Bank cash-reserve management and payout policy under peer pressure

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Abstract

We examine the interplay between cash reserve management, dividend policies, bankruptcy risk, and peer pressure in the banking sector, utilizing a blend of continuous-time economic modeling and empirical analysis of Federal Reserve Y-9C report data from 1987-2020. Our findings reveal that peer pressure significantly influences banks' liquidity strategies and dividend behaviors, promoting increased cash reserves and moderated dividend payouts, thereby leading to improved bank risk profiles. This study underscores the importance of peer dynamics in shaping financial strategies, offering important insights for policymakers and banking executives. It highlights the need for regulatory frameworks that recognize the role of peer influence, encouraging practices that enhance financial stability and resilience. (*JEL* E43, G12, G32)

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1 Introduction

Given the changing economic conditions and evolving regulatory landscapes, bank strategies for managing cash reserves and determining payout policies have become increasingly critical to both financial stability and shareholder value. Recent financial crises have underscored the importance of liquidity management, making it a focal point for both policy-making and academic research (e.g., Abreu and Gulamhussen (2013), Calomiris et al. (2015), Diamond and Kashyap (2016), Segura and Suarez (2017)). Despite the growing body of research on financial decision-making within banks, there remains a critical gap in understanding how internal policies on cash reserves intersect with external peer pressures to influence payout decisions and bank default risk. This study seeks to shed light on the relationship between cash reserve management and payout policies within the context of peer pressure effects.

Our study enriches the discourse initiated by Radner and Shepp (1996) for corporate entities by delving into the dynamics corporate firms employ to manage cash reserves in the face of uncertain earnings and probability of bankruptcy. We expand upon their theoretical model, which equates a firm's cash reserve to the balance between cumulative net earnings and cumulative dividends, by introducing a comprehensive framework that models the bank's cash reserve dynamics and allows firms to navigate dividend payout decisions, optimizing for expected total discounted dividends until bankruptcy—an eventuality our model accepts as inevitable under optimal management. In contrast to Radner and Shepp (1996) which focuses on corporate firms, our research advances the understanding of the interplay between cash reserve management, dividend policies, and bankruptcy risk within banks.

Our research also extends the theoretical model of Calomiris et al. (2015) on bank liquidity and integrates an empirical investigation into the dynamics of cash reserve management under peer pressure within the banking sector. We provide theoretical and empirical evidence that confirm their insights, demonstrating how banks adjust their liquidity in response to the actions of their peers. Our analysis not only validates the importance of cash reserves in mitigating risks but also highlights the role of collective bank behaviors in shaping the financial system's stability. By examining how banks' cash reserves are influenced by peer actions, our study underscores the need for regulatory policies to consider systemic risks and industry dynamics. Our findings offer a comprehensive view that bridges theory with real-world practices, reinforcing the critical role of liquidity management and regulatory oversight in ensuring the banking sector's resilience.

Drawing upon the theoretical insights from Ratnovski (2009), Farhi and Tirole (2012), Vives (2014); Acharya et al. (2016), Ozdenoren and Yuan (2017), Albuquerque et al. (2019), which discuss banks' collective risk-taking behaviors and the "too many to fail" problem (Acharya and Yorulmazer (2007), Acharya and Yorulmazer (2008), Brown and Dinç (2011)), our study contributes to the literature by exploring both theoretical and empirical dimensions of peer effects in bank cash reserve and dividend payout management and offering a pragmatic tool on peer pressure. Departing from Silva (2019)'s empirical investigation into strategic liquidity mismatches—which significantly deepens our understanding of how indirect peer networks influence banks' liquidity transformation activities—our research redirects attention towards the dynamics of cash reserves, with a particular emphasis on the role of industry norms.

Studying peer effects in banking is of paramount importance due to the distinctive operational, regulatory, and market contexts within which banks operate, diverging significantly from corporate firms in various industries. While some empirical research has examined peer influence on dividend policy among corporate entities, focusing on how firms adjust their dividend strategies in response to industry peers, this body of work often overlooks the banking sector's unique characteristics including regulatory factors and the specific risks associated with banking operations, all of which could influence how banks react to peer pressure, particularly in managing cash reserves and deciding on dividend policies (e.g., Adhikari and Agrawal (2018) and Grennan (2019)).

Our research advances the discourse on the influence of peer effects on the interplay between cash reserve management and dividend policies within banks, offering fresh insights into areas not comprehensively addressed in prior studies. Previous investigations have made significant strides in analyzing the determinants of dividend policies in U.S. bank holding companies, exploring dimensions such as equity valuation, the signaling hypothesis, regulatory pressures, and the agency hypothesis (e.g., Collins et al. (1994), Boldin and Leggett (1995), Filbeck and Mullineaux (1999), Theis and Dutta (2009), and Abreu and Gulamhussen (2013)). Our contribution is unique as it delves into the impact of peer effects on banks' strategic decisions regarding liquidity management and dividend payouts. By conducting a thorough theoretical and empirical examination, we highlight the central role of peer influence in navigating cash reserve and dividend decisions, effectively filling a notable gap in existing literature. Our study provides a comprehensive view of how banks' financial strategies are influenced by their peers, reinforcing the importance of considering peer dynamics for understanding the broader implications on industry practices and financial stability.

We study the dynamics of cash reserve management and payout policies within the banking sector, framed within a continuous-time economic model and substantiated by empirical analysis of data from Federal Reserve Y-9C reports covering the period from 1987 to 2020. Our study aligns theoretical predictions with observed empirical patterns and highlights the important role of peer pressure in shaping banks' financial strategies. Our findings provide significant insights into the operational challenges and strategic decisions faced by banks, offering valuable implications for policymakers, regulatory bodies, and banking executives.

A significant theoretical prediction of our model is the role of peer pressure in shaping banks' financial strategies. We hypothesize that banks do not operate in isolation; rather, their operating decisions, especially concerning cash reserve management, are heavily influenced by the actions and outcomes of their industry counterparts. This mean-field interaction, a novel addition to our analysis, is critical for understanding the collective behavior that dictates industry-wide operating and financial practices and risk management approaches.

Empirically, our findings reveal a pronounced sensitivity of banks' dividend payout policies to their cash reserve levels and deviations. Specifically, we observe a positive correlation between higher liquidity (cash reserves) and the propensity to distribute dividends, underscoring the liquidity-profitability trade-off that banks navigate. This empirical evidence is in line with our theoretical model's prediction that banks with higher cash reserves are more likely to engage in higher dividend payouts, a behavior further amplified by peer pressure dynamics within the industry.

Moreover, our analysis sheds light on the phenomenon of cash reserve deviations—how banks' liquidity positions deviate from the industry average—and its impact on payout decisions and default risk, revealing that banks strategically adjust their payout policies to maintain their competitive position and financial stability. Our findings indicate that higher peer pressure leads banks to maintain higher cash reserves and lower dividend payouts. This is driven by the need to conform to industry standards and avoid negative perceptions that could arise from falling significantly below the industry average. A direct consequence of higher cash reserves and lower dividend payouts is the reduction in bankruptcy risk. By prioritizing liquidity, banks can ensure they have sufficient funds to cover short-term liabilities and unexpected losses, thus reducing the likelihood of financial distress. This prudent management of resources reflects a strategic approach to risk mitigation, where banks use peer benchmarks as a guide to inform their liquidity management and payout strategies.

By closely monitoring and responding to the cash reserve levels of their peers, banks can make informed decisions regarding their payout policies, balancing the need to reward shareholders with the imperative to maintain adequate liquidity. This strategy not only helps banks maintain their competitive edge but also plays a critical role in safeguarding the broader financial system against the risks of bank failures and systemic crises.

Our comprehensive examination bridges the gap between theoretical constructs and empirical analyses, revealing the balance banks strike between liquidity management and dividend payouts to shareholders. The findings emphasize the significance of peer pressure in shaping financial strategies within the banking sector, offering profound insights for policymakers, regulators, and industry executives. By understanding the dynamics at play, stakeholders can better navigate the challenges of financial management, ensuring the banking sector's resilience and stability in the face of evolving economic landscapes.

Our study contributes to several strands in the literature: the stochastic modeling of financial decisions, the empirical analysis of banking practices, and the socio-economic dynamics influencing those practices. Firstly, our work contributes to the stochastic financial modeling literature by applying continuous-time models to explore how banks manage liquidity and payout dividends in an uncertain economic environment. While previous studies have extensively used stochastic calculus to model various financial processes, our research extends these applications to specifically address the dynamic interplay between cash reserve management and dividend distribution within banks. This approach allows for a more nuanced understanding of the decision-making processes under uncertainty, highlighting the flexibility and responsiveness of banks to both external shocks and internal policy shifts.

Secondly, the empirical aspect of our study provides valuable insights into the banking sector's operational strategies, complementing the theoretical model with an empirical analysis of Federal Reserve Y-9C report data spanning several decades. By empirically validating the theoretical predictions, our findings complement and expand upon the literature on dividend policies and liquidity management by not only confirming the significance of peer effects in banking operations but also by uncovering the important role that peer pressure plays in shaping these financial strategies.

Moreover, the exploration of peer pressure's impact on banks' financial decisions fills a critical gap in the literature. While the concept of peer influence is well-documented in corporate finance, particularly regarding investment decisions and financial signaling, its specific effects on liquidity and dividend policies within the banking sector have been less explored. Our research underscores the importance of the competitive landscape and the mean-field interactions among banks, offering a fresh perspective on how collective behaviors influence individual institutions' strategic choices.

Finally, by integrating these theoretical and empirical insights, our paper contributes to the broader academic discourse on financial stability, regulatory policy, and risk management. The policy implications drawn from our findings provide actionable recommendations for both regulators and banking executives, informed by an understanding of the balance between operational needs, market pressures, and strategic decision-making. This multidimensional approach positions our paper as a significant addition to the literature, offering a comprehensive analysis that bridges theoretical models, empirical evidence, and practical considerations.

Our theoretical and empirical insights into the role of peer pressure in banks' financial decision-making have far-reaching implications for regulatory approaches, risk management practices, financial stability monitoring, disclosure norms, and market discipline strategies. By tailoring policies and practices to account for these dynamics, regulators and banks can contribute to a more stable, resilient, and transparent banking sector.

By acknowledging the dual role of peer pressure, both as a potential source of systemic risk and as a catalyst for improved risk management practices, policymakers and regulators can fine-tune their approaches to encourage a culture of safety and stability within the banking sector. This involves leveraging regulatory incentives to not only deter risky collective behaviors but also to reward banks that adopt best practices in liquidity management and dividend strategies, as influenced by the positive aspects of peer pressure dynamics.

Such a balanced regulatory approach would motivate banks to not only align their practices with industry benchmarks for safety and stability but also to continuously innovate in risk management, inspired by the positive actions of their peers. This could lead to an industry-wide uplift in standards, where banks are encouraged to maintain profitability while ensuring robust liquidity positions, thereby fostering a healthier financial system resilient to market imbalances or crises. The beneficial impact of peer pressure, in this context, is instrumental in shaping a competitive yet prudent banking environment, where the collective aim is not just individual success but the stability and integrity of the entire sector.

Moreover, banks are advised to incorporate peer pressure considerations into their financial decision-making processes. This would help ensure that their competitive strategies do not inadvertently increase their exposure to risk. Enhancing transparency and disclosure concerning banks' liquidity management and dividend policies can also play a crucial role. By requiring banks to report comprehensively on the factors that influence their dividend decisions and their positioning in relation to industry standards, stakeholders are better equipped to make informed choices.

Based on our findings, we advocate for a regulatory approach that not only mitigates risks associated with collective behaviors but also promotes a culture of best practices in liquidity and payout management. Such regulatory strategies would encourage banks to align with industry benchmarks, fostering a financial system where financial stability is a shared goal, achieved through a blend of competitive excellence and prudent risk management. In doing so, our study lays the groundwork for future research and dialogue on optimizing banking operations in the face of peer influences, with the ultimate aim of enhancing the resilience and integrity of the financial system.

2 Model

Consider a continuous-time economy on the finite time span $[t,T]$, for initial time $t \leq T$. Uncertainty is represented by a probability space $(\Omega, \mathcal{F}, \mathbb{P})$ with augmented filtration $\mathbb{F} = (\mathcal{F}_s)_{s\in[t,T]}$ generated by N independent Brownian motions $Z^i = (Z^i_s)_{s\in[t,T]}$, with $i = 1, 2, ..., N$.

There are N banks in our economy. Bank $i \in \{1, 2, ..., N\}$ has monetary cash reserves M^i satisfying the following stochastic differential equation (SDE hereafter)

$$\begin{aligned} dM^i_s =& \left(\mu - \ell^i_s\right) ds + \sigma dZ^i_s, \\ M^i_t =& m^i, \end{aligned}$$

where $\mu > 0$ is the bank's reserve long-term mean, $\sigma > 0$ is the reserve's exposure to shocks Z^i, and $\ell^i = (\ell^i_s)_{s\geq t}$ is the dividend flow (i.e., the control) paid by Bank i to shareholders. We assume that ℓ^i is a progressively measurable, integrable process taking values on the set $A = [0, \infty)$. We denote this class of admissible controls by $\mathcal{A}[t,T]$. For simplicity, we assume that all banks to have the same long-run mean μ and diffusion coefficient σ.

In our economy, a bank default as soon as it is unable to finance its operations, i.e., when its cash reserves are fully depleted ($M^i_t < 0$), and the liquidation time τ_i of Bank i is defined as

$$\tau_i = \inf\{s > t \ ; \ M^i_s < 0\} \wedge T.$$

Bank i chooses a dividend payout policy $(\ell^i_s)_{s\in[t,T]}$ to maximize its expected utility[1]

$$V^{N,i}(t,\mathbf{m}) = \sup_{\ell^i \in \mathcal{A}[t,T]} \mathbb{E}\left[\int_t^{\tau_i} e^{-\rho s} f(M_s^i, \overline{M}_s^{N,i}, \ell_s^i) ds\right],$$

where $\rho \geq 0$, $\mathbf{m} = (m^1, \dots, m^N) \in \mathbb{R}_+^N$ represents the initial cash reserves of each bank at time t, and $\overline{M}_s^{N,i}$ is the average cash reserve in the banking industry at time s, given by

$$\overline{M}_s^{N,i} = \frac{1}{N-1} \sum_{j \neq i} M_s^j \mathbb{1}_{[t,\tau_j)}(s). \tag{1}$$

The indicator function $\mathbb{1}_{[0,\tau_j)}(s)$ in Eq.(1) tracks the banks that have declared bankruptcy. The interaction between all banks is through the banking industry average $\overline{M}^{N,i}$.

The running gain function f we are considering has three components:

$$f(m, \overline{m}, \ell) = \underbrace{\ell}_{\text{dividend policy}} - \underbrace{\alpha \ell^2/2}_{\text{adjustment cost}} + \underbrace{\beta m(m - \overline{m})}_{\text{peer pressure}}. \tag{2}$$

The first part represents the dividend policy of Bank i. The second term is the cost associated with the adopted dividend policy. Following the literature (Whited (1992); Gomes et al. (2003); Zhang (2005); Hennessy and Whited (2007)), we assume a quadratic adjustment cost function with coefficient $\alpha \in \mathbb{R}_+$.

The last term in Eq.(2) represents the reduced-form interbank mechanism in our setting and it is referred to as the peer pressure component. The exogenous parameter $\beta \in \mathbb{R}_+$ controls the intensity of the peer pressure on the running gain function of Bank i. The term $m - \overline{m}$ represents the deviation the cash reserve of Bank i from the banking industry. If the cash reserves of Bank i are low relative to the industry ($m - \overline{m} < 0$), then the peer-pressure component is negative and the running gain of Bank i is reduced. In these cases, any dividend payment will put more pressure on the bank by further depleting its cash reserves. In contrast, if Bank i's reserves are above the industry's ($m - \overline{m} > 0$), the peer-pressure

[1] We follow the literature on mean-field games and use the superscript N to refer to quantities of an economy populated by N players, that is, before the mean-field limit is taken.

component is positive and increases the bank's running gain. The larger cash reserve relative to the industry gives the bank more room to adjust its dividend policy upward, further benefiting the bank's shareholders. Thus, in our setting, peer pressure considerations shift the balance of the classic shareholder trade-off between accumulating cash reserves to minimize the risk of liquidation and distributing dividends.

Despite the quadratic functional form assumed for adjustment costs and peer pressure, our model does not fit into the popular class of linear-quadratic (LQ hereafter) models in mean-field games (Carmona et al. (2013), Bensoussan et al. (2016), Delarue and Tchuendom (2020)). LQ models are generally tractable and allow for analytical solutions of the equilibrium quantities. However, there are two assumptions in our model that prevent us from characterizing the equilibrium in closed form. First, unlike Carmona et al. (2013), we assume that banks are subject to structural default and declare bankruptcy when their cash reserves are fully depleted ($M^i_{\tau^i} = 0$). In other words, $M^i_{\tau^i} = 0$ is an absorption barrier and when banks fail, they exit the economy. Second, we restrict the dividend process ℓ^i to be positive. By introducing these two realistic assumptions, we lose the ability to derive analytical expressions for the equilibrium quantities and have to characterize them numerically.[2]

2.1 Mean-field Limit

Our objective is to characterize the optimal control (i.e., the dividend payout policy ℓ_t) that maximizes the running gain function with peer pressure (i.e., the shareholders' utility function) for each player (i.e., bank) when the economy is populated by a large number of players (i.e., when $N \to \infty$). To put it succinctly, we want to analyze the mean-field limit of the game described in Section 2.

For that, consider an economy populated by a continuum of banks and let $p(t, m)$ denote the sub-probability density function representing the distribution of cash reserves m across all banks at time t. An important difference from the models commonly used in the MFG literature is that p is now a density of a

[2]In the online appendix, we solve the equivalent LQ model by relaxing these two assumptions and derive the analytical expressions for the equilibrium quantities.

sub-probability, i.e.,

$$0 \leq p(t,m), \forall (t,m) \quad \text{and} \quad \int_0^\infty p(t,m)dm \leq 1.$$

In our economy, this loss of mass is due to the default of banks and their subsequent removal from the game.

Let $V(t,m)$ be the maximum discounted lifetime utility of the shareholders of a representative bank, and $\eta(t)$ be the expectation of $p(t,m)$ over m at time t, i.e.,

$$\eta(t) = \int_0^\infty m\, p(t,m)dm.$$

Given the Hamiltonian

$$H(m,a) = \mu a + \frac{(1-a)^{2+}}{2\alpha},$$

where $x^{2+} = (\max\{x,0\})^2$, and the function

$$F(m,\overline{m}) = \beta m(m-\overline{m}), \tag{3}$$

the MFG system is characterized by the following Hamilton-Jacobi-Bellman (HJB hereafter) and Fokker-Planck (FP hereafter) system of PDEs:

$$\begin{cases} \partial_t V(t,m) + \dfrac{\sigma^2}{2}\partial_{mm}V(t,m) + H(m,\partial_m V(t,m)) - \rho V(t,m) + F(m,\eta(t)) = 0, \\ \partial_t p(t,m) - \dfrac{\sigma^2}{2}\partial_{mm}p(t,m) + \partial_m\left(\partial_a H(m,\partial_m V(t,m))p(t,m)\right) = 0. \end{cases} \tag{4}$$

The system of PDEs in Eq.(4) is subject to the following boundary conditions:

$$\begin{aligned} V(t,0) &= 0, \qquad V(T,m) = 0, \\ p(t,0) &= 0, \qquad p(0,m) = p_0(m), \end{aligned} \tag{5}$$

for a given initial probability density of banks p_0.

The natural question that arises is whether the above system is well-posed and whether the MFG solution is a proper approximation of the finite population game described in Section 2. The next proposition presents the result.

Proposition 1. *The system of PDEs in Eq.(4) with boundary conditions Eq.(5) has a unique classical solution. Moreover, if we define* $U(t, m, p_0) := V(t, m)$ *given by the solution of the MFG, then there exists* $C > 0$ *such that, for any* $N \in \mathbb{N}$ *and* $\mathbf{m} = (m^1, \ldots, m^N) \in \mathbb{R}_+^N$, *it holds*

$$\sup_{i \in \{1,\ldots,N\}} |V^{N,i}(t, \mathbf{m}) - U(t, m^i, p_{\mathbf{m}}^N)| \leq \frac{C}{N},$$

where

$$p_{\mathbf{m}}^N = \frac{1}{N-1} \sum_{j \neq i} \delta_{m^j} \mathbb{1}_{\{m^j > 0\}},$$

and δ_x *is the Dirac mass at* x.

Proposition 1 shows that the mean-field limit of the economy in Section 2 is well defined. The key ingredient in our model that guarantees this result is the monotonicity of the peer pressure component in Eq.(3). Thus, there is a unique optimal dividend policy when the economy is populated by a continuum of banks. We present the result in the next proposition along with the optimal path of the aggregate cash reserves when the representative bank follows the optimal dividend policy.

Proposition 2. *The optimal dividend policy in feedback form is given by*

$$\ell^\star(t, m) = \frac{1}{\alpha}(1 - \partial_m V(t, m))^+. \tag{6}$$

If the shareholders of the representative bank follow the optimal dividend policy in Eq.(6), the optimal path of the aggregate cash reserves $M_t^\star$ *satisfies the following SDE*

$$dM_t^\star = \left(\mu - \frac{1}{\alpha}(1 - \partial_m V(t, M_t^\star))^+\right) dt + \sigma dZ_t.$$

Furthermore, the quadratic variation of the optimal dividend policy to the cash *reserve is given by*

$$\langle \ell^\star, \ell^\star \rangle_t = \frac{1}{\alpha^2} \int_0^t \mathbb{1}_{\{\partial_m V(s, M_s^\star) < 1\}} (\partial_{mm} V(s, M_s^\star))^2 d\langle M^\star \rangle_s.$$

Proposition 2 shows that the optimal dividend policy is determined by the marginal utility of cash reserves. In regions where $V(t, m)$ is a concave function, the optimal dividend policy in Eq.(6) is increasing on m, and the representative bank pays more dividends as its reserves increase. In contrast, if $V(t, m)$ is a convex function of m, the optimal dividend policy decreases with cash reserves, and banks pay less dividends as they accumulate cash reserves. At the terminal date, since $V(T, m) = 0$, we obtain an explicit characterization of the optimal dividend, which is given by $\ell^\star(T, m) = 1/\alpha$.

The characterization of the dynamics of the optimal dividend policy and the cash reserves in Proposition 2 allows us to assess the financial stability of the system by computing the probability of default of the representative bank by Monte Carlo approximation.

2.2 Numerical Analyses

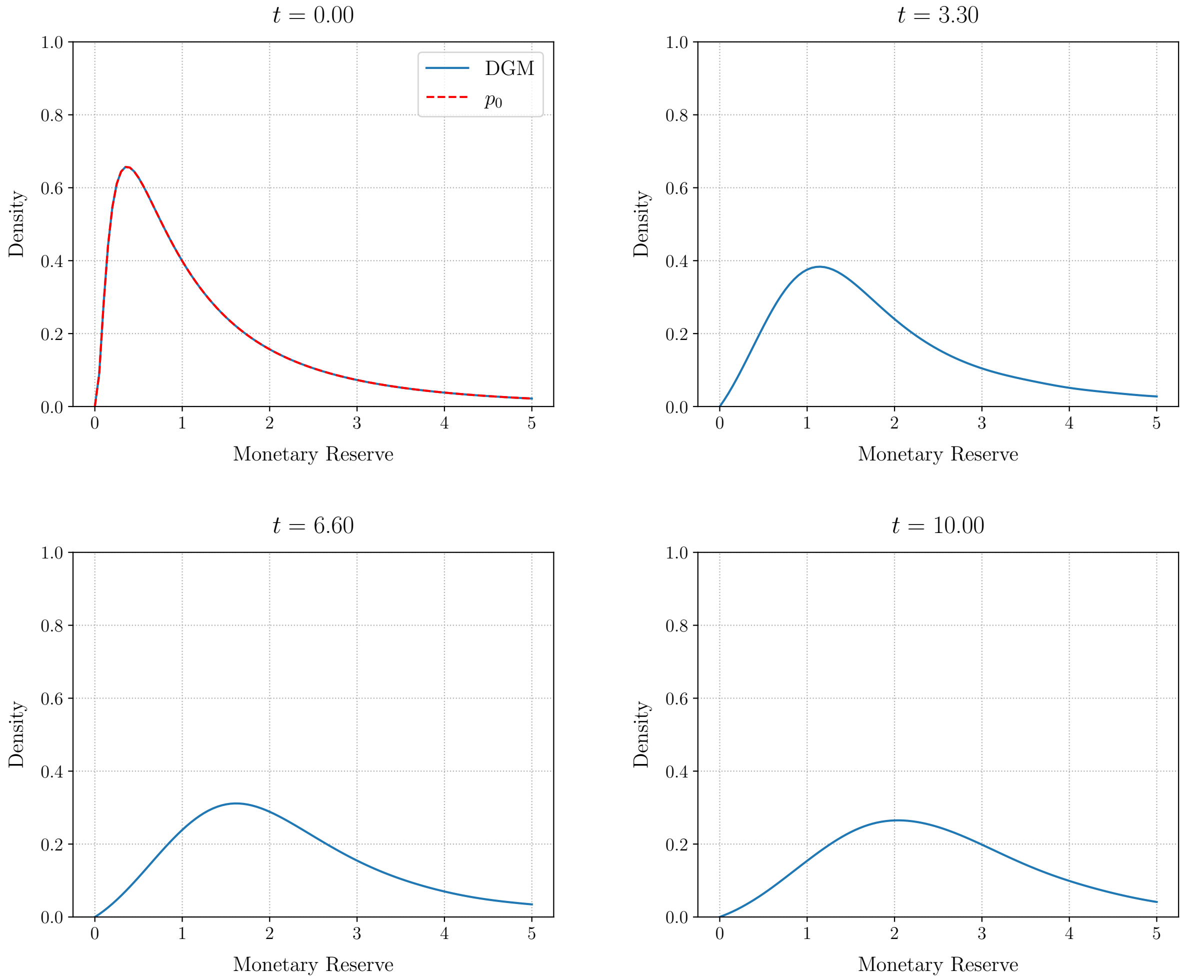
In this section, we conduct numerical analyses to understand (i) dynamics of the banking system, (ii) the effects of peer pressure on the optimal payout policy and the cash reserve management, and (iii) how peer pressure affects the stability of the financial system. Since our model does not allow for an analytical expression, we solve the HJB-FP system of PDEs in Eq.(4) using a machine-learning algorithm. More specifically, we use the deep Galerkin method (DGM hereafter) of Sirignano and Spiliopoulos (2018) to approximate value and policy functions. Similar to Duarte (2018), we train the neural network with the key parameters of the economic model (i.e., the peer-pressure parameter β and the adjustment cost α) as state variables and solve for the corresponding class of models to minimize the effects of a particular parameterization on the results. To guarantee a positive approximation for the sub-probability $p(t, m)$, we follow Al-Aradi et al. (2022) and parameterize it as $p(t, m) = p_0(m)e^{t \cdot h(t,m)}$. The benchmark calibration is similar to Carmona et al. (2013).

We begin by examining the dynamics of the banking system in our economy. Figure 1 shows the distribution of surviving banks in the economy for four different points in time: the start date $t = 0$ (top left), $t = T/3 = 3.3$ years (top right), $t = 2T/3 = 6.6$ years (bottom left), and the end date $t = T = 10$ years (bottom right). At the start date, the banking system consists of a large number of banks with relatively low cash reserves (i.e., close to bankruptcy) and only a few banks with large cash reserves. This is the only point in time when the distribution of banks is known analytically since we assume that the initial distribution of banks follows a log-normal distribution. For this reason, we use the analytical expression for the initial probability distribution p_0 as a sanity check for our machine-learning algorithm since the boundary conditions in Eq.(5) of the system of PDEs in Eq.(4) have to be satisfied. Note that despite solving the system of PDEs backward in time, the DGM accurately captures the initial probability distribution, with the numerical solution overlapping the analytical expression for the bank probability distribution (dotted red line).

As time evolves, banks with low cash reserves experience negative shocks and declare bankruptcy. As a large number of undercapitalized banks exit the economy, the total mass of banks shrinks (i.e., $p(t, m)$ does not integrate to one and becomes a sub-probability). However, the new average of the banking industry's cash reserve increases, since it is computed over the surviving banks only. Figure 2 illustrates these two features of the dynamics of the banking industry in our economy by plotting the mean-field total probability mass and the mean industry cash reserves as a function of time in Panels (a) and (b), respectively.

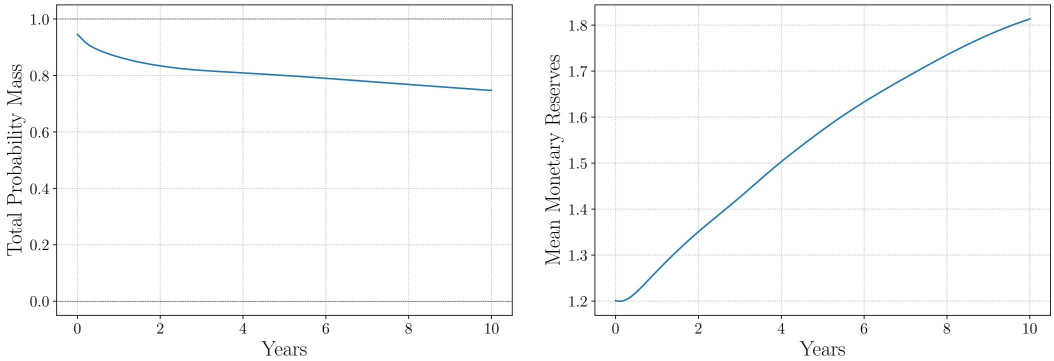
Having understood the dynamics of the banking system in this economy, we turn to the analysis of the dividend policy (i.e., the optimal control). Figure 3 shows the optimal dividend policy as a function of the level of monetary reserves for the same four points in time as in Figure 1. As shown by the solid blue lines, our model generates optimal dividend payments that increase with monetary cash reserves. Note, however, that due to the high nonlinearity of our model, the dividend policy is particularly sensitive to changes in the monetary reserve when the bank is below the industry average cash reserve, represented by the red dashed (vertical) line. In other words, the marginal increase in dividend payments is much larger when banks are below the industry cash reserve than when they are above it.

Figure 1: Density of Banks in the Economy



Notes. The figures show the density profile as a function of the monetary reserve level for $t = 0$ (top left), $t = T/3$ (top right), $t = 2T/3$ (bottom left), and $t = T = 10$ (bottom right).

Figure 2: Banking Industry Characteristics



(a) Total Probability Mass **(b)** Industry Mean Reserves

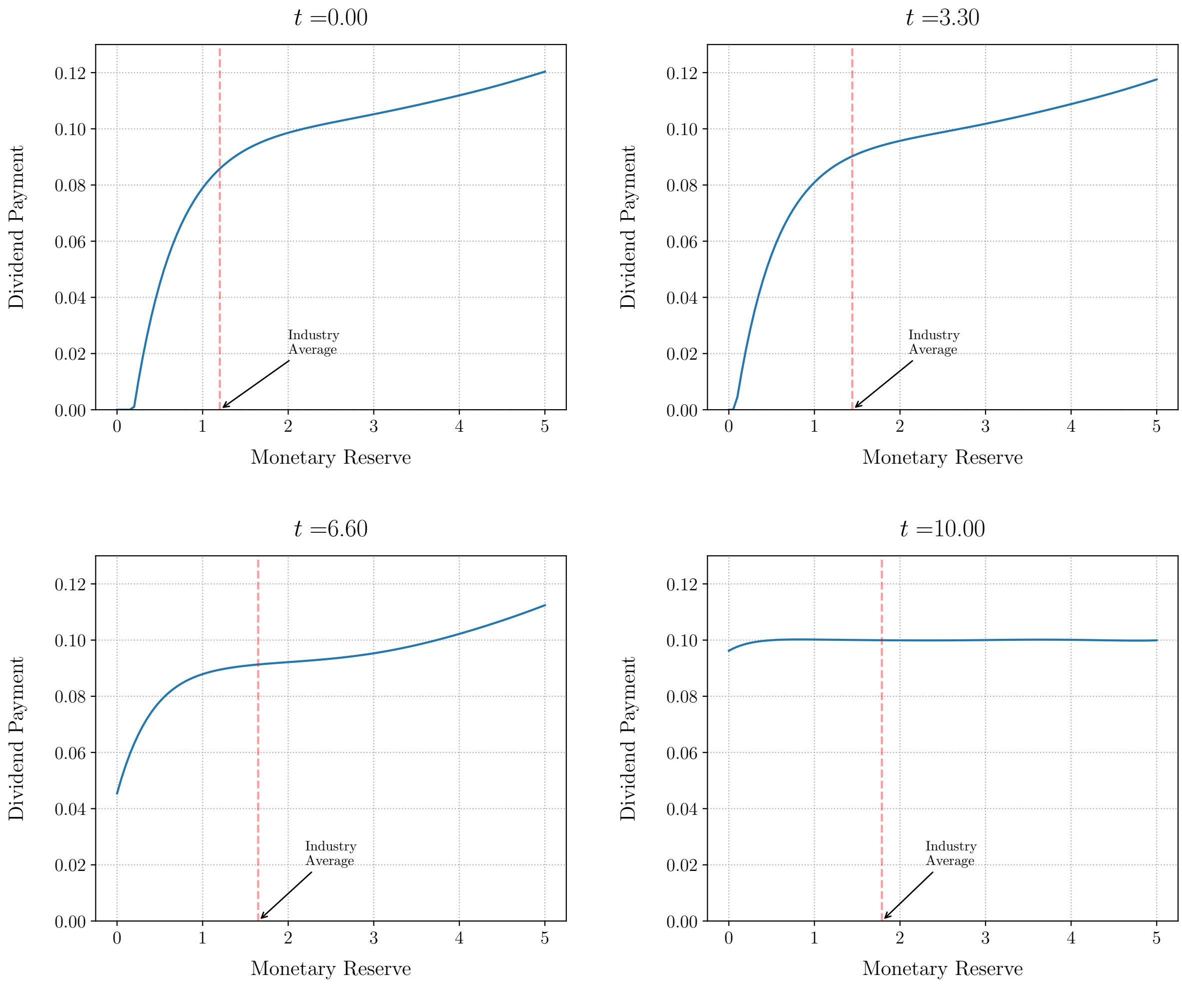
Notes. The figure shows the mean-field total probability mass and the industry average cash reserves.

In addition, as banks accumulate more reserves and deviate more from the industry level, they end up paying larger dividends, indicating a positive association between dividend payments and positive deviations from the industry mean cash reserve. The bottom right plot shows that, at the end date, the optimal policy flattens out and converges to the theoretical value derived in Proposition 2 of $\ell^{\star}(T, m) = 1/\alpha$, due to the final condition $V(T, m) = 0$.

Panel (a) of Figure 4 shows the effect of peer pressure on the optimal dividend policy. As illustrated, peer pressure effects, captured by the parameter β, have a negative effect on the optimal dividend policy. The reason is that when banks are pressured by competitors to accumulate cash, they increase reserves at the expense of dividend payouts. As a result, the greater the peer pressure considerations, the smaller the dividend payouts and the more variable the optimal policy.

Panel (b) of Figure 4 shows the effect of cash reserves on the optimal dividend policy as a function of time. The graph shows that the level of cash reserves affects both the amount of dividends paid and the sensitivity of the optimal policy. For example, while the optimal dividend policy for banks with cash reserves below the industry average (i.e., $m = 0.8\eta(0)$) is roughly insensitive to the passage of time during the first 6 years, the optimal dividend policy for banks with high cash reserves relative to the industry average (i.e., $m = 1.2\eta(0)$) declines sharply as

Figure 3: Optimal Dividend Policy and Monetary Reserves



Notes. The figures show the optimal dividend policy as a function of the monetary reserve level for $t = 0$ (top left), $t = T/3$ (top right), $t = 2T/3$ (bottom left), and $t = T = 10$ (bottom right). The parameters are given in Table **??**.

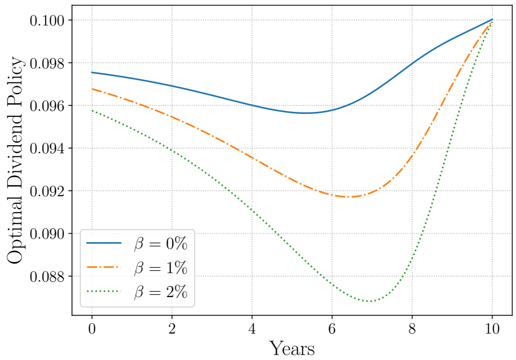
time passes by and undercapitalized banks exit the economy, even though they have significantly higher dividend payouts than undercapitalized banks. Note that as the economy approaches the end date, the absorption effects drive the optimal dividend policy to $\ell^\star(T, m) = 1/\alpha$, regardless of the level of cash reserves, as predicted by Proposition 2.

We conclude our numerical analysis by examining how peer pressure impacts the financial stability of the economy. Figure 5 shows the probability of default as function of time for four different levels of peer pressure: $0\%, 1\%, 2\%$, and 3%. For each peer pressure parameter, we simulate 100,000 paths for the aggregate cash reserves $M_t^\star$ presented in Proposition 2 and compute the default probability as the ratio of the number of paths in which the optimal cash reserve was depleted ($M_t^\star < 0$) to the total number of simulations.[3] As shown, the probability of default of the representative bank decreases as peer pressure increases. A larger peer pressure motive induces banks to accumulate reserves and reduce dividend payments. As a result, the entire financial system, represented by the representative bank, has a higher level of monetary reserves and, consequently, a lower probability of default. In addition, the figure shows that peer pressure reduces the instability of the financial system by lowering the probability of default of the representative bank, as banks manage their reserves to remain above the industry average.

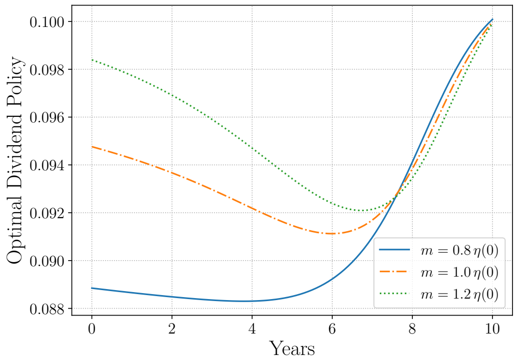
Taken altogether, our mean-field theoretical model of the banking system predicts that, in the presence of peer pressure considerations, (*i*) dividend payouts increase in a nonlinear fashion with the level of monetary reserves, (*ii*) positive deviations from the banking industry's average cash reserves yield larger dividend payouts, (*iii*) dividend payouts are negatively related to the level of peer pressure, i.e., the larger the peer pressure, the lower the dividend payouts, (*iv*) dividend payouts are more sensitive when the intensity of peer pressure is higher, (*v*) banks with below-average cash reserves pay less dividends than banks with above-average monetary reserves, (*vi*) dividend payouts of undercapitalized banks display smaller time variation than dividend payouts of banks with large cash reserves, and (*vii*) an increase on peer pressure reduces the probability of default, yielding a more financially stable banking system.

[3]We fix the random seed and use the same Brownian paths for each of the peer pressure parameters to ensure that any differences are solely due to peer-pressure effects.

Figure 4: Peer-pressure and Cash Reserve Effects



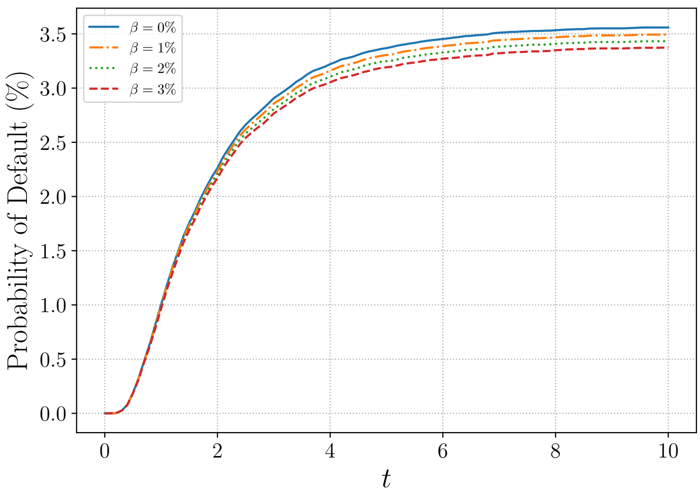
(a) Peer-pressure Effects



(b) Cash Reserves Effects

Notes.

Figure 5: Probability of Default



(a) Probability of Default

Notes. The figure shows the probability of default of the representative bank as the time approaches the terminal date $T = 10$. We simulate 100,000 optimal cash reserve paths and define the probability of default as the ratio of the number of paths in which the optimal cash reserve was depleted to the total number of simulations. The default probability is computed for four different levels of the peer pressure parameter β: 0% (dotted line), 0.5% (solid line), 1% (dashed line), and 1.5% (dashed-dotted line).

3 Empirical Analyses

3.1 Data sources, variables, and descriptive statistics

Our data sample consists of all bank holding companies with available data on the Federal Reserve Y-9C Consolidation Financial Statements for Bank Holding Companies reports (Y-9C reports, hereafter) for the period 1987–2020, resulting in 9,336 bank-year observations. Four variables are at the center of our analysis: dividends, total payouts, cash reserves, and cash reserve deviations.

The variable *dividends* is the cash dividends paid on common stock, while the variable *total payouts* is the sum of cash dividends paid on common stock and net share repurchases. The variable *cash reserves* represents the total of all non-interest-bearing balances due from depository institutions, currency and coin, cash items in process of collection, and unposted debits, while the variable *cash reserve deviations* denotes the difference between the level of actual cash reserves and the industry mean level of cash reserves. A detailed description along with the summary statistics of all variables used in our empirical analysis are presented in Table 1.

Figure 6 presents the time series averages of payouts and cash reserves among bank holding companies from 1987 to 2020, illustrating trends in dividends, total payouts, cash reserve levels, and cash reserve deviations. Over the years, both dividends and total payouts have fluctuated, with notable increases observed in the late 1990s and mid-2000s, and peaking in 2019, driven largely by share repurchases (Graham and Harvey 2001; Skinner 2008). This evolving pattern indicates a shift toward more substantial payouts over time, paralleling the trends observed for industrial firms (DeAngelo et al. 2004).

Cash reserve levels also displayed a large variability, peaking in 2020, which illustrates the banks' strategic liquidity management in response to changing economic conditions and regulatory environments (Gropp et al. 2018; Ramcharan 2019). The time series of the deviations in cash reserves complements this picture by highlighting the diverse strategies employed by banks with different levels of capitalization in managing liquidity, with peaks and troughs reflecting periods of financial stress or stability within the banking sector (Chopra et al. 2021).

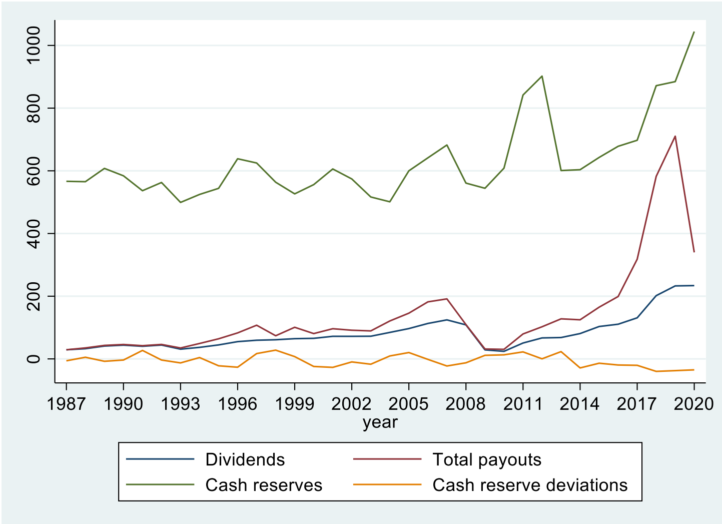


Figure 6: *Time series.* The figure shows the time series distribution of payouts and cash reserves (levels and deviations). The sample spans the period 1987-2020 and consists of 9,336 bank-year observations between 1987-2020 and consists of all bank holding companies with available data on Federal Reserve (FR) Y-9C Consolidated Financial Statements for Bank Holding Companies.

Panel A of Table 2 provides the descriptive statistics of cash reserves and payouts. The statistics indicate a wide disparity in the distribution of dividends and total payouts, with averages significantly higher than the medians, pointing towards a skewed distribution where a small number of firms account for a majority of the payouts. Similarly, cash reserve levels average at 622.43 with a median of 51.81, suggesting a few firms hold large reserves while most maintain lower balances. The deviations in cash reserves are centered around zero, by construction, and indicates that on average, banks' reserves align with the industry norm, though individual deviations can be large as shown by the median and standard deviation.

Panel B of Table 2 provides the correlation between cash reserves and payouts measures. Consistent with the theoretical framework presented in Proposition 2, the preliminary correlation analysis indicates a strong positive correlation between these variables, with the correlation of dividends and total payouts with cash reserve levels being .7954 and .6668, respectively. The correlation between cash reserve levels and cash reserve deviations is .999, indicating that deviations are a direct reflection of the levels and thereby reaffirming the measurement approach. Additionally, the positive association between cash reserves and total payouts can also be visualized in Figure 6. Here, we observed the parallel ascent in both variables, punctuated by sharp declines reflective of changing financial conditions.

We conclude our preliminary analysis by presenting the univariate statistics and t-test describing the relationship between cash reserves (levels and deviations) and the payout measures (dividends and total payout). For that, we categorize our dividends and total payout samples into terciles and conduct a Wilcoxon rank sum test to check whether there is a significant difference between the distributions. Table 3 presents the results for dividend sample in Panel A and total payout sample in Panel B.

Tercile 1 of Panel A, characterized by lower cash reserves, shows a median dividend of 1.4645 and a mean of 2.4651. In contrast, Tercile 3 of Panel A, characterized by significantly higher cash reserves, has a median dividend of 44.9295 and a mean of 220.5793. The marked difference in median dividends–43.4650 between Terciles 3 and 1–emphasizes the substantial impact of cash reserves on dividend size. This pattern holds for both cash reserve metrics (levels and deviations), suggesting that banks' dividend policies are shaped by their liquidity positions relative to both *absolute levels and industry benchmarks*.

A similar pattern is observed for total payouts in Panel B. Tercile 3, which has the highest cash reserves, presents a median total payout of 53.6650 and an average of 369.2854. This is in sharp contrast to Tercile 1, where the median payout is only 1.7815, with a mean of 3.6973. The stark difference in median payouts, amounting to 51.8835, highlights the significant influence of cash reserves on the size of total payouts. As indicated by all Wilcoxon Z-statistics and their associated p-values, the difference between the top and bottom terciles is highly significant for all four cases. The Wilcoxon Z-statistics and corresponding p-values confirm that the disparities between the top and bottom terciles are statistically significant in all four instances.

Overall, these descriptive insights lay the groundwork for a more in-depth analysis of the financial management practices among bank holding companies. The preliminary findings reveal substantial variations in how banks manage and distribute their financial resources, with liquid positions, proxied by cash reserves, playing a crucial role in shaping payout policies, with more liquid banks tending to return more capital to shareholders. Furthermore, industry benchmarks (peer pressure) appear to have a significant impact on the trade-off between cash reserves and total payout distributions.

3.2 Methodological approach

In this section, we delve deeper into the positive relationship between cash reserves and payout measures. This analysis deserves more attention because the observed unconditional positive relationship between these two variables may be mechanically driven by bank size. Typically, larger banks hold larger reserves, are more profitable, and face fewer financial constraints, which may ultimately lead to larger payouts. For this reason, we conduct a more detailed analysis that takes into account (*i*) observable bank characteristics and (*ii*) unobserved heterogeneity across banks and over time, within a multivariate setting.

Akin to industrial firms, the banking sector is known for a conservative approach to dividend policy, rooted in a reluctance to cut dividends once they have been initiated. This behavior is captured in the partial adjustment model, which accounts for the inherent persistence of dividends, consistent with the empirical finding that banks smooth dividends over time (Skinner 2008). The system GMM is particularly well suited to estimating this model as it allows for addressing the potential endogeneity of cash reserves and other independent variables, while recognizing the dynamic nature of the payout decision process.

To examine the effect of cash reserve management on the payout policy, we use the following regression model:

$$\begin{aligned}\textbf{Payout}_{i,t+1} =& (\lambda\theta)\textbf{Cash Reserves}_{i,t} + (1-\lambda)\textbf{Payout}_{i,t} + (\lambda\beta)\textbf{BC}_{i,t} \\ &+ \mu\textbf{Bank}_i + \kappa\textbf{Year}_t + \varepsilon_{i,t+1},\end{aligned} \tag{7}$$

where

(i) **Cash Reserves**$_{i,t}$ is a cash reserve measure (i.e., cash reserve level or deviation).

(ii) **Payout**$_{i,t}$ is a payout measure (i.e., dividend payout or total payout ratios).

(iii) $\mathbf{BC}_{i,t}$ represents the bank characteristics: size (log assets), ROA, ROA standard deviation, non-performing loans, and equity ratio.

(iv) $\mathbf{Bank}_i$ is a fixed effect for bank i.

(v) $\mathbf{Year}_t$ is a fixed effect for year t.

(vi) $\varepsilon_{i,t+1}$ is a random error.

We estimate Eq.(7) using a two-step system GMM to eliminate the bias introduced by the lagged dependent variable and to account for potential endogeneities in the independent variables, as in Flannery and Hankins (2013). The dynamic framework of the system GMM facilitates the understanding of how firms adjust their payout ratios in response to changing cash reserves, while adhering to a conservative strategy that prioritizes payout stability and predictability.

The lagged dependent variable captures the persistence of dividend policy, reflecting the firms' commitment to maintaining dividend levels and the significant reputational consequences of dividend cuts. The strong persistence component of the payout policies is captured by the coefficients λ.

The control variables include a broad array of financial and operational factors that may affect bank policy decisions, such as size (logarithm of assets), profitability (return on assets, or ROA), ROA volatility (standard deviation of ROA), a risk measure of the loan portfolio (non-performing loans, loan loss provisions), and capital structure (equity ratio), measures of market valuation, growth potential and charter value (market-to-book ratio), merger activities, operational efficiency (cost efficiency), counterparty risk exposure (retail deposits, business loans, and off-balance sheet items), and market dominance (Lerner index), as detailed in Table 1. These controls are selectively applied based on the analysis focus—be it cash reserves, dividends, or bankruptcy risk—to distinctly assess the impact of peer pressure on cash reserves, payout ratios, and bankruptcy risk, apart from other influencing factors tied to bank performance and financial tactics. Crucially, our findings are stable across different control variable sets, showing consistency of our findings across different sets of controls.

Bank fixed effects account for unobservable, time-invariant characteristics unique to each bank that might affect its payout policy, such as corporate culture, governance structure, and long-term strategic goals. Year fixed effects adjust for common macroeconomic or industry-wide shocks that uniformly impact all banks during a given period, such as changes in regulatory environments, tax rates, economic cycles, or market conditions. Collectively, these fixed effects ensure that the analysis isolates the distinct influence of cash reserves on payout choices, clear of wider systemic influences and enduring bank-specific characteristics.

3.3 Empirical Results

Table 4 presents the results of the two-step system GMM regression, controlling for various bank characteristics along with bank and year fixed effects, as shown in Eq.(7). The regression analysis reveals a significant and positive relationship between the cash reserve levels and banks' propensity to distribute capital to shareholders through dividends and share repurchases. As demonstrated in columns 1 and 3, banks with higher liquidity levels tend to increase both dividend distributions and share repurchases, indicating a strategic approach to using excess capital for shareholder returns and underscoring liquidity as a determinant of dividend policy. While a positive standard deviation increase in cash reserves increases the dividend payout ratio by 2.76 standard deviations, the total payout ratio increases by 4.10 standard deviations, holding all other variables constant.

Columns 2 and 4 of the regression analysis show the effects of cash reserve *deviations* on dividend and total payout ratios, respectively. The positive and highly significant coefficients of 0.0036 and 0.0032 indicate that banks with cash reserves above the industry average are tend to distribute higher dividends and make larger total payouts, which include dividends and share repurchases. For every one standard deviation increase in cash reserve deviations, there is a corresponding increase in the dividend and total payout ratios by 2.49 and 2.97 standard deviations, respectively, demonstrating a direct link between a bank's liquidity position relative to its peers and its ability to return capital to shareholders.

Taken altogether, the results in Table 4 show that liquidity is not just a buffer or operational necessity but a strategic tool in financial decision-making and shareholder value creation. As important, banks monitor their peers' liquidity management strategies and adjust their payout policies accordingly, with higher-than-average cash reserve banks engaging in more aggressive capital distribution strategies.

Next, we address the potential simultaneity between cash reserve decisions and payout policies. Extant literature reinforces the premise that dividend policy decisions, particularly dividend increases, are contingent upon fulfilling a firm's investment and liquidity requirements (Brav et al. 2005). Consequently, cash reserves may serve as both a determinant and a result of payout decisions, reflecting a reciprocal relationship where reserve levels may dictate payout strategies, and concurrently, payout policies might affect reserve holdings.

This precedence of financial obligations informs the application of our two-step system GMM model, in which we endogenously treat dividend payouts as a function of both the level and deviations in cash reserves. Consequently, our subsequent models account for this bidirectional causality, recognizing the interdependencies between cash reserves and payout management. This method is pivotal for capturing the dynamic nature of payout policies, which are fundamentally influenced by cash reserve positions.

To account for the potential joint determination of banks' cash reserves and payouts, we first estimate two-system GMM regressions separately for cash reserves and payouts. In the second step, we simultaneously estimate the two structural equations, incorporating the predicted values from the first-stage regressions as explanatory variables. The 2SLS methodology accounts for any correlation between the residuals of cash reserves and payouts that may arise from unobserved factors influencing both cash reserves and payouts.

Table 5 presents the results from the second-stage of a GMM two-stage least squares regression analysis, focusing on how banks' cash reserves influence their dividend and total payout ratios. The analysis distinguishes between the effects of predicted cash reserve levels and deviations, based on predicted values of cash reserves and cash reserve deviations.

In column 1, the findings reveal a significant positive relationship between cash reserves and dividend payouts. Specifically, an increase in predicted cash reserve levels leads to a significant increase in the dividend payout ratio (.1137, $p < .01$), indicating that banks with higher liquidity are more inclined to distribute profits to shareholders through dividends. Similarly, when examining cash reserve deviations in column 2, a positive impact is observed (.1005, $p < .01$), suggesting that deviations from the industry average in cash holdings are also positively associated with dividend payouts.

In column 3, the analysis extends to total payout ratios, including both dividends and share repurchases. Again, positive coefficients for predicted cash reserve levels (.1821, $p < .01$) and deviations (.1389, $p < .01$) are found, underscoring that banks' liquidity positions not only influence dividend payments but also broader capital return strategies including repurchases. This reflects a broader propensity to return capital to shareholders when liquidity is ample.

The robust and consistently positive coefficients on both predicted cash reserve levels and deviations affirm our main findings, confirming the significantly positive linkage between bank liquidity and payout decisions. This highlights the pivotal role of peer pressure effects on bank cash reserve management in shaping payout strategies, where prudent cash reserve management directly correlates with increase payouts.

Additionally, we estimate a 3SLS system of cash reserves and payouts after dropping the lagged dependent variables from the control variable sets (see Table 6). In each case, we find that the main results shown in Table 4 are robust to the use of these alternative empirical specifications.

The three-stage least squares regression model confirms the previously shown dynamics of cash reserve management and payout policies in banks, continuing to support the theoretical underpinnings suggested earlier. As before, the table shows the link between banks' cash reserves—both in terms of absolute levels and deviations from expected values—and subsequent payout behaviors, as captured in dividend payout ratios and total payout ratios, while controlling for various bank-level factors along with bank and year fixed effects. This approach ensures that the observed relationships between cash reserves and payout behaviors are not confounded by omitted variable bias or common macroeconomic shocks.

Firstly, the positive and statistically significant coefficients for 'Cash reserve levels' across all models robustly indicate that higher cash reserves within a bank are associated with more substantial payouts to shareholders. This empirical result aligns with the theoretical prediction that banks are likely to distribute more in dividends as their liquidity increases. It reinforces the model's assumption that banks, when enjoying abundance in cash reserves, increase their payout ratios, likely to maintain competitiveness and signaling financial health to the market.

Additionally, the analysis highlights that banks adjust their payout strategies in response to deviations from expected cash reserve levels. This adjustment is evident in both dividend and total payouts, aligning with the hypothesis that banks react to their comparative cash reserve positioning within the industry. Such deviations trigger adjustments in payout ratios, suggesting a sensitivity to industry benchmarks and a concerted effort to align with sectoral norms and expectations.

These robustness analyses, through alternative empirical specifications, reinforce the main findings from our two-step system GMM regressions. These analyses, utilizing a simultaneous equations framework to account for endogeneity between cash reserves and payouts, substantiates the significant positive relationship between banks' liquidity positions and their capital distribution strategies. It corroborates the idea that cash reserves are not merely a safeguard but an integral component of strategic financial decision-making that facilitates shareholder value maximization. These robustness analyses thus add to the credibility of our main findings and the conclusion that cash reserves and deviations are significant determinants of how banks navigate payout decisions in balancing financial stability with the demands for shareholder returns.

As shown in Table 7, the robustness results from the expanded control variable set corroborate our primary findings, reinforcing the assertion that cash reserves—both in terms of absolute levels and deviations from norms—have a positive effect on banks' dividend and total payout ratios. In economic terms, for every standard deviation increase in cash reserves, the total payout ratio increases by 4.13 standard deviations, holding all other variables constant. Similarly, for every standard deviation increase in cash reserve deviations, the dividend and total payout ratios increase by 3.61 and 3.22 standard deviations, respectively.

The positive coefficients for Ln(Assets) across all models suggest a tendency for larger banks to allocate a greater portion of their resources to shareholder dividends and total payouts, likely due to their enhanced capacity to generate earnings and maintain financial stability. Meanwhile, Return on Assets (ROA) displays a positive relationship with payout ratios, indicating that banks with higher profitability are more inclined to reward their shareholders, affirming the direct link between financial performance and payout capacity.

Conversely, the Standard Deviation of Return on Assets (ROA SD) bears negative coefficients in all models, implying that banks experiencing greater earnings volatility tend to adopt more conservative payout policies. This reflects a strategic caution, aiming to preserve liquidity and ensure stability amidst uncertain financial conditions. Surprisingly, banks with a higher ratio of non-performing loans exhibit a tendency towards increased payouts, a result that might seem counterintuitive but could represent a strategy to maintain shareholder confidence despite apparent credit risks.

Furthermore, the negative coefficients associated with the Equity Ratio suggest that banks with a stronger capital base relative to their assets are likely to retain earnings for growth or to bolster their financial standing, rather than distributing it to shareholders. This highlights the trade-off between capital retention for internal strength and the distribution of profits to shareholders.

The effects of other variables such as the Market to Book Ratio, Merger Dummy, Cost Efficiency, Retail Deposits, Business Loans, and Off-balance Sheet Items, although varied in their impact across different models, collectively underscore the complexity of the banking sector's payout decisions. These factors reflect the intricate balance banks must maintain between operational efficiency, strategic growth initiatives, risk exposure, and the imperative to deliver shareholder value.

Importantly, the relationships depicted in Table 4 continue to hold even when additional bank-specific characteristics are considered, underlining the notion that liquidity is not merely a precautionary asset but also an integral component of payout policy. Even after accounting for other relevant control variables such as market-to-book ratio, mergers, cost efficiency, retail deposits, business loans, and off-balance sheet items, the influence of cash reserves remains significant and materially unchanged. This suggests that liquidity considerations are at the forefront of banks' strategies for capital distribution, independent of other financial metrics. The analysis delineates a clear pathway through which cash reserves and relative position of the bank compared to the industry determine bank approach to capital distribution, validating liquidity as a strategic variable in financial decision-making and shareholder value optimization.

Overall, our findings not only validate the theoretical assertions regarding the influence of cash reserves on payout decisions but also illustrate the broader context in which banks operate. They reflect a nuanced understanding that banks' payout strategies are not solely dictated by internal metrics but are also profoundly influenced by cash reserve behaviors of their peers. These empirical findings affirm the theoretical stance that banks are guided not only by individual corporate governance and performance metrics but also by a collective industry narrative shaped by peer actions and expectations.

The study by Bates et al. (2009) on industrial firms' increasing cash holdings underscores the significance of precautionary motives behind significant cash reserves, driven by riskier cash flows and shifts in operational strategies. While this analysis primarily focuses on industrial corporations, the fundamental principles and findings offer a valuable lens through which to examine cash management practices within the banking sector, particularly under the influence of peer pressure.

Banks, akin to industrial firms, maintain cash reserves as a critical buffer against financial uncertainties and liquidity needs. However, the banking sector is distinguished by its unique operational, regulatory, and competitive dynamics, where peer effects play a central role in shaping financial management strategies, including cash reserve policies. The intensity of peer pressure can markedly influence industry-wide cash holding patterns, suggesting that during periods of financial volatility or heightened regulatory oversight, banks might increase their cash holdings in response to similar actions by their peers. This collective behavior could lead to an industry-wide escalation in cash reserves, propelled by a shared motive to mitigate risk and enhance liquidity amid uncertainties.

Conversely, in more stable financial climates, a decrease in peer pressure might encourage banks to reduce their cash holdings, reallocating resources towards more productive assets to optimize returns. This adaptive response to peer benchmarks highlights the crucial role of peer effects in guiding banks' liquidity management strategies.

Integrating the insights from Bates et al. (2009) with the dynamics of peer influence in the banking sector, we propose that fluctuations in peer pressure intensity are pivotal in shaping banks' cash reserve patterns. This approach not only extends the discussion on cash management beyond the traditional economic and operational factors but also underscores the need for further exploration into how peer dynamics influence banks' strategic decisions on liquidity management and financial stability.

In the context of our analysis, peer pressure refers to the influence that banks exert on each other regarding their financial decision-making, specifically cash reserve management and dividend payouts. The idea is that banks may adjust their cash reserves and dividend payouts based not only on their internal financial conditions but also in response to the actions and performances of their peers.

The peer variable, as defined by the product of a bank's cash reserves and the deviation of cash reserves among its peers, aims to measure the intensity of peer pressure based on both the magnitude of the bank's reserves and how significantly those reserves deviate from the norm within the peer group. This definition suggests a simple approach to quantifying peer pressure, where both the size of the bank's cash holdings and its relative position within the banking community's spectrum of cash reserves are considered. The creation of the peer variable in this manner is economically motivated by the hypothesis that banks not only respond to the average behavior of their peers but also adjust their strategies based on how their financial metrics (in this case, cash reserves) compare to the distribution of such metrics across the peer group. This comparison can inform strategic decisions, such as dividend payments, by signaling a bank's strength, conservatism, or aggressiveness in liquidity management compared to its peers.

To quantify the extent to which this peer pressure impacts specific financial behaviors, we introduce two empirical constructs: Beta 1 and Beta 2. These measures are crafted to capture how closely banks align their financial strategies—be it holding cash reserves or distributing dividends—with those of their peers, potentially as a response to competitive forces or market expectations. Beta 1 focuses on the dividend payout behavior, offering insights into how a bank's dividend strategy might be influenced by its peers. The underlying hypothesis is that banks' financial strategies, specifically their dividend payments, are influenced by their cash reserve standings relative to their peers. Conversely, Beta 2 quantifies the extent to which a bank's cash reserve levels are a reaction to or in anticipation of shifts in the average industry reserves. Like Beta 1, it captures how individual banks' strategies are influenced by industry norms.

To calculate Beta 1, a regression model is employed where the dependent variable is the bank's dividend payout ratio. The key independent variable is the peer measure, reflecting the interaction between a bank's cash reserves and its relative position within the peer group's cash reserve distribution. The coefficient obtained from this regression (Beta 1) quantifies the sensitivity of a bank's dividend payout ratio to the peer pressure exerted through cash reserve comparisons, with greater coefficient estimates indicating larger sensitivity of dividend payouts to peer pressure. Through Beta 1, stakeholders can gauge the interplay between competitive dynamics, strategic decision-making, and financial signaling in the banking sector's approach to dividend distributions.

We calculate Beta 2 by regressing the average industry cash reserves against an individual bank's cash reserves and predicting the values. This approach provides a mechanism to understand the sensitivity of a bank's liquidity strategy to industry standards. Beta 2, derived from this regression, essentially measures how closely a bank's cash reserve strategy is aligned with industry-wide practices. The magnitude of this coefficient captures the sensitivity of the individual bank's decision-making to these industry patterns. A larger coefficient implies a higher degree of sensitivity, meaning that the bank's cash reserve strategy is closely aligned with, and reactive to, changes in the industry average. Conversely, a smaller coefficient suggests a more independent approach to liquidity management, where the bank's cash reserve decisions are less influenced by industry-wide trends.

Following the calculation of Beta 1 and Beta 2 through regression analysis, we standardize these metrics to ensure their comparability and to enhance the interpretability of our findings. Standardization involves transforming the predicted values into a scale where they can be directly compared, regardless of the original units or scales. Specifically, we adjust the predicted values by subtracting the minimum value observed in the dataset, dividing by the range (maximum value minus minimum value), and finally scaling the result by a factor (in this case, 1.5).

Given the dynamic and potentially endogenous nature of banks' cash reserve management, we assess how peer pressure influences banks' cash reserve strategies using a two-step system GMM estimation that controls for lagged cash reserves, along with several bank-level controls including bank size, capital ratio, market-to-book ratio, mergers, cost efficiency, retail deposits, business loans, and off-balance sheet items, as well as year and bank fixed effects. The regression results shown in Table 8 indicate that both Beta 1 and Beta 2 have positive effects on cash reserves in their respective model specifications, indicating that as peer pressure increases, so do a firm's cash reserves. This suggests that peer pressure encourages firms to bolster their financial safety nets by holding more cash. A larger cash reserve is generally viewed as a protective measure, enhancing a firm's ability to weather financial uncertainties and reduce its risk of facing cash flow problems. In column 1, the positive coefficient for Beta 1 implies that peer pressure motivates firms to adopt financial practices that increase their cash reserves, potentially as a strategy to match or surpass the financial prudence of their peers. In column 2, Beta 2 also exhibits a positive effect on cash reserves: peer pressure is associated with an increase in cash reserves. This consistent positive relationship indicates that, under the influence of peer pressure, firms are likely to enhance their financial stability by maintaining higher levels of cash. This behavior may reflect a strategic response to competitive dynamics within the industry, where firms seek to demonstrate financial robustness or prepare for unpredictable financial challenges.

Our findings significantly contribute to the banking and corporate finance literature by elucidating how peer pressure influences banks' cash reserve policies. Our study not only bridges the gap between the precautionary motives identified by Bates et al. (2009) in industrial firms and the banking sector's unique dynamics but also highlights the important role of peer effects in shaping financial management strategies across industries. By offering a nuanced understanding of how peer dynamics can drive cash holdings, our research sheds light on the complex interplay between peer effects and financial decision-making, providing valuable insights for academics, practitioners, and policymakers alike.

Our subsequent findings on the effects of peer pressure on payouts, shown in Table 9 reveal intriguing patterns: while we observed a reinforcing effect of peer pressure on cash reserves, indicating a tendency among banks to shore up their financial buffers in response to peer behaviors, a contrasting trend emerges in dividend payout decisions. Specifically, the empirical analysis using system GMM reveals a strong negative relationship between peer pressure as captured by Beta 1 and dividend payouts: the coefficient for Beta 1 is significantly negative, indicating that an increase in peer pressure leads to a substantial decrease in the dividend payouts. This outcome suggests that firms under higher peer pressure may be more conservative in their dividend policies, potentially retaining earnings to invest in competitive strategies by bolstering their cash reserves. Such findings not only corroborate our theoretical predictions but also add a layer of empirical evidence to the discourse on how peer influences shape strategic financial management in the banking sector.

Furthermore, the negative coefficient for Beta 2 corroborates this finding, implying that even when considering different specifications, peer pressure remains a key factor in reducing dividend payouts. This aligns well with the theoretical model previously discussed, which posits that an increase in industry-average cash reserves – a proxy for peer pressure – would lead firms to manage their own reserves more conservatively, potentially leading to reduced dividend payouts.

The coefficients for lagged dividends are also negative and significant, reinforcing the idea that past dividend policies influence current dividend decisions. Larger firms, as indicated by the positive coefficient for Ln(Assets), tend to pay out more in dividends, which could reflect their greater financial flexibility and capacity to return profits to shareholders. The variables return on assets and standard deviation of the return on assets have significantly negative coefficients, suggesting higher variability in returns or lower average returns are associated with reduced dividend payouts.

The variable non-performing loans relative to assets, when significant, shows a negative impact on dividend payouts, which is consistent with the notion that poorer loan performance leads to more cautious capital distribution policies. Conversely, equity to total assets is negatively correlated with dividend payouts, hinting that a stronger equity position might lead to reduced immediate distributions to shareholders, potentially to support further equity growth or buffer against future uncertainties.

Overall, the empirical results underscore the economic intuition that peer pressure influences corporate financial decisions. Firms seem to adjust their dividend policies not only based on their historical practices and asset size but also in response to the competitive dynamics within their industry. This behavior is in line with the theoretical model's predictions, where peer effects play a significant role in shaping firms' reserve management and payout policies.

Our understanding of wide-ranging trends in dividend payouts, particularly within banks, can be enriched by considering the intensity and impact of peer effects. As peer pressure varies over time, influenced by economic conditions, regulatory environments, and market sentiments, it can lead to shifts in the industry's overall approach to liquidity management and dividend policies. For instance, an increasing trend in dividend payouts across the banking sector could reflect a period of diminished peer pressure, where banks feel less compelled to conform to conservative liquidity norms set by their peers. Conversely, a decline in dividend payouts might signal intensified peer pressure, prompting banks to prioritize cash reserves over dividends to align with industry benchmarks or to signal financial stability amidst uncertain economic landscapes.

Our study extends the conversation initiated by Fama and French (2001) by positing that peer pressure within the banking industry and showing how it significantly impacts dividend payout trends. Fama and French (2001) attribute the reduced incidence of corporate dividend payouts to the changing characteristics of publicly traded firms, such as smaller size, lower profitability, and stronger growth opportunities, alongside a general decrease in the propensity to pay dividends. Our primary finding that peer pressure leads banks to maintain higher cash reserves while simultaneously lowering dividend payouts offers a new perspective on the dynamics of dividend distribution decisions. In the context of the banking sector, this peer effect may act as a catalyst for firms to adopt more conservative financial strategies, prioritizing liquidity over immediate shareholder returns through dividends. This behavior is particularly rational in an environment where maintaining a strong liquidity position is crucial for financial stability and regulatory compliance. Thus, the influence of cash reserves in shaping dividend policies can be better understood through the lens of peer effects. Banks, observing the actions of their peers, may adjust their own policies to align with industry norms or to signal financial health and stability to the market. This herd behavior, while reducing the variance among banks in terms of liquidity and dividend policies, also reflects a collective move towards lower dividend payouts in banks, contributing to a similar trend identified by Fama and French (2001) for corporate firms. Therefore, analyzing the intensity and fluctuations of peer pressure provides a valuable lens through which to interpret the evolving landscape of dividend payouts.

In exploring the impact of peer pressure on bank risk profiles, we adopt a methodological approach that complements our earlier analyses on cash reserves and dividend policies. Specifically, our analysis employs a fixed effects regression model to examine the influence of peer pressure, as captured by Beta 1 and Beta 2, on banks' Z-scores, controlling for a comprehensive set of financial and operational variables alongside bank-specific and temporal fixed effects. This phase of the analysis specifically targets understanding how peer pressure influences banks' financial resilience, as measured by their Z-score—an indicator inversely related to the probability of default. The results are presented in Table 10.

The variable Beta 1 is significantly positive across different model specifications, suggesting that as the measure of peer pressure increases, the firm's z-score—a statistical measure of bankruptcy risk—also increases. Typically, a higher z-score indicates a lower probability of bankruptcy, so in this context, the positive coefficient for Beta2 implies that peer pressure may be driving firms to adopt financial practices that enhance their stability and lower their bankruptcy risk. This could be interpreted as firms striving to maintain or improve their financial standing in response to the competitive pressures exerted by their industry peers.

The Beta 2 variable similarly carries positive coefficient in the later columns of the regression table, indicating a trend towards lower bankruptcy risk under peer pressure. This finding aligns with Beta2, suggesting a consistent theme: peer pressure is associated with a decrease in bankruptcy risk, as measured by the z-score.

These empirical findings, which indicate that peer pressure might be leading to improved financial stability, align consistently with the theoretical model shared earlier. The theoretical model suggested that peer pressure could lead to more conservative reserve management and dividend policies, potentially reducing the probability of default. The empirical results appear to support this theory, demonstrating that in practice, firms respond to peer pressure by adopting strategies that improve their z-scores and, by extension, reduce their bankruptcy risk. This alignment between theory and empirical evidence underscores the practical relevance of the theoretical model in understanding firm behavior in the context of industry dynamics.

The insights provided by Srivastav et al. (2014) on bank payouts and the dynamics of risk-shifting between equity and debt holders offer a valuable framework for rationalizing our findings on the impact of peer pressure on bank risk profiles and financial stability. According to Srivastav et al. (2014) , bank payouts, through dividends or repurchases, can lead to a risk-shifting scenario where equity holders benefit at the potential expense of debt holders, as the bank retains riskier and less liquid assets. However, the presence of inside debt—debt held by bank CEOs—can mitigate this risk-shifting by aligning CEO incentives with the interests of debt holders, leading to more conservative payout policies that prioritize financial stability and the interests of debt holders. Our empirical findings, which show a positive relationship between peer pressure and banks' Z-scores (indicating lower bankruptcy risk), can be interpreted through this lens of risk management and conservative financial practices. The positive impact of peer pressure on Z-scores suggests that banks may be engaging in more conservative financial management practices, including cash reserve management and dividend policies, in response to the competitive pressures exerted by their industry peers. This behavior is consistent with the notion that banks, under the scrutiny of their peers and aiming to maintain or enhance their financial standing, adopt strategies that mitigate risk-shifting and align more closely with the interests of debt holders. Moreover, our findings suggest that the industry-wide norms and competitive pressures—reflected through peer effects—play a significant role in guiding banks' strategic decisions toward risk mitigation and stability enhancement. This aligns with Srivastav et al. (2014)'s conclusion regarding the role of inside debt in curbing risk-shifting behaviors by aligning CEO incentives with those of creditors and regulators. In the broader context of our study, peer pressure may serve a similar function at the industry level, encouraging banks to adopt financial practices that safeguard against risk-shifting and support the overall stability of the financial system. In other words, our study's empirical evidence on the positive impact of peer pressure on banks' financial stability, as indicated by improved Z-scores, resonates with the insights from Srivastav et al. (2014) regarding the interplay between bank payout policies, risk-shifting, and the protective role of conservative financial practices. By extending the dialogue to include the influence of peer effects, our research underscores the importance of industry dynamics in shaping banks' financial strategies in ways that prioritize risk management and align with the broader interests of debt holders, regulators, and the financial system as a whole.

These findings align with the theoretical model that suggested peer pressure could lead firms towards more conservative financial management, including prudent reserve and dividend policies, potentially enhancing their financial stability. The empirical evidence supports this theory, showing that in practice, firms respond to peer pressure by increasing their cash reserves, thereby potentially reducing their risk of financial distress. This connection between theory and empirical results highlights the importance of understanding how industry dynamics and peer influences shape firm behavior, particularly in terms of financial strategy and risk management.

3.4 Conclusion

This study enhances our understanding of cash reserve management and payout policies within the banking sector, offering a new theoretical model, empirical evidence, and insights into how peer pressure affects banking practices, paving the way for further research in this and related domains. We provide innovations in theoretical modeling and novel theoretical predictions strongly supported by empirical results to the literature. These include positive and negative effects of peer pressure on cash reserves and payouts respectively, consequently improving bank risk profiles, which is critical to bank performance, resilience, and prudential regulation and supervision. Our results add to several strands of literature on bank liquidity management, payout decision, and peer effects, shedding new light on longstanding policy debates on the panoply of regulations and their burdens on the banking industry. The observed positive relationship between liquidity levels and dividend payouts emphasizes the necessity for regulatory frameworks that compel banks to hold sufficient cash reserves. It suggests that regulators should adopt flexible guidelines that reflect the changing dynamics of market conditions and economic cycles. Such measures would ensure that banks maintain liquidity positions strong enough to fulfill operational requirements and shareholder expectations, without jeopardizing overall financial stability.

We conclude by offering recommendations and potential directions for future research and policy considerations in banking and related sectors. Future studies and policy adaptations in banking, influenced by regulatory shifts, technological advancements, or other external factors impacting industry dynamics, could benefit from integrating the concepts of peer effects. Peer pressure, measurable through publicly accessible data on industry-level cash reserves, offers a practical framework for understanding peer effects and can be readily applied in various contexts.

Our study reveals that peer pressure influences banks' decisions regarding liquidity management and dividend distributions, indicating that regulatory agencies could offer recommendations on sustainable liquidity and payout policies. This might include establishing benchmarks for payout ratios that take into account the banks' aspirations for growth, prevailing market conditions, and the imperative of maintaining adequate liquidity reserves. Implementing such benchmarks could deter banks from engaging in competitive behaviors that favor immediate shareholder gains at the expense of their long-term financial health.

Moreover, when dividends are disbursed, the depletion of safer, marketable assets like cash or government bonds, leaving behind riskier, less liquid assets, signifies a shift towards riskier asset profiles that favor equity holders. This dynamic points to a form of risk shifting that can disadvantage debt holders, given their different risk exposures compared to equity holders. The adverse effects of such dividend payments during crises have been critically viewed by scholars and policy-makers, suggesting that prudent regulatory oversight on cash reserves and dividend distributions can mitigate these negative incentives. Implementing policies that encourage banks to maintain higher cash reserves and moderate dividend payments, possibly through the influence of peer pressure, can help minimize these adverse incentives, aligning the interests of both equity and debt holders more closely and supporting the overall stability of the financial system.

Incorporating the beneficial aspects of peer pressure, the analysis of mean-field interaction within the banking sector highlights not only the systemic risks associated with collective actions but also the positive influence peer dynamics can exert on risk management practices. This nuanced understanding underscores the importance of regulatory bodies employing advanced monitoring tools not only to identify potential systemic risks but also to recognize and reinforce positive peer influences that promote prudent risk management across the industry.

In conclusion, our study illuminates the dynamics among cash reserve management and dividend policies, along with the influence of peer pressure on bankruptcy risk in the banking sector, offering insights that underscore the importance of informed regulatory guidance and the constructive role of peer dynamics. It prompts a reevaluation of current practices and encourages a dialogue on enhancing financial stability through cooperative efforts, laying the foundation for further investigation into the interplay of these important factors.

A Proofs

Proof of Proposition 1. This proposition follows directly as an application of results in Di Persio et al. (2022). Specifically, and using the numbering for sections and results of the aforementioned paper, the hypotheses stated in Section 2.3 are verified. Mainly, one should notice that F is clearly Larsy-Lions monotone as in hypothesis (iv) and satisfies the boundary condition in hypothesis (vi).

Then, the existence and uniqueness of classical solution of the PDE system above follows from Proposition 7. Additionally, the convergence result of the finite population game to the MFG is given in Theorem 2. □

Table 1: Variable Definitions and Summary Statistics

This table provides definitions, sources, and summary statistics for the variables used in our main analysis for the period 1987-2020. We report mean, median, and standard deviation on all variables. The Y-9C reports are collected from Compustat.

Variables	**Definitions**	**Source**	**Mean**	**Median**	**Stdv**
Dividends	Cash dividends paid on common stock.	Y-9C Reports	79.54	6.24	478.00
Total payouts	The sum of cash dividends paid on common stock and net share repurchases. Net share repurchases are measured as the increase in common treasury stock if the firm uses the treasury stock method. If the firm uses the retirement method instead, we measure repurchases as the difference between stock purchases and stock issuances from the statement of cash flows. If either of these amounts is negative or missing, repurchases are set to zero.	Y-9C Reports	132.24	7.84	1,024.82
Cash reserve levels	The total of all noninterest-bearing balances due from depository institutions, currency and coin, cash items in process of collection, and unposted debits.	Y-9C Reports	622.43	51.81	2,907.19
Cash reserve deviations	The difference between the level of actual cash reserves and the industry mean level of cash reserves.	Y-9C Reports	0.00	-520.27	2,904.87
Ln(Assets)	Natural logarithm of total assets.	Y-9C Reports	14.498	14.278	1.269
ROA	Return on assets (net income/total assets).	Y-9C Reports	0.009	0.010	0.005
ROA SD	Standard deviation of ROA over the past 12 quarters.	Y-9C Reports	0.004	0.002	0.005
Non-performing loans	The ratio of the sum of total loans, leasing financing receivables and debt securities and other assets - past due 90 days or more and still accruing (bhck5525) and total loans, leasing financing receivables and debt securities and other assets - nonaccrual (bhck5526) scaled by total assets.	Y-9C Reports	0.011	0.006	0.015
Equity ratio	Ratio of equity capital to total assets.	Y-9C Reports	0.089	0.086	0.022
Market-to-book	Market value of equity divided by the book value of equity.	Y-9C Reports	1.481	1.383	0.678
Cost efficiency	Noninterest expense / (net interest income + noninterest income).	Y-9C Reports	0.663	0.655	0.105
Retail deposits	Non-business transaction deposits + small certificates of deposits)/total liabilities.	Y-9C Reports	0.612	0.620	0.115
Business loans	(C&I loans + commercial real estate loans + construction and land development loans)/ total loans.	Y-9C Reports	0.262	0.243	0.124

Off-balance-sheet	Total gross notional amount of all derivative contracts/total assets.	Y-9C Reports	0.034	0.000	0.059
Mergers	Number of acquisitions.	Fed Chicago M&As Acquisitions data	0.048	0.000	0.263
Loan loss provisions	An inverse proxy for the riskiness of bank's loan portfolio measured by the provision for loan and lease leases scaled by net interest revenue.	Authors' calculations	0.130	0.063	0.255
Lerner index	Market power as measured by the Lerner (1934) index, calculated as the price-cost margin divided by price. Lower values of the index indicate greater competition.	Authors' calculations	0.157	0.176	0.235

Table 2: Descriptive statistics and Pearson correlations

The sample includes 9,336 bank-year observations between 1987-2020 and consists of all bank holding companies with available data on Federal Reserve (FR) Y-9C Consolidated Financial Statements for Bank Holding Companies.

A. Distribution of payouts and cash reserves

	Mean	**Median**	**SD**
Dividends	79.54	6.24	478.00
Total payouts	132.24	7.84	1,024.82
Cash reserve levels	622.43	51.81	2,907.19
Cash reserve deviations	0.00	-520.27	2,908.87

B. Pearson correlations between payouts and cash reserves

	Dividends	Total payouts	Cash reserve levels	Cash reserve deviations
Dividends	1			
Total payouts	.8822	1		
Cash reserve levels	.7954	.6668	1	
Cash reserves deviations	.7925	.6631	0.999	1

Table 3: Median (mean) dividends and total payouts categorized by cash reserves

This table presents univariate statistics and t-test describing the relationship between cash reserves and payouts. We present summary statistics on dividends and total payouts, segmented on the level of cash reserves and cash reserve deviations for all bank holding companies. The Wilcoxon Z-statistic is from the rank sum test for difference between the respective distributions. The median (mean) are reported below. *** describes significant at the 1% level.

	Cash reserve levels	**Cash reserve deviations**
A. Dividends		
Tercile 1	1.4645	3.1500
	(2.4651)	(10.6463)
Tercile 2	5.9335	2.9470.
	(9.5940)	(8.3866)
Tercile 3	44.9295	34.1640
	(220.5793)	(215.7731)
Difference between tercile 3 and tercile 1	43.4650	31.0140
	(218.1142)	(226.4194)
Wilcoxon's z	60.635***	47.254***
p-value	(.0000)	(.0000)
B. Total payouts		
Tercile 1	1.7815	4.2290
	(3.6973)	(15.7233)
Tercile 2	7.1450	3.4420
	(13.6404)	(11.7700)
Tercile 3	53.6650	40.0370
	(369.2854)	(362.7114)
Difference between tercile 3 and tercile 1	51.8835	35.808
	(49.9677)	(24.3137)
Wilcoxon's z	59.961***	44.408***
p-value	(.0000)	(.0000)

Table 4: The effects of cash reserves on dividend and total payout ratios

The table shows the estimation results from a two-step system GMM regression model. The dependent variable is the dividend payout ratio in columns 1 and 2; and the total payout ratio in columns 3 and 4. All variables are defined as in the Appendix. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Dividend payout ratio		**Total payout ratio**	
Dependent variable	**(1)**	**(2)**	**(3)**	**(4)**
Independent variables				
cash	0.0020***		0.0030***	
	(0.0276)		(0.0410)	
cash_dev		0.0025***		0.0030***
		(0.0249)		(0.0297)
L.dvcratio_C	-12.0394***	-12.0739***		
	(-1.2734)	(-1.2771)		
L.tpratio_C			-13.8810***	-13.9338***
			(-1.5502)	(-1.5561)
lnassetsw	0.0002***	0.0002***	0.0002***	0.0002***
	(0.1773)	(0.1552)	(0.1973)	(0.1868)
lroaw	-0.0081***	-0.0094***	-0.0005	-0.0010
	(-0.0278)	(-0.0323)	(-0.0016)	(-0.0036)
lstdevroa2w	-0.0034***	-0.0029***	-0.0044**	-0.0027
	(-0.0120)	(-0.0103)	(-0.0154)	(-0.0096)
npl_assets	0.0037***	0.0041***	0.0037***	0.0043***
	(0.0353)	(0.0389)	(0.0355)	(0.0414)
leq_assetw	-0.0009***	-0.0001	-0.0127***	-0.0119***
	(-0.0132)	(-0.0011)	(-0.1969)	(-0.1848)
Constant	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
Observations	Insert Number	Insert Number	Insert Number	Insert Number

Table 5: Second-stage regression coefficients explaining dividend and total payout ratios

The table shows the estimation results from a GMM two-stage least squares regression model. The dependent variable is the dividend payout ratio in columns 1 and 2; and the total payout ratio in columns 3 and 4. All variables are defined as in the Appendix. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Dividend payout ratio		**Total payout ratio**	
Dependent variable	**(1)**	**(2)**	**(3)**	**(4)**
Independent variables				
Cash reserve levels	.0020***		.0030***	
	(.000)		(.000)	
Cash reserve deviations		0.0025***		0.0030***
		(.000)		(.000)
Ln(Assets)	.0002***	.0002***	.0002***	.0002***
	(.000)	(.000)	(.000)	(.000)
ROA	-.0081***	-.0094***	-.0005	-.0010
	(.000)	(.000)	(.752)	(.450)
ROA SD	-.0034***	-.0029***	-.0044**	-.0027
	(.000)	(.000)	(.018)	(.137)
Non-performing loans	.0037***	.0041***	.0037***	.0043***
	(.000)	(.000)	(.000)	(.000)
Equity ratio	-.0009***	-.0001	-.0127***	-.0119***
	(.000)	(.609)	(.000)	(.000)
Lagged dividend payout	-12.0394***	-12.0739***		
	(.000)	(.000)		
Lagged total payout			-13.8810***	-13.9338***
			(.000)	(.000)
Constant	✓	✓	✓	✓
Bank fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
Observations	7,273	7,273	7,273	7,273

Table 6: three-stage least squares coefficients explaining dividend and total payout ratios

The table shows the regression results from a three-stage least squares regression model using static regressions of payouts and cash reserves where lagged dependent variables are omitted from the estimation specification. The dependent variable for the second-stage regressions is the dividend payout ratio in columns 1 and 2; and the total payout ratio in columns 3 and 4. For brevity, second-stage regression coefficients explaining cash reserves are not reported (see Table IA2). The predicted cash reserve levels (cash reserve deviations) is from the first-stage regression where the dependent variable is cash reserve levels (cash reserve deviations). All variables are defined as in the Appendix. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Dividend payout ratio		**Total payout ratio**	
Dependent variable	**(1)**	**(2)**	**(3)**	**(4)**
Independent variables				
Cash reserve levels	.0079***		.0078***	
	(.000)		(.000)	
Cash reserve deviations		.0083***		.0081***
		(.000)		(.000)
Ln(Assets)	.0000	.0000*	.0000	.0000*
	(.318)	(.098)	(.288)	(.091)
ROA	-.0088**	-.0093**	-.0086**	-.0090**
	(.023)	(.011)	(.026)	(.014)
ROA SD	.0005	.0001	.0008	.0003
	(.884)	(.973)	(.833)	(.927)
Non-performing loans	-.0011	-.0010	-.0011	-.0010
	(.435)	(.425)	(.440)	(.412)
Constant	✓	✓	✓	✓
Firm fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓
Observations	8,161	8,161	8,161	8,161

Table 7: The effects of cash reserves on dividend and total payout ratios

The table shows the estimation results from a two-step system GMM regression model. The dependent variable is the dividend payout ratio in columns 1 and 2; and the total payout ratio in columns 3 and 4. All variables are defined as in the Appendix. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Dividend payout ratio		**Total payout ratio**	
Dependent variable	**(1)**	**(2)**	**(3)**	**(4)**
Independent variables				
Cash	0.0035***		0.0030***	
	(0.000)		(0.000)	
Cash deviation		0.0036***		0.0032***
		(0.000)		(0.000)
Lagged dividend payout ratio	-11.7595***	-11.7930***		
	(0.000)	(0.000)		
Lagged total payout ratio			-13.7274***	-13.7816***
			(0.000)	(0.000)
Ln(Assets)	0.0005***	0.0004***	0.0004***	0.0004***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA	0.0108***	0.0079***	0.0207***	0.0178***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA SD	-0.0145***	-0.0142***	-0.0141***	-0.0139***
	(0.000)	(0.000)	(0.000)	(0.000)
Non-performing loans	0.0044***	0.0045***	0.0054***	0.0057***
	(0.000)	(0.000)	(0.000)	(0.000)
Equity ratio	-0.0016***	-0.0006***	-0.0119***	-0.0108***
	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book	-0.0000***	-0.0000***	-0.0001***	-0.0001***
	(0.000)	(0.000)	(0.000)	(0.000)
Mergers	0.0000***	0.0000***	-0.0000***	-0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)
Cost efficiency	0.0020***	0.0019***	0.0021***	0.0020***
	(0.000)	(0.000)	(0.000)	(0.000)
Retail deposits	0.0004***	0.0004***	0.0007***	0.0006***
	(0.000)	(0.000)	(0.000)	(0.000)
Business loans	-0.0004***	-0.0005***	-0.0013***	-0.0014***
	(0.000)	(0.000)	(0.000)	(0.000)
Off-balance sheet	-0.0027***	-0.0025***	-0.0017***	-0.0015***
	(0.000)	(0.000)	(0.000)	(0.000)
✓	Constant	Constant	Constant	Constant
✓	Bank fixed effects	Bank fixed effects	Bank fixed effects	Bank fixed effects
✓	Year fixed effects	Year fixed effects	Year fixed effects	Year fixed effects
Observations	Insert Number	Insert Number	Insert Number	Insert Number

Table 8: Cash Reserve Sensitivity to Peer Pressure

The table shows the regression results on the effects of peer pressure on cash reserve management using two-step system GMM regressions. All variables are defined as in Table 1. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Cash Reserves	
Dependent variable	**(1)**	**(2)**
Independent variables		
Beta 1	0.0197***	
	(.000)	
Beta 2		0.0517***
		(.000)
Lagged cash reserves	0.1717***	0.1394***
	(.000)	(.000)
Ln(Assets)	0.0067***	0.0048***
	(.000)	(.000)
Equity ratio	0.0667***	0.0821***
	(.000)	(.000)
Market-to-book	0.0035***	0.0038***
	(.000)	(.000)
Mergers	-0.0000***	-0.0000***
	(.000)	(.000)
Cost efficiency	0.0035***	0.0028***
	(.000)	(.000)
Retail deposits	0.0175***	0.0184***
	(.000)	(.000)
Business loans	-0.0073***	-0.0046***
	(.000)	(.000)
Off-balance sheet items	-0.0102***	-0.0076***
	(.000)	(.000)
Bank fixed effects	✓	✓
Year fixed effects	✓	✓
Observations	9,025	9,025

Table 9: Dividend Payouts Sensitivity to Peer Pressure

The table shows the regression results on the effects of peer pressure on payout policies using two-step system GMM regressions. All variables are defined as in Table 1. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	Dividend Payouts	
Dependent variable	**(1)**	**(2)**
Independent variables		
Beta 1	-0.1954***	
	(0.000)	
Beta 2		-1.4102***
		(0.000)
Lagged dividends	-0.0096***	-0.0095***
	(0.000)	(0.000)
Ln(Assets)	1.5061***	1.4257***
	(0.000)	(0.000)
ROA	-3.5357***	-2.9689***
	(0.000)	(0.000)
ROA SD	-6.1385***	-5.3371***
	(0.000)	(0.000)
Non-performing loans	-7.1180***	1.7409
	(0.000)	(0.666)
Equity ratio	-0.9532***	-0.7718***
	(0.000)	(0.000)
Bank fixed effects	✓	✓
Year fixed effects	✓	✓
Observations	7,989	7,989

Table 10: The Effects of Peer Pressure on the Probability of Default

The table shows the regression results on the effects of peer pressure on bankruptcy risk using panel regressions with bank and year fixed effects. All variables are defined as in Table 1. White's (1980) heteroscedasticity consistent t-statistics are reported in parentheses. * $p < .1$; ** $p < .05$; *** $p < .01$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Beta 1	1.0178***	1.0179***	1.0179***	1.0188***	1.0176***	1.0187***	1.0184***							
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)							
Beta 2								.7737***	.7739***	.7739***	.7744***	.7729***	.7738***	.7733***
								(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Cash res. levels		-0.0000			0.0001	0.0001	0.0001		-0.0000			0.0001	0.0001	0.0001
		(0.784)			(0.356)	(0.559)	(0.400)		(0.776)			(0.364)	(0.569)	(0.408)
Cash res. dev.			0.0000		0.0000		0.0000			0.0000		0.0000		0.0000
			(0.504)		(0.269)		(0.387)			(0.501)		(0.274)		(0.390)
Dividend payouts				-0.0001		-0.0005	0.0004				-0.0002		-0.0005	0.0004
				(0.586)		(0.454)	(0.777)				(0.583)		(0.460)	(0.776)
Cost efficiency	-2.9279***	-2.9283***	-2.9285***	-2.9361***	-2.9273***	-2.9356***	-2.9347***	-2.9235***	-2.9238***	-2.9240***	-2.9316***	-2.9229***	-2.9312***	-2.9302***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
Loan loss provisions	-.7118***	-.7118***	-.7119***	-.7072***	-.7125***	-.7073***	-.7079***	-.7134***	-.7134***	-.7136***	-.7089***	-.7141***	-.7090***	-.7096***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Retail deposits	-.2306**	-.2307**	-.2304**	-.2252*	-.2286*	-.2241*	-.2237*	-.2315**	-.2316**	-.2313**	-.2261*	-.2295**	-.2250*	-.2246*
	(.048)	(.048)	(.048)	(.053)	(.050)	(.054)	(.055)	(.048)	(.048)	(.049)	(.054)	(.050)	(.054)	(.055)
Business loans	.5660***	.5661***	.5662***	.5687***	.5662***	.5690***	.5684***	.5664***	.5665***	.5666***	.5691***	.5666***	.5693***	.5687***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Off balance items	-.8010***	-.8017***	-.8025***	-.8035***	-.8013***	-.8018***	-.8039***	-.8192***	-.8199***	-.8207***	-.8216***	-.8195***	-.8199***	-.8220***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Market-to-book	.1014***	.1013***	.1014***	.1018***	.1017***	.1021***	.1020***	.1007***	.1006***	.1007***	.1011***	.1009***	.1013***	.1013***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Mergers	.0036***	.0036***	.0036***	.0036***	.0035***	.0036***	.0035***	.0036***	.0036***	.0036***	.0036***	.0036***	.0036***	.0035***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Ln(Assets)	.0853***	.0853***	.0853***	.0857***	.0854***	.0859***	.0857***	.0898***	.0898***	.0898***	.0902***	.0899***	.0904***	.0902***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.000)	(.001)	(.000)	(.000)
Lerner index	.5587***	.5586***	.5584***	.5579***	.5582***	.5578***	.5576***	.5581***	.5580***	.5578***	.5573***	.5575***	.5572***	.5570***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Constant	2.6048***	2.6062***	2.6059***	2.5994***	2.5971***	2.5930***	2.5927***	2.5441***	2.5454***	2.5450***	2.5386***	2.5367***	2.5325***	2.5324***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Bank fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	8,785	8,785	8,785	8,784	8,785	8,784	8,784	8,785	8,785	8,785	8,784	8,785	8,784	8,784
R-squared	.724	.724	.724	.724	.724	.724	.724	.724	.724	.724	.724	.724	.724	.724

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Online Appendix

Linear-Quadratic Model

Let us consider the same model as stated in Section 2 with two simplifications that will allow us to find a closed-form solution of our problem. First, assume that the dividend flow ℓ takes value on $A = \mathbb{R}$ and denote the class of admissible controls by $\mathcal{A}^*[t,T]$. Moreover, we assume that banks do not exit the economy when their cash reserve hits zero:

$$V_{LQ}^{N,i}(t, \mathbf{m}) = \sup_{\ell^i \in \mathcal{A}^*[t,T]} \mathbb{E}\left[\int_t^T e^{-\rho s} f(M_s^i, \overline{M}_s^{N,i}, \ell_s^i) ds\right],$$

with

$$\overline{M}_s^{N,i} = \frac{1}{N-1} \sum_{j \neq i} M_s^j.$$

Under this model, the MFG becomes

$$\begin{cases} \partial_t V(t,m) + \dfrac{\sigma^2}{2} \partial_{mm} V(t,m) + H(m, \partial_m V(t,m)) - \rho V(t,m) + F(m, \eta(t)) = 0, \\ \partial_t p(t,m) - \dfrac{\sigma^2}{2} \partial_{mm} p(t,m) + \partial_m \left(\partial_a H(m, \partial_m V(t,m)) p(t,m)\right) = 0, \\ V(T,m) = 0, \quad p(0,m) = p_0(m), \end{cases}$$

with

$$H(m,a) = \mu a + \frac{(1-a)^2}{2\alpha} \text{ and } F(m, \overline{m}) = \beta m (m - \overline{m}).$$

The optimal control is given by

$$\ell^\star(t,m) = \frac{1}{\alpha}(1 - \partial_m V(t,m)).$$

We then consider the ansatz

$$V(t,m) = \theta_2(t) m^2 + \theta_1(t) m + \theta_0(t).$$

The boundary condition $V(T,m) = 0$ implies that $\theta_0(T) = \theta_1(T) = \theta_2(T) = 0$.

Substituting the partials in the HJB equation and using the method of undetermined coefficient for the polynomial coefficients on m gives that

$$\begin{cases} m^2: & \theta_2'(t) + \beta - \rho\theta_2(t) + \dfrac{2}{\alpha}\theta_2^2(t) = 0, \\ m^1: & \theta_1'(t) + 2\mu\theta_2(t) - \beta\eta(t) - \rho\theta_1(t) - \dfrac{2}{\alpha}(1-\theta_1(t))\theta_2(t) = 0, \\ m^0: & \theta_0'(t) + \sigma^2\theta_2(t) + \mu\theta_1(t) - \dfrac{1}{2\alpha}(1-\theta_1(t))^2 - \rho\theta_0(t) = 0. \end{cases}$$

The equation for θ_2 is a Riccati ODE and it can be transformed into a second-order linear ODE satisfying

$$u''(t) - Ru' + Su = 0,$$

where we define $R = -\rho$, $S = \frac{2}{\alpha}\beta$, and $\theta_2(t) = u'(t)/(\frac{2}{\alpha}u(t))$. Notice that

$$R^2 - 4S = \rho^2 - \frac{8}{\alpha}\beta.$$

which we assume to be positive.

Defining $\gamma = \sqrt{R^2 - 4S}$, $\lambda_+ = \dfrac{R+\gamma}{2}$, $\lambda_- = \dfrac{R-\gamma}{2}$, and $\zeta = \lambda_-/\lambda_+$, gives us

$$\theta_2(t) = \frac{\alpha\lambda_+(1 - e^{\gamma(T-t)})}{2(1 - \zeta e^{\gamma(T-t)})}.$$

Next, we solve for $\theta_1(t)$, which satisfies a linear ODE, once we know θ_2. Hence, defining

$$\begin{aligned} \phi(t) &= \rho - \tfrac{2}{\alpha}\theta_2(t), \text{ and} \\ \psi(t) &= 2(\mu - 1/\alpha)\theta_2(t) - \beta\eta(t), \end{aligned}$$

the functional form of $\theta_1(t)$ becomes

$$\theta_1(t) = \int_t^T e^{-\int_t^s \phi(u)du}\psi(s)ds.$$

Therefore, we find

$$\ell^{\star}(t,m)=\frac{1}{\alpha}(1-\theta_1(t)-2m\theta_2(t)).$$

Regarding the Fokker-Planck PDE, in this setting, the solution p is indeed the density of a probability distribution (i.e. positive and integrates to one).

To conclude the equilibrium characterization, we need to compute η and p. In order to do this, we can use the FP equation and integration by parts to find

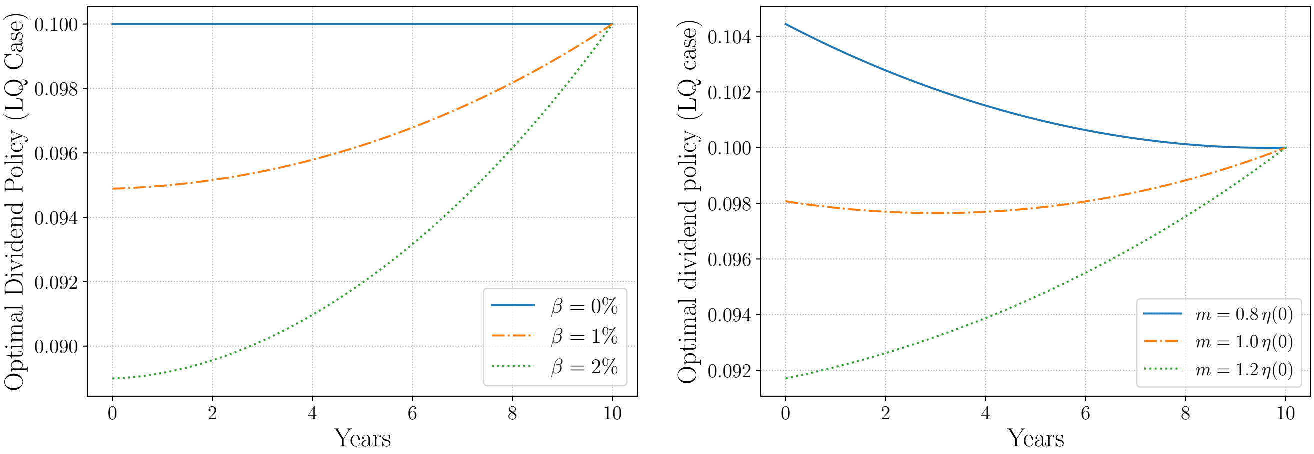
$$\begin{aligned}\eta'(t)=&\int_0^\infty m\partial_t p(t,m)dm=\int_0^\infty m\left(\frac{\sigma^2}{2}\partial_{mm}p(t,m)-\partial_m\left(\partial_a H\cdot p(t,m)\right)\right)dm\\=&\underbrace{\int_0^\infty\frac{\sigma^2}{2}m\partial_{mm}p(t,m)dm}_{=0}-\int_0^\infty m\partial_m\left(\partial_a H\cdot p(t,m)\right)dm\\=&-\underbrace{m\partial_a H(m,\eta(t),\partial_m V)p(t,m)\Big|_0^\infty}_{=0}+\int_0^\infty\underbrace{\partial_a H(m,\eta(t),\partial_m V)}_{\mu-(1-\theta_1(t)-2m\theta_2(t))/\alpha}p(t,m)dm\\=&\mu-\frac{1}{\alpha}(1-\theta_1(t))+\frac{2}{\alpha}\eta(t)\theta_2(t)\end{aligned}$$

Thus, it follows that

$$\eta''(t)-\rho\eta'(t)+\frac{\beta}{\alpha}\eta(t)+\rho\left(\mu-\frac{1}{\alpha}\right)=0,$$

with $\eta'(T)=\mu-1/\alpha$ and $\eta(0)=\eta_0$.

Figure 7: Peer-pressure and Cash Reserve Effects on the LQ Model



(a) Peer-pressure Effects

(b) Cash Reserves Effects