reduce compliance expenses. The aforementioned developments are perceived positively by market participants, evidenced by increases in market valuations.

Overall, the results of our study have implications for policymakers and practitioners. As the first study focusing on the impacts of the EGRRCPA (the most influential regulatory modification for large banks since the passing of the Dodd-Frank Act) on the banking industry, we show that a reduction in regulatory oversight designed to reduce the regulatory and compliance burdens facing large banks has the unintended consequences of increasing individual and systemic bank risk.

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Table 1: Variable Definitions and Summary Statistics

Panel A: Variable Definitions

Variables	Definitions	FRY-9C Mnemonics
ΔRWA	$\ln((\text{Risk-Weighted Assets})_t/(\text{Risk-Weighted Assets})_{t-1})$	$\ln(BHCKG641_t/BHCKG641_{t-1})$
Deposit Funding	Interest Bearing Deposits/Total Assets	(BHDM6636+BHFN6636)/BHCK2170
Provisions	Loan Loss Provisions/Total Loans	BHCK4230/BHCK2122
Operating Efficiency	Non-Interest Expenses/(Non-Interest Income + Net Interest Income)	BHCK4093/(BHCK4079+BHCK4074)
Liquidity	Cash and Equivalents/Total Assets	(BHCK0081+BHCK0395+BHCK0397)/BHCK2170
Dividends	Dividends/Total Assets	BHCK4460/BHCK2170
Derivatives	Derivatives Held for Trading/Total Assets	(BHCKA126+BHCKA127)/BHCK2170

Panel B: Summary Statistics

Variables	Obs.	Mean	Std. Dev.	Median	P5	P95
ΔRWA	1,820	0.0247	0.0462	0.0158	-0.0207	0.0973
Deposit Funding	1,820	0.5527	0.0988	0.5576	0.3704	0.7344
Provisions	1,820	0.0898	0.1574	0.0443	-0.0155	0.4568
Operating Efficiency	1,820	0.6239	0.1087	0.6205	0.4339	0.8190
Liquidity	1,819	0.0455	0.0402	0.0325	0.0114	0.1159
Dividends	1,820	0.0848	0.0636	0.0849	0.0000	0.1828
Derivatives	1,820	0.1421	0.3129	0.0176	0.0000	0.5400

Notes: This table reports the detailed definitions, FRY-9C form mnemonics and summary statistics for the variables used in the main regressions. The sample covers the observations of 91 BHCs over the period 2015Q1-2020Q1. We winsorize all continuous variables at 1st and 99th percentiles.

Table 2: Impact of a Reduction in Regulatory Oversight on Bank Risk

	(1) ΔRWA	(2) ΔRWA
Post x Treated	0.0166***	0.0195***
	(0.0037)	(0.0044)
Deposit Funding		-0.0097
		(0.0319)
Provisions		0.0115
		(0.0170)
Operating Efficiency		0.2401***
		(0.0505)
Liquidity		-0.1311**
		(0.0649)
Dividends		-0.0546*
		(0.0294)
Derivatives		0.0176
		(0.0133)
Observations	1,820	1,819
Other Controls	No	Yes
Bank FE	Yes	Yes
Time FE	Yes	Yes
Adj. R-Squared	0.077	0.161

Notes: This presents the estimation results of the baseline DiD model specified in Equation (1). The sample covers the observations of 91 BHCs over the period 2015Q1-2020Q1. In both columns, the dependent variable is the quarterly logarithmic growth of risk-weighted assets (ΔRWA). We control for bank and time (quarter-by-year) fixed effects. Column (1) is the parsimonious specification, while column (2) includes other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$. The main independent variable is $Post\ x\ Treated$ interaction term. We winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Table 1. Standard errors clustered at the bank level are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 3: Impact of a Reduction in Regulatory Oversight on Alternative Measures of Bank Risk

	(1) Z-Score	(2) NPA Ratio 1	(3) NPA Ratio 2
Post x Treated	-0.0955**	0.0386*	0.0251
	(0.0459)	(0.0219)	(0.0426)
Observations	1,910	1,910	1,910
Other Controls	Yes	Yes	Yes
Bank FE	No	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.194	0.949	0.939
	(4) Δ(Tier-1 Capital/RWA)	(5) Market Risk	(6) Systemic Risk
Post x Treated	-0.0139**	0.0007*	0.0015**
	(0.0056)	(0.0004)	(0.0007)
Observations	1,819	1,596	1,596
Other Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.110	0.881	0.909

Notes: This table presents the estimation results of the DiD model with alternative bank risk indicators. In columns (1), (2) and (3), the dependent variables are $Z - Score$, $NPA\ Ratio$ 1 and $NPA\ Ratio$ 2, respectively. In column (4), the dependent variable is the change in the capital adequacy ratio calculated following the Basel III guidelines ($\Delta(Tier - 1\ Capital/RWA)$). In columns (5) and (6), the dependent variables are chosen as market-based total risk indicator proxied by stock price return volatility ($Market\ Risk$) and systemic risk indicator ($Systemic\ Risk$) proxied by marginal expected shortfall approach of Acharya et al. (2017b). We control for bank and time fixed effects (except for column (1) incorporating $Treated$ and $Post\ x\ Treated$ terms together with time fixed effects due to the use of bank-level time-invariant σ(Return on Assets) in $Z - Score$ calculations). All columns include other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$. The main independent variable is $Post\ x\ Treated$ interaction term. We winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Tables 1 and A1. Standard errors clustered at the bank level are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 4: Robustness Tests

	(1) ΔRWA	
	Coefficient	Obs.
(1) Standard errors clustered at state level	0.0195***	1,819
(2) State-by-time fixed effects	0.0199***	1,538
(3) Excluding private banks	0.0197***	1,559
(4) Excluding non-complex banks	0.0180***	927
(5) Excluding banks with asset size $50-65 billion	0.0213***	1,774
(6) Excluding banks with asset size $35-50 billion	0.0206***	1,695
(7) Lagged control variables	0.0159***	1,820
(8) Non-winsorized data	0.0224***	1,819
(9) Estimations with collapsed data	0.0176***	182
(10) Estimations with [-4, +4] quarter event window	0.0245***	728
(11) Propensity score matching	0.0196***	799
(12) Entropy balancing	0.0229***	1,819
(13) Borusyak et al. (2021) DiD estimator	0.0184***	1,819
(14) Placebo test 1	-0.0004	1,092
(15) Placebo test 2	-0.0046	1,819

Notes: This table shows the robustness checks to the baseline model provided in column (2) of Table 2. For each exercise, the coefficients assigned to $Post\ x\ Treated$ term, significance levels and the number of observations are provided in the form of rows for the sake of brevity. Row (1) employs standard errors clustered at state (of-headquarters) level. Row (2) replaces time fixed effects with state-by-time fixed effects to control for regional time-varying factors. Rows (3) and (4) restrict the sample by excluding privately held and non-complex banks, respectively. Rows (5) and (6) handle indirect treatment effects by omitting bank observations with asset sizes ranging between $50 and $65 billion as well as $35 and $50 billion. Row (7) deals with simultaneity concerns by incorporating one-quarter lagged values of control variables. Row (8) repeats the estimations with non-winsorized versions of series. Row (9) implements estimations with data averaged over pre- and post-treatment periods to contain serial correlation problems. Row (10) restricts the sample coverage to an event window four-quarters before and after the enactment of the EGRRCPA. Row (11) presents the estimation results using matched sample derived from propensity score matching analysis. In this context, we utilize one-to-one matching without replacement including first-step probit regression estimated to produce propensity scores (which employs bank-level control variables). We use the Stata command “psmatch2” to implement the analysis. Row (12) presents the estimation results for the analysis performed to remedy endogeneity concerns via the entropy balancing approach. In this context, we obtain entropy-balanced samples by applying a re-weighting scheme to observations in the control group in line with the method of Hainmueller (2012) and Hainmueller and Xu (2013). We use the Stata command “ebalance” to implement the analysis. entropy balancing is performed to balance the first and second moments, concurrently, of bank-level covariates between the treatment and control groups. Row (13) uses an alternative DiD estimator based on the imputation approach of Borusyak et al. (2021) via the Stata command “did_imputation”. Row (14) provides the first placebo test conducted by dropping the post-treatment observations and assuming the pseudo enactment of the EGRRCPA in 2016Q4. Row (15) demonstrates the second placebo test by keeping the sample period intact and randomizing the treatment status across banks. Unless otherwise stated, all empirical models include bank and time fixed effects and other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$. The main independent variable is $Post\ x\ Treated$ interaction term. Unless otherwise stated, we winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Table 1. Unless otherwise stated, standard errors clustered at the bank level are reported. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 5: Impact of a Reduction in Regulatory Oversight on Risk Exposure and Portfolio Adjustment

	(1) ΔOBS	(2) ΔOFBS	(3) Δ20%RW	(4) Δ50%RW	(5) Δ100%RW
Post x Treated	0.0175**	0.0765***	0.0147	0.0136	0.0333***
	(0.0075)	(0.0192)	(0.0139)	(0.0170)	(0.0078)
Observations	1,819	1,819	1,819	1,819	1,819
Other Controls	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.127	0.006	0.010	0.041	0.134

Notes: This table presents the estimation results of the DiD model predicting risk exposure and portfolio re-balancing tendencies. The sample period covers the interval between 2015Q1 and 2020Q1. In columns (1) and (2), the dependent variables are quarterly logarithmic growth of exposure to on-balance (ΔOBS) and off-balance sheet ($\Delta OFBS$) items subject to risk-weighting calculations, respectively. In columns (3), (4) and (5), the dependent variables are quarterly logarithmic growth of exposure to items subject to 20% ($\Delta 20\% RW$), 50% ($\Delta 50\% RW$) and 100% ($\Delta 100\% RW$) risk-weights in the scope of risk-weighting calculations. We control for bank and time fixed effects. All columns include other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$. The main independent variable is $Post\ x\ Treated$ interaction term. We winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Tables 1 and A1. Standard errors clustered at the bank level are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 6: The Impact of a Reduction in Regulatory Oversight on Bank Profitability

	(1) ROE	(2) Compliance Expenses
Post x Treated	0.2421**	-0.8496**
	(0.1194)	(0.4232)
Observations	1,910	1,910
Other Controls	Yes	Yes
Bank FE	Yes	Yes
Time FE	Yes	Yes
Adj. R-Squared	0.740	0.749

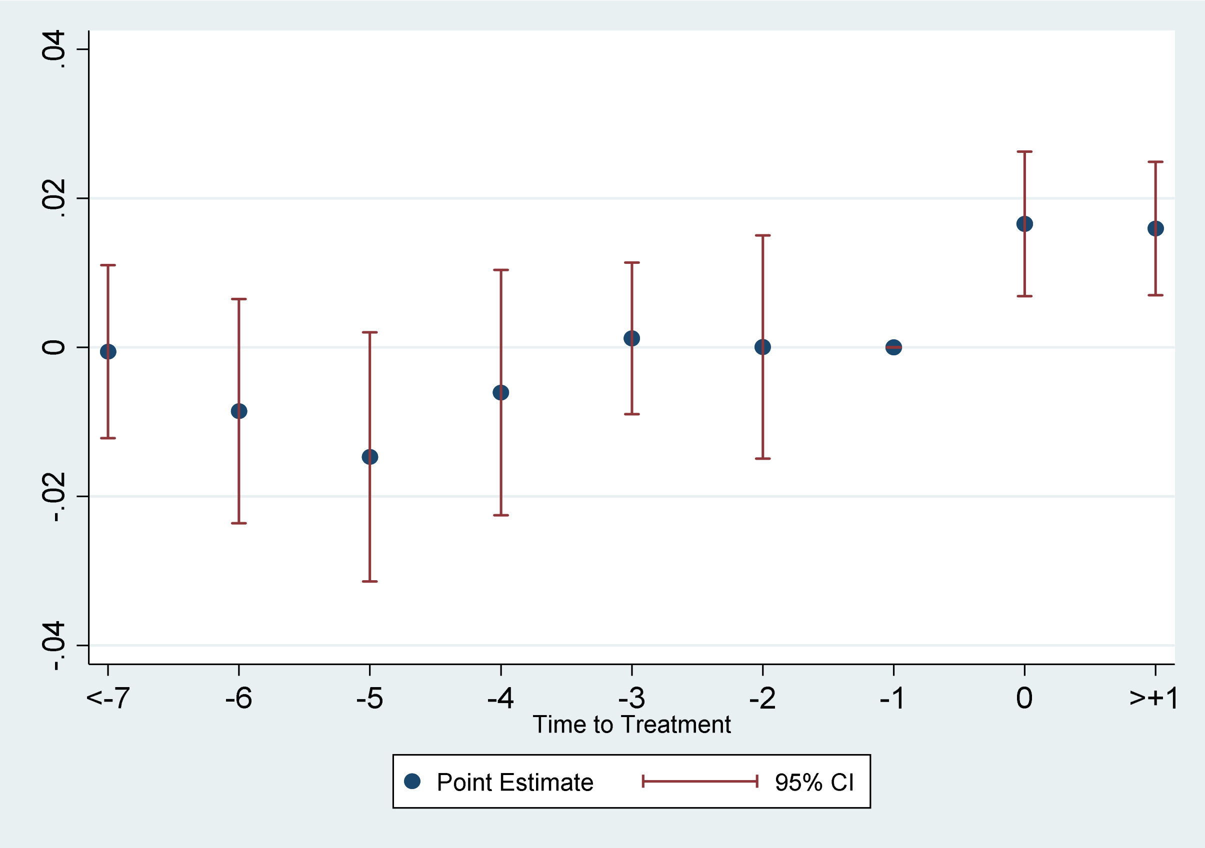
Notes: This table presents the estimation results of the DiD model predicting bank profitability and compliance costs. The sample period covers the interval between 2015Q1 and 2020Q1. In column (1), the dependent variable is the ratio of net income to total equity (ROE). In column (2), the dependent variable is the ratio of compliance expenses (data processing, accounting and auditing, consulting and advisory expenses) to non-interest expenses ($Compliance\ Expenses$). These ratios are multiplied by 100 for the ease of interpretation. We control for bank and time fixed effects. Columns (1) and (2) include other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$ (except for $Operating\ Efficiency$ in column (2)). The main independent variable is $Post\ x\ Treated$ interaction term. We winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Tables 1 and A1. Standard errors clustered at the bank level are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 7: Impact of a Reduction in Regulatory Oversight on Bank Valuation

	(1) Market-to-Book Ratio	(2) Tobin's Q	(3) P/E Ratio
Post x Treated	0.1941***	0.0203***	2.8834*
	(0.0457)	(0.0051)	(1.6406)
Observations	1,596	1,596	1,596
Other Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.894	0.880	0.638

Notes: This table presents the estimation results of the DiD model predicting bank valuation. The sample period covers the interval between 2015Q1 and 2020Q1. In column (1), the dependent variable is the ratio of market value to book value of total equity ($Market-to-Book\ Ratio$). In column (2), the dependent variable is $Tobin's\ Q$. In column (3), the dependent variable is price-to-earnings ratio ($P/E\ Ratio$). We control for bank and time fixed effects. All columns include other bank-level control variables $Deposit\ Funding$, $Provisions$, $Operating\ Efficiency$, $Liquidity$, $Dividends$ and $Derivatives$. The main independent variable is $Post\ x\ Treated$ interaction term. We winsorize all bank-level continuous variables at 1st and 99th percentiles. Detailed variable definitions are available in Tables 1 and A1. Standard errors clustered at the bank level are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Figure 1: Parallel Trends



Notes: This chart demonstrates the dynamics of the treatment effects. To this end, we augment the specification in column (2) of Table 2 by replacing $Post\ x\ Treated$ variable with interaction terms constructed by relative time dummy variables and $Treated$ term. For the sake of brevity, interactions are combined for more than seven quarters interval in the pre-treatment period, whereas post-treatment interactions are also merged. The vertical axis describes coefficients assigned to dynamic interaction terms. Blue dots and red straight lines represent point estimates and 95% confidence intervals, respectively.

Appendix

Table A1: Variable Definitions and Summary Statistics

Panel A: Variable Definitions	
Variables	Definitions
Z-Score	(Capital Ratio + Return on Assets)/σ(Return on Assets)
NPA Ratio 1	(Past Due 30-89 Days Loans, Lease Financing Receivables, Debt Securities, Other Assets)/Total Assets (x100)
NPA Ratio 2	(Past Due 90 Days and Non-Accruing Loans, Lease Financing Receivables, Debt Securities, Other Assets)/Total Assets (x100)
Δ(Tier-1 Capital/RWA)	ln((Tier-1 Capital/Risk-Weighted Assets)$_t$/(Tier-1 Capital/Risk-Weighted Assets)$_{t-1}$)
Market Risk	σ(Daily Stock Returns)
Systemic Risk	Marginal Expected Shortfall (Acharya, 2017b)
ΔOBS	ln((Exposure to On-Balance Sheet RW Items)$_t$/(Exposure to On-Balance Sheet RW Items)$_{t-1}$)
ΔOFBS	ln((Exposure to Off-Balance Sheet RW Items)$_t$/(Exposure to Off-Balance Sheet RW Items)$_{t-1}$)
Δ20%RW	ln((Exposure to 20% RW Items)$_t$/(Exposure to 20% RW Items)$_{t-1}$)
Δ50%RW	ln((Exposure to 50% RW Items)$_t$/(Exposure to 50% RW Items)$_{t-1}$)
Δ100%RW	ln((Exposure to 100% RW Items)$_t$/(Exposure to 100% RW Items)$_{t-1}$)
ROE	Net Income/Total Equity (x100)
Compliance Expenses	(Data Processing Expenses+Accounting and Auditing Expenses+Consulting and Advisory Expenses)/Non-Interest Expenses (x100)
Market-to-Book Ratio	Market Value of Total Equity/Book Value of Total Equity
Tobin's Q	(Market Value of Total Equity+Book Value of Total Liabilities)/Book Value of Total Assets
P/E Ratio	Price per Share/Earnings per Share

Panel B: Summary Statistics						
Variables	Obs.	Mean	Std. Dev.	Median	P5	P95

Z-Score	1,911	4.8571	0.7144	5.0358	3.4827	5.7892
NPA Ratio 1	1,911	0.3526	0.4640	0.2368	0.0428	0.9802
NPA Ratio 2	1,911	0.6821	0.9100	0.5026	0.1193	1.4964
Δ(Tier-1 Capital/RWA)	1,820	-0.0031	0.0365	0.0003	-0.0671	0.0479
Market Risk	1,596	0.0174	0.0092	0.0154	0.0102	0.0393
Systemic Risk	1,596	0.0257	0.0251	0.0204	0.0048	0.0656
ΔOBS	1,820	0.0243	0.0499	0.0133	-0.0201	0.1033
ΔOFBS	1,820	0.0310	0.1179	0.0205	-0.1067	0.2213
Δ20%RW	1,820	0.0149	0.0918	0.0078	-0.1050	0.1746
Δ50%RW	1,820	0.0264	0.0818	0.0131	-0.0733	0.1605
Δ100%RW	1,820	0.0257	0.0507	0.0172	-0.0280	0.1078
ROE	1,911	2.2813	1.1837	2.1831	0.6993	4.3091
Compliance Expenses	1,911	5.7562	4.3392	5.2758	0.0000	12.7304
Market-to-Book Ratio	1,596	1.3688	0.5351	1.2499	0.7444	2.4260
Tobin's Q	1,596	1.0413	0.0584	1.0302	0.9702	1.1476
P/E Ratio	1,596	39.3455	13.2598	38.7267	18.9247	58.2484

Notes: This table reports the detailed definitions and summary statistics for the variables used in the subsequent regressions. We winsorize all continuous variables at 1st and 99th percentiles.

Table A2: Correlation Matrix

	Deposit Funding	Provisions	Operating Efficiency	Liquidity	Dividends	Derivatives
Deposit Funding	1					
Provisions	-0.1988	1				
Operating Efficiency	-0.0286	-0.0634	1			
Liquidity	-0.0909	0.2421	0.0907	1		
Dividends	-0.0458	0.0078	-0.2494	-0.0893	1	
Derivatives	-0.0917	-0.0360	0.1627	0.3733	-0.0750	1

Notes: This table reports the correlations among bank-level control variables used in the main regressions.