Decoupling concentration and pricing power in banking

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Abstract

We propose a theory of informational origins of pricing power in banking. Banks face two informational frictions: limited pledgeability and effort moral hazard. Bankers are ex-ante identical, can costlessly offer contracts to depositors, and compete in prices (deposit rates). Yet, those bankers who manage to attract depositors earn a strictly higher return than those who do not. Bankers charge a markup which can be traced back to the primitives of the economy. Counterintuitively, but consistent with empirical evidence, pricing power may decline with concentration. Pass-through of investment shocks to depositors is partial and varies non-monotonically with pledgeability.

Keywords: Bank concentration, Competition, Moral hazard, Pledgeability, Capacity constraints, Pass-through.
Jel codes: D40, G21, G28.

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1 Introduction

Deposits are the most important funding source for banks, with the US deposit market exceeding \$18 trillion in 2025, accounting for over 80% of bank liabilities. Banks compete for these deposits primarily along one dimension – the deposit rate they offer. Yet, despite a fiercely competitive landscape comprising numerous banks, evidence shows that banks possess significant pricing power in deposit markets (see, e.g., Drechsler et al. (2017) and Corbae and D'Erasmo (2021)). More puzzling still, this pricing power does not always increase with concentration: empirical evidence suggests that greater bank concentration can paradoxically lead to *higher* deposit rates in some cases (see, e.g., Jackson (1992)). Common explanations for banks' observed pricing power include product differentiation in deposit markets and depositor switching costs. However, neither explanation alone can account for the finding that greater market concentration may actually reduce pricing power. We propose a framework built on information frictions in which concentration and pricing power are endogenously determined in equilibrium, to provide a joint explanation for these related puzzles.

We present a model of bank competition in the deposit market which features two informational frictions: an effort moral hazard problem where bankers must exert costly and unobservable effort (after collecting deposits), and a diversion constraint which limits banks' ability to pledge future output to secure funding in the deposit market. Despite price competition among banks in their attempt to attract deposits, the interaction of the informational constraints prevents the standard Bertrand outcome and gives rise to markups. Specifically, the markup is traced back to the primitives of the economy. Our most striking theoretical result is that, even though bankers are identical to begin with, compete in prices, and there is free entry and exit, those bankers who manage to attract depositors in equilibrium earn strictly higher returns than those who do not attract depositors. The inactive bankers invest in the storage technology and cannot disrupt the equilibrium. The usual indifference condition governing entry decisions breaks down because of the interaction between the informational constraints: removing either constraint restores the competitive benchmark. The same interaction decouples concentration from pricing power.

Preview of the model and results. In the model, ex ante identical bankers, each with an initial endowment of one unit, compete to attract depositors. Depositors choose between delegating the management of their funds to a banker and investing in a storage technology. Bankers who attract sufficient depositors invest both their own endowment and the collected funds directly in a project; those who fail to attract depositors fall back on the storage technology. The model features two frictions: ex ante effort moral hazard and ex post diversion.

Banks can improve the probability of the project's success by exerting costly and unobservable effort (see, e.g., Holmstrom and Tirole (1997), Morrison and White (2005), Mehran and Thakor (2011), He and Krishnamurthy (2012)). There is a fixed and a variable cost. One can think of the fixed cost as the acquisition of information that is reusable across borrowers, such as macroeconomic or sector-specific knowledge. The presence of a fixed cost is common in most classical theories of financial intermediation (e.g., Diamond (1984), Boyd and Prescott (1986), Williamson (1986a), and Williamson (1987)).[1] The cost of effort is assumed to be sufficiently high such that a banker investing only their own funds would not find it worthwhile to exert effort. However, when the banker also manages external funds and earns rents from doing so, effort exertion becomes incentive compatible. Hence, unlike the standard models of effort moral hazard, this incentive constraint imposes a lower bound, rather than an upper bound, on bank leverage.

Banks also possess a diversion technology which allows the manager to divert a fraction of the final cash flow from depositors (see, e.g., Calomiris and Kahn (1991), Hart and Moore (1995), Shleifer and Wolfenzon (2002), Holmstrom and Tirole (2011), Gennaioli and Rossi (2013), Donaldson et al. (2018), and Biswas and Koufopoulos (2022)). Calomiris and Haber (2014) present a compelling case for diversion to be considered a central friction in the banking industry. They highlight several channels through which bank insiders can

[1] As noted by Williamson (1986b), some degree of scale economy is generally necessary for delegated intermediation to dominate bilateral trading. Consistent with this premise, a large empirical literature finds that larger banks tend to exhibit lower average costs and benefit from increasing returns to scale (e.g., Berger and Mester (1997), Berger and Hannan (1998), Mester (2008), Wheelock and Wilson (2012), Hughes and Mester (2013), Davies and Tracey (2014), Kovner et al. (2014), and Wheelock and Wilson (2018)).

extract value: politically connected bankers may extend loss-making loans to themselves and connected firms[2], pay themselves dividends even when the bank is distressed[3], and shift risks onto depositors or taxpayers through implicit or explicit guarantees. In environments where corrupt politicians shield bank insiders from effective oversight, insiders can systematically divert resources from the institution and eventually walk away when insolvency becomes unavoidable.[4]

In the unique equilibrium of our model, both the diversion constraint and the effort incentive constraint bind. Despite price competition among banks and costless free entry and exit, the Bertrand outcome does not obtain. This is because the interaction of the diversion constraint and the moral hazard constraint prevents undercutting beyond a point, allowing banks to offer a deposit rate which is lower than the competitive rate. As we clarify in Section 3.1, if either the diversion constraint or the moral hazard constraint is removed from the model, the outcome reverts to the Bertrand benchmark. Thus, it is the interaction of the two frictions, rather than either friction alone, that drives the result that banks possess pricing power. To see it more clearly, we consider the case that effort is contractible. We show that in this case the diversion constraint still binds, but active and inactive bankers earn the same expected return in equilibrium.

Empirical predictions and policy implications. The interaction of the diversion constraint with the effort moral hazard constraint produces a number of new implications:

Consistent with the evidence in Smirlock (1985), Berger (1995), and Claessens and Laeven (2004), our model predicts that rising bank concentration can coincide with declining bank profitability. Jackson (1992) documents a non-linear relationship between con-

[2]See also the case of the failure of the Baoshang Bank in China.

[3]In the context of the 2007-2009 financial crisis, Acharya et al. (2011) document that banks continued to pay substantial dividends despite widely anticipated credit losses, thereby transferring value from creditors to shareholders. Goetz et al. (2025) find that banks with higher pre-crisis insider stakes issued significantly less common equity during the crisis period, arguably to avoid diluting insiders' private benefits of control.

[4]They highlight Mexico as a prominent example. Following the reprivatization of banks in the early 1990s in which wealthy families gained access to bank ownership through political connections, the bankers engaged in extensive insider lending and paid themselves overly generous dividends, leaving institutions undercapitalized leading up to the mid-90's Tequila Crisis. When losses materialized during the crisis, the government absorbed bad loans through FOBAPROA, effectively socializing the losses while insiders had already captured private gains. By contrast, they note that Canada's institutions have prevented such rent extraction by bank insiders, and as a result the country has experienced far fewer financial crises.

centration and pricing power in the deposit market, with a negative correlation emerging for banks operating in highly concentrated markets. Likewise, using a cross-country sample, Forssbaeck and Shehzad (2015) report a negative correlation between concentration and the deposit-market Lerner index. Our model explains this decoupling between concentration and pricing power.

The mechanism behind the decoupling result is as follows: as pledgeability rises, banks offer higher deposit rates and operate with higher leverage, yet increased leverage leads to fewer banks in equilibrium (higher concentration). Our analysis therefore suggests that pledgeability should be controlled for when examining the link between concentration and pricing power. We are not aware of existing studies that have tested this mechanism directly. In Section 4.2, we present preliminary correlational evidence from 134 countries that is consistent with our mechanism.

A few illustrative cases bring out the pattern. Among economies with the strongest institutions (a proxy for pledgeability) several of the most concentrated banking systems display the lowest pricing power. In Finland, Sweden, the Netherlands, and Denmark, the banking systems are very concentrated with the three largest banks holding between 82% and 93% of total commercial banking assets, yet net interest margins (a proxy for pricing power) range from just 0.8% to 1.1%, among the lowest in the world and far below the 3.6% average.[5] At the other extreme, Mexico – which Calomiris and Haber (2014) single out as a textbook case of weak pledgeability and pervasive insider diversion – combines a markedly less concentrated system (a three-bank share near 50%) with a net interest margin above 5.5%. These contrasts are only suggestive: the proxies are imprecise, and the model's comparative static demands a shock to pledgeability to identify the effects cleanly. Still, they line up with the model's central prediction that higher pledgeability is associated with more concentrated deposit markets, while margins are smaller.

Beyond rationalizing existing evidence, the model delivers a sharp new prediction about pass-through of investment shocks. Even with free entry and price competition, an

[5]The figures are for 2021 and cover 134 economies. Bank concentration is the share of total banking-system assets held by the three largest banks (World Bank Global Financial Development Database, series GFDD.OI.01); pricing power is the net interest margin (GFDD.EI.01); and pledgeability is proxied by the World Bank Worldwide Governance Indicators rule-of-law estimate.

improvement in banks' investment opportunities (for instance, a rise in the policy rate) is only partially passed through to depositors, and the strength of pass-through is non-monotonic in pledgeability: it rises with pledgeability when pledgeability is low and falls once it is high. This generates a concrete cross-country test. Using the diversion-based ranking in Calomiris and Haber (2014), an increase in pledgeability in a high-diversion economy such as Mexico should strengthen pass-through, whereas the same increase in a low-diversion economy such as Canada or the United States should weaken it – a prediction that, to our knowledge, no existing model delivers. We present several other new predictions in Section 4.1.

In terms of policy implications, and if the objective is the maximization of the net social surplus, we show that the number of banks is excessively high in the unregulated equilibrium. An utilitarian regulator can intervene to correct this inefficiency by imposing an upper bound on the number of banking licenses issued. In this regulated equilibrium, bankers who succeed in attracting depositors earn even higher returns relative to inactive bankers than they would in the unregulated case.

Related literature. We contribute to several strands of the literature. First, we contribute to the theory of the origins of market power, and specifically, why price competition in a homogeneous good need not lead to the Bertrand outcome. The second strand concerns pass-through of shocks to depositors. Finally, we relate to models with endogenous market concentration.

The literature offers a number of sources for the origins of market power. In the monopolistic competition tradition of Dixit and Stiglitz (1977), markups arise from product differentiation. In the search-theoretic tradition of Butters (1977), Varian (1980), and Burdett and Judd (1983), products are homogeneous but some buyers cannot access all sellers, so market power is determined by frictions in the *buyers'* choice sets. Menzio (2026) shows that both frameworks rationalize the same markup data while implying very different conclusions about welfare, counterfactuals, and policy – so identifying the source of market power is essential.

Neither tradition fits the deposit market well: deposits are largely homogeneous, contrary to the Dixit and Stiglitz (1977) premise of differentiated products, and depositors can open an account at most banks without difficulty, contrary to the search-theoretic premise of restricted access. Our paper offers a new source of pricing power that is a more natural fit for banking: market power arising purely from informational frictions on the *seller's* contracting side – the interaction of limited pledgeability and non-contractible effort. Notably, our equilibrium is Pareto efficient despite substantial pricing power, reinforcing the lesson of Menzio (2026) that the level of markups is uninformative about welfare, absent knowledge of the source of market power. Different from the search-theoretic models, in which entry is efficient also from an utilitarian standpoint, in our case, the net social surplus can be increased by regulatory intervention of setting an upper bound on the number of bank licences granted, which makes depositors strictly worse off.

Another source of pricing power is switching costs (e.g. Farrell and Klemperer (2007)). Although theories featuring switching costs can potentially explain the emergence of pricing power, they cannot predict the negative correlation between concentration and pricing power. Furthermore, we model the uninsured deposit market. This segment of the deposit market features large deposits. Drechsler et al. (2026) provide evidence that even though pricing power is somewhat smaller in the uninsured segment of the deposit market compared to insured segment, it remains substantial there. At the same time, fixed switching costs are less likely to be a significant factor in determining depositor behavior in this segment due to the size of the deposits. Finally, switching costs have become increasingly less relevant given recent regulation.[6] These observations suggest that existing models relying on switching costs are ill-suited for explaining pricing power in the large-deposit segment of the market. A new framework is therefore needed to rationalize substantial pricing power in the large-deposit market segment, while also accounting for the observed inverse relationship between market concentration and pricing power. Our model aims to fill this gap.

Our work is also related to static models in which price competition does not necessarily lead to zero profits which is the standard Bertrand result. Kreps and Scheinkman

[6] E.g., in Europe, the open banking provisions in the Payment Services Directive 2 shifts the burden of switching from depositors to banks.

(1983) analyze a two-stage game where firms first commit to a production capacity which, in combination with a fixed number of firms in the industry, softens price competition in the subsequent stage (see Marquez (2002), Schliephake and Kirsten (2013), and Green (2007) for applications in banking and finance). In our model, even though leverage (quantity) and the deposit rate (price) are determined simultaneously, as opposed to quantity first and price second as in the Kreps and Scheinkman (1983) game, price competition does not lead to the Bertrand outcome.

Maggi (1996) extends the Kreps and Scheinkman (1983) framework to allow firms to produce quantities beyond the announced capacities at a higher marginal cost. This extension captures intermediate situations between the two extremes of Bertrand and Cournot. In these models, a capacity constraint along with an exogenously fixed number of firms in the industry chokes competition and prevents the Bertrand outcome. If we allow for costless free entry in these models, the Bertrand outcome obtains as the unique equilibrium (see Section 6.2). In contrast, in our model, despite free and costless entry and exit, the markup is positive, lies within a range from monopoly to perfect competition, and is determined by the deep parameters underlying the diversion and effort moral hazard constraints. This contrast highlights that, despite superficial similarities, the mechanisms at work are fundamentally different.

In one set of models, asymmetric information on the asset side endogenously restricts competition in the banking sector which enables banks to earn information rents (see, e.g., Broecker (1990), Shaffer (1998), Dell'Ariccia et al. (1999), Boot and Thakor (2000), Marquez (2002), and Sengupta (2007)). In contrast, we focus on the funding side of banks. As noted by Beyhaghi et al. (2025), the nature of informational frictions on the asset side differs from those on the funding side. For example, a key feature of the asset-side models is that some banks possess superior information about certain borrowers' credit quality. This type of friction is not relevant in the deposit market; hence, we consider a distinct problem. Another key difference is conceptual. In much of the existing literature, the structure of the banking industry is imposed rather than derived; even when entry is allowed, the baseline market configuration is typically taken as given (e.g., by assuming N incumbent banks that are endowed with some form of informational advantage relative to potential entrants). By contrast, we do not impose any default structure. Instead, we endogenize the emergence of market structure as an equilibrium outcome, which allows us to generate new insights.

Several models of imperfect competition in banking study how monetary policy shocks affect deposit franchise values and their transmission to the real economy (e.g., Drechsler et al. (2017), Drechsler et al. (2021), Wang et al. (2022), Drechsler et al. (2026)). These models typically interpret the partial pass-through of shocks to depositors as evidence of market power arising from switching costs or imperfect competition. In our model, however, pass-through of shocks to banks' investment opportunities to depositors can be partial even when there is free entry and exit and banks compete in prices. This observation has a methodological implication. Fitting a model based on imperfect competition to data generated by our mechanism would observationally recover a "deposit demand elasticity" that is in fact a reduced form of the deep parameters of our model. Such an elasticity would not be stable under shocks to these parameters (e.g., pledgeability or institutional reforms), and counterfactuals computed under the assumptions of the imperfect competition model would be invalid – a concern analogous to the one Menzio (2026) raises for the Dixit and Stiglitz (1977) model vis-a-vis the search-theoretic model.

There are models which try to endogenize market concentration, but do not allow for price competition (i.e., they assume pricing power), relying on assumptions such as asymmetric technologies to microfound positive profits or adopting Cournot competition. Specifically, the efficiency structure hypothesis (see, e.g., Demsetz (1973), Demsetz (1974), and Peltzman (1977)) argues that more efficient firms expand their market share, leading to greater market concentration, and that their lower costs translate into higher profits. Relatedly, Lambson (1987) shows that lumpy or indivisible technologies can generate a spurious positive correlation between concentration and profitability. In contrast, in our model we allow for price competition and free entry, and both pricing power and market concentration are determined endogenously in equilibrium. The markup is traced back to the primitives of the economy and is decoupled from market concentration.

2 Model

We develop a model in which banks raise funds in the deposit market and invest them directly. Direct investment by banks may be thought of as fee-generating investment banking activities. Another equivalent interpretation is that banks behave monopolistically in the loan market and extract the full surplus in this market.

2.1 Set-up

We consider an economy with two types of agents: a measure $m \gg 1$ of bankers who may raise funds from external investors, and a separate set of agents of measure 1 who may delegate the management of their funds to a banker (depositors) or invest in an unproductive storage technology (which produces a zero net return). Each agent is endowed with an initial wealth of 1 unit.

There are two dates, $t \in \{0, 1\}$. At $t = 0$, bankers offer contracts to depositors. Entry into banking is costless. A fraction $\lambda \in [0, 1]$ of bankers raise sufficient funds to operate a bank, where λ is determined in equilibrium by agents' optimizing behavior. There are $n = \lambda m$ bankers who successfully raise funds from depositors and invest them in a project. Those bankers who fail to do so invest their funds in the unproductive storage technology. At $t = 1$, project returns are realized. Per unit of investment, the project yields X if it succeeds and 0 otherwise. The project exhibits constant returns to scale and is infinitely scalable.

There are two informational frictions:

Effort moral hazard. After obtaining the funds through deposits, a banker can choose to exert effort or not. The project succeeds with probability p_h and fails with probability $1 - p_h$ if the banker exerts effort. Effort is costly (in terms of utility) and consists of two components: a fixed cost, k, and a variable cost, c, per unit of investment. The fixed cost is interpreted as the acquisition of information that is reusable across borrowers (such as macroeconomic or sector-specific knowledge), while the variable cost reflects the increasing difficulty of managing a larger bank; both components are incurred *after* a banker has collected deposits and the scale of the bank is known. If the banker does not exert effort, the project succeeds with a lower probability, $p_l < p_h$. We normalize the return from a project when the banker shirks to equal the return from the storage technology, i.e., $p_l X = 1$. We denote the incremental success probability from exerting effort, $p_h - p_l$, as Δ. Effort exertion is not observable or verifiable, and hence, effort is not contractible.

Diversion. A banker can divert a fraction, $(1-\phi)$, of the realized output at $t = 1$, $\phi \in (0,1)$. Diversion of funds is not verifiable, and hence, the banker cannot credibly commit ex ante to not diverting these funds even if he would like to be able to do so, i.e., pledgeability is limited.

We make the following parametric assumptions:

A1: $k > \Delta X - c > \phi \Delta X$

A2: $\phi < \frac{1}{p_h X}$

A3: $m > \frac{(1-\phi)\Delta X - c}{k + c - (1-\phi)\Delta X}$

The first inequality in Assumption *A1* says that the fixed cost of effort is large. This implies that exerting effort would be worthwhile only if multiple agents pool their resources and share the cost (see also, Boyd and Prescott (1986)). Thus, unless a banker raises sufficient funds in the deposit market, he invests his endowment of one unit in the storage technology. The second inequality in Assumption *A1* says that the marginal cost of effort is small. Assumption *A2* says that diversion is sufficiently large. These assumptions ensure that the two information constraints are binding in equilibrium. Assumption *A3* implies that, given binding informational frictions, there are sufficiently many potential bankers to serve all depositors, such that some bankers fail to attract external funds.

2.2 Equilibrium

A contract is a triple (d, R, I), where d is the amount of deposits the bank accepts, R is the deposit rate, and $I \in \{0,1\}$ is an indicator variable which equals 1 if the banker commits to contributing his own endowment to the project and 0 otherwise.

The following lemma pins down I and simplifies the subsequent analysis.

Lemma 1 *The contract sets $I = 1$: a banker commits to contributing his own endowment to the bank he manages.*

Proof. The proof is in the Appendix. ■

Lemma 1 establishes that the banker always invests his own endowment alongside externally raised deposits; if the banker does not commit to doing so, depositors would not recover their funds in expectation and will never choose such a contract. A bank's total investment is therefore $(1+d)$ units. With probability p_h or p_l (depending upon the level of effort exertion), these funds produce X (per unit), and they produce 0 with the complementary probability. In the event of success, the banker repays dR to depositors. A feasible contract must satisfy four constraints:

1. the diversion constraint: If the project fails, there are no cash flows to disburse and nothing to divert. In the case that the project succeeds, due to the possibility of diversion, the total verifiable cash flow is $\phi(1+d)X$. This total verifiable cash flow must be weakly greater than the promised return to the depositors, dR.

$$\phi(1+d)X \geq dR \tag{1}$$

2. the effort incentive constraint: exerting effort leads to a higher success probability, but it imposes a cost on the banker. A banker will exert effort only if he is (weakly) better off from exerting effort than not. The incentive constraint is written as follows:

$$\begin{aligned}&(1+d)p_hX - dp_hR - 1 - k - (1+d)c \geq (1+d)p_lX - dp_lR - 1\\ \Longrightarrow\ & d[\Delta(X-R) - c] \geq k + c - \Delta X\end{aligned} \tag{2}$$

3. the depositors' participation constraint: the depositors must be weakly better off from depositing their funds with the bank, in which case they obtain, p_hR, than investing in the storage technology.

$$p_hR \geq p_lX = 1 \tag{3}$$

4. the banker's participation constraint: It must be the case that managing a bank is

(weakly) more profitable than investing in the storage technology:

$$\Pi = (1+d)p_h X - d p_h R - 1 - k - (1+d)c \geq 0 \tag{4}$$

We show below that this constraint is always slack.

We consider each of the constraints in turn:

Diversion constraint. First, we re-write the diversion constraint as follows:

$$d \leq \frac{\phi X}{R - \phi X} \tag{5}$$

The diversion constraint puts an upper bound on the amount of funds that the depositors are willing to provide to the bank. To derive the slope of the diversion constraint in the (d, R) space, we totally differentiate Equation (5) with respect to d and R:

$$\left.\frac{dd}{dR}\right|_{DC} = -\frac{d}{R - \phi X} < 0 \tag{6}$$

The slope of the diversion constraint is negative (and it is convex). This reflects that as each depositor is promised a higher repayment, the bank can accept fewer deposits since the diversion constraint tightens. A feasible equilibrium must lie on or below the diversion constraint.

Depositors' PC. The depositors' participation constraint, $R = \frac{1}{p_h} = R^P$ is a vertical line in the (d, R) space. A feasible equilibrium must lie to the right of the depositors' participation constraint.

Bankers' IC. Next we turn to the incentive constraint. In contrast to existing models featuring this friction (e.g., Holmstrom and Tirole (1997)), it imposes a *lower* bound on bank leverage. The intuition is as follows. Given Assumption *A1* that the fixed cost of effort is high, $k > \Delta X - c$, it is not worthwhile for bankers to exert effort when investing solely their own funds. Effort becomes worthwhile only when the banker manages external funds and thereby obtains rents from doing so. For any R, if a given level of deposits d provides sufficient rents for the banker to satisfy the incentive constraint, then the constraint must also hold for a higher d.

To derive the slope of the incentive constraint in the (d, R) space, we totally differentiate Equation (2) with respect to d and R:

$$\left.\frac{dd}{dR}\right|_{IC} = \frac{\Delta d}{\Delta(X - R) - c} > 0 \tag{7}$$

The effort incentive constraint has a positive and convex slope. The positive slope reflects that as depositors are offered a higher promised repayment, bankers retain a smaller share of the surplus, thereby reducing their incentive to exert effort. Starting from a (d, R) pair that lies on the incentive constraint – such that the bank is just willing to exert effort – an increase in R must be accompanied by a higher d in order to preserve incentive compatibility. Moreover, as R increases, the slope of the constraint becomes steeper, approaching infinity as $R \to X - \frac{c}{\Delta}$ (i.e., the constraint becomes vertical in the limit). A feasible equilibrium must lie on or above the incentive constraint.

Bankers' PC. Finally, we consider the banker's participation constraint.

Lemma 2 *For any $R < X$, whenever the effort incentive constraint of the banker is satisfied, his participation constraint is slack.*

Proof. The incentive constraint requires $R \leq X - \frac{c}{\Delta}$, so any incentive-compatible contract necessarily satisfies $R < X$. The left-hand side of the incentive constraint coincides with that of the participation constraint, while the right-hand side of the incentive constraint is strictly positive for $R < X$. Since the participation constraint has a right-hand side equal to zero, it follows that whenever the incentive constraint holds, the participation constraint is automatically satisfied with slack. ∎

Equilibrium. Having introduced the four constraints, we are now in a position to define the equilibrium concept. We adopt a *free-entry competitive equilibrium*: a contract is taken as given by individual agents, who choose whether to participate; the deposit market clears through the endogenous adjustment of the measure of active banks; and the equilibrium is robust to entry by inactive bankers, in the sense that no inactive banker can attract depositors away from incumbents and earn strictly positive profits by offering a feasible alternative contract. We consider that each contract includes a Right of First Refusal (ROFR) feature. Each contract specifies that, once a depositor chooses a contract, the depositor's funds are locked in with the bank. If the depositor receives a more attractive offer, the incumbent bank has the opportunity to match it. If it fails to do so, the bank releases the funds back to the depositor, who can then deposit them with the competing bank. This ROFR feature serves a tie-breaking role.[7]

Definition 1 *A free-entry competitive equilibrium is a quintuple* $(R^*, d^*, I^*, \lambda^*, e^*) \in \mathbb{R}_{++} \times \mathbb{R}_{++} \times \{0,1\} \times [0,1] \times \{0,1\}$ *such that:*

(E1) ***Feasibility.*** *The contract* $C^* \equiv (R^*, d^*, I^*)$ *satisfies the diversion constraint, the effort incentive constraint, the depositors' participation constraint, and the bankers' participation constraint; each active banker invests his own endowment,* $I^* = 1$*, and exerts effort,* $e^* = 1$*.*

(E2) ***Market clearing.*** $\lambda^* m\, d^* = 1$*.*

(E3) ***No profitable entry.*** *There exists no contract* C' *satisfying the relevant constraints such that* $\Pi(C') > 0$ *for an inactive banker.*

Conditions (E1) states that a feasible contract must respect the informational frictions, and both bankers and depositors must (weakly) prefer participation to their outside options (storage). (E2) is the market clearing condition: the aggregate demand for deposits is endogenous – both the measure of active banks, $\lambda^* m$, and the deposits per bank, d^*, are determined in equilibrium – while aggregate supply is fixed at the unit measure of depositors.[8] (E3) is a free-entry condition: it captures the Bertrand-style undercutting that

[7] For any R, both depositors and bankers (weakly) prefer to sign ROFR contracts to ones that do not specify ROFR. As we show in Section 3.1, if we remove either of the informational constraints, the Bertrand outcome obtains despite the ROFR.

[8] As we see below, in equilibrium, some bankers are inactive, i.e., $\lambda^* < 1$. We still refer to this as market clearing since the inactive bankers do not demand deposits.

price competition would induce (given feasibility, depositors only care about R). Specifically, the equilibrium contract must be such that no inactive banker can profitably attract depositors by offering a contract featuring any R which could be less than, equal to, or greater than R^*. Compared to the free-entry equilibrium concepts in Holmstrom and Tirole (1997) and Martinez-Miera and Repullo (2017), which embed contestability inside a pricing rule, we state the no profitable entry condition (E3) separately. This makes transparent which deviations are ruled out by the interaction of the two informational frictions – the central mechanism of the paper.

Increasing the cost of exerting effort, c, makes the effort incentive constraint tighter, but it does not affect any of the other constraints. The intersection of the effort incentive constraint and the diversion constraint depends on this cost. The lower the cost, the intersection of the two constraints is further to the right in the (d, R) space. Given the parametric restrictions made above, there are two cases to consider:

1. $c > \bar{c} \equiv (1-\phi)\Delta X - (1-\phi p_h X)k$

2. $\bar{c} \geq c > \Delta X - k$

2.2.1 Case 1: $c > \bar{c}$

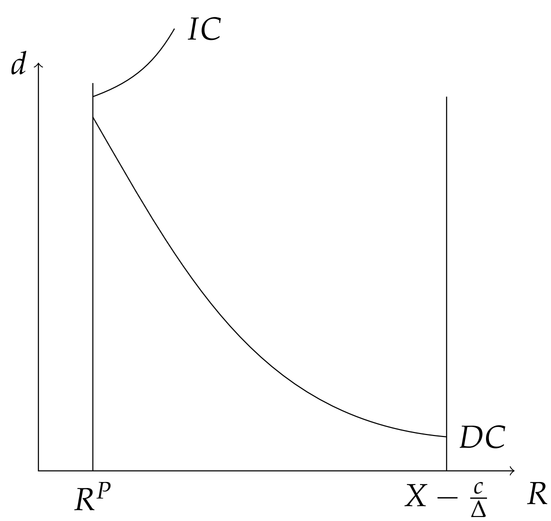

Figure 1: No banks

We illustrate the depositors' participation constraint, the diversion constraint, and for

$c > \bar{c}$, the bankers' incentive constraint in Figure 1. In this case, the incentive constraint intersects the diversion constraint to the left of the depositors' participation constraint. Bankers exert effort for a (d, R) pair which lies above the incentive constraint. It can be seen that the set of parameters where bankers exert effort, and at the same time, none of the constraints is violated, is empty. That is, the cost of effort is so high that the surplus generated from effort exertion is always strictly less than the cost. Anticipating that it is never incentive-compatible for banks to exert effort – and thus that depositors would not deposit their funds in banks – none of the bankers make an offer to attract depositors. Instead, all agents (both bankers and depositors) invest in the storage technology. We summarize this results in the proposition below:

Proposition 1 (No banks) *Suppose that $c > \bar{c}$. There are no banks and all agents invest in the storage technology.*

2.2.2 Case 2: $\bar{c} \geq c > \Delta X - k$

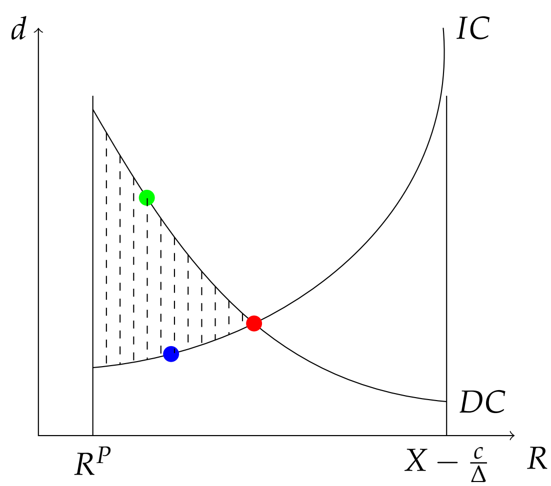

Figure 2: Pricing power

In Figure 2, we consider the $\bar{c} > c > \Delta X - k$ case. In this case, the incentive constraint intersects the diversion constraint to the right of the depositors' participation constraint and this intersection is represented by the red dot. If banks do not exert effort, their investment will be negative-NPV, and depositors will not be able to recover their funds. Hence, banks will not obtain funds, implying that any (d, R) pair below the IC constraint can be ignored. By a similar argument, contracts above the diversion constraint are infeasible, since depositors would not recover their funds in expectation. Thus, the feasible contracts are in the shaded area. We argue below that the unique free-entry competitive equilibrium is at the intersection of the two constraints (the red dot). In this equilibrium, bankers commit to investing their own funds in the bank, $I^* = 1$, and exerting effort, $e^* = 1$. Using the diversion constraint and the incentive constraint, we derive the expressions for d and R at the red dot:

$$d = \frac{k + c - (1-\phi)\Delta X}{(1-\phi)\Delta X - c} \equiv d^* \tag{8}$$

$$R = \frac{\phi k X}{k + c - (1-\phi)\Delta X} \equiv R^* \tag{9}$$

Given Assumptions *A1* and *A2*, $d^* > 0$ and $R^P \leq R^* < X$. Our main result is that at the red dot, bankers who successfully attract depositors (active bankers) make strictly higher expected profits than inactive bankers despite ex ante identical bankers, free entry, and price competition.

We present this result in the proposition below:

Proposition 2 (Pricing power) *Suppose that $\bar{c} \geq c > \Delta X - k$. A fraction λ^* of bankers manage banks and all depositors are served. The unique equilibrium is characterized by $(R^*, d^*, I^*, \lambda^*, e^*)$, where:*

$$\lambda = \frac{(1-\phi)\Delta X - c}{m\left[k + c - (1-\phi)\Delta X\right]} \equiv \lambda^* \tag{10}$$

Proof. The proof is in the Appendix. ■

The unique equilibrium is at the red dot. By Definition 1, no banker can profitably deviate. Given feasibility, depositors only care about one element of the contract, which is the deposit rate, R. Clearly, $R < R^*$ will not attract any depositors given that R^* is on the table. The ROFR feature of the contract rules out deviations using $R = R^*$. Finally, a more attractive offer ($R = R^* + \epsilon$) violates at least one of the two informational constraints and is therefore infeasible. In any other feasible allocation, where $R < R^*$, undercutting is always profitable, and hence, none of these allocations can sustain as an equilibrium. To derive the equilibrium fraction of active bankers, λ^*, we use the market clearing condition (E2), $m\lambda^* d^* = 1$. Under the parametric assumptions, $\lambda^* < 1$, so a positive mass of bankers remain inactive in equilibrium and invest in the storage technology.

Pricing power. We refer to this as the equilibrium with pricing power. As shown in Lemma 2, the bankers' participation constraint is slack whenever the incentive constraint binds, which is the case at the red dot. That is, banks offer a deposit rate low enough to earn strictly positive expected profits at this allocation. Despite these profits and costless free entry, a strictly positive mass of inactive bankers remains, investing in the storage technology. They cannot disrupt the equilibrium due to the binding informational constraints. Thus, although bankers are identical to begin with, and inactive bankers may offer contracts at zero cost in an attempt to undercut incumbents, active bankers earn strictly higher profits than inactive ones.

3 Discussion

3.1 Both frictions matter

Strikingly, even though entry and exit are costless, banks make strictly positive profits in equilibrium. Indeed, these profits exceed the informational rent, $\frac{c}{\Delta} - c$. At first sight, it may seem that this result is driven by the diversion constraint which acts as a capacity constraint. However, as we show below, if either the diversion constraint or the effort moral hazard constraint is removed, the outcome reverts to the corresponding Bertrand benchmark. Thus, it is the interaction of the two frictions, rather than either friction alone, that drives the results.

Costless effort. Consider the case in which effort is costless, $k = c = 0$ (violating parametric restrictions). In this case, the equilibrium deposit rate will be equal to that under full information, i.e., $R = X$. Hence, given free entry and exit, bank profits will be 0 if the only constraint faced by banks is the diversion constraint. As before, the equilibrium must lie on the diversion constraint. Suppose the equilibrium occurs at some $R < X$.

Then, bankers make strictly positive profits. Since entry is costless, an inactive banker in this allocation can profitably deviate by offering a deposit contract with a slightly higher deposit rate, attracting depositors away from incumbent banks. This process iterates until $R = X$. Thus, when effort is costless and the only relevant friction is limited pledgeability, the Bertrand outcome obtains.

Lemma 3 **(Costless effort)** *If $k = c = 0$, the Bertrand outcome obtains in which case, $R = X$.*

Thus, Lemma 3 implies that while the diversion constraint in our model resembles a capacity constraint in the spirit of Kreps and Scheinkman (1983), it does not, by itself, yield strictly positive profits under free entry.

No diversion. Next, consider the case that pledgeability is perfect, $\phi = 1$ (violating parametric restrictions). In this case, the diversion constraint no longer binds, so there is no upper limit on the amount of deposits a bank can accept. For any $R < X - \frac{c}{\Delta}$, banks would undercut each other by offering a slightly higher deposit rate (by an arbitrarily small ϵ) to capture the entire market, implying that the Bertrand logic applies. Any offer above $X - \frac{c}{\Delta}$, however, would violate the incentive constraint and is therefore infeasible.

Lemma 4 **(No diversion)** *If $\phi = 1$, in equilibrium, a bank attracts the full measure of depositors by offering $R \to X - \frac{c}{\Delta}$.*

In Kreps and Scheinkman (1983), a capacity constraint along with an exogenously fixed number of firms in the industry chokes competition and allows these firms to make strictly positive profits. As we show in Section 6.2, when we allow for costless free entry in the Kreps and Scheinkman (1983) game, the Bertrand outcome obtains as the unique equilibrium. In contrast, in our model, the positive profits arise due to the interaction of two informational constraints (neither of which can be contracted away) even under free costless entry and exit in the industry. This contrast highlights that, despite superficial similarities, the mechanisms at work are fundamentally different.

Contractible effort. Finally, consider the case that effort is costly but contractible. In this case, the IC constraint is no longer relevant (the dotted curve in Figure 3), since con-

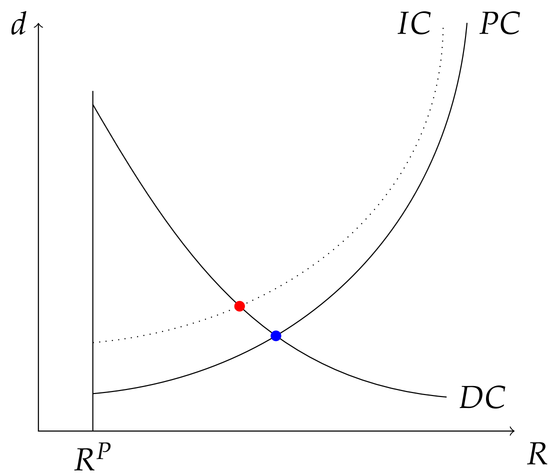

Figure 3: Contractible effort

tracts can specify not only R but also the level of effort. As with the IC constraint, the banker's participation constraint (Equation (4)) is upwards sloping in the (d, R) space and it becomes vertical as R approaches $X - \frac{c}{p_h}$. As argued in Lemma 2, for any $R < X$, the banker's participation constraint lies strictly below the IC constraint (see Figure 3). Contractibility of effort enlarges the set of feasible equilibria to also include the region between the IC constraint and the banker's participation constraint.

As before, the diversion constraint must bind. The unique equilibrium is given by the intersection of the diversion constraint and the banker's participation constraint (the blue dot in Figure 3). No agent can profitably deviate from this allocation since a banker will be strictly worse off if he attempts to undercut another and move further down along the participation constraint. At this allocation, active bankers and those who do not attract depositors earn identical expected returns because the banker's participation constraint binds. Therefore, the result that Bertrand competition is disrupted despite costless free entry and price competition relies crucially on the assumption of non-contractibility of effort.

Lemma 5 (No moral hazard) *Under contractible effort, bankers who successfully attract depositors and those who do not earn identical expected returns.*

We summarize these results in the proposition below:

Proposition 3 *The interaction of effort moral hazard and diversion frictions, not either friction alone, prevents the equilibrium bank profits from being driven down to zero, the Bertrand outcome.*

In canonical moral hazard models (e.g., Prescott and Townsend (1984); Holmstrom and Tirole (1997)), free entry drives profits to zero. The same holds in our setting when only moral hazard is considered, even with identical bankers, free entry, and price competition. Adding limited pledgeability overturns this benchmark.

3.2 Degree of competition

Monopoly pricing. Consider the special case, $c = \bar{c}$. In this case, the incentive constraint and the diversion constraint intersect on the depositors' participation constraint, which is characterized as follows:

$$d = \frac{\phi p_h X}{1 - \phi p_h X} \equiv d^M \tag{11}$$

$$R = \frac{1}{p_h} = R^P \tag{12}$$

In this equilibrium, the depositors are on their participation constraint. Hence, we refer to this as the monopoly pricing equilibrium.

Perfect competition. Suppose that $c = \Delta X - k + \epsilon$, where ϵ is strictly positive but arbitrarily small. Substituting into Equation (9), as $\epsilon \to 0$, we obtain:

$$R^* \to X - \frac{c}{\Delta} \tag{13}$$

This implies that as c falls and converges to $\Delta X - k$, the equilibrium is the same as the Bertrand outcome under only effort moral hazard (in the absence of the diversion constraint) in which the margin that banks charge is arbitrarily close to the gross informational rent, $\frac{c}{\Delta}$.

Thus, the level of competition, whether it is monopoly, oligopoly, or perfect competition, is traced to the primitives of the economy, as summarized in the following proposition:

Proposition 4 *The degree of competition lies within a range from monopoly to perfect competition and is determined by the deep parameters:*

1. $c = \bar{c}$*: Monopoly pricing,* $R = R^P$.

2. $\bar{c} > c > \Delta X - k$*: Oligopoly,* $R = R^* > X - \frac{c}{\Delta}$.

3. $c \to \Delta X - k$*: Perfect competition,* $R \to X - \frac{c}{\Delta}$.

Our analysis parallels Menzio (2026), who derives the entire markup distribution from the primitives of the economy rather than assuming it; in our case, the market structure itself is endogenous as the number of active banks and bank leverage are also equilibrium outcomes. This result is reminiscent of Maggi (1996) who captures all situations between the Cournot and the Bertrand outcome, depending on parameters. However, the result in Maggi (1996) is driven by the assumption of an exogenously fixed number of firms in the industry, whereas we allow for free entry and exit, and the number of banks in our model is endogenous. As in the Kreps and Scheinkman (1983) model, when we allow for free costless entry in Maggi (1996), the unique equilibrium is the Bertrand outcome.

4 Implications

In this section, we present the empirical and policy implications of the model which arise from the interaction of the diversion constraint and the ex ante effort moral hazard constraint.

4.1 Comparative statics

In this section, we derive some novel empirical predictions out of the model. Consider the case that the cost of effort is in the intermediate range, $0 < c < \bar{c}$, implying that banks retain a part of the surplus.

Lemma 6 *An increase in banks' investment opportunities,* X*, leads to more banks,* λ^**, a higher deposit rate,* R*, and a lower bank leverage,* d*.*

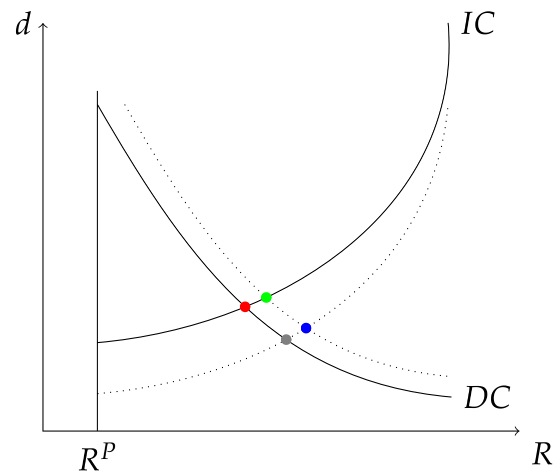

Figure 4: Comparative Statics

Proof. The proof is in the Appendix. ■

When the bank's investment opportunities improve, which is captured by a higher X, there are two forces at play:

It relaxes both the diversion constraint and the effort incentive constraint. The new intersection of these two constraints is at the blue dot. Both forces have a positive effect on the deposit rate, which increases as a result of a higher X. Interestingly, the two forces have conflicting effects on leverage – the first effect boosts leverage, taking as given the number of banks operating, but the second effect boosts the number of banks operating in equilibrium (λ increases), which leads to a lower bank leverage. We show in the proof of Lemma 6 that the second effect dominates, and the new equilibrium features a lower d when X increases – in Figure 4, the equilibrium moves from the red to the blue dot. That is, even though banks' investment opportunities improve allowing banks to attract more deposits (all else given), more bankers are active in equilibrium due to the relaxation of the effort incentive constraint, and this leads to a lower equilibrium leverage.

Lemma 7 *An increase in pledgeability, ϕ, leads to fewer banks, a higher deposit rate, R, and a higher bank leverage, d.*

Proof. The proof is in the Appendix. ■

When pledgeable income increases because diversion, $1-\phi$, falls, the diversion constraint is relaxed while the other constraints are unaffected. The equilibrium moves up along the incentive constraint implying that there are fewer banks, and it features a higher R and a higher d – in Figure 4, the equilibrium moves from the red to the green dot. Intuitively, a higher ϕ implies that banks can pledge more of their output to depositors. This intensifies competition for depositors leading to higher deposit rates. As a result, per unit of investment, banks retain a smaller surplus, and an increase in leverage is necessary to satisfy the effort incentive constraint.

Various regulatory measures over the years have fortified stability in the banking system and presumably led to greater pledgeability. Our model thus predicts the banking sector should become more concentrated over time (featuring fewer, larger banks), with banks becoming more levered. There are numerous studies providing supporting evidence for these predictions: Saunders and Wilson (1999) document that the banking sectors in the US, UK, and Canada have become increasingly consolidated over the very long run, and at the same time, banks have become more levered. Corbae and D'Erasmo (2020) document increasing concentration in the US banking sector and Miles et al. (2013) find that UK banks have become more levered over time.

If we assume that the strength of institutions is increasing in GDP/capita, then richer countries are characterized by a lower threat of diversion. Given this, the prediction is that bank pricing power is falling in GDP/capita, but the banking sector is more concentrated (fewer banks).

Thus, when pledgeable income increases, the effect on the deposit rate is unambiguously positive regardless of whether X or ϕ contributes to the increase in pledgeable income – higher pledgeable income leads to lower pricing power in the deposit market. However, the effect of a higher pledgeable income on bank leverage may be positive or negative depending upon whether ϕ or X contributes to the increase in pledgeable income. If pledgeable income increases due to institutional factors which allows banks to commit to diverting a smaller fraction of the output (e.g., the regulatory environment), then it leads to higher leverage. However, if pledgeable income increases due to improved investment opportunities, then it leads to lower leverage.

Lemma 8 *A fall in the cost of effort, c or k, leads to more banks, a higher deposit rate, R, and a lower bank leverage, d.*

Proof. The proof is in the Appendix. ■

When the cost of effort, c or k, falls, it relaxes the effort incentive constraint while the other constraints are unaffected. The equilibrium moves down along the diversion constraint and features a higher R and a lower d – in Figure 4, the equilibrium moves from the red to the gray dot. This prediction aligns with the intuition that lowering the cost of effort increases the number of banks. Somewhat less obvious, however, is the accompanying decline in leverage.

4.2 The decoupling of concentration and pricing power

Higher concentration in the banking sector driven by an increase in pledgeability is associated with lower pricing power.

When pledgeability increases, banks can offer higher deposit rates and accept more deposits. This, in turn, leads to fewer banks. To see this, note that a higher ϕ relaxes the diversion constraint while leaving the other constraints unaffected. As shown in Figure 4, the equilibrium shifts from the red to the green dot. This new equilibrium is characterized by fewer banks, and yet, a higher deposit rate. Since we assume that banks behave monopolistically in the loan market, a higher deposit rate in our model indicates lower profitability (controlling for bank size) – the net interest margin, $X - R$, falls. Thus, a negative correlation between pricing power in the deposit market, and hence, overall bank profitability, and bank concentration can emerge.

Consistent with this prediction, Smirlock (1985), Berger (1995), and Claessens and Laeven (2004) document that bank concentration and profitability can be negatively correlated. Likewise, Demirguc-Kunt et al. (2004) show that the positive correlation between concentration and net interest margins disappears once regulatory impediments to competition and inflation are taken into account. A small number of studies also directly look at the impact of concentration on pricing power in the deposit market. Jackson (1992) documents a non-linear relationship between concentration and pricing power in the deposit market, with a negative correlation emerging for banks operating in highly concentrated markets. Examining rural U.S. counties (those outside Metropolitan Statistical Areas), Rosen (2003) find that higher deposit market concentration can be associated with higher deposit rates. In an international sample of banks, Forssbaeck and Shehzad (2015) report a negative correlation between concentration and pricing power (Lerner index) in the deposit market, even though the correlation is positive in the loan market.

The decoupling of concentration and pricing power is our most counterintuitive prediction. While existing work documents the negative correlation, no study directly tests the mechanism we propose: that pledgeability drives the two apart. As a first step, Table 1 presents preliminary correlational evidence from a cross-section of 134 economies, split at the median of the rule-of-law proxy for pledgeability. Both differences are consistent with the model and are statistically significant on a difference-in-means test. The high-pledgeability group is more concentrated, with a three-bank asset share of 71% versus 64%, and yet displays substantially lower pricing power, with a net interest margin, $X - R$ in our model, of 2.5% versus 4.8%. We regard this evidence as suggestive rather than conclusive: a more careful empirical analysis using more granular data, more precise proxies, and ideally exploiting shocks to pledgeability, would be required to identify the effects cleanly.

Table 1: Bank concentration and pricing power, by pledgeability

Pledgeability group	n	Concentration (%)	Net interest margin (%)
High (rule of law $\geq$ median)	67	71.27	2.45
Low (rule of law $<$ median)	67	63.49	4.79
Difference		7.78^{***}	-2.34^{***}
t-statistic		2.62	-6.11

Notes. Group means for 134 economies, split at the sample median of the pledgeability proxy. Concentration is the share of banking-system assets held by the three largest banks (World Bank Global Financial Development Database, GFDD.OI.01, 2021); net interest margin is GFDD.EI.01 (2021); pledgeability is proxied by the World Bank Worldwide Governance Indicators rule-of-law estimate (2024). Significance from a difference-in-means test: *** $p < 0.001$.

At the same time, holding the degree of diversion constant, an increase in the fixed cost of effort, k, makes the IC constraint more binding and reduces the number of banks, leading to higher concentration, and banks enjoy greater pricing power in this new equilibrium. Thus, our model also delivers the conventional prediction of a positive correlation between pricing power and concentration (see, e.g., Berger and Hannan (1989) for supporting empirical evidence).

Thus, there are countervailing forces which determine the correlation between concentration in the banking sector and the deposit rate, which can go either way depending on which of the two forces dominate. In general, although the US banking sector has become increasingly concentrated over the last few decades (as documented widely, see e.g., Corbae and D'Erasmo (2020)), bank profitability has remained at a roughly similar level over time (see Drechsler et al. (2021)), thereby highlighting the disconnect between concentration and profitability. In our model, a simultaneous fall in diversion and an increase in the cost of effort (both, possibly due to heightened regulatory burden) can reconcile the observed rise in market concentration with stable profitability. Our analysis shows that treating concentration as an endogenous outcome rather than an exogenous variable yields a richer set of predictions. The sign of the concentration–pricing-power correlation depends on whether ϕ or k drives the underlying variation; hence, the same model can rationalize either a positive or a negative correlation for an appropriate configuration of primitives. The correlation is therefore not a sufficient statistic for the degree of competition; inferring market power from concentration without conditioning on the pledgeability environment can be misleading. This is in the spirit of the "anything goes" results in Menzio (2026). The median split in Table 1 is best understood as a first pass at exactly the conditioning this logic requires – splitting the cross-section on the pledgeability proxy before relating concentration to margins.

4.3 The pass-through effect

The strength of the pass-through effect increases with pledgeability, ϕ, when ϕ is low, and decreases in ϕ when ϕ is high.

The extent to which an increase in X (e.g., due to a rise in the monetary policy rate) is passed through to depositors is given by:

$$\frac{\delta R^*}{\delta X} = \frac{\phi k(k+c)}{[k+c-(1-\phi)\Delta X]^2} \tag{14}$$

The pass-through effect is *partial* (i.e., the change in the equilibrium deposit rate is smaller than the change in X) if this derivative is less than one. Thus, there can be partial pass-through even when banks compete in prices, and there is neither product differentiation nor a switching cost for depositors.

The pass-through depends on pledgeability, ϕ:

$$\frac{\delta^2 R^*}{\delta X\, \delta\phi} = \frac{k(k+c)[k+c-(1+\phi)\Delta X]}{[k+c-(1-\phi)\Delta X]^3} \tag{15}$$

The pass-through is increasing in ϕ if:

$$\phi < \frac{k+c-\Delta X}{\Delta X} \tag{16}$$

This implies that when pledgeability is low, an increase in ϕ leads to greater pass-through, but when pledgeability is already high, the relationship may reverse. One could test this prediction using cross-country data. For example, an increase in pledgeability in Mexico (which is characterized by high diversion according to Calomiris and Haber (2014)) should strengthen the pass-through effect, whereas the same increase in Canada or the United States should weaken it.

The pass-through also depends on investment opportunities, X. Specifically:

$$\frac{\delta^2 R^*}{\delta X^2} = \frac{2\phi k(k+c)(1-\phi)\Delta}{[k+c-(1-\phi)\Delta X]^3} > 0 \tag{17}$$

Since the second derivative is positive, the pass-through is convex in X. Thus, an increase in X has a larger effect on pass-through when X is already high, implying that pass-through becomes more complete at higher levels of X.

Lemma 9 *The strength of the pass-through effect is non-linear in ϕ and increasing in X.*

4.4 Optimal policy

An utilitarian regulator can eliminate a problem of excessively high number of banks by introducing an upper bound on the number of bank licences to be allocated.

When $c = \bar{c}$, there is monopoly pricing and the minimum number of bankers enter the market, $\lambda = 1 - \phi p_h X$, such that the market for deposits clears. Thus, in this monopoly equilibrium, the entire initial endowment of the economy is managed by banks, and at the same time, this arrangement minimizes the exertion of costly effort. For $c < \bar{c}$, there is inefficient duplication of the fixed component of effort since there are too many banks, $\lambda > 1 - \phi p_h X$. As the fixed cost of effort, k falls, the net surplus in the economy increases, and more bankers are active in equilibrium. However, *for a given k*, net social surplus in the economy is maximized by minimizing the number of bankers to the extent that all depositors are served.

Suppose $c < \bar{c}$. A regulator whose objective is to maximize the net social surplus can eliminate the inefficiency by announcing a cap on the number of banking licences. The regulator will choose a maximum of $\frac{1-\phi p_h X}{\phi p_h X}$ (derived by setting $c = \bar{c}$ in λ^*) bankers to apply for a licence on a first-come-first-served basis. Since $c < \bar{c}$, the incentive constraint is slack and all chosen bankers exert effort. Thus, the problem of too many banks is eliminated since there are just enough banks in equilibrium such that all depositors are served. This regulated equilibrium resembles the unregulated monopoly equilibrium which arises when $c = \bar{c}$ in terms of the outcome variables, d and R. Compared to the laissez faire monopoly (i.e., when $c = \bar{c}$), active bankers in the regulated monopoly extract a higher fraction of the surplus. The licence cap regulation boosts the net social surplus, but the depositors are strictly worse off in this regulated equilibrium since their participation constraint, slack in the decentralized equilibrium, now binds.

Unlike the charter value hypothesis (see, e.g., Hellmann et al. (2000)) in which a higher market power promotes stability by making banks more prudent in anticipation of higher charter values, in our theory, restricting competition in the banking sector boosts the net social surplus by eliminating the unnecessary duplication of costly effort.

5 Conclusion

We develop a model of bank competition in the deposit market in which there are two informational frictions at play – an ex ante effort moral hazard problem and an ex post threat of diversion. The interaction of these two constraints (which cannot be contracted away) allows active banks to make strictly positive profits in the deposit market despite allowing for price competition and free entry and exit; a strictly positive mass of inactive bankers who invest in the storage technology cannot disrupt the equilibrium.

Our model generates several novel implications. When pledgeability increases, the new equilibrium features fewer banks yet a higher deposit rate – giving rise to a negative correlation between concentration and pricing power (the decoupling result). This negative correlation is documented in several empirical papers, and we provide additional preliminary correlational evidence consistent with the prediction that concentration driven by higher pledgeability is associated with lower pricing power. Even though we allow for price competition and free entry, improvements in banks' investment opportunities may be only partially passed through to depositors. We also derive a novel prediction that the pass-through effect strengthens when pledgeability is low but weakens once pledgeability becomes sufficiently high.

6 Appendix

6.1 Proofs

Proof of Lemma 1.

Suppose $I = 0$. For any d and R, total bank output is dp_hX, of which the pledgeable portion is ϕdp_hX, or ϕp_hX per unit. By Assumption $A2$, $\phi p_hX < 1$, so depositors cannot recover their funds under any contract with $I = 0$ and will never choose such a contract.

Proof of Proposition 2.

We verify each of the three conditions in Definition 1 at the proposed equilibrium $(R^*, d^*, I^*, \lambda^*, e^*)$, and then argue that no other quintuple satisfies all relevant constraints.

(E1) Feasibility. By construction, the red dot lies on both the diversion constraint and the incentive constraint, so both bind. The depositors' participation constraint holds since $R^* \geq R^P$ for $c \leq \bar{c}$ (holding with equality for $c = \bar{c}$; under the tie-breaking rule, indifference is resolved in favor of depositing). Given that the incentive constraint is satisfied, the bankers' participation constraint is slack by Lemma 2. Active bankers commit their funds to the bank $I^* = 1$ by Lemma 1 and they exert effort $e^* = 1$ since the incentive constraint is satisfied.

(E2) Market clearing. There is a mass m of bankers, of whom a fraction λ^* successfully attract funding, giving $n = \lambda^* m$ active banks, each accepting d^* deposits. Setting $\lambda^* m d^* = 1$ and solving yields:

$$\lambda^* = \frac{(1-\phi)\Delta X - c}{m\,[k + c - (1-\phi)\Delta X]} \tag{A.1}$$

By Assumption *A3*, $\lambda^* < 1$, so a positive mass of bankers remain inactive but all depositors are served.

(E3) No profitable entry. A contract featuring $R' < R^*$ will not be chosen by depositors since this is a less attractive option and the ROFR feature of the contracts renders contracts with $R' = R^*$ unprofitable. Any contract featuring $R' > R^*$ violates at least one of the diversion constraint and the incentive constraint, since the red dot is their intersection and the feasible region lies between them in the (d, R) space. Hence, no inactive banker can offer a strictly preferred contract that is also feasible implying that the allocation at the intersection of the two constraints is an equilibrium.

Uniqueness. It remains to show that no quintuple other than $(R^*, d^*, I^*, \lambda^*, e^*)$ satisfies (E1)–(E3). The deviations described below are phrased as offers by an inactive banker; the same deviations are also available to any incumbent, and ROFR is only used to break indifference at $R' = R^*$.

Step 1: Autarky is not an equilibrium. Suppose $\lambda = 0$, so that all depositors invest in the storage technology. In this conjectured equilibrium, an inactive banker can attract depositors by offering a contract with $R = R^P + \epsilon$ for arbitrarily small $\epsilon > 0$. By Assumption *A1* (in the case $\bar{c} \geq c > \Delta X - k$), there exists a d such that this contract satisfies both the diversion constraint and the incentive constraint, and depositors strictly prefer it to storage. The inactive banker earns strictly positive profits upon attracting depositors since the participation constraint is slack throughout the feasible region (Lemma 2). This contradicts (E3).

Step 2: The diversion constraint must bind. Consider a feasible allocation which satisfies the diversion constraint with strict inequality. Then an inactive banker can offer a deposit rate $R + \epsilon$ for arbitrarily small $\epsilon > 0$, attracting depositors away from incumbents. This is feasible for any $R < X - \frac{c}{\Delta}$ and is strictly profitable for the entrant since the participation constraint remains slack, contradicting (E3).

Step 3: The incentive constraint must bind. Consider a feasible allocation in which the effort incentive constraint does not bind. By Lemma 2, active bankers earn strictly higher profits than the storage payoff, so an inactive banker has strictly positive profits available by entering. An inactive banker can offer $R + \epsilon$ for arbitrarily small $\epsilon > 0$, attracting depositors away from incumbents. This contradicts (E3).

Combining Steps 1–3, the unique equilibrium is at the intersection of the diversion and the effort incentive constraints and is characterized by $(R^*, d^*, I^*, \lambda, e^*)$. Then, by free entry, we obtain $\lambda = \lambda^*$. We show that all depositors are served in this equilibrium. Suppose, to the contrary, that $\lambda m d^* < 1$, so that some depositors invest in storage. An inactive banker can offer $R = R^P + \epsilon$ to unserved depositors, who strictly prefer this to storage. By the argument in Step 1, this is feasible and strictly profitable, contradicting (E3). Conversely, if $\lambda m d^* > 1$, some active bankers cannot attract d^* deposits and exit at zero cost, restoring market clearing. The unique equilibrium therefore satisfies $\lambda^* m d^* = 1$.

Proof of Lemma 6.

Differentiating d^* with respect to X:

$$\frac{\delta d^*}{\delta X} = -\frac{(1-\phi)\Delta k}{[(1-\phi)\Delta X - c]^2} < 0 \tag{A.2}$$

Differentiating R^* with respect to X:

$$\frac{\delta R^*}{\delta X} = \frac{\phi k(k+c)}{[k+c-(1-\phi)\Delta X]^2} > 0 \tag{A.3}$$

Differentiating λ^* with respect to X:

$$\frac{\delta \lambda^*}{\delta X} = -\frac{\delta d^*}{\delta X}\frac{1}{d^{*2}} > 0 \tag{A.4}$$

Below we provide a graphical proof which illustrates the mechanism. Totally differentiating the diversion constraint with respect to R and X:

$$\left.\frac{dR}{dX}\right|_{DC} = \frac{\phi(1+d)}{d} \tag{A.5}$$

Totally differentiating the incentive constraint with respect to R and X:

$$\left.\frac{dR}{dX}\right|_{IC} = \frac{1+d}{d} \tag{A.6}$$

For a given increase in X, both the diversion and incentive constraints shift to the right in the (d, R) space indicating that a higher X leads to an increase in R. To assess the impact of a higher X on leverage and entry, we compare the magnitude of the lateral shift in the two constraints. The magnitude of the lateral shift in the diversion constraint is smaller than that of the incentive constraint if:

$$\begin{aligned} \frac{\phi(1+d)}{d} &< \frac{1+d}{d} \\ &\implies \phi < 1 \end{aligned}$$

The above condition is always satisfied. Given this observation that an increase in X

leads to a smaller lateral shift in the diversion constraint than in the incentive constraint, when X increases, the diversion and incentive constraints intersect at a lower point. This implies that a higher X leads to more banks and a lower d.

Proof of Lemma 7.

Differentiating d^* with respect to ϕ:

$$\frac{\delta d^*}{\delta \phi} = \frac{k\Delta X}{[(1-\phi)\Delta X - c]^2} > 0 \tag{A.7}$$

Differentiating R^* with respect to ϕ:

$$\frac{\delta R^*}{\delta \phi} = \frac{kX(\overbrace{k+c-\Delta X}^{>0 \text{ by A1}})}{[k+c-(1-\phi)\Delta X]^2} > 0 \tag{A.8}$$

Differentiating λ^* with respect to ϕ:

$$\frac{\delta \lambda^*}{\delta \phi} = -\frac{\delta d^*}{\delta \phi}\frac{1}{{d^*}^2} < 0 \tag{A.9}$$

Proof of Lemma 8.

Differentiating d^* with respect to k:

$$\frac{\delta d^*}{\delta k} = \frac{1}{\underbrace{(1-\phi)\Delta X - c}_{>0 \text{ by A1}}} > 0 \tag{A.10}$$

Differentiating R^* with respect to k:

$$\frac{\delta R^*}{\delta k} = \frac{\phi X[\overbrace{c-(1-\phi)\Delta X}^{<0 \text{ by A1}}]}{[k+c-(1-\phi)\Delta X]^2} < 0 \tag{A.11}$$

Differentiating λ^* with respect to k:

$$\frac{\delta \lambda^*}{\delta k} = -\frac{\delta d^*}{\delta k}\frac{1}{{d^*}^2} < 0 \tag{A.12}$$

Differentiating d^* with respect to c:

$$\frac{\delta d^*}{\delta c} = \frac{k}{[(1-\phi)\Delta X - c]^2} > 0 \tag{A.13}$$

Differentiating R^* with respect to c:

$$\frac{\delta R^*}{\delta c} = -\frac{\phi k X}{[k + c - (1-\phi)\Delta X]^2} < 0 \tag{A.14}$$

Differentiating λ^* with respect to c:

$$\frac{\delta \lambda^*}{\delta c} = -\frac{\delta d^*}{\delta c}\frac{1}{{d^*}^2} < 0 \tag{A.15}$$

6.2 Kreps and Scheinkman with free entry

In this section, we consider the Kreps and Scheinkman (1983) game with capacity constraints and fixed number of firms in the industry. We extend this game to allow for free (costless) entry, and show that, in this extended game, the Bertrand outcome arises as the unique equilibrium.

Consider a simplified version of our model in which there are no informational frictions and the project always succeeds (i.e., $p_h = 1$). Let's now apply the Kreps and Scheinkman (1983) approach to this setting. There are N banks indexed $i = \{1, ..N\}$, each demanding deposits, d_i. They face an upward sloping supply curve, $R = a + D$, where a is a positive constant, R is the deposit rate, and D is the total deposits demanded by banks, $D = \sum_{i=1}^{N} d_i$. Banks use deposits to make loans and the loan rate is exogenously given and constant at X, where $0 < a < X$. This corresponds to the exogenously given marginal cost in Kreps and Scheinkman (1983).

The original game has two stages: In Stage 1 of the game, banks simultaneously and independently choose their capacity to accept deposits, l_i. In Stage 2, each bank observes the other banks' choices of their pre-committed capacities, and they simultaneously choose the deposit rate. We look for the sub-game perfect Nash equilibrium of this game and solve for the equilibrium backwards.

In Stage 2, given capacities, l_i, depositors deposit their funds first to the bank offering the highest deposit rate till this bank's capacity is exhausted. Then, depositors take the residual supply to the bank offering the next highest deposit rate and so on. This iterates till the deposit rate reaches depositors' reservation price. If banks offer the same deposit rate, the market is split equally among them.

In Stage 1, banks set their capacity to accept deposits by anticipating the outcome in the next stage. If the total capacity is higher than the supply of deposits, then banks set the deposit rate equal to the loan rate, X. Thus, to avoid this Bertrand price war, banks choose capacity, l_i to be equal the Cournot quantities, d^*, thereby softening price competition in the following stage.

A bank j's profit function is:

$$\Pi_j = (X - R)d_j \tag{A.16}$$

Using $R = a + D$, and taking the first order condition with respect to d_j:

$$d_j = \frac{X - a - \sum_{i \neq j} d_i}{2} \tag{A.17}$$

In the symmetric equilibrium, $d_j = d^*$. Substituting, we derive the equilibrium of the Kreps and Scheinkman (1983) game:

$$l_i = d_i = d^* = \frac{X - a}{N + 1}$$

Thus, the total amount of deposits demanded in equilibrium is $D = Nd^*$. Substituting into R:

$$R^* = \frac{NX + a}{N + 1} < X$$

Because banks choose their capacity in the first stage of the game, they are able to earn strictly positive profits even though they compete in deposit rates in the final stage. Anticipating the equilibrium deposit rate that will prevail in the next stage, each bank sets its capacity such that it is exactly filled – there is no excess supply of deposits. As a result, banks can offer a deposit rate strictly below the loan rate, X, since the limited capacity prevents undercutting by competitors from driving the rate up to X.

We now introduce to the Kreps and Scheinkman (1983) game the possibility of bank entry in the first stage of competition. Suppose, as we do throughout the paper, entry is free and costless. Then, anticipating positive profits, a new bank (indexed $i = N + 1$) enters the market and offers the same capacity in the first stage. This leads to unfulfilled demand in the next stage. Anticipating this, banks adjust their announced capacity. As the number of entrants goes up, the equilibrium approaches the Bertrand outcome, and in equilibrium, $R^* = \frac{NX+a}{N+1} = \frac{X+\frac{a}{N}}{1+\frac{1}{N}} = X$ since $N = \infty$.

Proposition 5 (Kreps and Scheinkman (1983) with free entry) *When banks can freely enter the market, the equilibrium reverts to the Bertrand outcome, even if banks can pre-commit to capacity constraints before competing in prices.*

The Kreps and Scheinkman (1983) model shows that with a fixed number of firms, pre-committed capacity followed by price competition can yield Cournot-like outcomes. However, once free entry is introduced, firms have an incentive to enter until all economic profits are dissipated. This undermines the disciplining role of capacity constraints, and the outcome reverts to the perfectly competitive Bertrand benchmark. This implies that pass-through is complete, $\frac{\delta R}{\delta X} = 1$.

References

Acharya, V. V., Gujral, I., Kulkarni, N., and Shin, H. S. (2011). Dividends and bank capital in the financial crisis of 2007-2009. *NBER Working paper*.

Berger, A. (1995). The profit-structure relationship in banking – tests of market-power and efficient-etructure hypotheses. *Journal of Money, Credit, and Banking*, 27(2):404–431.

Berger, A. N. and Hannan, T. H. (1989). The price-concentration relationship in banking. *Review of Economics and Statistics*, 71(2):291–299.

Berger, A. N. and Hannan, T. H. (1998). The efficiency cost of market power in the banking industry: A test of the quiet life and related hypotheses. *Review of Economics and Statistics*, 80(3):454–465.

Berger, A. N. and Mester, L. J. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking and Finance*, 21(7):895–947.

Beyhaghi, M., Fracassi, C., and Weitzner, G. (2025). Adverse selection in corporate loan markets. *Journal of Finance*. Forthcoming.

Biswas, S. and Koufopoulos, K. (2022). Bank capital structure and regulation: Overcoming and embracing adverse selection. *Journal of Financial Economics*, 143(3):973–992.

Boot, A. and Thakor, A. (2000). Can relationship banking survive competition? *Journal of Finance*, 55(2):679 – 713.

Boyd, J. H. and Prescott, E. C. (1986). Financial intermediary-coalitions. *Journal of Economic Theory*, 38(2):211–232.

Broecker, T. (1990). Credit-worthiness tests and interbank competition. *Econometrica*, 58(2):429–452.

Burdett, K. and Judd, K. L. (1983). Equilibrium price dispersion. *Econometrica*, 51(4):955–969.

Butters, G. R. (1977). Equilibrium distribution of sales and advertising prices. *Review of Economic Studies*, 44(3):465–491.

Calomiris, C. and Kahn, C. (1991). The role of demandable debt in structuring optimal banking arrangements. *American Economic Review*, 81(3):497–513.

Calomiris, C. W. and Haber, S. H. (2014). *Fragile by Design: The Political Origins of Banking Crises and Scarce Credit*. Princeton University Press, Princeton, NJ.

Claessens, S. and Laeven, L. (2004). What drives bank competition? some international evidence. *Journal of Money, Credit and Banking*, 36(3):563 – 583.

Corbae, D. and D'Erasmo, P. (2020). Rising bank concentration. *Journal of Economic Dynamics and Control*, 115(C).

Corbae, D. and D'Erasmo, P. (2021). Capital buffers in a quantitative model of banking industry dynamics. *Econometrica*, 89(6):2975–3023.

Davies, R. and Tracey, B. (2014). Too big to be efficient? the impact of implicit subsidies on estimates of scale economies for banks. *Journal of Money, Credit and Banking*, 46(s1):219–253.

Dell'Ariccia, G., Friedman, E., and Marquez, R. (1999). Adverse selection as a barrier to entry in the banking industry. *RAND Journal of Economics*, 30(3):515–534.

Demirguc-Kunt, A., Laeven, L., and Levine, R. (2004). Regulations, market structure, institutions, and the cost of financial intermediation. *Journal of Money, Credit, and Banking*, 36(3):593–622.

Demsetz, H. (1973). Industry structure, market rivalry, and public policy. *Journal of Law and Economics*, 16:1–9.

Demsetz, H. (1974). Two systems of belief about monopoly. In Goldschmid, H. J., Mann, H. M., and Weston, J. F., editors, *Industrial Concentration: The New Learning*, pages 164–184. Little, Brown, Boston.

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies*, 51(3):393–414.

Dixit, A. K. and Stiglitz, J. E. (1977). Monopolistic competition and optimum product diversity. *American Economic Review*, 67(3):297–308.

Donaldson, J. R., Piacentino, G., and Thakor, A. V. (2018). Warehouse banking. *Journal of Financial Economics*, 129(2):250–267.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The deposits channel of monetary policy. *Quarterly Journal of Economics*, 132(4):1819–1876.

Drechsler, I., Savov, A., and Schnabl, P. (2021). Banking on deposits: Maturity transformation without interest rate risk. *Journal of Finance*, 76(3):1091–1143.

Drechsler, I., Savov, A., Schnabl, P., and Wang, O. (2026). Deposit franchise runs. *The Journal of Finance*, 81(3):1573–1617.

Farrell, J. and Klemperer, P. (2007). Coordination and lock-in: Competition with switching costs and network effects. volume 3 of *Handbook of Industrial Organization*, pages 1967–2072. Elsevier.

Forssbaeck, J. and Shehzad, C. T. (2015). The conditional effects of market power on bank risk - cross country evidence. *Review of Finance*, 19:1997–2038.

Gennaioli, N. and Rossi, S. (2013). Contractual resolutions of financial distress. *Review of Financial Studies*, 26(3):602 – 634.

Goetz, M. R., Laeven, L., and Levine, R. (2025). Do bank insiders impede equity issuances? *Journal of Financial Intermediation*, 64:101182.

Green, R. C. (2007). Presidential address: Issuers, underwriter syndicates, and aftermarket transparency. *Journal of Finance*, 62(4):1529–1550.

Hart, O. and Moore, J. (1995). Debt and seniority: An analysis of the role of hard claims in constraining management. *American Economic Review*, 85(3):567–585.

He, Z. and Krishnamurthy, A. (2012). A model of capital and crises. *The Review of Economic Studies*, 79(2):735–777.

Hellmann, T. F., Murdock, K. C., and Stiglitz, J. E. (2000). Liberalization, moral hazard in banking, and prudential regulation: Are capital requirements enough? *American Economic Review*, 90(1):147–165.

Holmstrom, B. and Tirole, J. (1997). Financial intermediation, loanable funds and the real sector. *Quarterly Journal of Economics*, 112(3):663–691.

Holmstrom, B. and Tirole, J. (2011). *Inside and Outside Liquidity*. The MIT Press, Cambridge, MA.

Hughes, J. P. and Mester, L. J. (2013). Who said large banks don't experience scale economies? evidence from a risk-return-driven cost function. *Journal of Financial Intermediation*, 22(4):559–585.

Jackson, W. (1992). The price-concentration relationship in banking: A comment. *Review of Economics and Statistics*, 74(2):373–376.

Kovner, A., Vickery, J., and Zhou, L. (2014). Do big banks have lower operating costs? *Economic Policy Review*, 20(2):1–28.

Kreps, D. M. and Scheinkman, J. A. (1983). Quantity precommitment and bertrand competition yield cournot outcomes. *Bell Journal of Economics*, 14(2):326–337.

Lambson, V. E. (1987). Is the concentration-profit correlation partly an artifact of lumpy technology? *American Economic Review*, 77(4):731–733.

Maggi, G. (1996). Strategic trade policies with endogenous mode of competition. *American Economic Review*, 86(1):237–258.

Marquez, R. (2002). Competition, adverse selection, and information dispersion in the banking industry. *Review of Financial Studies*, 15(3):901–926.

Martinez-Miera, D. and Repullo, R. (2017). Search for yield. *Econometrica*, 85(2):351–378.

Mehran, H. and Thakor, A. (2011). Bank capital and value in the cross-section. *Review of Financial Studies*, 24(4):1019–1067.

Menzio, G. (2026). Markups: A search-theoretic perspective. *Journal of Political Economy*. Forthcoming.

Mester, L. J. (2008). Optimal industrial structure in banking. In *Handbook of Financial Intermediation and Banking*, chapter 5, pages 133–162. Elsevier.

Miles, D., Yang, J., and Marcheggiano, G. (2013). Optimal bank capital. *The Economic Journal*, 123(567):1–37.

Morrison, A. and White, L. (2005). Crisis and capital requirements in banking. *American Economic Review*, 95(5):1548–1572.

Peltzman, S. (1977). The gains and losses from industrial concentration. *Journal of Law and Economics*, 20:229–263.

Prescott, E. C. and Townsend, R. M. (1984). Pareto optima and competitive equilibria with adverse selection and moral hazard. *Econometrica*, 52(1):21–45.

Rosen, R. (2003). Banking market conditions and deposit interest rates. Technical Report WP 2003-19, Federal Reserve Bank of Chicago.

Saunders, A. and Wilson, B. (1999). The impact of consolidation and safety nets on bank risk-taking. *Journal of Banking & Finance*, 23(2-4):327–358.

Schliephake, E. and Kirsten, R. (2013). Strategic effects of regulatory capital requirements in imperfect banking competition. *Journal of Money, Credit and Banking*, 45(4):675–700.

Sengupta, R. (2007). Foreign entry and bank competition. *Journal of Financial Economics*, 84(2):502–528.

Shaffer, S. (1998). The winner's curse in banking. *Journal of Financial Intermediation*, 7(4):359–392.

Shleifer, A. and Wolfenzon, D. (2002). Investor protection and equity markets. *Journal of Financial Economics*, 66(1):3–27.

Smirlock, M. (1985). Evidence on the (non) relationship between concentration and profitability in banking. *Journal of Money, Credit and Banking*, 17(1):69–83.

Varian, H. R. (1980). A model of sales. *American Economic Review*, 70(4):651–659.

Wang, Y., Whited, T., Wu, Y., and Xiao, K. (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *Journal of Finance*, 77(4):2093–2141.

Wheelock, D. C. and Wilson, P. W. (2012). Do large banks have lower costs? new estimates of returns to scale for u.s. banks. *Journal of Money, Credit and Banking*, 44(1):121–149.

Wheelock, D. C. and Wilson, P. W. (2018). The evolution of scale economies in u.s. banking. *Journal of Applied Econometrics*, 33(1):16–28.

Williamson, S. D. (1986a). Costly monitoring, financial intermediation and equilibrium credit rationing. *Journal of Monetary Economics*, 18(2):159–179.

Williamson, S. D. (1986b). Increasing returns to scale in financial intermediation and the non-neutrality of government policy. *The Review of Economic Studies*, 53(5):863–875.

Williamson, S. D. (1987). Costly monitoring, loan contracts and equilibrium credit rationing. *Quarterly Journal of Economics*, 102(1):135–146.