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Internal Capital Markets and Macroprudential Policy Lessons from the 2007–2009 Crisis

Nilufer Ozdemir

Department of Economics and Geography, Cogging College of Business, The University of North Florida,
Jacksonville, FL 32224, USA; n.ozdemir@unf.edu; Tel.: +1-(904)-620-2640

Abstract

Financial regulation assumes that parent firms reliably support distressed subsidiaries during crises. We test this assumption with evidence from the 2007–2009 financial crisis and find that parent support was selective rather than reliable. Using novel measures of sibling distress and granular parent-affiliate funding flows, our findings reveal that capital allocation within bank holding companies (BHCs) disproportionately favored stronger affiliates. The results show that BHCs channeled capital toward more liquid and resilient subsidiaries while limiting support to weaker ones. Profitable parents became increasingly selective under stress, and nonbank subsidiaries emerged as critical internal liquidity providers when external markets froze. This selective reallocation highlights a gap between regulatory doctrine and actual behavior: intra-group capital allocation mechanisms can amplify systemic stress rather than mitigate it. By examining overlooked internal market dynamics during this major financial crisis, the study offers insights for strengthening financial stability against future systemic shocks. Assessing parent firm strength alone appears insufficient. Effective crisis prevention requires supervisory frameworks that monitor sibling fragility across conglomerates, evaluate the liquidity roles of nonbank affiliates, and stress test intra-group capital flows.

Keywords: internal capital markets; bank holding companies; financial crisis; financial regulation; macroprudential policy; financial stability; source of strength

1. Introduction

The allocation of scarce capital within financial conglomerates during times of distress is among the most consequential, yet least scrutinized, decisions in modern banking. These choices, made within the complex structures of BHCs, shape not only the survival of individual institutions but also the stability of the financial system as a whole. Regulatory frameworks are built on the premise that BHCs act as reliable “sources of strength,” stepping in to support troubled affiliates when needed. Yet despite the critical importance of these internal capital allocations, we know surprisingly little about how such decisions are actually made, particularly during crises, when institutional pressure is most acute and the consequences of inaction are most severe. This study takes up a set of fundamental questions at the center of intra-group capital dynamics: When resources are constrained, how do BHCs decide which affiliates to support? Is assistance guided by financial need, or by internal constraints, and strategic priorities?

These questions also lie at the heart of modern financial regulation. In the United States, policymakers have progressively strengthened the framework governing internal capital allocation. The [Financial Institutions Reform, Recovery, and Enforcement Act \(1989\)](#)



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introduced cross-guarantee liability, making parent companies responsible for the financial health of affiliated depository institutions. The Dodd-Frank Act of 2010 ([Dodd-Frank Wall Street Reform and Consumer Protection Act, 2010](#)) formally codified the source-of-strength doctrine, extending these obligations to nonbank holding companies and requiring periodic assessments of each holding company's capacity to support subsidiaries.

These regulatory developments parallel broader international efforts to strengthen macroprudential oversight of financial conglomerates. The Basel Committee ([Basel Committee on Banking Supervision, 2012](#)) has emphasized group-wide supervision and intra-group exposures, while European banking union reforms have focused on consolidated supervision and resolution mechanisms ([Schoenmaker & Véron, 2016](#)). Cross-country evidence suggests that internal capital market oversight effectiveness varies substantially across jurisdictions, with regulatory architecture and enforcement credibility playing critical roles ([Fecht et al., 2012](#)). Understanding how capital is allocated within financial conglomerates is thus a priority for macroprudential authorities worldwide. Whether BHCs actually allocate capital in accordance with these regulatory expectations remains an open empirical question and the central focus of this paper.

Complementing this regulatory evolution, a rich theoretical literature has explored why organizational capital allocation may function imperfectly and thus deviate from regulatory expectations. [Stein \(1997\)](#) argues that parent companies often struggle to allocate capital efficiently, particularly when faced with internal competition or organizational complexity. Building on this foundation, [Wang \(2022\)](#) shows that firms may shift among different capital allocation approaches, ranging from performance-based reinforcement to strategic favoritism or uniform distribution, in response to internal constraints and external pressures such as financial distress or capital scarcity.

Early empirical studies have confirmed these theoretical predictions. [Campello \(2002\)](#), [Houston et al. \(1997\)](#), and [Scharfstein and Stein \(2000\)](#) demonstrate how agency frictions, informational asymmetries, and liquidity constraints can distort capital allocation within conglomerates. [Almeida et al. \(2004\)](#) further show that financially constrained firms rely more heavily on internal cash flows, suggesting internal markets often fail to deliver capital where it is most needed. Recent work by [Lu et al. \(2024\)](#) deepens this view, documenting how liquidity within large BHCs moves sluggishly over short horizons—undermining the promise of centralized liquidity management. International evidence reinforces these findings: [Cetorelli and Goldberg \(2012a\)](#) document how global banks manage liquidity through internal capital markets during stress, while [de Haas and van Lelyveld \(2010, 2014\)](#) show that multinational banks adjust credit supply across countries through internal capital reallocation, with effects varying by host country regulatory environment and parent bank strength.

While this extensive body of work has advanced our understanding of internal capital market inefficiencies, existing studies have largely overlooked two critical dimensions that may fundamentally shape internal capital allocation decisions. First, most studies focus on bilateral parent-subsidiary relationships without considering how the financial health of sibling banks within the same BHC affects resource allocation. Second, the literature provides limited insight into the directional flow of resources between parents and their subsidiaries, particularly the role of nonbank entities in internal capital management.

To address these gaps, our analysis advances the literature through three key innovations that examine the hidden mechanics of internal capital markets. First, we develop a novel “distressed sibling share” measure that quantifies how much of a BHC's banking assets are tied to financially vulnerable affiliates. This metric reveals whether internal support depends not only on a bank's own condition but on the collective health of its organizational family. Second, we construct comprehensive measures of internal funding flows

that trace the actual movement of capital between parents and their bank and nonbank subsidiaries, providing the first direct evidence of how group-level liquidity dynamics shape individual bank support. Third, we employ a segmented approach that separately analyzes distressed and healthy banks across crisis and normal periods, thereby revealing how resource allocation strategies adapt under resource constraints. Our approach builds on recent methodological advances in analyzing financial conglomerate behavior such as [Eisfeldt and Shi \(2018\)](#) and [Giannetti and Saidi \(2018\)](#).

We apply these methods to examine behavior during the subprime mortgage crisis, which provides an exceptional laboratory for testing these dynamics under extreme pressure. This period witnessed the collapse of over 300 financial institutions, creating a rare window into how internal capital markets function when survival is at stake. The crisis exposed fundamental vulnerabilities in financial conglomerates: organizational complexity that obscured risk, opacity that hindered decision-making, and liquidity pressures that forced stark choices about resource allocation.

The relevance of our research questions extends beyond the 2007–2009 crisis. Recent banking sector stress, including the 2023 failures of Silicon Valley Bank and First Republic Bank, underscores the continued importance of understanding intra-group capital allocation under acute stress. We focus our analysis on the 2007–2009 period because it provides the last major systemic episode with sufficient bank failures and granular data for rigorous statistical analysis. The mechanisms we identify—sibling fragility effects, intra-group capital flow dynamics, and selective support patterns—represent general features of internal capital markets likely to operate across different regulatory environments, including the post-Dodd-Frank framework with its strengthened supervisory requirements.

Our findings paint a nuanced picture of internal capital markets operating more strategically than as simple support mechanisms. Support disproportionately flows towards larger, more liquid, and better-capitalized affiliates. Conversely, weaker banks, particularly those within fragile sibling networks, are less likely to receive capital injections. Capital support also diminishes when the parent BHC becomes a net borrower from its subsidiaries. Perhaps most revealing is the increasing role of nonbank subsidiaries as internal liquidity providers, a dynamic that becomes especially crucial during crises.

2. Data and Methods

2.1. Data

This study draws on a rich and integrated dataset constructed from multiple regulatory sources, allowing for a detailed analysis of capital allocation within BHCs during the pre-crisis and crisis period. The primary source is the Call Reports obtained from the dataset compiled by [Drechsler et al. \(2017\)](#). This dataset serves as the foundation for measuring key bank-level variables which are factors that influence a bank's need for and access to internal capital.

Complementing the bank-level data, the study incorporates FR Y-9LP and FR Y-9SP filings, which capture consolidated financial information at the BHC level. These reports are crucial for identifying group-level structures and financial conditions, including total BHC assets, equity levels, and net income, as well as enabling the construction of variables such as net transfers between the parent and its subsidiaries. FR Y-9LP and FR Y-9SP reporting forms and related documentation are publicly available from the Board of Governors of the Federal Reserve System (Washington, DC, USA). All statistical analyses were conducted using Stata 18 (StataCorp LLC, College Station, TX, USA).

Analysis is performed for all affiliated banks across two periods: the pre-crisis years (2006–2007) and the crisis period (2008–2010). The literature typically examines the two years preceding a crisis to analyze institutional vulnerabilities and behavioral changes in

banks (Berger & Bouwman, 2013). The pre-crisis time frame offers an ideal baseline for assessing how BHC affiliation functions as a source of strength before extreme financial stress. This period predates the full onset of the financial crisis while capturing the early signs of emerging financial stress, particularly in housing markets, credit quality, and funding liquidity. Studying this transitional period sheds light on how BHCs allocate capital in an environment of incipient stress, offering a view into the initial responses of parent companies to mounting risk.

Our crisis period is motivated by the timing of bank failures, which is central to our analysis of internal capital allocation under extreme stress. Bank failures escalated from three in 2007 to 25 in 2008, 140 in 2009, and 157 in 2010—the highest annual total since 1992 (Federal Deposit Insurance Corporation, 2025). This sharp increase contrasts with the pre-crisis period of 2001–2006, which saw only 22 total failures and zero in 2005–2006, demonstrating that the financial crisis represented a fundamental break from the preceding period of stability and validates our sample period selection. Our sample includes all banks affiliated with BHCs during 2006–2010, including both banks that survived the crisis and those that ultimately failed. Our distressed bank subsample specifically includes banks that failed during 2008–2010, allowing us to observe capital allocation patterns for troubled institutions up to the point of failure. This approach minimizes survivorship bias, as the extraordinarily low failure rate prior to 2006 means few relevant institutions are excluded from our analysis. This concentration of failures during 2008–2010 makes it the ideal window for examining how BHCs reallocate capital when institutional survival is at stake.

Having established the data foundation and period selection, we now turn to the empirical strategy for identifying how BHCs allocate capital across affiliates.

2.2. Empirical Strategy

2.2.1. Baseline Model

The empirical analysis begins with a baseline model, presented in Equation (1), which follows the methodological approach established by Ashcraft (2004). Our model adopts a similar structure, estimating CAP_{it} , a measure of capital support received by bank i at time t , using fixed-effects panel regressions. We select fixed effects over alternative panel data estimators for reasons we discuss below. The objective of this baseline is to assess how traditional bank, group and parent-level characteristics influence capital injections, providing a foundational framework for subsequent analysis that incorporates novel variables and identification strategies aimed at capturing intra-group frictions.

Our use of fixed-effects panel regressions is motivated by the need to control for time-invariant bank-level heterogeneity that may correlate with both capital injections and our explanatory variables. Bank-specific characteristics such as management quality, historical relationships with the parent, and stable institutional features are difficult to measure directly but likely influence capital allocation patterns. The fixed-effects estimator differences out these time-invariant unobservables, identifying effects from within-bank variation over time. We include both bank fixed effects to absorb persistent bank-specific factors and quarter fixed effects to control for common macroeconomic and regulatory shocks affecting all banks in each period.

To formally test the appropriateness of fixed effects versus random effects, we conduct Hausman (1978) specification tests comparing our baseline fixed-effects model to random-effects alternatives. The tests strongly reject the null hypothesis that unobserved bank heterogeneity is uncorrelated with our regressors (χ^2 statistics ranging from 50 to 120 across specifications, $p < 0.01$ in all cases), supporting the fixed-effects specification. This result is consistent with time-invariant bank characteristics that are correlated with both capital

injections and our key regressors. Fixed effects address this concern through within-bank differencing.

We address potential panel data complications through clustered standard errors. Standard errors are clustered at the bank level to account for serial correlation in the error term within banks over time (Wooldridge, 2002). The combination of fixed effects, clustered standard errors, and instrumental variables provides a robust framework for identifying causal relationships in our panel data setting.

Our baseline specification is:

$$CAP_{it} = \alpha_0 + \alpha_1 \text{Bank-level}_{it} + \alpha_2 \text{Group-level}_{it} + \alpha_3 \text{Parent-level}_{it} + \mu_{it} \quad (1)$$

where CAP_{it} measures parent-to-bank capital injections scaled by bank capital for bank i in period t , Bank-level_{it} captures bank-specific characteristics, Group-level_{it} captures group-specific characteristics, Parent-level_{it} captures parent company characteristics and μ_{it} is the error term.

We analyze three distinct definitions of CAP_{it} , again following the approach of Ashcraft (2004). The first, presented in Column (1) of the regression tables, is total capital injection, defined as the sum of capital received from the parent company and capital raised through net stock issuance. The second measure, shown in Column (2), includes only capital injections from the parent, such as direct equity infusions by the BHC. The third, reported in Column (3), captures net stock sales, representing capital raised externally through equity issuance. By construction, the first measure equals the sum of the second and third. All dependent variables are expressed as a share of the bank's existing capital, allowing for proportional comparisons across institutions of varying size and capital structure. This framework captures how parent companies allocate capital and highlights the differing roles of internal and external funding sources during periods of financial stress.

Bank-level controls account for bank-specific financial and structural characteristics. These include EQUITY, the bank's equity-to-assets ratio, measuring capital adequacy; LLR (loan loss reserves relative to total loans), indicating provisioning for expected credit losses and potential risk exposure; NPA (nonperforming assets to total assets), a direct measure of asset quality and financial health; SECURITY, the share of securities in total assets, capturing balance sheet composition and potential risk exposures; BD (brokered deposits ratio), signaling dependence on non-core funding sources and potential liquidity pressures; CASH (cash-to-assets ratio), reflecting readily available liquidity; ROA (return on assets), a measure of profitability and internal funding capacity; and LNSIZE (log of bank assets), controlling for bank size.

Group-level control variables capture structural aspects of the group. These variables include COUNTER, which represents the number of bank subsidiaries within the holding company and reflects potential complexity or competition for internal capital among affiliated banks; and MBHC, a dummy variable taking a value of one if a bank is part of a BHC with more than one bank affiliate and zero otherwise, controlling for the multi-bank structure of the BHC.

Parent-level control variables capture the broader financial condition and capacity of the parent firm itself. These include BHCEQUITY, the parent's equity-to-assets ratio, measuring the overall capitalization of the holding company; LNBHCSIZE, the log of total parent holding company assets, proxying for the size and complexity of the parent organization; and BHCNETINC, the net income of the parent holding company scaled by assets, reflecting the parent's overall profitability (For variable definitions, see Appendix A).

2.2.2. Augmented Model

The baseline model focuses on structural and balance sheet characteristics but does not explicitly account for interactions within the BHC network. We address this limitation by incorporating two key intra-group allocation frictions that may fundamentally shape allocation decisions within multi-entity financial organizations.

First, we examine peer fragility effects. While prior literature has examined bilateral parent-subsidiary relationships (Ashcraft, 2004; Campello, 2002), leaving the role of sibling bank health largely unexplored. Corporate finance research demonstrates that resource allocation within conglomerates depends on the relative performance of different divisions (Matvos & Seru, 2014; Shin & Stulz, 1998; Santioni et al., 2020), suggesting that bank subsidiaries similarly compete for scarce internal capital based on both their own condition and that of their peers.

Second, we analyze strategic internal fund flows by introducing measures that capture the net financial position of parents relative to their banking and nonbank subsidiaries. Prior research demonstrates that financial conglomerates actively manage liquidity through internal transfers (Cetorelli & Goldberg, 2012a; de Haas & van Lelyveld, 2010), with crisis periods intensifying this strategic reallocation (Acharya et al., 2017a). Nonbank affiliates may serve as particularly important internal liquidity sources during stress (Matvos & Seru, 2014).

$$\text{CAP}_{it} = \alpha_0 + \alpha_1 \text{Bank-level}_{it} + \alpha_2 \text{Group-level}_{it} + \alpha_3 \text{Parent-level}_{it} + \alpha_4 \text{Distressed Sibling Share}_{it} + \alpha_5 \text{BANK TRANS}_{it} + \alpha_3 \text{NONBANK TRANS}_{it} + \mu_{it} \quad (2)$$

The augmented model in Equation (2) operationalizes these concepts through specific variable construction. First, we incorporate the distressed sibling share, which measures the proportion of affiliated sibling assets held by financially fragile institutions. We define a bank as financially distressed if it either failed during the crisis period or meets the “technical failure” criteria of Cole and White (2012), where the sum of equity and loan loss reserves falls below half of nonperforming assets.

Second, we introduce BANKTRANS_{it} and NONBANKTRANS_{it}, which capture the net financial position of the parent BHC with its banking and nonbank subsidiaries, respectively. BANKTRANS_{it} is calculated as the difference between amounts due to and amounts due from bank subsidiaries, scaled by total BHC assets. A positive value indicates that the parent is a net borrower from its banks, reflecting upward capital flows that may signal internal liquidity stress or centralized cash management. NONBANKTRANS_{it} is constructed analogously for nonbank subsidiaries. These measures reflect strategic liquidity management within BHCs, where parent companies may extract funds from banks or rely on nonbank affiliates as liquidity buffers. Prior research demonstrates that financial conglomerates actively manage liquidity through internal transfers (Cetorelli & Goldberg, 2012a; de Haas & van Lelyveld, 2010), with such reallocation intensifying during stress periods (Behn et al., 2022). While prior work has focused primarily on bank-to-parent flows, our inclusion of NONBANKTRANS builds on Matvos and Seru (2014), who show that nonbank affiliates can serve as crucial internal liquidity sources during crises.

Ashcraft (2004), which treats all explanatory variables as exogenous, we acknowledge that three variables in our augmented model may suffer from endogeneity: the distressed sibling share, BANK TRANS_{it}, and NONBANK TRANS_{it}. The distressed sibling share may reflect strategic capital allocation decisions rather than being purely exogenous to them. More critically, BANK TRANS_{it} and NONBANK TRANS_{it} present bidirectional causality concerns: parents may adjust internal fund flows in response to capital allocation decisions, or capital injections may themselves be influenced by the net financial position of the parent relative to its subsidiaries. This simultaneity presents a form of time-varying endogeneity, as contemporaneous shocks may affect both capital injections and internal fund flows.

Our instrumental variable strategy using lagged instruments specifically addresses this time-varying bias by isolating the predetermined component of the endogenous variables.

To address these concerns, we employ instrumental variables estimation using a two-stage least squares (2SLS) framework with multiple endogenous regressors. Our instrument set is designed to satisfy both relevance (instruments must be correlated with the endogenous variables) and the exclusion restriction (instruments must affect capital injections only through the endogenous variables, not directly).

For the distressed sibling share, we use lagged financial characteristics of distressed siblings—specifically, their real estate loan share, MBS holdings, equity ratio, securities ratio, brokered deposit reliance, and nonperforming asset ratio. These predetermined characteristics capture persistent financial vulnerability while mitigating simultaneity bias (Angrist & Pischke, 2009).

For BANK TRANS_{it}, we instrument using the second and third lags of the variable itself, along with the lagged parent cash-to-assets ratio. The lagged values are predetermined and highly relevant predictors of current transfers, while the parent's lagged cash position captures the underlying capacity for internal fund management independent of current capital allocation decisions.

For NONBANK TRANS_{it}, we employ the second and third lags of the variable and the lagged share of nonbank assets in total BHC assets. The lagged nonbank asset share captures the structural capacity of nonbank subsidiaries to serve as internal liquidity providers—a feature determined by the BHC's organizational composition rather than by immediate capital allocation needs.

We also considered using aggregate financial conditions, such as changes in the federal funds rate and the CBOE Volatility Index (VIX), as instruments given their relevance for parent funding costs and nonbank subsidiary conditions. However, these variables—whether contemporaneous or lagged—vary only over time and lack cross-sectional variation. With quarter fixed effects absorbing all time-varying macroeconomic conditions, aggregate variables cannot provide additional identifying variation even when lagged. Identification therefore relies on cross-sectional and lagged bank- and BHC-level instruments, which provide both sufficient variation within quarters and plausible exclusion restrictions.

The more challenging condition for valid instruments is the exclusion restriction—that instruments affect capital injections only through the endogenous variables, not directly. Our instrument design exploits temporal and cross-sectional separation to support this restriction. For distressed sibling characteristics, one-quarter-lagged characteristics of other banks (siblings j) reflect their ex-ante vulnerability before the current capital allocation decision to focal bank i . These lagged sibling characteristics should not directly determine current capital flows to bank i except through their impact on the competitive landscape for internal capital—the mechanism we aim to identify. For BANK TRANS_{it} and NONBANK TRANS_{it} instruments, the temporal distance of two- and three-quarter lags provides separation from current decisions, while lagged parent cash holdings and nonbank asset share capture structural capacity that evolves slowly due to regulatory requirements and business model considerations, distinct from discretionary quarter-to-quarter capital allocation. Our comprehensive controls (current bank fundamentals, parent variables, quarter fixed effects) absorb the most obvious direct pathways through which instruments might affect capital injections, leaving the intended indirect channels through the endogenous variables.

Our instrumental variables strategy addresses endogeneity through four key safeguards: (1) Bank fixed effects control for persistent bank-specific characteristics, (2) quarter fixed effects absorb all time-varying macroeconomic and regulatory conditions, (3) comprehensive bank-level controls capture direct exposures, and (4) lagged rather than contemporaneous instruments reduce simultaneity. The Hansen J-test supports instrument

validity across all specifications (p -values 0.28–0.73). Our approach follows established methods in banking research: [Houston et al. \(1997\)](#) and [Campello \(2002\)](#) use lagged organizational and balance sheet characteristics as instruments, arguing that persistence combined with appropriate controls satisfies the exclusion restriction. We extend these precedents with multiple instrument sets tailored to different endogenous variables and extensive first-stage diagnostics.

First-stage diagnostics, reported at the bottom of tables confirm the strength and validity of our instruments. As detailed in those tables, Sanderson–Windmeijer F-statistics for the three endogenous variables generally exceed conventional weak instrument thresholds of 10 ([Stock & Yogo, 2005](#)), with two marginal exceptions, 9.97 and 9.243 that do not materially affect interpretation. The Kleibergen–Paap Wald F-statistics exceed the 10% critical values, and Hansen J-tests support instrument validity (p -values > 0.25). All specifications include bank and quarter fixed effects, with comprehensive time-varying controls at the bank, parent, and internal capital market levels as described in Section 2.2.1. Standard errors are clustered at the bank level throughout.

2.2.3. Segmented Samples

The augmented model in Equation (2) incorporates group-level frictions that may influence capital allocation. We extend this framework by examining whether internal capital market dynamics operate differently for banks with varying financial health. Analyzing segmented samples is a standard approach in applied economics for uncovering heterogeneous effects across key dimensions, for example, by gender in labor studies ([Kleven et al., 2023](#); [Albanesi, 2019](#)) or by health status in healthcare research ([Okediji et al., 2017](#)). This segmentation allows us to identify whether these allocation frictions operate differently depending on subsidiary health status—a dimension that pooled regressions would obscure.

Several theoretical streams predict that capital allocation operates through fundamentally different mechanisms for distressed versus healthy subsidiaries. Agency and bargaining power theories ([Scharfstein & Stein, 2000](#); [Rajan et al., 2000](#)) suggest that distressed subsidiaries have weak bargaining positions due to immediate resource needs, while healthy subsidiaries retain stronger bargaining positions due to credible outside options. Financial constraints literature ([Almeida et al., 2004](#); [Campello, 2002](#)) demonstrates that allocation shifts from efficiency-maximizing to survival-focused under distress. Selective intervention theory ([Boot et al., 1993](#); [Berger et al., 2014](#)) suggests parents engage in selective support based on salvageability, inherently implying different treatment of distressed versus healthy subsidiaries. [Ozdemir and Altinoz \(2018\)](#) further show that capital allocation within BHCs varies systematically with subsidiary health and size.

This segmentation directly addresses whether BHCs allocate capital selectively based on subsidiary characteristics or reliably support all troubled affiliates as regulatory frameworks assume. Financial health is the theoretically optimal dimension because it directly measures need for internal capital market assistance—the fundamental question in evaluating whether these mechanisms function as safety nets or operate selectively. Our approach follows established precedents: [Houston et al. \(1997\)](#) segment banks by regulatory status, while [Berger et al. \(2014\)](#) and [Campello \(2002\)](#) analyze banks separately by financial condition to identify differential behavior patterns.

We classify banks as distressed if they either failed during the crisis period or meet the “technical failure” criteria of [Cole and White \(2012\)](#), where the sum of equity and loan loss reserves falls below half of nonperforming assets. This definition captures vulnerability to failure rather than just realized failure, incorporates capital adequacy relative to credit risk, and approximates regulatory intervention triggers. Banks not meeting these criteria

are classified as healthy. This binary classification reflects natural thresholds in regulatory treatment and market perceptions—banks crossing distress thresholds face heightened regulatory scrutiny, restricted activities, and potential resolution, creating qualitatively different operating environments.

Our distressed bank subsample comprises 35 banks that actually failed during 2008–2010 and 89 banks that remained operating but met the [Cole and White \(2012\)](#) technical distress criteria, where equity plus loan loss reserves fell below half of nonperforming assets. Failed banks represent 22.0% of distressed bank-quarter observations. By construction, this subsample exhibits more extreme values than healthy banks on certain financial metrics. Distressed banks have substantially higher nonperforming assets (mean = 11.90%, with 728 observations exceeding 10% of assets), lower equity ratios (mean = 7.23%, with 84 observations below the 2% critically undercapitalized threshold), and higher loan loss reserves (mean = 0.87%). These extreme values reflect genuine financial distress rather than data errors or outliers requiring exclusion. Notably, our key findings—particularly the disappearance of the distressed sibling share effect during the crisis and the strong MBHC coefficient (0.55, $p < 0.01$)—are not confined to failed banks alone. Since failed banks represent only 22.0% of distressed bank-quarter observations, the statistical significance of these results indicates that the patterns extend to technically distressed banks that survived the crisis, suggesting systematic capital allocation mechanisms for financially stressed institutions rather than idiosyncratic outcomes driven by bank failures.

Section 3.3 demonstrates that internal capital market frictions operate differently across these groups in both magnitude and statistical significance, validating our segmentation approach.

3. Results

Having detailed our empirical strategy, we now turn to the empirical results of our analysis. Section 4 presents the findings from both our baseline and augmented models, with a clear distinction between the pre-crisis and crisis periods to highlight the impact of financial distress on internal capital allocation.

3.1. Baseline Model Results

Tables 1 and 2 present fixed-effects regressions of the baseline model for the pre-crisis and crisis periods, using three definitions of capital injection: (1) total capital inflows, (2) direct transactions with the parent, and (3) net stock issuance.

Table 1. Baseline Model Capital Injection Regressions (2006–2007).

	(1)		(2)		(3)	
	Total Cap Inj		Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.04 ***	0.01	0.02 ***	0.01	0.02 ***	0.00
COUNTER	−0.00	0.00	0.00	0.00	−0.00 **	0.00
EQUITY	0.27	0.46	−0.12	0.41	0.39 ***	0.14
LLR	1.96 **	0.95	1.47	0.92	0.49	0.45
NPA	0.09	0.16	0.16	0.16	−0.08	0.06
SECURITY	0.01	0.06	0.00	0.06	0.01	0.01
BD	−0.10	0.10	−0.03	0.08	−0.07	0.07

Table 1. *Cont.*

	(1)		(2)		(3)	
	Total Cap Inj		Trans. with Parent		Net Sale of Stock	
CASH	−0.12	0.16	−0.14	0.17	0.03	0.04
ROA	−0.30	0.65	−0.02	0.63	−0.28	0.17
LNSIZE	0.11 ***	0.02	0.10 ***	0.02	0.02 *	0.01
BHCEQUITY	0.16	0.32	0.18	0.29	−0.02	0.09
LNBHCSIZE	−0.01	0.01	−0.00	0.01	−0.01 *	0.00
BHCNETINC	−0.79 *	0.42	−0.95 **	0.43	0.16	0.15
Constant	−1.35 ***	0.29	−1.20 ***	0.28	−0.15	0.12
Time dummies	Yes		Yes		Yes	
N	12,593		12,593		12,593	
pseudo_r2	0.06		0.08		0.06	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 2. Baseline Model Capital Injection Regressions (2008–2010).

	(1)		(2)		(3)	
	Total Cap Inj		Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.05 **	0.02	0.06 **	0.02	−0.01 *	0.01
COUNTER	−0.01	0.01	−0.01	0.01	−0.00	0.00
EQUITY	0.36	0.36	0.04	0.21	0.32	0.21
LLR	0.04	1.39	0.65	1.26	−0.61	0.58
NPA	0.80	0.49	0.21	0.25	0.59 *	0.36
SECURITY	−0.04	0.09	−0.06	0.07	0.02	0.04
BD	−0.19	0.13	−0.20	0.13	0.01	0.04
CASH	0.15 *	0.08	0.10	0.08	0.05	0.06
ROA	0.13	0.50	−0.06	0.37	0.19	0.31
LNSIZE	0.12	0.08	0.14 *	0.07	−0.02	0.03
BHCEQUITY	0.38	0.26	0.19	0.17	0.19	0.24
LNBHCSIZE	0.01	0.02	0.01	0.01	0.00	0.01
BHCNETINC	−2.29 ***	0.61	−1.89 ***	0.59	−0.40 **	0.20
Constant	−1.77 *	0.95	−1.95 **	0.87	0.18	0.26
Time dummies	Yes		Yes		Yes	
N	16,897		16,897		16,897	
pseudo_r2	0.05		0.06		0.02	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Several variables show stable effects across both periods. MBHC remains consistently positive and significant, indicating that multi-bank affiliation facilitates capital access even under systemic stress. Bank size (LNSIZE) positively predicts capital flows, though this

effect weakens during the crisis. Most notably, BHCNETINC exhibits strong negative coefficients in both periods, with the effect prevailing during the crisis. This suggests profitable BHCs systematically reduce internal support, possibly redirecting resources toward dividends or nonbank investments—a pattern consistent with strategic rationing theories.

The crisis period reveals important shifts in allocation patterns. NPA becomes positively associated with external capital raising, indicating that banks with deteriorating credit quality sought precautionary funding. CASH gains significance for total capital injections, suggesting liquid banks were better positioned during the crisis. Conversely, traditional size advantages eroded—LNSIZE effects became marginal or disappeared entirely, potentially reflecting system-wide constraints that neutralized individual bank advantages.

These results are consistent with Ashcraft (2004), particularly regarding the facilitating role of multi-bank affiliation and size-based capital allocation. However, our crisis period analysis reveals that systemic stress fundamentally alters the relative importance of different bank characteristics, with traditional advantages like size becoming less predictive of internal support access.

3.2. Augmented Model Results

The augmented model introduced in Equation (2) advances the analysis by incorporating two key features of internal capital markets that the Ashcraft (2004) framework does not explicitly capture: (1) peer fragility, measured through the Distressed Sibling Share, and (2) liquidity transfers between the parent and its bank and nonbank subsidiaries. This framework also addresses endogeneity concerns through IV estimation.

Table 3 presents IV estimates for the pre-crisis period. The augmented model reveals significant internal capital market frictions even during the pre-crisis period. Most notably, the distressed sibling share exhibits a negative effect on both total capital injections and parent transactions. This finding demonstrates that the presence of financially fragile affiliates constrains capital support to other banks within the same BHC, suggesting competitive dynamics for scarce internal resources.

Table 3. Augmented Model Capital Injection Regressions (2006–2007).

	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.04 **	0.02	0.03 *	0.02	0.01 **	0.00
COUNTER	−0.00 *	0.00	−0.00	0.00	−0.00	0.00
EQUITY	−0.90	0.82	−1.03	0.80	0.13 *	0.08
LLR	0.77	1.07	1.03	1.11	−0.27 **	0.13
NPA	0.42 **	0.20	0.39 *	0.21	0.03	0.04
SECURITY	0.04	0.07	0.04	0.07	0.00	0.02
BD	−0.08	0.12	0.04	0.11	−0.12 *	0.07
CASH	0.12	0.19	0.14	0.19	−0.02	0.03
ROA	1.69	1.29	1.79	1.28	−0.11	0.08
LNSIZE	0.13 ***	0.05	0.12 ***	0.04	0.02	0.02
BHCEQUITY	0.85 *	0.51	0.84 *	0.49	0.01	0.11
LNBHCSIZE	0.00	0.03	0.00	0.03	−0.00	0.00

Table 3. Cont.

	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
BHCNETINC	−1.82 ***	0.69	−1.81 **	0.71	−0.00	0.12
DISTRESSED SIBLING SHARE	−0.83 *	0.50	−0.78 *	0.45	−0.05	0.37
BANK TRANS	−31.58 *	19.00	−32.04 *	18.06	0.46	0.73
NONBANK TRANS	6.84	7.42	6.91	7.45	−0.06	0.42
N	10,589		10,589		10,589	
R2	0.07		0.06		0.02	
Time dummies	Yes		Yes		Yes	
Sanderson- Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	15.20 ***		15.20 ***		15.20 ***	
BANK TRANS	22.85 ***		22.85 ***		22.85 ***	
NONBANK TRANS	10.22 ***		10.22 ***		10.22 ***	
Kleibergen-Paap Wald F-statistic	13.52		13.52		13.52	
(Stock-Yogo 10% critical value)	10.01		10.01		10.01	
Hansen J-statistic (<i>p</i> -value)	8.91 (0.45)		7.856 (0.55)		10.95 (0.28)	
Underidentification test (<i>p</i> -value)	0.00		0.00		0.00	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

BANK TRANS shows a large negative coefficient, which is marginally significant, indicating that when parents extract net funds from banking subsidiaries, they simultaneously reduce capital injections to individual banks. This pattern is consistent with centralized liquidity management and supports theories of internal capital market distortions under resource constraints. In contrast, NONBANK TRANS remains statistically insignificant, suggesting that nonbank subsidiaries operated largely independently from bank capital allocation decisions during normal economic conditions.

Table 4 provides the results for the augmented model for the crisis period. While coefficient significance shifts for several controls under system-wide stress, some relationships persist across periods. In particular, better-capitalized banks continue to exhibit systematically different capital support outcomes, and NPA remains a significant predictor of net stock issuance (Column 3). Likewise, the size advantage observed in normal times disappears in both models during the crisis, suggesting that system-wide stress neutralized the scale-related benefits healthy banks typically enjoy.

Table 4. Augmented Model Capital Injection Regressions (2008–2010).

	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.11 **	0.05	0.11 **	0.05	−0.00	0.01
COUNTER	−0.01	0.01	−0.01	0.01	0.00	0.00
EQUITY	0.14	0.26	−0.09	0.23	0.23 *	0.13
LLR	−1.42	1.21	−0.58	0.80	−0.84	0.94
NPA	0.08	0.42	−0.30	0.42	0.38 **	0.16
SECURITY	−0.04	0.09	−0.06	0.09	0.02	0.02
BD	−0.39 **	0.17	−0.40 **	0.18	0.01	0.03
CASH	0.20	0.15	0.20	0.15	−0.00	0.06
ROA	0.37	0.54	0.18	0.45	0.19	0.29
LNSIZE	0.21	0.17	0.19	0.16	0.02	0.02
BHCEQUITY	0.43	0.28	0.20	0.26	0.22	0.28
LNBHCSIZE	0.05	0.09	0.03	0.09	0.01	0.03
BHCNETINC	−2.68 ***	0.81	−2.32 ***	0.78	−0.35	0.22
DISTRESSED SIBLING SHARE	−0.83 **	0.35	−0.64 **	0.31	−0.19	0.15
BANK TRANS	0.02	2.40	0.47	2.38	−0.44	0.34
NONBANK TRANS	0.37 **	0.18	0.26 **	0.10	0.11	0.12
Wald Test Chi2(3)	13.99 ***		11.45 ***		7.11 *	
N	14,627		14,627		14,627	
R2	0.09		0.09		0.03	
Time dummies	Yes		Yes		Yes	
Sanderson- Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	16.64 ***		16.64 ***		16.64 ***	
BANK TRANS	53.26 ***		53.26 ***		53.26 ***	
NONBANK TRANS	534.88 ***		534.88 ***		534.88 ***	
Kleibergen-Paap Wald F-statistic	14.34		14.34		14.34	
(Stock-Yogo 10% critical value)	10.01		10.01		10.01	
Hansen J-statistic (p-value)	7.132 (0.62)		6.59 (0.68)		6.11 (0.73)	
Underidentification test (p-value)	0.00		0.00		0.00	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Crisis-period results confirm that profitable parents (BHCNETINC) remain selective in providing support, while well-capitalized banks retain access to external funding and riskier banks face both external and internal funding constraints. This persistent selectivity

during crisis periods underscores that allocation decisions reflect parent-level strategic priorities rather than subsidiary needs alone.

The results also reveal how the crisis period affected internal capital market dynamics. While the distressed sibling share continues to exhibit a negative and highly significant effect, the crisis brings notable shifts in other dimensions. BANK TRANS is not statistically significant during the crisis period across all specifications. One possible explanation is that the effect of peer fragility overwhelmed liquidity-based considerations, or that internal fund flows became more volatile and less predictive of capital allocation during the height of the crisis.

During the crisis period, nonbank subsidiaries show a markedly different pattern. NONBANK TRANS becomes positive and highly significant, indicating that nonbank affiliates transformed from passive entities into active liquidity providers for banking operations. This represents a fundamental reconfiguration of internal capital flows—nonbank subsidiaries began serving as internal liquidity buffers, supporting bank affiliates when external funding markets tightened.

The economic magnitude of these effects is substantial. The distressed sibling share coefficient of -0.83 (Tables 3 and 4) implies that a 0.1 increase in the distressed sibling share (e.g., from 0.2 to 0.3) reduces the capital-injection-to-capital ratio by 8.3 percentage points. The BANK TRANS coefficient of -31.58 (Table 3) implies even larger effects: a 0.01 increase in parent net borrowing from bank subsidiaries, measured relative to total BHC assets, reduces the capital-injection-to-capital ratio by approximately 31.6 percentage points of bank capital. The NONBANK TRANS coefficient of 0.37 (Table 4) suggests that a 0.1 increase in parent net borrowing from nonbank subsidiaries raises the capital-injection-to-capital ratio by about 3.7 percentage points, highlighting the economically meaningful role of nonbank affiliates as internal liquidity providers during the crisis. Together, these magnitudes demonstrate that organizational capital allocation frictions exert first-order effects on subsidiary capital access rather than marginal adjustments.

To formally test whether these shifts represent statistically significant structural changes, we conduct joint Wald tests comparing the coefficients on BANK TRANS, NONBANK TRANS, and DISTRESSED SIBLING SHARE across the pre-ris and crisis periods. These tests evaluate whether the three coefficients jointly differ between periods for each of the three measures of capital support. The results, presented in Table 4, confirm significant structural breaks across all three dependent variables: total capital injections, transactions with parent, and net sale of stock. These findings provide statistical evidence that internal capital market dynamics fundamentally transformed during the crisis, with the relationships between sibling fragility, internal fund flows, and capital allocation undergoing significant structural change across all dimensions of capital support.

3.3. Segmented Sample Results

Building on the insights from our augmented model, this section examines internal capital allocation separately for distressed and healthy banks. As discussed in Section 2.2.3, this segmentation is motivated by theories predicting fundamentally different allocation mechanisms based on subsidiary financial health. We next show that the data are broadly consistent with these theoretical predictions.

The results validate this approach: the effects of distressed sibling share, BANK TRANS, and NONBANK TRANS differ substantially across subsamples in both magnitude and statistical significance. Most strikingly, during the crisis, the distressed sibling share effect disappears entirely for distressed banks while remaining strong for healthy banks. Traditional allocation determinants also show different patterns, confirming that underlying mechanisms differ by health status. These systematic differences demonstrate that pooling

would obscure critical heterogeneity in how internal capital market mechanisms operate under stress, consistent with recent evidence showing significant heterogeneity in internal support patterns during the 2020 COVID–19 stress (Carlson et al., 2022).

Before presenting the segmented results, we note the distribution of MBHC—the key dummy variable in our analysis—across subsamples to facilitate interpretation. During the crisis period, 34.6% of distressed bank-quarter observations ($N = 424$ observations) have $MBHC = 1$, compared to 57.6% of healthy bank observations ($N = 7719$ observations). This pattern is consistent with multi-bank holding companies tending to comprise larger, better-capitalized institutions. Both subsamples contain sufficient multi-bank observations to provide adequate statistical power for identifying MBHC effects. Despite distressed banks being less likely to have multi-bank affiliation, we still detect a strong, statistically significant MBHC effect for this subsample during the crisis, indicating that multi-bank structures provide valuable internal support for financially stressed institutions

3.3.1. Distressed Bank Sample Results

Table 5a reveals that internal capital market frictions become significantly pronounced when focusing solely on distressed banks. The internal funding position proves decisive—BANK TRANS exhibits highly significant negative coefficients, indicating that distressed banks are particularly vulnerable when parents extract resources from the banking network. Among control variables, EQUITY becomes strongly positive and significant, suggesting parents engage in selective reinforcement of distressed banks that retain recovery prospects. At the same time, both NPA and bank size enter positively and are statistically significant, indicating that larger distressed banks and those experiencing more severe asset quality deterioration receive greater internal support.

Table 5. (a) Distressed Banks Capital Injection Regressions (2006–2007). (b) Distressed Banks Capital Injection Regressions (2008–2010).

	(a)					
	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.01	0.00	0.00	0.00	0.00	0.00
COUNTER	0.02	0.02	0.00	0.01	0.02	0.01
EQUITY	3.47 ***	0.93	1.92 *	1.10	1.55	1.16
LLR	−1.16	1.30	−1.01	1.21	−0.15	0.29
NPA	0.64 *	0.34	0.52 *	0.30	0.12	0.10
SECURITY	0.33	0.24	0.38	0.25	−0.05	0.10
BD	0.16	0.17	0.30 *	0.16	−0.14	0.15
CASH	−0.16	0.18	−0.17	0.19	0.01	0.13
ROA	−2.74	1.98	−0.74	1.67	−2.01	1.43
LNSIZE	0.38 *	0.23	−0.04	0.14	0.42	0.27
BHCEQUITY	−0.11	0.96	0.75	0.88	−0.86	0.71
LNBHCSIZE	−0.31	0.21	0.09	0.14	−0.40 *	0.23
BHCNETINC	−3.54 **	1.50	−4.26 ***	1.28	0.72	0.93
DISTRESSED SIBLING SHARE	−2.81 *	1.71	−1.96 *	1.19	0.44	0.98
BANK TRANS	−25.85 ***	2.37	−26.93 ***	3.65	1.08	2.76
NONBANK TRANS	108.94	317.94	30.93	212.48	78.01	125.56

Table 5. Cont.

N	1002		1002		1002	
R2	0.06		0.06		0.04	
Time dummies	Yes		Yes		Yes	
Sanderson-Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	13.76 ***		13.76 ***		13.76 ***	
BANK TRANS	112.43 ***		112.43 ***		112.43 ***	
NONBANK TRANS	378.51 ***		378.51 ***		378.51 ***	
Kleibergen-Paap Wald F-statistic	14.57		14.57		14.57	
(Stock-Yogo 10% critical value)	10.01		10.01		10.01	
Hansen J-statistic (p-value)	10.89 (0.28)		11.73 (0.23)		6.33 (0.71)	
Underidentification test (p-value)	0.00		0.00		0.00	
(b)						
	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.55 ***	0.20	0.51 ***	0.19	0.03	0.06
COUNTER	−0.05 **	0.02	−0.06 **	0.03	0.00	0.00
EQUITY	−0.75	1.55	−0.39	1.61	−0.36	0.35
LLR	−3.53	2.20	−1.54	1.27	−2.00	1.85
NPA	−1.05	1.00	−1.59	1.03	0.54	0.35
SECURITY	0.07	0.39	−0.15	0.35	0.22	0.16
BD	−0.53 *	0.32	−0.66 **	0.33	0.13	0.09
CASH	−0.55	0.55	−0.22	0.44	−0.33	0.34
ROA	1.14	1.91	−0.01	1.68	1.15	1.14
LNSIZE	−0.09	0.23	−0.05	0.24	−0.05	0.05
BHCEQUITY	−0.44	0.46	−0.48	0.42	0.04	0.17
LNBHCSIZE	0.22	0.28	0.13	0.27	0.09	0.10
BHCNETINC	−3.27 **	1.57	−2.28 *	1.29	−0.98	0.96
DISTRESSED SIBLING SHARE	−1.10	1.05	−0.79	0.98	−0.32	0.39
BANK TRANS	−51.59	54.32	−12.46	46.72	−39.13	41.28
NONBANK TRANS	8.04 *	4.87	5.26 *	3.14	2.78	2.16
Wald Test Chi2(3)	12.16 **		13.37 **		6.57 *	
N	1227		1227		1227	
R2	0.25		0.29		0.07	
Time dummies	Yes		Yes		Yes	
Sanderson-Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	9.97 ***		9.97 ***		9.97 ***	
BANK TRANS	640.78 ***		640.78 ***		640.78 ***	
NONBANK TRANS	273.72 ***		273.72 ***		273.72 ***	

Table 5. *Cont.*

Kleibergen-Paap Wald F-statistic	494.77	494.77	494.77
(Stock-Yogo 10% critical value)	10.01	10.01	10.01
Hansen J-statistic (p-value)	10.88 (0.28)	8.26 (0.51)	4.15 (0.90)
Underidentification test (p-value)	0.00	0.00	0.00

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 5b reveals a striking transformation for distressed banks during the crisis. The distressed sibling share effect disappears entirely, while MBHC becomes strongly positive and COUNTER turns significantly negative, pointing to shifting competitive dynamics within distressed banking groups. BD also turns significantly negative, indicating parents became highly selective about which distressed banks received support. Most importantly, NONBANK TRANS becomes a positive predictor, confirming the crucial role of nonbank liquidity providers for distressed banks specifically.

Joint Wald tests—which evaluate whether the coefficients on BANK TRANS, NON-BANK TRANS, and DISTRESSED SIBLING SHARE jointly differ between pre-crisis and crisis periods—confirm statistically significant structural breaks across all three dependent variables. These results suggest that the mechanisms governing capital allocation to distressed banks fundamentally changed during the crisis.

3.3.2. Healthy Bank Sample Results

This section contrasts our previous findings by focusing on healthy banks, revealing how internal capital markets operate under less severe financial stress and how these dynamics evolve during a crisis.

Table 6a examines healthy banks during the pre-crisis period. Traditional structural advantages are evident—MBHC remains positive and significant, and bank size drives capital access. Notably, even healthy banks show some sensitivity to internal frictions: distressed sibling share is marginally significant for parent transactions, and BANK TRANS shows marginal significance, suggesting that internal constraints affect all banks to some degree, though less severely than for distressed institutions.

Table 6. (a) Healthy Banks Capital Injection Regressions (2006–2007). (b) Healthy Banks Capital Injection Regressions (2008–2010).

(a)						
	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.04 **	0.02	0.03 *	0.02	0.01 **	0.00
COUNTER	−0.00	0.00	−0.00	0.00	−0.00	0.00
EQUITY	−1.01	0.82	−1.08	0.80	0.07	0.05
LLR	0.58	1.34	0.79	1.33	−0.21	0.18
NPA	0.24	0.17	0.16	0.16	0.08	0.05
SECURITY	0.03	0.07	0.03	0.07	0.01	0.02

Table 6. Cont.

BD	−0.08	0.13	0.03	0.11	−0.11	0.07
CASH	0.14	0.20	0.16	0.20	−0.02	0.03
ROA	1.78	1.41	1.84	1.42	−0.07	0.06
LNSIZE	0.12 ***	0.05	0.12 ***	0.04	0.00	0.01
BHCEQUITY	0.78	0.52	0.80	0.50	−0.02	0.12
LNBHCSIZE	0.00	0.03	0.00	0.03	−0.00	0.00
BHCNETINC	−1.58 **	0.69	−1.47 **	0.68	−0.11	0.09
DISTRESSED SIBLING SHARE	−0.11 *	0.06	−0.16 *	0.09	0.27	0.20
BANK TRANS	−32.37 *	19.27	−32.50 *	19.32	0.13	0.47
NONBANK TRANS	6.93	7.26	6.69	7.24	0.24	0.32
N	9587		9587		9587	
R2	0.10		0.12		0.02	
Time dummies	Yes		Yes		Yes	
Sanderson-Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	95.22 ***		95.22 ***		95.22 ***	
BANK TRANS	26.66 ***		26.66 ***		26.66 ***	
NONBANK TRANS	9.23 ***		9.23 ***		9.23 ***	
Kleibergen-Paap Wald F-statistic	39.8		39.8		39.8	
(Stock-Yogo 10% critical value)	10.01		10.01		10.01	
Hansen J-statistic (p-value)	10.10 (0.34)		11.73 (0.23)		10.06 (0.35)	
Underidentification test (p-value)	0.00		0.00		0.00	
(b)						
	(1)		(2)		(3)	
	Total Cap Inj		Direct Trans. with Parent		Net Sale of Stock	
	b	se	b	se	b	se
MBHC	0.09 *	0.05	0.09 *	0.05	−0.00	0.01
COUNTER	0.00	0.00	0.00	0.00	0.00	0.00
EQUITY	0.44 **	0.21	0.18	0.21	0.27	0.19
LLR	0.90	0.75	0.64	0.73	0.26	0.23
NPA	0.13	0.24	−0.07	0.24	0.20 **	0.08
SECURITY	−0.02	0.09	−0.04	0.08	0.02	0.02

Table 6. Cont.

BD	−0.12	0.08	−0.10	0.08	−0.02	0.02
CASH	0.26 **	0.13	0.22	0.15	0.04	0.04
ROA	0.21	0.41	0.31	0.39	−0.10	0.11
LNSIZE	0.29	0.18	0.25	0.18	0.04	0.02
BHCEQUITY	0.71 ***	0.25	0.41	0.31	0.30	0.34
LNBHCSIZE	0.00	0.08	0.01	0.08	−0.01	0.03
BHCNETINC	−2.17 **	0.89	−1.98 **	0.89	−0.19	0.12
DISTRESSED SIBLING SHARE	−0.49 ***	0.18	−0.46 **	0.18	−0.04	0.10
BANK TRANS	0.02	2.31	0.42	2.35	−0.40	0.30
NONBANK TRANS	0.35 **	0.16	0.25 **	0.11	0.10	0.10
N	13,400		13,400		13,400	
R2	0.15		0.13		0.07	
Wald Test Chi2(3)	14.22 ***		10.34 **		6.51 *	
Time dummies	Yes		Yes		Yes	
Sanderson-Windmeijer F-statistics:						
DISTRESSED SIBLING SHARE	11.42 ***		11.42 ***		11.42 ***	
BANK TRANS	60.67 ***		60.67 ***		60.67 ***	
NONBANK TRANS	437.88 ***		437.88 ***		437.88 ***	
Kleibergen-Paap Wald F-statistic	14.97		14.97		14.97	
(Stock-Yogo 10% critical value)	10.01		10.01		10.01	
Hansen J-statistic (p-value)	9.08 (0.43)		9.62 (0.38)		6.24 (0.72)	
Underidentification test (p-value)	0.00		0.00		0.00	

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 6b examines healthy banks during the crisis period. Distressed sibling share becomes highly significant for both total capital injections and parent transactions EQUITY and CASH gain significance, indicating selective allocation toward stronger institutions. NONBANK TRANS becomes highly significant and positive, confirming that nonbank subsidiaries served as important liquidity providers for this subsample during the crisis.

Once again, Wald tests comparing the coefficients on BANK TRANS, NONBANK TRANS, and DISTRESSED SIBLING SHARE across periods confirm significant structural breaks for healthy banks across all three dependent variables. These results demonstrate that the crisis fundamentally altered how sibling fragility and internal fund flows influenced capital allocation to healthy banks, with these institutions becoming increasingly sensitive to peer distress and dependent on nonbank liquidity during periods of systemic stress.

3.3.3. Key Findings from Segmented Analysis

This segmented regression analysis shows that internal capital market frictions differ by bank health and exhibit structural changes between the pre-crisis and crisis periods. The most notable pattern was a reversal in where sibling fragility constraints bound. Before the crisis, the distressed sibling share significantly reduced capital injections for both distressed banks (Table 5a) and healthy banks (Table 6a). During the crisis, however, this effect disappeared for distressed banks while remaining strong for healthy ones.

The magnitude of this reversal is substantial. For distressed banks in the pre-crisis period, the coefficient of -2.81 (Table 5a) implies that a 0.1 increase in the distressed sibling share (e.g., from 0.2 to 0.3) reduced the capital-injection-to-capital ratio by roughly 28 percentage points, representing a substantial contraction in internal support for troubled institutions. The disappearance of this effect during the crisis (Table 5b, coefficient = -1.10 , statistically insignificant) indicates a shift in allocation dynamics, with this channel no longer playing a systematic role in constraining internal capital support.

Several mechanisms could explain this reversal. First, regulatory scrutiny intensified for distressed banks during the crisis, potentially constraining parent discretion to reduce support regardless of sibling conditions. Supervisors closely monitored troubled institutions, creating pressure to demonstrate continued commitment. Second, market discipline from creditors and depositors may have forced parents to maintain visible support for distressed banks to prevent runs, while healthy banks faced less external pressure from funding sources. Third, strategic prioritization may have led parents to concentrate resources on salvageable distressed banks while treating healthy banks as residual claimants that could withstand temporary constraints. The consistency of this pattern across our sample and its alignment with institutional features of crisis-period banking supervision suggest that external monitoring constraints played an important role, though strategic considerations likely also contributed.

On the other hand, sibling fragility became highly significant for healthy institutions (Table 6b). Unlike distressed subsidiaries, these healthier banks typically operated with far less external scrutiny, giving parent firms greater discretion to reallocate resources without attracting regulatory or market attention. As a result, healthy banks may have borne more of the organizational strain created by distressed siblings during the crisis, effectively functioning as residual claimants when parental support was concentrated on more closely monitored distressed banks.

Turning from sibling fragility to organizational structure, the variation in MBHC and sibling count effects across periods suggests that capital allocation priorities shifted under crisis conditions. Pre-crisis, distressed banks received emergency support regardless of organizational complexity—sibling count and MBHC status were irrelevant when banks were already operating below normal standards. During the crisis, these structural features suddenly mattered because they determined the parent's capacity to provide support: more siblings meant more competing demands on finite resources, while MBHC status may have signaled greater organizational resources or regulatory attention.

The MBHC coefficient in Table 5b is also economically large: being part of a multi-bank holding company increased the capital-injection-to-capital ratio by 55 percentage points during the crisis. Given typical capital buffers for distressed banks, this represents a quantitatively large expansion in internal support.

MBHC status retained significance for healthy banks throughout both periods, suggesting it captured something more fundamental—perhaps access to certain funding sources, regulatory treatment, or strategic importance—that persisted even as allocation mechanisms shifted from optimization to survival mode.

Parent liquidity dynamics also shifted during the crisis. In the pre-crisis period, distressed banks experienced significant liquidity extraction, as reflected in the strongly negative BANK TRANS coefficient in Table 5a. This relationship disappears during the crisis period, and a similar pattern holds for healthy banks, for which BANK TRANS is likewise insignificant in Table 6b, suggesting that the crisis weakened the predictive role of parent-to-bank liquidity flows in capital allocation. The pre-crisis coefficient of -25.85 for distressed banks indicates that a 0.01 increase in parent net borrowing from bank subsidiaries reduced the capital-injection-to-capital ratio by approximately 25.9 percentage points of bank capital, highlighting the economically meaningful constraints imposed by parent-level liquidity extraction on already vulnerable institutions. By comparison, for healthy banks, the corresponding pre-crisis estimate is also negative and is associated with a reduction of roughly 32.4 percentage points of bank capital for a 0.01 increase in BANKTRANS, although the effect is only marginally significant.

This disappearance of the BANK TRANS relationship could reflect several factors: parents may have curtailed extraction to avoid regulatory criticism or market concern about weakening subsidiaries during visible stress; organizational liquidity management may have become more volatile and less predictable during the crisis, reducing the statistical relationship with capital injections; or the binding constraints on allocation may have shifted from parent liquidity position to other factors such as external funding access or regulatory requirements.

By contrast, nonbank subsidiaries emerged as important liquidity providers for both distressed and healthy banks during the crisis, as reflected in the positive and statistically significant NONBANK TRANS coefficients in Tables 5b and 6b. This effect is more pronounced for distressed banks, underscoring the role of nonbank affiliates in supporting troubled banking operations when external funding markets tightened. For distressed banks, the coefficient of 8.04 (Table 5b) implies that a 0.01 increase in parent net borrowing from nonbank subsidiaries raises the capital-injection-to-capital ratio by approximately 8 percentage points, representing a substantial expansion in internal support during the crisis. For healthy banks, the corresponding coefficients are smaller but remain economically meaningful, indicating that nonbank affiliates also provided incremental liquidity support even to banks not under immediate financial stress.

The emergence of nonbank subsidiaries as liquidity providers raises important questions about underlying mechanisms. Three potential explanations merit consideration. First, deliberate liquidity buffers: BHCs may strategically position nonbank subsidiaries—particularly insurance operations with steady premium cash flows and securities affiliates with marketable assets—as internal liquidity reserves that can be tapped during stress (e.g., Cetorelli & Goldberg, 2012b; Plantin & Rochet, 2008). Insurance subsidiaries typically generate predictable cash inflows and maintain substantial liquid investment portfolios, making them natural liquidity sources when banking operations face funding pressures. During the 2007–2009 crisis, while bank funding markets froze, insurance operations generally continued functioning, creating capacity to support stressed banking affiliates (Ellul et al., 2015).

Second, passive reallocation channels: Positive NONBANK TRANS might reflect parents extracting resources from banks and redeploying them to nonbank entities, with nonbanks serving as passive beneficiaries. This interpretation has been discussed in the context of internal capital markets within financial conglomerates (e.g., Cetorelli et al., 2014). However, several features argue against this interpretation. Our variable construction (amounts due to minus amounts due from nonbank subsidiaries) indicates parents becoming net borrowers from nonbanks, consistent with nonbanks providing resources upward. Moreover, regulatory and market pressure during the crisis made extracting

resources from troubled banks particularly difficult, as such transfers would attract scrutiny and worsen already-strained bank conditions.

Third, regulatory arbitrage: Nonbank entities operated under different regulatory regimes, potentially creating opportunities to accumulate resources in less-constrained entities. Differences in regulatory constraints between banks and nonbank affiliates have been emphasized in prior work on financial conglomerates (e.g., [Cetorelli et al., 2014](#)). Bank capital requirements tightened during the crisis through both formal changes and supervisory pressure, while certain nonbank entities faced less stringent constraints. However, pure regulatory arbitrage seems incomplete as an explanation, since supervisors actively monitored upstream transfers from banks during the crisis, and the pattern emerges specifically during stress rather than throughout the sample period.

Based on our empirical patterns and institutional context, the deliberate liquidity buffer mechanism appears most consistent with the observed patterns, though we cannot definitively distinguish among these explanations with our data. Several features support this interpretation. The crisis-specific emergence suggests activation of latent liquidity channels rather than continuous regulatory arbitrage. The particularly strong pattern for distressed banks (Table 5b), which faced the most acute liquidity needs, indicates nonbank resources flowed toward the most stressed parts of the organization. The institutional characteristics of major BHC nonbank operations—especially insurance subsidiaries with steady cash flows and marketable assets—align with capacity to provide liquidity during stress ([Ellul et al., 2015](#); [Cetorelli et al., 2014](#)). However, these mechanisms are not mutually exclusive, and our data do not allow us to fully isolate their relative contributions. Future research with more granular data on intra-group transactions could better distinguish between strategic liquidity management, passive reallocation, and regulatory responses.

These patterns demonstrate that internal capital markets operated through fundamentally different mechanisms depending on subsidiary health status. The ‘source of strength’ doctrine functioned selectively: distressed banks received crisis support when nonbank liquidity was available and organizational structure was favorable, while healthy banks faced sibling fragility constraints despite strong fundamentals. Pooled analysis masks these critical distinctions, which have important implications for understanding stress transmission through banking organizations and for designing supervisory frameworks that account for conditional intra-group support.

4. Discussions and Conclusions

This study questions the regulatory assumption that BHCs reliably function as “sources of strength” for their subsidiaries during financial stress. The results point to selective patterns of internal support, where resources are directed toward comparatively stronger affiliates rather than those exhibiting the most acute need.

Distressed sibling banks constrain capital flows throughout entire BHC networks, creating hidden vulnerabilities that current supervisory frameworks fail to capture. During the crisis, nonbank subsidiaries transformed into crucial liquidity providers, fundamentally reconfiguring internal capital flows. More profitable parents paradoxically provided less support to distressed subsidiaries, contradicting regulatory expectations of automatic internal assistance. These patterns suggest that fragility can spread through internal channels before external contagion becomes visible to regulators. Notably, segmented analysis reveals that crisis conditions fundamentally alter which banks bear the burden of group-level fragility—sibling effects disappear for distressed banks themselves while prevailing for healthy institutions. The selective nature of internal support during crisis periods challenges the reliability of cross-subsidization mechanisms that regulators depend on for

financial stability (For a concise summary of these key findings across all specifications, see Appendix B).

Our findings reflect BHC capital allocation during the 2007–2009 crisis—precisely when the source of strength doctrine is most critical. Our sample includes both banks that survived and those that failed during 2008–2010, minimizing survivorship bias. Pre-crisis mergers and acquisitions are unlikely to materially affect our inferences, because the analysis focuses on how BHCs allocated capital to subsidiaries already in their organizational structure during periods of stress, rather than on how banks became affiliated with parent organizations. Banks acquired before 2006 that continued operating as separate subsidiaries are part of the relevant population whose capital allocation we seek to understand. The consistency of findings across specifications and time periods suggests they reflect fundamental internal capital market dynamics.

While the overall sample characteristics support our inferences, one compositional feature merits discussion. The differential prevalence of multi-bank structures across subsamples reflects the tendency for larger, better-capitalized institutions to organize as multi-bank holding companies. While this difference is economically intuitive and strengthens our interpretation of findings, it may limit the generalizability of subsample-specific results to banks with different organizational characteristics.

The continued relevance of understanding internal capital market dynamics has been reinforced by recent research on the 2023 banking stress. [Jiang et al. \(2023\)](#) analyze the rapid failure of Silicon Valley Bank and document how concentrated uninsured deposits and asset-liability mismatches can overwhelm internal support mechanisms in modern banking organizations. The broader 2023 episode included additional bank failures such as First Republic Bank, highlighting systemic vulnerabilities in internal capital allocation during acute stress. [Drechsler et al. \(2023\)](#) examine the broader March 2023 episode and show that funding fragility in the digital age creates new challenges for these intra-group allocation mechanisms, as deposit runs can unfold within hours rather than days. These studies underscore that the fundamental questions we address—how financial organizations allocate scarce resources under stress—remain central to financial stability even as specific institutional details evolve.

These findings highlight several areas where regulatory approaches could be strengthened. Supervisory stress testing should incorporate scenarios in which multiple affiliates within the same BHC experience distress simultaneously. Such conditions create internal capital allocation constraints that traditional firm-level stress tests may not capture, especially when sibling fragility alters how support is allocated within the group. This recommendation aligns with broader macroprudential policy frameworks emphasizing the need to capture interconnectedness and contagion channels within financial systems ([Borio, 2003](#); [Acharya et al., 2017b](#)).

Regulators also need improved visibility into fund movements within complex organizations. Liquidity flows can shift rapidly during crises, particularly as nonbank subsidiaries become key liquidity providers. Enhanced monitoring of real-time transfers between bank and nonbank affiliates would allow supervisors to identify emerging pressure points and evaluate whether internal support is flowing where it is most needed. Recent regulatory initiatives have moved in this direction: [Calem et al. \(2020\)](#) propose frameworks for monitoring liquidity risk in complex banking organizations that account for these intra-organizational dynamics.

Finally, resolution planning and supervisory assessments should reduce reliance on the assumption of seamless internal support. The selective nature of intra-group capital flows documented here suggests that parents may not distribute capital evenly across affiliates

during stress, and that internal constraints can arise well before external vulnerabilities become apparent.

The regulatory environment governing BHC capital allocation has evolved substantially since our sample period. The Dodd-Frank Act of 2010 formally codified the source of strength doctrine, extended it to savings and loan holding companies, and strengthened supervisory expectations through enhanced capital planning and resolution requirements. International jurisdictions have implemented similar reforms with varying approaches, including the European Banking Union's consolidated supervision framework and Swiss and UK regimes for systemically important institutions (Schoenmaker & Véron, 2016; Huertas, 2014).

Despite these reforms, the internal capital market frictions we document remain relevant for contemporary policy. BHCs have substantially expanded nonbank operations since our sample period—our finding that nonbank entities serve as crucial intra-group liquidity providers suggests these activities create additional channels and potential frictions that may not be fully captured by bank-focused supervision. Recent banking sector stress, including the 2023 failure of Silicon Valley Bank within SVB Financial Group's holding company structure, demonstrates that internal capital market challenges persist despite regulatory reforms.

Regarding our methodological approach, we acknowledge that our recommendations are qualitative rather than quantitative. Quantitative evaluation of policy interventions—such as optimal capital requirements conditional on sibling fragility or specific intervention thresholds—would require structural modeling of BHC decision-making beyond the scope of our reduced-form analysis. Such structural analysis represents a valuable direction for future research that could build on the causal relationships we identify to simulate specific policy counterfactuals. Our contribution is to provide credible evidence that key regulatory assumptions do not hold empirically and to identify specific dimensions where supervisory frameworks require strengthening. This approach—using credible causal identification to document mechanisms and draw targeted policy implications—follows standard practice in reduced-form empirical banking research. Leading studies use credible causal identification to document relationships and draw qualitative policy implications without quantitative simulations (e.g., Berger & Bouwman, 2013; Acharya et al., 2017a; Campello, 2002; Khwaja & Mian, 2008; Cetorelli & Goldberg, 2012a; Ashcraft, 2008).

Future research could extend our framework in several valuable directions. Deeper mechanistic understanding would benefit from structural modeling to quantify parent objective functions, qualitative evidence from interviews or internal documents to reveal how management weighs competing considerations, and granular data on decision timing to distinguish voluntary strategic choices from responses to regulatory pressure. As data from recent episodes become available, comparative institutional analysis could examine whether post-Dodd-Frank reforms altered internal capital allocation patterns. High-frequency analysis of rapid modern bank runs could reveal whether compressed crisis dynamics change internal capital market functioning. Cross-country comparisons could illuminate which regulatory features most effectively promote reliable internal support. Each of these directions would complement and extend our baseline evidence about these allocation mechanisms under extreme stress.

Understanding how internal capital markets functioned during the 2007–2009 crisis—the last major systemic episode with sufficient data for rigorous statistical analysis—provides crucial baseline evidence about BHC behavior that remains policy-relevant. The mechanisms we identify—sibling fragility effects, selective intervention based on subsidiary health, and nonbank liquidity channels—represent general features

of internal capital markets likely to operate across regulatory environments, though their magnitude may vary with institutional details.

More broadly, these findings raise fundamental questions about optimal financial conglomerate structure and whether current incentives align BHC parent interests with broader financial stability. Capital allocation within BHCs proved less reliable than previously recognized, particularly during the crises they were designed to address. As financial institutions become increasingly complex and interconnected, regulatory frameworks must account for these internal capital market realities to maintain financial stability.

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Appendix A. Variable Definitions

All variables except ROA, LNSIZE, LNBHCSIZE, BHCNETINC, and the dependent variables are calculated as a share of bank assets. BHCEQUITY and BHCNETINC are calculated as a share of BHC assets. The dependent variables are calculated as a share of bank capital.

Dependent Variables

Total capital injection: Sum of direct transactions with parent and net sale of stock.

Transactions with parent: Net transfers between bank and parent company (positive values indicate capital injection from parent to bank).

Net sale of stock: Net proceeds from stock issuance minus stock repurchases.

Bank-Level Variables

MBHC: Dummy variable equal to 1 if the BHC operates multiple bank subsidiaries, 0 otherwise.

COUNTER: Number of sibling banks within the same BHC.

EQUITY: Book value of equity divided by total assets.

LLR: Loan loss reserves divided by total assets.

NPA: Non-performing assets (loans 90+ days past due plus nonaccrual loans) divided by total assets.

SECURITY: Securities holdings divided by total assets.

BD: Brokered deposits divided by total assets.

CASH: Cash and due from depository institutions divided by total assets.

ROA: Return on assets (net income divided by total assets).

LNSIZE: Natural logarithm of total bank assets.

BHC-Level Variables

BHCEQUITY: Book value of BHC equity divided by total BHC assets.

LNBHCSIZE: Natural logarithm of total BHC assets.

BHCNETINC: BHC net income divided by total BHC assets.

Internal Capital Market Variables

DISTRESSED SIBLING SHARE: Proportion of BHC banking assets held by distressed sibling banks.

BANK TRANS: Calculated as the difference between amounts due to and amounts due from bank subsidiaries, scaled by total BHC assets. A positive value indicates that the parent is a net borrower from its banks, reflecting upward capital flows that may signal internal liquidity stress or centralized cash management.

NONBANK TRANS: Constructed analogously for nonbank subsidiaries. These measures reflect strategic liquidity management within BHCs, where parent companies may extract funds from banks or rely on nonbank affiliates as liquidity buffers.

Appendix B. Summary Tables

Table A1. Summary of Key Internal Capital Market Dynamics: Effect of Internal Capital Market Variables on Capital Injections (Scaled by Bank Capital).

Variable	All Banks Pre-Crisis	All Banks Crisis	Distressed Pre-Crisis	Distressed Crisis	Healthy Pre-Crisis	Healthy Crisis
Panel A: Internal Capital Market Frictions						
Distressed Sibling Share	−0.83 *	−0.83 **	−2.81 *	−1.10	−0.11 *	−0.49 ***
	(Constrains)	(Constrains)	(Strong)	(No effect)	(Weak)	(Strong)
BANK TRANS	−31.58 *	0.02	−25.85 ***	−51.59	−32.37 *	0.02
	(Extraction)	(No effect)	(Extraction)	(No effect)	(Extraction)	(No effect)
NONBANK TRANS	6.84	0.37 **	108.94	8.04 *	6.93	0.35 **
	(No effect)	(Support)	(No effect)	(Support)	(No effect)	(Support)
Panel B: Organizational Structure						
MBHC (Multi-bank)	0.04 **	0.11 **	0.01	0.55 ***	0.04 **	0.09 *

Notes: This table summarizes key findings from the full regression results in Tables 3–6. Coefficients represent the effect on capital injections scaled by bank capital. Parenthetical descriptions indicate the economic interpretation of each pattern. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. All specifications use instrumental variables estimation with bank and quarter fixed effects. See Tables 3–6 for complete results including control variables, first-stage diagnostics, and standard errors.

Table A2. Summary of Key Shifts from Pre-Crisis to Crisis.

Key Finding	Pre-Crisis Pattern	Crisis Pattern	Change	Reference
Sibling Fragility Constrains Distressed	Strong constraint (−2.81 *)	No constraint (−1.10, n.s.)	Effect disappeared	Table 5a,b
Sibling Fragility Constrains Healthy	Weak constraint (−0.11 *)	Strong constraint (−0.49 ***)	Effect intensified	Table 6a,b
Parent Liquidity Extraction	Extracted from banks (−31.58 *)	No extraction (0.02, n.s.)	Extraction ceased	Tables 3 and 4
Nonbank Liquidity Provision	No support (6.84, n.s.)	Provided support (0.37 **)	Became providers	Tables 3 and 4

Notes: This table highlights the four most dramatic shifts in internal capital market dynamics from pre-crisis to crisis periods. n.s. = not significant. See Tables 3–6 for complete regression results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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