Journal of Financial Stability 64 (2023) 101105

Contents lists available at ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfstabil

Regulatory oversight and bank risk☆

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ARTICLE INFO

JEL Classifications:
G21
G28
G32

Keywords:
Bank Regulation
Bank Risk
Difference-in-Differences
Dodd-Frank Act
Economic Growth
Regulatory Relief
And Consumer Protection Act

ABSTRACT

We investigate how a change in regulatory oversight affects bank risk, using the passage of the Economic Growth, Regulatory Relief, and Consumer Protection Act of 2018 as a setting. Using a sample of bank holding companies (BHCs) covering the period 2015Q1 through 2020Q1, we find that risk increases for large BHCs affected by a change in regulatory oversight. In addition to increasing bank level risk, affected BHCs increase their respective contribution to the systemic risk. These BHCs also experience higher profitability, increased market valuation and reduced compliance costs.

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.[1] The global financial crisis and subsequent bailouts of large too-big-to-fail banks highlighted the dangers to the financial system (and real economy) arising from the increased size and complexity of large banks. 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 pre-defined asset size threshold). These changes ushered in a period of so-called tiered bank regulation, and appear to have reduced the risk that large banks pose to the financial system. However, the regulatory compliance costs of banks and the oversight costs of government agencies tasked with supervising the financial system have increased (Hogan and Burns, 2019). This has 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 2018, US congress passed the Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA). The EGRRCPA removed many of the regulations enacted following the Dodd-Frank Act, and resulted in a decline in regulatory requirements and oversight of some large banks.[2] In this paper, we investigate how this decline in regulatory oversight impacted

☆ We thank Iftekhar Hasan (Editor) and three anonymous reviewers for extensive and insightful comments. We gratefully acknowledge the comments by the participants at: the EFiC 2022 Conference in Banking and Corporate Finance; the 11th International Conference of the Financial Engineering & Banking Society; and the British Academy of Management Conference 2022. We also thank Barbara Casu, Angela Gallo, Sotiris Kokas, Jose Linares Zegarra, Anna Sobiech, Mao Zhang, Süheyla Özyıldırım and Alexandros Skouralis (Discussant) for useful comments and suggestions. The usual disclaimer applies. The views presented in this paper are those of authors and do not represent the official views of authors' institutions.

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[1] We use the terms "banks" and "bank holding companies (BHCs)" interchangeably throughout the text.

[2] 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 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.

https://doi.org/10.1016/j.jfs.2023.101105
Received 2 May 2022; Received in revised form 3 January 2023; Accepted 9 January 2023
Available online 19 January 2023

the risk of large banks.[3]

The effectiveness of regulation in curbing bank risk is contested. An agency-based view asserts that external bank regulation is necessary to reduce agency conflicts, promote robust corporate governance and curb excessive risk-taking at banks (Alexander, 2006; Hagendorff et al., 2010). The public interest view of regulation asserts that official regulators and supervisors have resources and incentives to mitigate market failures by promoting the efficient allocation of funds and disciplining excessive risk-taking (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, with subsequent improvements to financial stability (Laeven and Levine, 2009; 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, regulatory arbitrage and exacerbate moral hazard (Koehn and Santomero, 1980; Kroszner and Strahan, 2011). Moreover, regulatory capture and industry lobbying can impede the effectiveness of bank regulation (Shleifer and Vishny, 1998; Lambert, 2019).

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.[4] Advocates of the changes contend that the EGRRCPA provides much needed regulatory relief for banks. By reducing compliance costs, the EGRRCPA frees up valuable resources that can be used by banks to better serve customers.[5] Opponents argue that the removal of regulations introduced via the Dodd-Frank Act will lead to an increase in bank risk-taking.[6] 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 in the current study allows us to identify the large BHCs affected by the enactment of the EGRRCPA versus counterparts that were unaffected. Drawing inferences based on a single country setting reduces concerns regarding cross-country confounding factors (differences in legal enforcement, income, bank competition, cross-border banking activities, macroeconomic fundamentals, institutional quality, degree of economic development and monetary policy) that could impact the relationship between regulation and risk (Buch and DeLong, 2008; Anginer et al., 2016). Consequently, our setting provides the basis for a robust research design and estimable model(s) to investigate whether large bank risk increases or decreases following a decline in 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. Our baseline model compares 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). The results of our empirical analysis suggest that following the enactment of the EGRRCPA, affected banks increased risk relative to unaffected counterparts. These findings support the 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 support the causal interpretation of our main findings. Our baseline findings also hold when using alternative bank risk measures. In addition to an increase in standalone risk, the enactment of the EGRRCPA leads to an increase in systemic risk. Our findings continue to hold following a myriad of additional 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 is driven via an adjustment in bank asset portfolios toward riskier assets. We also observe that the enactment of EGRRCPA is translated into increased 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. Prior 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). We extend this evidence base by considering the impact of adjusting 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.[7] We find that a reduction in regulatory oversight contributes to an increase in bank risk. 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 examining the consequences of US bank 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. Evidence suggests that the enhanced bank competition following the IBBEA: improved bank efficiency (Jayaratne and Strahan, 1997); generated abnormal stock returns (Brook 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

[3] Prior literature uses the terms "regulation", "supervision" and "oversight" interchangeably. However, regulation and supervision differ. Regulations are broad sets of rules designed to: alleviate information asymmetries; contain moral hazard and negative externalities and prevent bank runs, while supervision corresponds to the monitoring of bank activities in order to ensure compliance with regulations. While the changes introduced by EGRRCPA alter regulation, they are also inextricably bound up with bank supervision, given that the EGRRCPA altered procedures for large BHC stress testing, reporting processes and risk management systems. This is why we have chosen to use the term "regulatory oversight" throughout the text.

[4] 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.

[5] 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).

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

[7] Related evidence suggests that the Dodd-Frank Act: improved market discipline (Balasubramnian and Cyree, 2014); reduced stock returns (Gao et al., 2018); and reduced risk (Calluzzo and Dong, 2015; Akhigbe et al., 2016; Clark et al., 2020; Jiang, 2020).

bank risk (Jiang et al., 2017).[8] Moreover, the increased product freedoms and diversification opportunities brought about by 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). Using the EGRRCPA as a significant deregulatory event, we demonstrate that reduced regulatory oversight leads to an increase in bank level risk.

Third, we advance the literature on how regulation influences bank efficiency via compliance costs. In addition to considerable direct costs, banks also incur substantial expenses in satisfying supervisory requirements (Franks et al., 1997; Barth et al., 2013; Cyree, 2016; Hogan and Burns, 2019; Dolar and Dale, 2020). Specifically, banks are required to: generate and report additional data; train and develop human resources; maintain and improve the technological infrastructure; and revise organizational structure. In this study, we complement this literature by presenting evidence, which suggests that the removal of certain provisions of the Dodd-Frank Act reduces the compliance expense burden at US banks.

The remainder of the paper is structured as follows. Section 2 provides a background to US bank (de)regulation (Section 2.1), an overview of the EGRRCPA (Section 2.2), data sources (Section 2.3) and methodology (Section 2.4). Section 3 presents the empirical findings, while Section 4 provides concluding remarks.

2. Background, research setting, data and methods

2.1. Background

Strict regulation and supervision of the banking industry is often enacted in response to a crisis (Spong, 2000). In contrast, deregulation often occurs during periods of economic prosperity and banking industry tranquillity. In the US, the Glass-Steagall Act of 1933 that legislated for the separation of commercial and investment banking, and founded the Federal Deposit Insurance Corporation (FDIC) for insuring bank deposits was passed in response to widespread bank failures during the great depression. Subsequent legislation was enacted to regulate the activities of increasingly important BHCs. The Bank Holding Company Act of 1956 served as a turning point in how the activities of single-bank and multi-bank holding companies were regulated and supervised by the Federal Reserve (Spong, 2000; Omarova and Tahyar, 2011; Avraham et al., 2012). Later notable regulatory milestones included: the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA), which revised deposit insurance arrangements and established a system of prompt corrective action alongside regulatory minima for bank capital; and the Dodd-Frank Act of 2010, which initiated a myriad of new regulations pertaining to liquidity, capital, and corporate governance among others (Acharya et al., 2010; Acharya and Richardson, 2012).

Evidence regarding the impact of regulation on bank risk suggests that the Glass-Steagall Act and the Bank Holding Company Act paved the way for a more stable banking industry, which lasted for decades (Calomiris, 2019). The later enactment of the FDICIA improved internal control practices and resulted in increased bank soundness (Jin et al., 2013). Moreover, the extensive regulatory package (involving imposing stricter rules on large BHCs based on the asset size and the scope of bank activities) included in the post-crisis Dodd-Frank Act of 2010 appears to have reduced both individual (Akhigbe et al., 2016; Jiang, 2020) and systemic bank risk (Acharya and Richardson, 2012; Krainer, 2012).

Empirical evidence regarding the impact of deregulation on bank risk is rather mixed. Considerable state-level geographical banking and branching barriers existed prior to the IBBEA of 1994. Following the passage of IBBEA, BHCs were allowed to expand operations via bank acquisitions and engage in financial activities on an intrastate and interstate basis. This led to increased competition, improvements in bank efficiency and profitability and financial stability (Shiers, 2002; Akhigbe and Whyte, 2003; Berger et al., 2020). In terms of deregulation pertaining to business activities, the barriers separating commercial and investment banking activities were revoked with the GLBA of 1999. Evidence suggests that this product market deregulation amplified bank risk and reduced financial stability (Akhigbe and Whyte, 2004; Mamun et al., 2005; Filson and Olfati, 2014). The present study provides new empirical evidence regarding the impact of deregulation of specific post global financial crisis provisions for large US BHCs.

2.2. 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.[9] 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.[10] 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 a grace period of 18 months), with discretion allocated to the Federal Reserve for re-implementation of enhanced regulatory oversight if deemed necessary.[11]

For the purposes of our empirical design, we combine the aforementioned two sub-classes of BHCs (with asset size ranging from \$50

[8] Berger, Molyneux and Wilson (2020) provide a discussion of the impact of the IBBEA on households, SMEs and corporates.

[9] We acknowledge that lobbying efforts by industry representatives (especially of larger BHCs) could be a contributing factor in driving the rolling back of some of the Dodd-Frank Act provisions. If this were the case, then the EGRRCPA is not strictly exogenous. However, the sudden and unexpected timing of EGRRCPA and the resultant application to arbitrarily assigned asset size thresholds is likely to alleviate possible endogeneity concerns in this regard.

[10] 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.

[11] The EGRRCPA also grants the power to the Board of Governors of the Federal Reserve System to exempt any BHCs with asset below \$250 billion from the regulatory oversight arrangements passed under the Dodd-Frank Act at any point during the grace period.

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 of banks—a key component of prudential bank regulation following the global financial crisis. Second, the enactment of the EGRRCPA removed 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 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.

2.3. 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 BHCs are 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 these banks complement the "standard" approach with an "advanced" approach in calculating their risk-weighted assets, unlike counterparts with assets below the $250 billion threshold. Moreover, 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-9 C 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 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.

2.4. 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].

$$\Delta RWA_{it} = \beta(Post_t xTreated_i) + \gamma X_{it} + f_i + \delta_t + \varepsilon_{it} \tag{1}$$

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 for 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 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 as of 2018Q1, 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-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 by bank asset size, standard errors are clustered at the BHC level.

Eq. (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

[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 are subject to advanced oversight after the enactment of the EGRRCPA.

[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).

[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. Particularly, all banks in our sample are required to use the "standard" approach in calculating risk-weighted assets. However, within the scope of our robustness testing, we also analyse alternative proxies for bank risk with narrower definitions and ex-post features. These comprise insolvency risk ($Z-Score$) and asset quality (*NPA Ratio*).

[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 (Calomiris and Jaremski, 2016; Anginer and Demirgüç-Kunt, 2019).

Table 1
Variable Definitions and Summary Statistics.

Panel A: Variable Definitions

Variables	Definitions	FRY-9 C Mnemonics
ΔRWA	ln((Risk-Weighted Assets)$_t$/(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	1820	0.0247	0.0462	0.0158	-0.0207	0.0973
Deposit Funding	1820	0.5527	0.0988	0.5576	0.3704	0.7344
Provisions	1820	0.0898	0.1574	0.0443	-0.0155	0.4568
Operating Efficiency	1820	0.6239	0.1087	0.6205	0.4339	0.8190
Liquidity	1819	0.0455	0.0402	0.0325	0.0114	0.1159
Dividends	1820	0.0848	0.0636	0.0849	0.0000	0.1828
Derivatives	1820	0.1421	0.3129	0.0176	0.0000	0.5400

Notes: This table reports the detailed definitions, FRY-9 C 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.

(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 measure captures the availability of liquid assets at banks. Funding long-term assets with short-term liabilities inherently exposes banks to liquidity risk (Diamond and Dybvig, 1983). The holding of highly liquid assets to meet immediate liquidity demands and unexpected withdrawals is likely to reduce bank risk and the probability of bank runs (Curry et al., 2008; Jokipii and Milne, 2011). Given that lack of liquidity can play a significant role in bank failures, post-financial crisis reforms have included regulations designed to ensure that banks maintain an adequate level of liquidity (Hong et al., 2014). In theory, requiring banks to hold a greater proportion of liquid assets should encourage prudent bank behaviour by reducing moral hazard (Calomiris et al., 2015).

*Dividends*are defined as the ratio of dividends declared on common stock to total assets. On the one hand, dividends could be positively related to risk if used to transfer wealth from other stakeholders to owners via risk-shifting (Srivastav et al., 2014; Acharya et al., 2017a). On the other hand, payouts may be negatively correlated with risk if dividends are used as a device to signal a reduction in risk to outside stakeholders (Michaely 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.[20]

3. Empirical results

3.1. Baseline findings

3.1.1. Main results

In this section, we present baseline empirical results derived from estimating Eq. (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 Eq. (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 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. Given that the average risk-weighted assets for our sample is $32.22 billion, our results imply that affected banks have an incremental annual growth in risk exposure of $2.57 billion. 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).

To remedy any concerns regarding the discretionary nature of treatment for certain banks, we partition the treatment group into two asset size sub-groups by creating dummy variables *Treated*_50_100 (equal to one for banks with asset sizes $50-$100 billion and zero otherwise) and *Treated*_100_250 (equal to one for banks with asset sizes $100-$250 billion and zero otherwise). We then re-estimate Eq. (1) including these aforementioned variables as covariates in order to assess any heterogeneous treatment effects on banks in these asset size groups. The results presented in column (3) suggest that an increase in risk is not limited to one sub-group, but rather is evident in both asset size sub-groups. Moreover, the observed difference in the treatment effect

[20] In an unreported analysis, we produce variance inflation factor (VIF) values, which remain lower than the commonly accepted threshold of 5. This further supports the non-existence of multicollinearity.

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

	(1) ΔRWA	(2) ΔRWA	(3) ΔRWA
Post x Treated	0.0166 * **	0.0195 * **	
	(0.0037)	(0.0044)	
Post x Treated_50_100			0.0269 * **
			(0.0069)
Post x Treated_100_250			0.0171 * **
			(0.0048)
Deposit Funding		-0.0097	-0.0104
		(0.0319)	(0.0329)
Provisions		0.0115	0.0115
		(0.0170)	(0.0170)
Operating Efficiency		0.2401 * **	0.2412 * **
		(0.0505)	(0.0507)
Liquidity		-0.1311 * *	-0.1288 *
		(0.0649)	(0.0663)
Dividends		-0.0546 *	-0.0559 *
		(0.0294)	(0.0295)
Derivatives		0.0176	0.0181
		(0.0133)	(0.0133)
Observations	1820	1819	1819
Controls	No	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.077	0.161	0.161
F-test			1.61

Notes: This presents the estimation results of the baseline DiD model specified in Eq. (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 columns (2) and (3) include bank-level control variables *Deposit Funding*, *Provisions*, *Operating Efficiency*, *Liquidity*, *Dividends* and *Derivatives*. The main independent variable is *Post x Treated* interaction term. In column (3), the main independent variable (*Post x Treated* interaction term) is replaced with *Post x Treated*_50_100and *Post x Treated*_100_250 representing the different sub-groups among treatment banks depending on asset size intervals. The difference of these coefficients is tested with an F-test. The F-statistic is reported in the last row of the table. 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 3
The 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	-0.0740 * **	0.0386 *	0.0251
	(0.0239)	(0.0219)	(0.0426)
Observations	1910	1910	1910
Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.989	0.949	0.939
	(4)	(5)	(6)
	Δ(Tier-1 Capital/RWA)	Market Risk	Systemic Risk
Post x Treated	-0.0139 * *	0.0007 *	0.0015 * *
	(0.0056)	(0.0004)	(0.0007)
Observations	1819	1596	1596
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 $Z-Score$, $NPA\ Ratio1$ and $NPA\ Ratio2$, respectively. In column (4), the dependent variable is the change in the capital adequacy ratio calculated following the Basel III guidelines ($\Delta(Tier-1Capital/RWA)$). 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. All models include 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.

across the two groups is not statistically significant.

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).

3.1.2. Alternative Bank Risk Measures

We extend our empirical investigation by considering a variety of alternative measures 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; Ashraf, 2017).[21] 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 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-9 C forms) is granular enough to construct various credit risk measures. $NPA\ Ratio1$ denotes the portion of total contractual assets (loans, lease financing receivables, debt securities and other assets) past due 30–89 days, while $NPA\ Ratio2$ 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,

[21] We 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. Our results are also robust to a time-varying version of the $Z-Score$ normalized by the standard deviation of stock price returns.

Table 4
Robustness Tests.

	(1) ΔRWA	
	Coefficient	Obs.
(1) Standard errors clustered at state level	0.0195 * **	1819
(2) State-by-time fixed effects	0.0199 * **	1538
(3) Excluding private banks	0.0197 * **	1559
(4) Excluding non-complex banks	0.0180 * **	927
(5) Controlling for the foreign presence of BHCs	0.0188 * **	1478
(6) Excluding banks with asset size $35–50 billion	0.0206 * **	1695
(7) Using entire BHC universe for sample composition	0.0172 * **	6280
(8) Lagged control variables	0.0159 * **	1820
(9) Using *Discretionary Provisions* as a control variable	0.0199 * **	1819
(10) Non-winsorized data	0.0224 * **	1819
(11) Estimations with collapsed data	0.0176 * **	182
(12) Excluding 2020Q1 from sample period	0.0174 * **	1729
(13) Estimations with [− 4, + 4] quarter event window	0.0245 * **	728
(14) Propensity score matching	0.0196 * **	799
(15) Entropy balancing	0.0229 * **	1819
(16)Borusyak et al. (2021) DiD estimator	0.0184 * **	1819
(17) Placebo test 1	-0.0004	1092
(18) Placebo test 2	-0.0046	1819
(19) Placebo test 3	-0.0029	5645

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. Row (5) controls for the foreign presence of BHCs by incorporating control variables describing the liquid assets, deposits, loans, interest income and interest expense related to foreign offices. Row (6) handles indirect treatment effects by omitting bank observations with asset sizes ranging between $35 and $50 billion. Row (7) extends the sample composition process to the entire BHC universe (involving 316 BHCs subject to sample formation criteria) including banks above $250 billion and below $10 billion in estimations. Row (8) deals with simultaneity concerns by incorporating one-quarter lagged values of control variables. Row (9) replaces the control variable *Provisions* with *Discretionary Provisions* which represents the discretionary component of total loan provisioning extracted by the auxiliary model described in Beatty and Liao (2014). Row (10) repeats the estimations with non-winsorized data. Row (11) implements estimations with data averaged over pre- and post-treatment periods to address possible serial correlation problems. Row (12) excludes the 2020Q1 from the sample coverage. Row (13) restricts the sample coverage to an event window four-quarters before and after the enactment of the EGRRCPA. Row (14) 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 (15) 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 (16) uses an alternative DiD estimator based on the imputation approach of Borusyak et al. (2021) via the Stata command "did_imputation". Row (17) provides the first placebo test conducted by dropping the post-treatment observations and assuming the pseudo enactment of the EGRRCPA in 2016Q4. Row (18) demonstrates the second placebo test by keeping the sample period intact and randomizing the treatment status across banks. Row (19) utilises the entire BHC universe below $50 billion to form the sample and assumes $10 billion as the pseudo threshold to implement the third placebo test. Unless otherwise stated, all bank-level continuous variables are winsorized at 1st and 99th percentiles, and all empirical models include bank and time fixed effects and bank-level control variables *Deposit Funding*, *Provisions*, *Operating Efficiency*, *Liquidity*, *Dividends* and *Derivatives*. The main independent variable is *Post x Treated* interaction term. 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.

albeit the statistical significance is marginally retained for the initial ratio definition only.

In column (4), we use another dependent variable $\Delta(Tier-1Capital/RWA)$ (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.

To complement our analysis using financial statement data, we use a market-based 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.[22] 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 Yasuda, 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 Vennet, 2020). Relative to smaller 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:

$$MarginalExpectedShortfall_{it}^{q} = E\left(r_{it}|r_{mt} \leq VaR_{r_{mt}}^{q}\right) \tag{2}$$

In Eq. (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.[23] We choose the value of the parameter q as 10%, so that

[22] This table is accessed at: https://www.newyorkfed.org/research/banking_research/datasets.html

[23] 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.

the expression $r_{mt} \leq VaR^{q}_{r_{mt}}$ corresponds to the trading days during which market return is lower than 10% tail outcomes in each quarter.[24] We reverse the sign of daily returns to retrieve *Systemic Risk* indicator in a way that larger values describe higher level of systemic risk. The results, which are presented in column (6), suggest that treated banks contribute more systemic risk following the adoption of the EGRRCPA.

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).

3.2.1. 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). 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.

3.2.2. Bank ownership and complexity

3.2.2.1. 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 behaviour 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.

3.2.2.2. 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-9 C form indicator RSSD9057. This series is created with supervisory purpose and captures 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.

3.2.2.3. Foreign Presence. Cross-country differences in regulatory oversight and scrutiny could interact with banks' foreign presence and network of operations. Prior literature suggests that banks with foreign operations tend to exploit regulatory arbitrage stemming from heterogeneities in regulatory oversight across different jurisdictions, which in turn can impact bank risk and lending practices (Ongena et al., 2013; Frame et al., 2020). The existence of interconnected and complex global financial networks among large banks could also diminish the ability of regulators to mitigate systemic risk (Andrieş et al., 2022). In order to overcome any possible confounding effects of BHCs' foreign operations on our results, we collect additional information on the liquid assets, deposits and loans at foreign offices of BHCs. We also collect data for interest income on loans and interest expenses on deposits at foreign offices. In a subsequent step, we extend the baseline model specification to incorporate these variables as additional controls (*Foreign Liquid Assets*, *Foreign Deposits*, *Foreign Loans*, *Foreign Interest Income* and *Foreign Interest Expense*). Given that treated banks continue to experience increased bank risk even after the inclusion of additional controls, the results presented in row (5) suggest that the existence of foreign operations is not a confounding factor in driving our baseline findings.

3.2.3. 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 behaviour, 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 behaviour acknowledge this possibility (Bouwman et al., 2018; Bindal et al., 2020). In line with prior practice, we adjust our empirical design to exclude observations belonging to 30% band around the asset size regulatory threshold. Specifically, we eliminate banks with asset size in the interval \$35 billion to \$50 billion. Our result, presented in row (6) suggest that our baseline findings are not distorted by indirect treatment effects.[25]

[24] Our findings are robust to the use of 1% threshold for tail outcome definition (see Table A3 of the Appendix).

[25] Our results are invariant to the exclusion of the observations around treatment threshold including \$45-\$55 billion, \$40-\$60 billion, \$35-\$65 billion, \$30-\$70 billion and \$25-\$75 billion intervals separately.

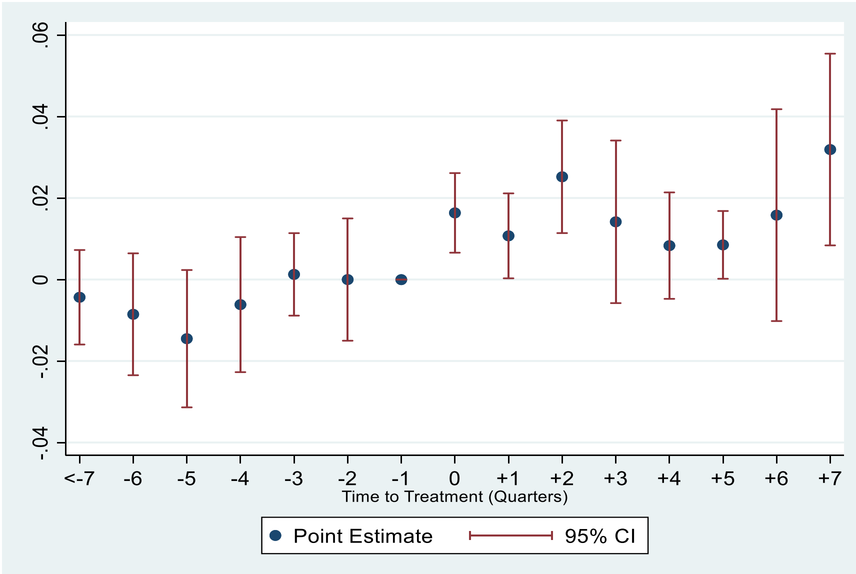

Fig. 1. Parallel Trends, Notes: This chart demonstrates the dynamics of the treatment effects. We augment the specification in column (2) of Table 2 by replacing *Post x Treated* variable with interaction terms constructed by relative time dummy variables and *Treated* term. For the sake of brevity, interactions are combined for more than seven quarters interval in the pre-treatment period, whereas post-treatment interactions are demonstrated individually. The vertical axis describes coefficients assigned to dynamic interaction terms. Blue dots and red straight lines represent point estimates and 95% confidence intervals, respectively.

Table 5
The 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	1819	1819	1819	1819	1819
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 (Δ*OBS*) and off-balance sheet (Δ*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% (Δ20%*RW*), 50% (Δ50%*RW*) and 100% (Δ100%*RW*) risk-weights in the scope of risk-weighting calculations. We control for bank and time fixed effects. All columns include 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	1910	1910
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 ease of interpretation. We control for bank and time fixed effects. Columns (1) and (2) include 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.

3.2.4. Data handling, serial correlation and shortened event window

There are multiple statistical issues that could threaten the validity of our baseline findings. These include the choice of sample composition, simultaneity, winsorization, serial correlation and the choice of sample interval. Although banks with asset size below \$10 billion and above \$250 billion are excluded from our baseline empirical design, these banks could still serve as alternative control units given that the EGRRCPA did not impose any changes in regulatory oversight for these banks. Consequently, we extend our coverage to the entire universe of US BHCs (subject to the earlier set of sample filtering criteria) by retaining 316 BHCs with 6599 bank-quarters in which treatment group remains unaltered. In row (7), we present the results of re-estimating the baseline model using this larger sample. The results suggest that our inferences regarding the increased risk of treated banks following the enactment of the EGRRCPA remain valid (despite varying the composition of the control group).

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 (8) and show that the sign and significance of the baseline effect do not change. Moreover, the extent to which *Provisions* are regarded as an appropriate measure of bank opacity is somewhat contested (Gallemore, 2022). Consequently, as an alternative strategy, we follow an approach described in Beatty and Liao (2014) and isolate the discretionary (from the non-discretionary) component of loan loss provisions. We then incorporate discretionary loan loss provisions in the model specification, instead of *Provisions*. The results of this

Table 7
The 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	1596	1596	1596
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 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.

estimation, which are presented in row (9), suggest that there are no significant differences to our baseline findings.

In order to ensure that the winsorization of variables does not drive our results, we re-estimate our baseline regression using raw versions of variables (without winsorization). The results, which are presented in row (10), suggest that the main findings hold. 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 (11) continue to indicate a positive and significant coefficient.

Moreover, given that the early economic impacts of the COVID-19 pandemic could plausibly be present in the data for 2020Q1, we exclude this particular quarter from our sample, and re-estimate our baseline model. The results, which are presented in row (12) of Table 4 are similar to our main findings. Regarding the potential impact of events occurring before and / or after the enactment of EGRRCPA, in row (13), 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.

3.2.5. 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.

3.2.6. Propensity score matching

We use a propensity score matching approach to create a sample of control banks that more closely resemble (match) our treatment group (Rosenbaum and Rubin, 1983; Lambert, 2019). In order to do so, we retain cross-sectional bank observations one period prior to the enactment of the EGRRCPA (2018Q1) and estimate a probit regression model to predict the probability of treatment via the set of control variables included in Eq. (1). Specifically, we compute propensity scores using the levels of the variables *Deposit Funding*, *Provisions*, *Operating Efficiency*, *Liquidity*, *Dividends* and *Derivatives*. The results of the probit model estimation are tabulated in Table A4 of the Appendix. We then conduct one-to-one matching without replacement based upon the estimated propensity scores. The matching procedure leads to a final matched sample of 40 (20 treated; 20 control) banks. The impact of the matching is illustrated in Table A5 of the Appendix, where summary statistics of the control variables for both treated and control banks are presented. Relative to the unmatched sample, the matched sample improves the similarity in covariates across treated and control BHCs. We repeat the baseline estimation using the matched sample of banks. The results presented in row (14) validate our baseline results.

3.2.7. 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).[26] 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 (15), the impact of the EGRRCPA on bank risk holds when a balanced sample is utilized for the estimations.

3.2.8. 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, 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'd'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 (16) continue to find an increase in the risk of treated banks using this alternative DiD estimator.

3.2.9. 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

[26] 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 (Amusa et al., 2019; McMullin and Schonberger, 2020).

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)
Foreign Liquid Assets	Liquid Assets Held in Foreign Offices/Total Assets
Foreign Deposits	Deposits Collected in Foreign Offices/Total Assets
Foreign Loans	Loans Extended in Foreign Offices/Total Assets
Foreign Interest Income	Interest Income on Loans Extended in Foreign Offices/Total Assets
Foreign Interest Expense	Interest Expenses on Deposits Collected in Foreign Offices/Total Assets
Discretionary Provisions	Discretionary component of total loan loss provisions obtained by the auxiliary model (Beatty and Liao, 2014)
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)$_{t-1}$)
Δ20%RW_Loans	ln((Exposure to 20% RW Loan Items)$_t$/(Exposure to 20% RW Loan Items)$_{t-1}$)
Δ50%RW_Loans	ln((Exposure to 50% RW Loan Items)$_t$/(Exposure to 50% RW Loan Items)$_{t-1}$)
Δ100%RW_Loans	ln((Exposure to 100% RW Loan Items)$_t$/(Exposure to 100% RW Loan Items)$_{t-1}$)
Real Estate Loans/Total Loans	Loans Backed by Real-Estate/Total Loans
C&I Loans/Total Loans	Commercial and Industrial Loans/Total Loans
Consumer Loans/Total Loans	Other Consumer Loans/Total Loans
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	1911	4.8571	0.7144	5.0358	3.4827	5.7892
NPA Ratio 1	1911	0.3526	0.4640	0.2368	0.0428	0.9802
NPA Ratio 2	1911	0.6821	0.9100	0.5026	0.1193	1.4964
Δ(Tier-1 Capital/RWA)	1820	-0.0031	0.0365	0.0003	-0.0671	0.0479
Market Risk	1596	0.0174	0.0092	0.0154	0.0102	0.0393
Systemic Risk	1596	0.0257	0.0251	0.0204	0.0048	0.0656
Foreign Liquid Assets	1910	0.0025	0.0150	0.0000	0.0000	0.0111
Foreign Deposits	1571	0.0106	0.0577	0.0000	0.0000	0.0544
Foreign Loans	1.908	0.0048	0.01628	0.0000	0.0000	0.0324
Foreign Interest Income	1555	0.0069	0.0233	0.0000	0.0000	0.0390
Foreign Interest Expense	1556	0.0007	0.0025	0.0000	0.0000	0.0039
Discretionary Provisions	1911	0.0017	0.0023	0.0009	0.0001	0.0056
ΔOBS	1820	0.0243	0.0499	0.0133	-0.0201	0.1033
ΔOFBS	1820	0.0310	0.1179	0.0205	-0.1067	0.2213
Δ20%RW	1820	0.0149	0.0918	0.0078	-0.1050	0.1746
Δ50%RW	1820	0.0264	0.0818	0.0131	-0.0733	0.1605
Δ100%RW	1820	0.0257	0.0507	0.0172	-0.0280	0.1078
Δ20%RW_Loans	1615	-0.0017	0.2629	-0.0088	-0.3708	0.3599
Δ50%RW_Loans	1810	0.0277	0.0889	0.0133	-0.0719	0.1586
Δ100%RW_Loans	1820	0.0263	0.0527	0.0166	-0.0286	0.1124
Real Estate Loans/Total Loans	1911	0.6074	0.2131	0.6624	0.1728	0.8949
C&I Loans/Total Loans	1911	0.2071	0.1249	0.1816	0.0287	0.4327
Consumer Loans/Total Loans	1911	0.0833	0.1417	0.0311	0.0006	0.3522
ROE	1911	2.2813	1.1837	2.1831	0.6993	4.3091
Compliance Expenses	1911	5.7562	4.3392	5.2758	0.0000	12.7304
Market-to-Book Ratio	1596	1.3688	0.5351	1.2499	0.7444	2.4260
Tobin's Q	1596	1.0413	0.0584	1.0302	0.9702	1.1476
P/E Ratio	1596	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.

Table A3
Alternative Threshold for Systemic Risk Indicator.

	(1) Systemic Risk	(2) Systemic Risk	(3) Systemic Risk
Post x Treated	0.0092 * **	0.0070 * **	0.0072 * **
	(0.0016)	(0.0017)	(0.0022)
Observations	1596	1596	1596
Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.822	0.815	0.787

Notes: This table presents the robustness of the baseline results with respect to the construction of the systemic risk indicator. In all columns, the dependent variable is proxied by marginal expected shortfall approach of Acharya et al. (2017b). The systemic risk indicator is created with a conservative approach taking 1% level to identify the occurrence of tail risk. S&P 500 index, value-weighted CRSP equity index and equal-weighted CRSP equity index are used to compose systemic risk proxies in columns (1), (2) and (3), respectively. All columns include 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 A4
First-Step Probit Estimation for PSM Analysis.

	(1) Treated
Deposit Funding	-3.5135 *
	(1.9884)
Provisions	2.9855 **
	(1.3488)
Operating Efficiency	-1.6828
	(1.9684)
Liquidity	2.2051
	(5.3673)
Dividends	-6.9317 *
	(3.6279)
Derivatives	2.9178 ***
	(0.8314)
Observations	91
Pseudo R-Squared	0.359

Notes: This table presents the cross-sectional probit estimation performed to obtain propensity scores. The dependent variable is *Treated* taking the value of one for the set of treated banks. The set of control variables are 2018Q1 values of bank-level *Deposit Funding*, *Provisions*, *Operating Efficiency*, *Liquidity*, *Dividends* and *Derivatives*. Detailed variable definitions are available in Tables 1 and A1. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

via placebo tests and dynamic treatment effects.

Initially, we employ a number of different placebo tests. 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 (17) 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 (18) suggest that the pseudo interaction coefficient obtained from this placebo test is insignificant. In the third and final placebo test, we employ the universe of US BHCs below $50 billion asset size and assign a pseudo $10 billion threshold to designate a shift in regulatory oversight. The coefficient presented in row (19) is insignificant and of smaller magnitude - once again emphasizing the internal validity of our findings.

Fig. 1 plots an augmented version of Eq. (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 lag effects in the post-treatment interval. These findings together with placebo tests hint that the parallel trends assumption is supported in our empirical setting.

3.3. *Underlying Mechanisms*

3.3.1. *Impact of a Reduction in Regulatory Oversight on Risk 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 amplification (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-9 C 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, respectively, aggregating the individual on- and off-balance sheet financial statement items (listed on Schedule HC-R) subject to risk-weight categorizations. We re-estimate Eq. (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.

To garner further insights regarding the portfolio re-balancing mechanism, we focus on how various loan risk exposures (measured by different risk-weight levels) change following the EGRRCPA. In order to do so, we create outcome variables $\Delta 20\%RW\_Loans$, $\Delta 50\%RW\_Loans$ and $\Delta 100\%RW\_Loans$, which represent the change in risk exposure to loans with 20%, 50% and 100% risk-weights respectively. We then re-estimate our baseline model using the aforementioned outcome variables. The findings presented in Table A6 suggest exposure of treated banks to riskier loans increases following the enactment of the EGRRCPA. Moreover, when we examine the share of different loan types (in Table A7 of the Appendix), we find that following the enactment of

Table A5
Covariate Balance Evaluation for the Matched Sample.

	(1) Unmatched			(2) Matched		
	Mean Treated (n = 20)	Mean Control (n = 71)	Difference (t-test)	Mean Treated (n = 20)	Mean Control (n = 20)	Difference (t-test)
Deposit Funding	0.5005	0.5664	-0.0659 * **	0.5005	0.5308	-0.0303
Provisions	0.1572	0.0525	0.1047 * **	0.1572	0.0811	0.0761
Operating Efficiency	0.6207	0.6130	0.0077	0.6001	0.6207	-0.0206
Liquidity	0.0669	0.0382	0.0287 * **	0.0669	0.0562	0.0107
Dividends	0.0612	0.0909	-0.0297 * *	0.0612	0.0483	0.0129
Derivatives	0.3547	0.0750	0.2797 * **	0.3547	0.1361	0.2186 *

Notes: This table presents the degree of covariate balance for the original (column (1)) and PSM-matched sample (column (2)). In both cases, mean values of set of control variables including *Deposit Funding*, *Provisions*, *Operating Efficiency*, *Liquidity*, *Dividends* and *Derivatives* are provided together with t-test of mean differences. Detailed variable definitions are available in Tables 1 and A1. * ** , * *, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table A6
The Impact of a Reduction in Regulatory Oversight on Loans Based on Allocation by Risk-Weights.

	(1) Δ20%RW_Loans	(2) Δ50%RW_Loans	(3) Δ100%RW_Loans
Post x Treated	0.0328	0.0031	0.0225 * **
	(0.0286)	(0.0135)	(0.0050)
Observations	1614	1809	1819
Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.005	0.096	0.185

Notes: This table presents the estimation results regarding the shift in risk exposure and portfolio re-balancing with respect to loans. Δ20%*RW_Loans*, Δ 50%*RW_Loans* and Δ100%*RW_Loans* representing the quarterly logarithmic growth of the loan exposures subject to 20%, 50% and 100% risk weights are the dependent variables in columns (1), (2) and (3), respectively. We control for bank and time (quarter-by-year) fixed effects. All columns include 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 A7
The Impact of a Reduction in Regulatory Oversight on Loan Portfolio.

	(1) Real Estate Loans/ Total Loans	(2) C&I Loans/ Total Loans	(3) Consumer Loans/ Total Loans
Post x Treated	-0.0233 * *	-0.0010	0.0132 * **
	(0.0106)	(0.0107)	(0.0048)
Observations	1910	1910	1910
Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Adj. R-Squared	0.982	0.958	0.990

Notes: This table presents the estimation results regarding the change in loan shares following the enactment of the EGRRCPA. *Real Estate Loans*/*Total Loans*, C&I Loans/*Total Loans* and *Consumer Loans*/*Total Loans* represent the share of real estate-backed loans, commercial and industrial loans and other consumer loans in total loan portfolio are the dependent variables in columns (1), (2) and (3), respectively. We control for bank and time (quarter-by-year) fixed effects. All columns include 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.

the EGRRCPA, treated banks reduce real-estate backed loans (which tend to be low-risk loan category given its higher level of collateralization), and increase (riskier) consumer loans.

3.3.2. *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).[27] Prior evidence suggests that the Dodd-Frank Act led to higher loan rates to borrowers and increased funding costs for banks (Balasubramnian 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 Eq. (1) including bank-level control variables. The results presented in column (1) of Table 6 suggest that the reduction in regulatory oversight leads to improved bank profitability.

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 Eq. (1) with bank-level control 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.

[27] 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) find that interventionist bank policies exacerbate the inefficiency of European banks. Hirtle et al. (2020) examine the relevance of regulatory scrutiny for US bank profitability.

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

Given the limited liability structure prevalent in the modern corporations, 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 modelled 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. Laeven and Levine (2009) demonstrate that banks controlled by large 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 favourable reaction to the increased risk and profitability of BHCs following the EGRRCPA. We analyse 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 favourable perception of enhanced risk and increased profitability.[28]

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 the 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 placed on large (as well as small) banks. Consequently, in (part) 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 analyse 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, modelling 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 consequence of increasing individual and systemic bank risk.

Appendix

See Appendix Tables A1–A7.

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[28] To understand the short-term market reaction to the dissemination of information about EGRRCPA, we implement an event study analysis straddling November 16, 2017 when the proposed legislation was introduced to the US Senate. By estimating a risk-adjusted market model for treated banks and using a three-day window around the event date, we obtain the statistically significant cumulative average abnormal return of 0.44% suggesting favourable stock market reaction regarding the impact of the EGRRCPA on affected banks' market value. However, our analysis so far does not aim to address welfare reducing/improving effects from a general equilibrium perspective given that such an investigation is beyond the scope of this paper.

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