Interbank Trading and Financial Regulation

Dean Corbae\textsuperscript{1} and Michael Gofman\textsuperscript{2}

\textsuperscript{1}University of Wisconsin - Madison and NBER
\textsuperscript{2}University of Rochester

August 31, 2018

Abstract

Financial regulation has become a key policy issue after the recent financial crisis. Limits on interbank exposures have been proposed to reduce the likelihood of contagion, even if they come at the cost of limiting banks’ ability to allocate liquidity in the economy. We study an environment where limits on interbank trading can increase welfare, instead of reduce it, when the interbank market facilitates collusion between competing banks. By lending its funds to a competitor, a bank commits not to compete. The borrowing bank makes monopolistic profits in the lending market and splits these profits with the lending bank through the interest rate on the interbank loan. We show that limitations on the interbank market in the decentralized economy implement the planner’s solution. The paper provides both normative and positive implications of this novel interaction between interbank trading and competition.

\[\text{[Preliminary and Incomplete]}\]

\textsuperscript{*Email: dean.corbae@wisc.edu and michael.gofman@simon.rochester.edu. We would like to thank Gadi Barlevy, Briana Chang, Camelia Minoiu, Erwan Quintin, Roberto Robbato, Randy Wright, and participants in Chicago Fed Summer Workshop on Money, Banking, Payments and Finance, brownbag participants in IDC and in UW-Madison for helpful comments and discussions. The research has been supported by NSF-OFR grant 1560831. All errors are our own.}
1 Introduction

Interbank markets are an integral part of the financial system; banks provide loans to each other to allocate liquidity in the economy. Despite the potential benefits of the interbank market, we propose a novel cost. Our argument is based on a simple observation that banks compete with each other in the provision of loans to businesses and consumers in one market, but provide loans to each other in another market. We build a stylized model to study how strategic spillovers between these two markets can generate an inefficient allocation of resources and provide a role for government regulation. The model provides a surprising result – in certain regions of the parameter space, an interbank market can facilitate collusion between banks and regulations limiting trade in that market can implement the planner’s solution.

The collusion happens when one bank provides a loan to another bank and as a result does not itself have sufficient funds to provide business loans, mortgages, etc. If these two banks are the only two banks in the region, the second bank effectively becomes a monopolist. The second bank makes monopolistic profits by rationing out the supply of loans. The interbank loan is a credible commitment device for the first bank not to compete. The bank benefits from this commitment because it receives an interest rate on the interbank loan that represents a share of the monopolistic profits earned by the borrowing bank. Without an interbank market, both banks would compete and receive zero profits, an allocation which a social planner would choose.

To establish a benchmark for the constrained efficient allocation of funds, we first solve the planner’s problem. The planner chooses optimal set of transfers between risk-averse households, risk-neutral bankers and risk-neutral entrepreneurs, as well as chooses the optimal reporting strategy by entrepreneurs and monitoring strategy by bankers, that maximize
the aggregate utility of all the agents in the economy, subject to resource feasibility, participation, and incentive compatibility constraints. In the planner’s solution, bankers and households receive no surplus relative to their utility in autarky, and borrowers receive all the surplus generated by investment in risky projects.

Next, we show that the planner’s solution is implemented in the decentralized economy in which banks compete on prices for loans and are not allowed to trade with each other. On one side, Bertrand competition between banks drives their profits to zero. On the other side, banks use their full bargaining power to set deposit rates at the level that drives households to their outside option. In equilibrium, entrepreneurs who decide to borrow and invest in the project receive all the surplus, as in the planner’s solution.

The main result of the paper is to show that opening an interbank market makes the decentralized solution inefficient. The decentralized solution changes because interbank trading allows banks to collude to increase their profits. With interbank markets open, banks bargain over the quantity and price of a loan from one bank to another. The quantity is determined to maximize the joint surplus of the banks. The price is determined to split the surplus between the banks.

The joint surplus of the two banks is maximized when only one bank provides the monopolistic level of loans to entrepreneurs. Therefore, to avoid competition one bank lends its excess funds to another bank. It allows the bank to commit that it will not compete simply because it endogenously reduced its lending capacity. Importantly, in certain regions of the parameter space, the interbank loan is not part of the planner’s solution because the borrowing bank does not need the funds and does not have any comparative advantage over the lending bank in provision or monitoring of loans to entrepreneurs. That implies that the interbank market can facilitate collusion without providing any social benefit. Even when such benefit exists, due to bank heterogeneity in resources, investment opportunities
or both, the welfare loss from collusion could still outweigh this benefit.

The interbank market also provides a convenient way for the colluding banks to split the surplus from collusion. The interest rate on the interbank loan is equal to some part of the monopolistic profits received by the borrowing bank. The share of surplus that a lending bank receives depends on its bargaining power. The interest rate would be higher, when the bargaining power is higher. The surplus is computed relative to the decentralized solution without interbank trading, which results in zero profits to both banks. Importantly, the inefficient level of business loans does not depend on the way the surplus is split, as the joint surplus is maximized when there is a monopolistic level of investment.

The policy implications of this result are striking. If indeed some banks use interbank markets for collusion, the cost of restricting interbank trading is not as high as previously thought. While it is well understood that interbank loans increase fragility of the banking system due to contagion, the cost of interbank linkages due to undersupply of loans has not been studied before. We find that interbank trading can reduce competition. If interbank lending was not allowed, competition would be restored. However, a complete ban on interbank trading is not optimal either because not all interbank trades are for collusion. If one bank has a comparative advantage to monitor loans in a particular market, but does not have enough resources to provide loans, interbank lending is welfare improving. Given the mixed nature of interbank loans, it makes direct intervention in the interbank trading a significant challenge for regulators.

Instead of banning the interbank market, regulators can utilize usury laws that limit interest on bank loans. If banks cannot charge interest above the level prescribed in the planner’s solution, interbank loans would not be an effective mechanism for banks to collude. Even if a transfer of funds would limit bank’s ability to compete, the second bank cannot take advantage of its monopolistic power when the cap is set at the competitive rate
level. The downside of this policy is that the planner’s solution changes with the scarcity of funds available to banks. If banks do not have enough deposits to provide loans, the optimal interest on the loans should be adjusted upwards to assure that entrepreneurs who take the loans are the ones with low outside option.\(^1\) If loans are priced artificially low in times when the resource feasibility constraint is binding, funding can go to entrepreneurs who are not the most efficient borrowers.

Given that optimal financial regulation of banks depends on banks’ motives in providing interbank loans, it would be beneficial to study empirically whether banks’ behavior is consistent with the collusion argument. We derive two empirical implications from the model. First, if the probability of an interbank trade increases with the similarity of the two trading banks, then it is more likely to suggest that collusion cannot be ruled out. In general, we would expect that interbank trading for liquidity allocation purposes would be between banks that have a smaller overlap in the markets and companies they serve. Our prediction is consistent with empirical findings that show that the probability of an interbank loan and the size of the loan are increasing with the geographical proximity of the banks (Bech and Atalay, 2010; Afonso et al., 2014).

Our model also suggests a low sensitivity between interbank borrowing and business lending. If banks borrow from other banks because they lack their own resources to invest, we should expect a positive correlation between the amount of business lending by a bank and the net amount borrowed in the interbank market. In our model, funds borrowed in the interbank market are not needed for business lending. Therefore, if the correlation is low it would be consistent with the collusion channel.

**Literature.** We find that adding an interbank market can reduce aggregate welfare

---

\(^1\)Outside options are private information of the borrowers and the interest rate on loans is used by the planner to attract the right borrowers.
in the economy. This result is similar to the famous result by Hart (1975) that with incomplete markets opening a new market can decrease welfare. It also resembles a result in Gofman (2014) that with incomplete networks, adding a link between two banks can reduce allocational efficiency. While there is some common pattern to all these results, the intuition is not the same. In our model, adding an interbank market changes banks’ interaction in another market. In a one-shot game they cannot commit to not compete without an interbank market. Even if one bank could commit not to compete, how would this bank benefit from it given that sending cash to a competitor would trigger questions from the regulators? The interbank market provides not only a commitment technology, it is also perfectly suited for sharing profits via the interest rate on the interbank loan.

The paper is also related to work on how to incentivize behavior in one market by linking it to another market. That has been used in the sovereign debt literature by Cole and Kehoe (1998). Chatterjee et al. (2008) use this idea to show that incentives in the insurance market can generate good behavior in the credit market. For example, auto insurers give people with good credit scores a better price than to those with worse scores. The relationship to our paper is that we also have interaction between two distinct markets – a market for interbank loans and a market for business loans. In our model, a bank that provides a loan in the interbank market restricts its lending capacity and therefore provides incentives to the borrowing bank to switch to monopolistic pricing of business loans.

The rest of the paper is organized as follows. In the next section, we present the model. In Section 3, we present the main result of the paper how interbank market can facilitate collusion. We provide policy implications of this result in Section 4. In Section 5, we discuss empirical predictions that can help to test whether interbank trading is used to restrict bank competition. Section 6 concludes.
2 The Model

There are \( m \) markets in the economy. These markets can either capture different geographical locations, in which case a market can be a country or a region, or different business segments, such as small businesses would be one market and large corporations would be another market. There are three types of agents in the economy: a measure \( M \geq 1 \) of risk-neutral entrepreneurs in each market, \( n \) risk-neutral bankers, and a measure \( H \geq 1 \) of risk-averse households. There are two dates in the model: beginning-of-period (BOP) and end-of-period (EOP). Consumption by all agents takes place at the EOP. Next, we provide details about each one of the agents and how they can interact with each other.

Entrepreneurs. In each market, an entrepreneur can invest in a project 1 unit of consumption good at the BOP. A project has two idiosyncratic states of the world at the EOP: success or failure (\( \sigma = \{s, f\} \)). If a project succeeds, it generates a gross return \( R^P > 0 \) (\( \sigma = \{s\} \)) with prob. \( p \) and 0 (\( \sigma = \{f\} \)) with prob. \( 1 - p \), where \( \sigma \) is the state of the project at the EOP. The risk of failure is iid across entrepreneurs. Figure 1 provides a graphic representation of the payoffs.

Figure 1: Project’s Payoffs

\[
\begin{array}{c}
p & R^P \\
1 - p & 0
\end{array}
\]

Entrepreneurs have an outside option of \( \omega \) of EOP goods drawn from a uniform distribution on \([0, M]\). For example, we can interpret this outside option as their utility from leisure. The outside option of each entrepreneur is his private information. The role of the outside option is to generate a downwards sloping demand for bank loans, which we will in-
troduce later. Entrepreneurs do not have own resources so if they want to invest, they need to get resources from other type of agents. We assume limited liability for entrepreneurs, meaning that their consumption cannot be negative.

**Households.** Households have a log utility over consumption and are each endowed with one indivisible unit of goods. At the BOP, some households are randomly matched with bankers, such that a generic banker $i$ is matched with a mass $\overline{D}_i$ of households. $\overline{D} = (\overline{D}_1, ..., \overline{D}_n)$ is a vector of matches for all the bankers. Any matched or unmatched household have access to a risk-free storage technology with a gross rate of return $\overline{R} = 1$.

A household can match with an entrepreneur in market $i$ and offer to lend one unit at BOP in return for an EOP transfer conditional on the outcome of the project. However, given that with $1 - p$ probability a project fails and household’s EOP utility is $\log(0) = -\infty$, direct lending will not happen in the model.

**Bankers.** Bankers do not have own resources. Their sources of funding are deposits and interbank loans. To get deposits, a banker $i$ posts a gross deposit rate $R_i^D$, and households, who were matched to banker $i$, decide whether they want to exchange their unit endowment of consumption good for EOP transfer of $R_i^D$. Let $D_i$ be the mass of households matched to banker $i$ who accept banker $i$’s offer. If households are indifferent, we are going to assume that they accept the offer. Under this assumption, a banker will always set the deposit rate to be equal to the outside option of the household: $R_i^D = \overline{R} = 1$. All households, matched to banker $i$, agree to the offer, resulting in $D_i = \overline{D}_i$ funds available to the banker at the BOF. As we explain below, additional BOP funds are available to a banker if she borrows from other bankers. The interbank loans are junior to bank’s liabilities to households.

Each banker can use available funds in three ways. Banker $i$ can store $A_i$ out of the $D_i$ available funds using the risk-free storage technology with a gross return $\overline{R} = 1$. She can
agree to transfer $B_{i,j}$ of her funds to banker $j$ at the BOP for a promise to receive $F_{j,i}$ at the EOP. The third investment option is to provide funding to entrepreneurs. In particular, banker $i$ can offer to an entrepreneur in any market, call it $j$, one unit of goods at the BOP in exchange to an EOP payment that depends on the outcome of his project. We will describe the optimal contract between a banker and an entrepreneur after we describe the informational frictions that this contract needs to account for.

**Informational Frictions.** The contract cannot discriminate between different entrepreneur in the same market because the outside option of each entrepreneur is his private information. If a banker would provide better terms to entrepreneurs with a higher outside option relative to entrepreneurs with a low outside option, the latter would have an incentive to pretend to be the former. Given that a project requires one unit of investment and cannot be scaled up or down, a banker cannot offer loans of different sizes in an attempt to separate between entrepreneurs with different outside options.

The optimal contract between a banker and an entrepreneur in a given market can condition on the outcome of the project, but this is also a private information of the entrepreneur. Because of the limited liability, an entrepreneur cannot pay back anything if the project fails. Therefore, a payoff needs to take place if the projects succeeds. However, an entrepreneur can report that the project has failed even if it succeeded. As a result, bankers need to monitor projects that they fund. Bankers use a costly state verification (Townsend, 1979) to monitor entrepreneurs. We provide the details of the monitoring technology next.

**Monitoring.** Banker $i$ can verify the outcome of a project in market $j$ at a cost $c_{i,j}$. When we combine the monitoring costs for every $i$ and $j$, we get an $n$ by $m$ matrix $C$, which describes of all verification costs between $n$ bankers and $m$ markets. If $c_{i,j} = \infty$, it means that bank $i$ cannot provide loans to market $j$ because none of them will be repaid.
Depending on the interpretation of a market, it could mean that bank \( i \) does not have a geographical presence in country/region \( j \) or that it does not have an expertise or a license to provide loans to a business segment \( j \).

Matrix \( C \) effectively defines the amount of competition in each market. When only one bank has low monitoring cost in a given market, this bank is effectively a monopolist. When two or more banks have the lowest monitoring cost, the potential competition between the banks is increasing. We write 'potential' because we are going to show that banks can use interbank lending to reduce the effective competition in the market even though there would be a perfect competition without interbank trading.

Given the monitoring cost and the report of an entrepreneur about the outcome of his project, a banker needs to decide when to pay the verification cost and to check whether the entrepreneur is telling the truth. The verification can be random, such that a banker verifies the report only with some probability. Formally, let \( h_{i,j,\hat{\sigma}} \in [0,1] \) be a probability of banker \( i \) to verify reports in market \( j \) when an entrepreneur report state \( \hat{\sigma} \) of the project at the EOP. Each banker can choose a different probability for each market. A verified entrepreneur who is found to lie needs to pay the contracted amount and also suffers an additional loss of \( \epsilon \).

**Timing.** The timing of the model is as follows:

1. Depositors are matched with a banker, receive a deposit offer from her and decide whether to accept the offer or to store resources in the risk-free storage.

2. Banker \( j \) takes deposits, trades with other bankers, makes loans to entrepreneurs, and invests in the risk-free storage technology.

3. Project success or failure is realized \( (\sigma) \).
4. Entrepreneurs make \((\bar{\sigma})\) reports and bankers choose whether to verify the state of the project and with what probability.

5. Entrepreneurs repay to bankers, bankers repay to depositors, and bankers repay interbank loans.

3 Interbank Linkages and Collusion

In this section, we study how interbank lending can help bank to collude in the product market resulting in suboptimal supply of loans to entrepreneurs. We are going to greatly simplify the environment to convey the intuition behind this non-intuitive result. In particular, we are going to assume that there are only two bankers \((n = 2)\) and one market \((m = 1)\). For symmetry assume that both bankers are matched with the same measure of households, \(\bar{D}\). Further, we assume that if all matched households of each of the banks deposit their funds with the banker, it would be sufficient for each banker alone to provide socially optimal amount of loans. In this way, there is no scarcity of resources, so any socially suboptimal level of lending in equilibrium is driven by strategic decisions of the bankers and not but a binding resource constraint. For simplicity, we assume that the cost of monitoring is zero \((c = 0)\) for both bankers. This will guarantee a truthful reporting about the outcome of the project by the entrepreneurs. The qualitative results do not depend on this assumption.

We start by solving the planner’s problem. Then we show that the decentralized solution without interbank trading achieves the same allocation. The surprising result is that opening the interbank market for trade reduces the aggregate welfare in the economy. The decentralized solution with interbank trading increases bankers’ consumption, but reduces entrepreneurs’ consumption even more.
3.1 Planner’s problem

The social planner maximizes expected utility of entrepreneurs, depositors, and bankers subject to resource feasibility, participation and incentive compatibility constraints.

With one market \((m = 1)\) and symmetric monitoring cost \((c = 0)\) imply no interbank transfers between bankers are needed. A planner can transfer funds from each banker to entrepreneurs directly. A need for an interbank transfer at the BOP would exist if one bank had a comparative advantage in monitoring the loans, but lacked the funds needed for socially optimal level of lending.

Given our assumption that resources available to one banker are sufficient for optimal lending, we can reduce the problem to having one banker. The utility of the households matched to the second banker is zero because their funds are not needed for investment, so they are stored at the risk-free rate \(R = 1\), such that their utility is \(log(1) = 0\). Allocating higher consumption to the households is not optimal because of the decreasing marginal utility from consumption. The utility of the second banker is also zero because she is not needed for optimal investment and her endowment is zero. Given that both bankers are risk neutral, the social welfare does not depend on which one of the two bankers intermediates between the households and the entrepreneurs.

Formally, the planner’s problem is to maximize the following objective:
\[
\int_{0}^{M} [1 - 1_\omega] \omega d\omega \\
+ \int_{0}^{M} 1_\omega \left[ p \cdot (R^P - \tau_s) + (1 - p) \cdot (-\tau_f) \right] d\omega \\
+ \int_{0}^{M} 1_\omega \left[ p\tau_s + (1 - p)(\tau_f) \right] d\omega + \left[ D - \int_{0}^{M} 1_\omega d\omega \right] \bar{R} - DR^D \\
+ D\log(R^D) + (\bar{D} - D)\log(\bar{R})
\] (1)

subject to constraints: resource feasibility constraint, participation constraint, and incentive compatibility constraint. We describe the constraints below.

The first line in the planner’s objective represents the utility of entrepreneurs who take their outside option. $1_\omega$ is an indicator function that is equal 1 if a planner decides to fund a project of an entrepreneur whose outside option is $\omega$.

The second line captures the utility of entrepreneurs who receive funding and invest in the project. The expected gross return on the project is $pR^P$, the $\tau_s$ is the transfer from an entrepreneur to the banker when the project succeeds. The $\tau_f$ is the transfer from an entrepreneur to the banker when the project fails. Notice that with the limited liability assumption, this transfer cannot be positive because the project returns zero in this state of the world.

The third line represents the utility of the banker who is chosen by a planner to provide intermediation services. The first term represents the expected payoff from the entrepreneurs. The second term is the payoff on the risk-free assets ($A$), which equal to deposits minus funds used for financing the projects. The last term is the transfer from the banker to the households according to the deposit rate $R^D$, where $D$ represents the measure of households who transferred funds to the banker at the BOP.
The last line computes the utility of the households. The first term captures the utility of the households who deposited funds at the BOP and the second term captures the utility of the households who decided to store their funds at the risk-free storage technology.

Next we define the resource feasibility, the participation constraints and the incentive compatibility constraints.

### 3.1.1 Resource Feasibility

Let $\tau_{\sigma}(\omega)$ be a transfer of an entrepreneur with an outside option $\omega$ to a banker when the state of project is $\sigma$. For all $\omega$, $\sigma$ contingent transfers must satisfy:

$$R^P - \tau_s(\omega) \geq 0 \quad \text{(RF Success)}$$

$$-\tau_f(\omega) \geq 0 \quad \text{(RF Failure)}$$

It means that in case of success, the transfer to a banker cannot exceed the proceeds from the project, and in case of failure, the transfer cannot be positive because there are no resources to transfer.

For the banker, resource feasibility requires:

$$A + \int_0^M 1_\omega d\omega \leq D \leq D \quad \text{(RF BOP)}$$

$$\int_0^M 1_\omega \{p\tau_s(\omega) + (1-p)(-\tau_f(\omega))\} d\omega + \left[D - \int_0^M 1_\omega d\omega\right] \mathcal{R} \geq DR^D \quad \text{(RF EOP)}$$

The resource feasibility constraints include the constraint that the banker has enough resources to make the transfers to the entrepreneurs at the BOP and enough resources to repay fully to depositors at the EOP. The EOP constraint assures that the banker has enough resources at the EOP to transfer to the household the amount promised by the
planner. The calculation relies on the fact that the project risk is idiosyncratic and the banker invests in a pool of projects achieving a perfect diversification of the idiosyncratic risk.

### 3.1.2 Participation Constraints

The planner faces three participation constraints: one for entrepreneurs who receive the funding, one for the banker who provides the funding, and one for households who provide deposits.

The participation constraint for an entrepreneur with an outside option $\omega$ is given by

$$p \cdot (R^P - \tau_s(\omega)) + (1 - p)(-\tau_f(\omega)) \geq \omega \quad \text{(PC ENT)}$$

This constraint states that the expected payoff for an entrepreneur who invests in the project is higher than his outside option.

The participation constraint for the banker is:

$$\int_0^M 1_\omega \{p\tau_s(\omega) + (1 - p)\tau_f(\omega)\} d\omega + \left[ D - \int_0^M 1_\omega d\omega \right] \bar{R} - DR^D \geq 0 \quad \text{(PC BK)}$$

The banker needs to have expected revenues higher than liabilities, otherwise her consumption would be negative. The outside option of the banker is not to intermediate the transaction and to receive a payoff of zero.\(^2\)

\(^2\)Both bankers are equally suited to be an intermediary in this environment so banker’s participation constraint needs to provide her at least zero, but not more than zero, even after she received deposits from the households.
The participation constraint for households is:

\[ \log(R^D) \geq \log(R) \quad \text{(PC HH)} \]

The household needs to receive a deposit rate that is at least as high as the return on the risk-free storage technology.

### 3.1.3 Incentive Compatibility Constraints

The incentives arise in our setting because of the informational frictions. An entrepreneur with a low outside option can pretend that he has a high outside option if that would reduce the required transfer to the banker. An entrepreneur has incentives to report that the project failed and to keep all the proceeds to himself. Therefore, the truthtelling needs to be incentivized either via payoffs or punishment.

Let \( \tau_{\tilde{\omega}}(\tilde{\omega}) \) denote the transfer from an entrepreneur who follows reporting strategy \((\tilde{\omega}, \tilde{\sigma})\) to a banker.

Entrepreneur’s truthtelling about \( \omega \) requires:

\[
p \cdot (R^P - \tau_s(\omega)) + (1 - p) \cdot (-\tau_f(\omega)) \geq \\
p \cdot (R^P - \tau_s(\tilde{\omega})) + (1 - p) \cdot (-\tau_f(\tilde{\omega})), \tilde{\omega} \neq \omega \quad \text{(IC Type)}
\]

Entrepreneur’s truthtelling about \( \sigma \) requires:

\[
R^P - \tau_s(\omega) \geq (1 - h_f)R^P + h_f(R^P - \tau_s(\omega) - \epsilon) \quad \text{(IC Success)}
\]

\[
-\tau_f(\omega) \geq (1 - h_s)(-\tau_s(\omega)) + h_s(-\tau_f(\omega) - \epsilon) \quad \text{(IC Failure)}
\]
where $h_{\sigma}$ is the probability of the verification by a banker if an entrepreneur reports state $\sigma$.

3.1.4 Planner’s Solution

First, we start by simplifying the objective function by noticing that payments between entrepreneurs and a banker are simply transfers. They cancel out of the objective function because both agents are risk-neutral. Of course, they can affect other constraints which impact the objective. Notice that payments between households and a banker ($R^D$) are also transfers, but they do not cancel out of the objective function because households are risk-averse and a banker is risk-neutral.

Second, given that the entrepreneurs are risk-neutral, they care only about the expected payoff and not about the transfer in each state. On the other side, the state-contingent transfers are important for the incentive compatibility constraint because they change the incentives to misreport the outcome of the project. The feasibility constraint states that $\tau_f(\omega)$ cannot be positive. For any $\omega$, as the $\tau_f(\omega)$ becomes more negative, the higher is the incentive to lie about the state of the project. Therefore, the planner would set $\tau_f(\omega) = 0$ for all $\omega$ to reduce incentives to lie that the project failed.

Third, given that the investment in the project is not scalable, a banker cannot use investment quantity as part of the mechanism. The mechanism is restricted to EOP transfers for one unit of investment at the BOP. If the transfers were to depend on the unobservable type ($\omega$), entrepreneurs would always report a type that minimizes the transfer. Therefore, to get truthful reporting, the planner needs to set the transfer not to depend on type. The incentive compatibility constraint (IC Type) for revealing the true $\omega$ is satisfied if $\tau_\sigma$ does not depend on $\omega$.

If $\tau_s$ is independent of $\omega$ and $\tau_f = 0$, then the left hand side of (PC ENT) is independent
of $\omega$, while the right hand side is an increasing function of $\omega$, so there is a single crossing point $\omega^{SP} \in [0, M]$ such that

$$p \cdot (R^P - \tau_s) = \omega^{SP}$$

(2)

and for all $\omega \leq \omega^{SP}$, we have $1_\omega(\sigma) = 1$ while $\omega > \omega^{SP}$ we have $1_\omega(\sigma) = 0$. All entrepreneurs with $\omega > \omega^{SB}$ will not invest and all entrepreneurs with $\omega < \omega^{SB}$ will invest. We can use this threshold property of the optimal contract to simplify the objective function. Specifically, instead of the indicator function $1_\omega$, which indicated for each entrepreneur whether he gets funding or not, now we have two groups of entrepreneurs: those below the threshold outside option and those above the threshold.

From equation 2, we can compute $\tau_s$ as a function of $\omega^{SP}$ that the planner chooses.

$$\tau_s = R^P - \frac{\omega^{SP}}{p}$$

(3)

Lastly, given the assumption that $c = 0$, the planner will choose that the banker monitors the entrepreneur who reports a failed project with probability $h_f = 1$. There is no need to monitor if the report is that the project succeeded, so $h_s = 0$. This monitoring strategy assures that both IC constraints (IC Success and IC Failure) are satisfied with inequality and are not binding.

We simplified the problem of the planner to choose $R^D$, $\tau_s$ and $\omega^{SB}$. Using the threshold property, and canceling transfers we can write the objective as

$$\int_{\omega^{SP}}^{M} \omega d\omega + \int_{0}^{\omega^{SP}} \left[p \cdot R^P\right] d\omega + \left[D - \int_{0}^{\omega^{SP}} d\omega\right] R - D R^D + D \log(R^D) + (D - D) \log(R).$$

(4)

We start with analysis of the optimal $R^D$. To satisfy households’ participation constraint

\footnote{We assume that $R^P$ is such that the crossing point does not exceed $M$.}
$R^D$ should be at least equal to the risk-free return. The planner will not want to set $R^D$ higher than $\overline{R}$ because households’ marginal utility from consumption is decreasing so any surplus transfer from a banker to a household results in a reduction in the aggregate welfare. It is easy to see it when we differentiate the objective function with respect to $R^D$: 

$$-D + \frac{D}{R^D} = 0.$$ 

Solving for optimal $R^D$, without accounting for constraints, we get that the planner would want to set $R^D = 1$, which is the same as the risk-free return $\overline{R}$. Bankers play a role of intermediaries in the model because they are able to diversify idiosyncratic risk and offer risk-free deposits to risk-averse households like in Diamond (1984).

This optimal choice of the deposit rate might not be feasible because of the constraints. $R^D$ enters only participation constraints of the households and the banker. The participation constraint of households is satisfied with equality when $R^D = \overline{R}$ because of the assumption that $\overline{R} = 1$.\footnote{If the return on the risk-free technology was above 1, the planner would set $R^D = \overline{R}$ because the participation constraint would be binding.} The participation constraint of the banker is not binding when $R^D = \overline{R}$ because the banker also has access to the risk-free storage technology.

For $R^D = \overline{R} = 1$, households are indifferent between storing their endowment at the risk-free storage technology or providing the funds to banker as a deposit, so according to our assumption they make the deposit at the offered rate. Therefore, $D = \overline{D}$, meaning that resources of all matched households become available to the banker. We assume that these funds are sufficient to provide socially optimal investment, therefore the feasibility constraint (RF BOP) is not binding.\footnote{Our goal is to show that bankers undersupply loans in the decentralized economy. If both the planner’s solution and the decentralized solution undersupply loans because banker’s resources are limited, it would not be surprising.}

Next we solve for the optimal level of investment in the projects. We simplify the
objective function 4 further by dropping constants:

\[-\left(\frac{\omega^{SP}}{2}\right)^2 + pR^P \omega^{SP} - \overline{R} \omega^{SP}.\]  

(5)

The objective is strictly concave in \(\omega^{SB}\) (due to the presence of the negative quadratic term). Intuitively, the entrepreneur’s outside option is part of the marginal cost of making a loan and which is increasing.\(^6\) The first order condition with respect to \(\omega^{SP}\) is given by

\[-\omega^{SP} + pR^P - \overline{R} = 0\]  

(6)

The FOC states that at the optimal amount of funds provided for projects, the marginal benefit of higher investment \((pR^P)\) is equal to the marginal cost of taking the project: the opportunity cost of the entrepreneur \((\omega^{SP})\) and of the funds \((\overline{R})\). As we noticed earlier, \(\omega^{SP}\) is both the quantity of loans provided and the price of investing in the marginal project and foregoing the outside option.

Given our assumption that this a sufficient amount of deposits to fund loans, we can solve (6) for \(\omega^{SP}\):

\[\omega^{SP} = pR^P - \overline{R}.\]  

(7)

Now we can substitute (7) in (3) to compute the optimal transfer from the borrower to the banker if the project succeeds:

\[\tau_s = \frac{\overline{R}}{p}.\]  

(8)

This transfer makes the entrepreneur with \(\omega^{SP}\) outside option indifferent between investing or not. All entrepreneurs with \(\omega < \omega^{SP}\) have a strictly positive utility from investing. The

\(^6\)The marginal cost to provide a loan from the social planner’s perspective is constant.
banker is compensated for not using the risk-free technology, but her utility is zero because all the transfers from entrepreneurs are paid back to the depositors. Despite zero profits to the banker, the participation constraint (PC BK) and the EOP resource feasibility (RF EOP) are satisfied given the solution for \( \omega^{SP} \) and \( \tau_s \).

We need to ensure that the optimal provision of loans does not exceed the feasible number of projects. That results in an upper bound on \( R^P \):

\[
\omega^{SP} = pR^P - \overline{R} \leq M \iff R^P \leq \frac{M + \overline{R}}{p}.
\]  

(9)

The total surplus achieved by the planner’s allocation is:

\[
\int_{\omega^{SP}}^{M} \omega d\omega + \int_{0}^{\omega^{SP}} \left[ p \cdot R^P - \overline{R} \right] d\omega + D \left( \overline{R} - R^D \right) + D \log(R^D)
\]

Substituting \( \omega^{SP} = pR^P - \overline{R}, R^D = \overline{R} = 1 \) we get:

\[
\frac{M^2}{2} + \frac{(pR^P - \overline{R})^2}{2}
\]

(TS Social Planner)

Relative to an autarky, the total utility increases by \( \frac{(pR^P - \overline{R})^2}{2} \). The aggregate utility in autarky is \( \int_{0}^{M} \omega d\omega = \frac{M^2}{2} \).

The distribution of surplus in the planner’s solution is such that entrepreneurs receive all the surplus from investment. The banker does not receive any transfer under planner’s solution. Households receive transfers that only compensate them for their outside option.
Next, we solve for the decentralized allocations without interbank market.

3.2 Decentralized Economy without Interbank Trading

In the decentralized economy, bankers compete in prices for providing loans to entrepreneurs. Bank \( i \) makes loans at the BOP by choosing rate \( R_i \) to be repaid if the project succeeds. If the project fails, the entrepreneur needs to pay 0 because of the limited liability. A negative payment (insurance) in the state of project failure would provide more incentives to misreport, but would not provide any benefit because entrepreneurs are risk neutral.

The interest rate on the loans does not depend on the outside option (\( \omega \)) because outside options are private information. If a banker would provide a menu of repayment options as a function of \( \omega \), entrepreneurs would pick the cheapest option and misreport their type. Therefore, as is in the planner’s solution, optimal contracts in the decentralized solution are not contingent on the unobservable type.

Definition 1. Equilibrium without Interbank Trading

- Bankers choose \( R_i^D \), then \( R_i \) and \( A_i \) at the BOP and \( h_{\sigma,i} \) at the EOP to maximize their consumption (profits).

- Households matched with a banker \( i \) choose optimally between depositing resources with the banker for \( R_i^D \) or investing in a risk-free storage technology with a return \( \overline{R} \).

- At the BOP, entrepreneurs choose optimally between borrowing from the banker who offers the lowest rate or pursuing their outside options. At the EOP, entrepreneurs who borrowed decide on their report to the banker about the outcome of their project.

- Market for loans clears.
In the market for deposits, we assume that bankers post deposit rates and households decide whether to accept them or not. Effectively, bankers have a full bargaining power and are able to extract full surplus by offering a rate $R_1^D = R_2^D = \overline{D} = 1$. Households are indifferent, so they deposit their funds with the banker, such that $D_1 = \overline{D}_1$ and $D_2 = \overline{D}_2$. The assumption behind this result is that bankers can commit to pay the deposit rate that they promised. This is a natural assumption given that our goal is to compare the planner’s solution to the decentralized solution, and we assumed that the planner can commit to pay depositors $R^D$.

We maintain the assumption that $\overline{D}_1 = \overline{D}_2 \geq \omega^{SP}$ for both banks. It means that each banker matches with enough households to be able to provide planner’s level of investment in the project. This assumption is important because it results in a classic case of Bertrand competition without capacity constraints. As we show next, the competition will result in zero profits to bankers and the decentralized level of investment will be the same as the planner’s. This result will change once we open interbank market for trade in subsection (3.3).

The ex-post optimal monitoring decision in the decentralized solution is the same as in the planner’s solution. With $c_1 = c_2 = 0$, both banks will verify project’s outcome if a borrower reports a failed project. Given this verification strategy, borrowers will truthfully report failure. They do not have incentives to report success when the project fails because it will make them pay back the loan. They will not report failure when the project succeeds because they will be verified and found to be lying, requiring them to repay the loan and to suffer an additional cost $\epsilon$.

The allocations at the market for loans to entrepreneurs depend on the prices bankers charge. These prices will crucially affect the total surplus generated in the decentralized economy.
Bank $i$’s problem is to choose $R_i$ to maximize expected EOP profits. Bankers supply loans to meet demand for loans that they face given prices ($R_i, R_{-i}$).

Bank $i$’s maximization problem is:

$$\max \left\{ [pR_i] \ell_i + DA_i - RD_i, 0 \right\}. \quad (10)$$

where $\ell_i$ is the supply of loans by banker $i$. The BOP balance sheet identity for bank $i$ is

$$A_i = D_i - \ell_i \quad (11)$$

Funds that were not invested in projects ($A_i$) are stored by the bankers in the risk-free storage technology.

Market clearing for $i = \{1, 2\}$ requires:

$$\ell_i = L_i^d \quad (12)$$

where $L_i^d$ is demand for loans provided by banker $i$.

The borrower’s problem is, given his realization of $\omega$, to decide whether to borrow or choose the outside option and if to borrow, from whom. A borrower of type $\omega$ chooses to take out a loan if and only if

$$p \cdot (R^P - \min\{R_i, R_{-i}\}) \geq \omega. \quad (13)$$

Hence all borrowers with $\omega \leq \omega_i^* = p \cdot (R^P - \min\{R_i, R_{-i}\})$ would want to invest, the loan
demand from banker $i$ is given by

$$L_i^d = \begin{cases} 
0 & \text{if } R_i > R_{-i} \\
p \cdot (R^P - R_i) & \text{if } R_i < R_{-i} \\
p \cdot (R^P - R_i) / 2 & \text{if } R_i = R_{-i}
\end{cases} \quad (14)$$

In that case, bank $i$ should choose $R_i \in [\frac{R}{p}, R_{-i}]$. Both banks have the same marginal cost of providing loans and they have enough lending capacity to meet demand of the whole market. Unique Nash equilibrium in pure strategies is:

$$R_i^* = \frac{\bar{R}}{p} \text{ for } i = \{1, 2\}. \quad (15)$$

When both bankers charge this rate, no banker has can reduce it any further because it would lead to a loss. Increasing the rate would just result that the other bank provides all the loans.

At the equilibrium rate, the aggregate demand for loans is given by

$$L^d = \int_0^{\omega_1^*} d\omega = \omega_i^* = p \cdot \left( R^P - \frac{\bar{R}}{p} \right). \quad (16)$$

Each banker’s demand is half of the aggregate demand (the bankers split the market). Both bankers make zero profits at this rate.

We conclude that the decentralized equilibrium without interbank trading results in the same allocations and the same total surplus as in the planner’s problem. We study the effect of the interbank market on the allocations and total surplus in next subsection.
3.3 Decentralized Economy with Interbank Trading

If bankers can trade prior to deciding on the prices for loans, it can change the allocations. Interbank trading changes bankers’ lending capacities as they move funds between them. In terms of the timing, bankers first make an offer to households and collect the deposits, then they decide about the interbank loan, then they compete for loans to entrepreneurs by setting prices, once the loans to entrepreneurs has been made, the bankers deposit remaining funds in the risk-free storage technology.

Let $B$ be a loan from banker 1 to banker 2 at the BOP, and $F$ is the EOP repayment from banker 2 to banker 1. Interbank loans are junior relative to deposits. If $B > 0$ and $F > 0$, it means banker 1 is the lender and banker 2 is the borrower in the interbank market. If $B < 0$ and $F < 0$ it means banker 2 is the lender and banker 1 is the borrower.

The definition of equilibrium with interbank trading is:

**Definition 2. Equilibrium with Interbank market**

- Bankers maximize their profits by choosing deposits rate ($R^D$), lending rate ($R_i$), $B$, $F$ and $A_i$. Bankers choose optimally interbank loan ($B$) that maximizes their profits. The repayment of interbank loan ($F$) is an outcome of Kalai bargaining between the bankers.

- Depositors choose optimally between depositing money with a banker or keeping it at the risk-free rate ($\bar{R}$).

- Entrepreneurs choose optimally between borrowing at rate lowest rate offered or pursuing their outside options.

- The market for loans to entrepreneurs clears
Interbank loans market clears

Interbank loans change the resource feasibility constraint of the bankers, as well as their participation constraint and profits. The IC and PC constraints of the entrepreneurship and the PC constraint of the households do not change.

Bank $i$’s problem is to choose $R^D_i$, $R_i$, $B$, and $F$ to maximize expected EOP profits subject to limited liability and bargaining to solve

$$
\max \left\{ \left[ pR_i \ell + RA_i + \tau_i B - \tau_j F - RD_i \right], 0 \right\}.
$$

where

$$
\tau_i = \begin{cases} 
-1 & \text{if } i = 1 \\
1 & \text{if } i = 2
\end{cases}
$$

The beginning of period balance sheet identity for bank $i$ is

$$
\ell_i + A_i + \tau_i B - D_i = 0
$$

Market clearing requires

$$
\ell_i = L^d_i
$$

where $L^d_i$ denotes the demand for loans offered by bank $i$ and it is defined in equation (14).

Households’ problem is similar to the one in the previous subsection. They will agree to provide funds to the banker if $R^D \geq \overline{R}$. The banker will set $R^D$ to be equal to $\overline{R} = 1$. It guarantees that $D_i = \overline{D}_i$ for both bankers.

To determine $B$ and $F$, we proceed as follows. First, we will solve for $B$ that maximizes the joint profits of the bankers. Then we will solve for $F$ given $B$. 
The joint profits of the bankers are when there is no competition and one of the bankers is a monopolist. Any level of competition will reduce the joint profits. Without loss of generality, assume that banker 2 is the monopolist in the market for loans. So the key question is what level of \( B > 0 \) would assure that banker 2 is the monopolist. If banker 1 does not have resources to lend to entrepreneurs, then banker 2 will be a monopolist. Banker 1 has \( D = \bar{D} \) level of deposits. Therefore, \( B = D \) maximizes the joint profits of two bankers. With this loan, banker 2 has \( 2D = 2\bar{D} \) funds to lend to entrepreneurs and banker 1 has zero.

The next step is to compute the optimal level of lending by banker 2 and the amount of monopolistic profits (\( \pi^M \)) that this level of investment generates. The repayment of the loan (\( F \)) by banker 2 to banker 1 depends on (\( \pi^M \)). Without the loan (\( B = 0 \)), both banks compete and receive zero profits as we saw in the previous subsection. With the loan (\( B = D \)), they jointly generate the monopolistic profit \( \pi^M \), collected by banker 2. Therefore, the surplus from trade (joint profits minus outside options) is equal to \( \pi^D \). Assuming banker 1’s bargaining power is \( \theta \in [0,1] \), \( F = B + \theta \frac{\pi^M}{2} \), which means that the “interest” on the interbank loan reflects part of the profit generated by the lack of competition. Conceptually, banker 1 commits not to compete with banker 2 by lending her the available resources. With restricted lending capacity, the competition disappears and both bankers benefit.

Next, we calculate \( \pi^M \) by solving the problem of banker 2 when she is a monopolist with \( 2\bar{D} \) funds to be allocated between loans and the risk-free storage. Given our assumption that \( \bar{D} \geq \omega^{SP} \), it is obvious that the addition funds from banker 1 are not needed to provide the optimal level of investment. These funds are deposited at the risk-free storage by banker 2. What part of her own deposits she wants to put in the risk-free storage depends on the loans to entrepreneurs. Banker 2 chooses \( R_2 \) to maximize:
\[
\max \left\{ [pR_2] \ell_2 + \overline{R}(D - \ell_2) - \overline{R}D \right\}.
\]

where \( \ell_2 \) is the supply of loans to entrepreneurs.

The demand for loans is determined by the entrepreneurs’ decision between investing and the outside option. An entrepreneur of type \( \omega \) chooses to take out a loan from banker 2 if and only if

\[
p \cdot (R^P - R_2) \geq \omega.
\]

Hence all entrepreneurs with \( \omega \leq \omega^*_i = p \cdot (R^P - R_2) \) demand for loans from banker 2 is given by

\[
L^d_2 = p \cdot (R^P - R_2)
\]

Notice, the demand is decreasing with the interest on the loan.

Market clearing requires: \( \ell_2 = L^D_2 \).

Now, we can express \( R_2 \) as a function of \( \ell_2 \). Rearranging, \( \ell_2 = p \cdot (R^P - R_2) \), we get \( R_2 = R^P - \frac{\ell_2}{p} \). Next, we substitute it into banker’s optimization problem (17) and after dropping constants we get:

\[
\max \left\{ [pR_P - \ell_2] \ell_2 - \overline{R}\ell_2 \right\}.
\]

The FOC with respect to \( \ell_2 \) gives us:

\[
[pR_P - 2\ell_2] - \overline{R} = 0
\]

From that we get:

\[
\ell^*_2 = \frac{pR_P - \overline{R}}{2}
\]
Now, we can compute the loan rate that results in this level of lending.

\[ R_2^* = \frac{R_P + \overline{R}/p}{2} \quad (23) \]

Several observations about the above solution. First, the monopolistic level of loan provision is half of the provision by the social planner. A monopolist rations the supply of loans to increase the price. Banker 2 has enough deposits to provide planner’s level of investment in the projects, but that level results in zero profits to the banker. So banker 2 provides \( \ell_2^* \) loans and the remaining deposits \( (A_2 = D - \ell_2^*) \) she stores in the risk-free storage.

Second, the interest rate on the loans is larger than in the planner’s solution \( (R_2^* > \overline{R}_2) \). The expected return on a loan in the planner’s solution is just the risk-free return. The expected return on a loan provided by a monopolist is \( \frac{pR_P + \overline{R}}{2} > \overline{R} \). With this per loan expected return, the profit from lending is:

\[ \pi^M = \frac{(pR_P - \overline{R})^2}{2} \quad (24) \]

Then, the repayment of the interbank loan is:

\[ F = B + \theta \pi^M = D + \theta \frac{(pR_P - \overline{R})^2}{2} \quad (25) \]

The total surplus in the decentralized solution with interbank trading is given by

\[ \int_{\ell_2^*}^{M} \omega d\omega + \int_{0}^{\ell_2^*} [p \cdot R_P - \overline{R}] d\omega \quad (26) \]
Substituting $\ell_2^* = \frac{pR - R}{2}$ we get:

$$\frac{M^2}{2} + \frac{3(pR^P - \bar{R})^2}{8}$$

(27)

The welfare loss from the lack of competition is defined as the difference between the total surplus achieved by the planner and that of a decentralized market. This is also the loss from opening the interbank market because the decentralized solution without interbank trading achieves the same level of total surplus as in the planner's solution.

The welfare loss is:

$$\frac{M^2}{2} + \frac{(pR^P - \bar{R})^2}{2} - \left( \frac{M^2}{2} + \frac{3(pR^P - \bar{R})^2}{8} \right) = \frac{(pR^P - \bar{R})^2}{8}$$

(28)

The welfare loss is larger if projects have higher expected return and lower opportunity cost. The intuition for this result is as follows. When banks collude using the interbank market, they ration out the provision of loans. Therefore, the welfare loss from this rationing depends on the surplus created by the loans. When the surplus is high, the welfare loss is high as well.

Despite the fact that interbank market reduces aggregate welfare, the decentralized equilibrium with interbank market is still higher than in autarky. In the autarky, the aggregate utility is $\frac{M^2}{2}$. The decentralized economy with interbank trading increases it by $\frac{3(pR^P - \bar{R})^2}{8}$.

### 4 Policy Implications

The analysis in the previous section sheds light on the dark side of interbank trading. The existing policy focuses on interbank linkages as potential facilitators of financial con-
tagion. If one bank fails, it can cause its trading partners to fail as well. As a result, a number of policies were introduced to limit the risk of contagion. First, capital and liquidity requirements forced banks to improve their ability to absorb a failure of a counterparty. Second, limitations were put into place to restrict an exposure to a single counterparty. Third, some type of interbank transactions were novated to central counterparty (CCPs). In general, regulation implicitly assumes that interbank trading is needed for efficient allocation of resources in the economy, but the same trading increases fragility of the banking system. After the financial crisis, regulators around the world expressed preference towards higher stability, presumably sacrificing some efficiency.

Our main insight is to show that the trade-off between efficiency and stability is not fundamental. We provide a simple example where reducing interbank market actually reduces welfare. If the situation we describe is prevalent in the real markets, it means that restricting interbank trading can not only improve stability, but also can increase efficiency.

The policy implication of our model is that welfare benefits of interbank trading should not be taken for granted, specially when two banks are competitors. At the same time, our result should not be used as a justification to ban interbank lending all together. While in the model parametrization we used this would be welfare improving, another parametrization would show that interbank loans are welfare improving.\footnote{If $c_1 = 0$, $c_2 = \infty$, $D_1 = 0$ and $D_2 > 0$, an interbank loan from banker 2 to banker 1 would improve welfare because banker 1 can monitor loans but does not have deposits, while banker 2 has deposits, but cannot monitor the loans.} In reality, some of the interbank lending can be welfare improving and some is not. The model is too stylized to quantify what percent of the hundreds of billions of dollars in interbank trades is due to collusion. However, given the enormous size of global and local interbank markets, even a small fraction of loans used to reduce competition could amount to a non-negligible welfare losses.

\[32\]
Our model also speaks to the benefits of the usury laws that limit the interest rate on business loans and lines of credit. The majority of states in US have some type of usury laws in place. The limits can depend on the type of a financial institution and on the type of the loan. The maximum interest caps also differ across the states. In the model, the interest rate on the loans to entrepreneurs is higher in the decentralized economy with interbank markets than in the planner’s solution. The planner’s solution tells us what usury law would increase the total welfare. Specifically, if the cap on the lending rate was \( \frac{R}{p} \), then the decentralized solution would be the same as the planner’s solution even with interbank market open.

Lastly, we would like to discuss the importance of the objective function used by the planner for deriving optimal policies. We assumed that the planner maximizes the aggregate welfare in the economy by summing up utilities of all the agents. The planner’s solution is just one point on the Pareto frontier. The decentralized solution is another point on the frontier. It means that any policy used to push the economy towards the planner’s solution is not Pareto improving. Such policy would be reduce utility of the bankers and increase utility of the entrepreneurs. While the net effect of such policy is positive, there is no set of transfers that would allow to compensate the bankers for the lost profits. If such transfers would exist, they have to come from entrepreneurs with project that succeeded, because entrepreneurs with failed projects have zero resources and households’ participation constraint is already binding. However, any extra charge of successful entrepreneurs affects the demand for loans because more entrepreneurs take their outside option when facing additional charges.
5 Empirical Predictions

In this section, we discuss empirical predictions generated by the model. The first prediction is about the probability of trade between a pair of banks. In the model, we analyzed a pair of identical banks. They have the same monitoring technology, which can be interpreted as having branches in the same geographical locations. The model suggests that more similar banks are more likely to trade in order to reduce competition. Heterogeneous banks are more likely to trade in order to allocate resources efficiently. Heterogeneous banks could be banks located at different locations and, as such, having different monitoring costs. For example, one bank having high levels of deposits, but also high monitoring costs. Another bank has low monitoring costs, but lacks the funds. A loan from the first bank to the second is welfare increasing.

A number of papers have found a strong correlation between the probability of trade in the interbank market and the geographical proximity between the banks. For the Fed funds market, Bech and Atalay (2010) find that the trade flows between banks in the same district are 165% higher than between banks in two non-neighboring districts. Similarly, Afonso et al. (2014) find that banks are 20 times more likely to trade in the Fed funds market with banks in the same state. Moreover, they find that banks of similar size are more likely to trade. These findings are consistent with our prediction that more similar banks are more likely to trade. There are also alternative explanations for these findings. Maybe banks that are geographically close find it easier to monitor counterparties, especially for unsecured loans. Our explanation does not depend on the counterparty risk, so it would apply to collateralized loans as well.

Our second prediction is about the sensitivity of lending to interbank borrowing. If banks borrow money in the interbank market in order to provide loans, we should expect
a high sensitivity of business lending to interbank borrowing. In our model, the borrower in the interbank market does not use the funds for lending. If interbank loans are used as a commitment device to collude, we should not see an increase in bank’s lending when it borrowers from another bank, especially if the two banks are likely to be competitors. To the best of our knowledge, this prediction has not been tested yet in the data.

6 Conclusion

Banks compete with each other in the markets for business loans, mortgages, etc. Banks also provide loans to each other. We build the simplest possible model (with two banks and one loan market) to show how interbank trading can reduce interbank competition.

First, we solve a planner’s problem to create a benchmark allocation that achieves the largest aggregate surplus. We use a mechanism design approach to solve for the optimal allocation of resources given incentive compatibility, resource feasibility and participation constraints.

We show that a decentralized equilibrium without interbank trading achieves the same allocations as the planner’s solution. Price competition between bankers drives their profits to zero. We then extend the model to allow for interbank loans. The main result of the paper is to show that trade in the interbank market can be used to help bankers collude in the loan market. As a result, aggregate welfare in the economy with an interbank market can be smaller than without the interbank market. This is a surprising result because we would expect that opening more opportunities to trade would help banks to allocate liquidity more efficiently, so it should not reduce welfare. The intuition for this result is that the interbank market helps banks to commit not to compete in the market for loans. When one competitor provides an interbank loan to another competitor, it limits its capacity to
compete in the loan market. Once the borrower becomes the only bank with resources, it sets a monopolistic level of lending that maximizes its profits. The monopolistic profits can then be split between the banks. The interest on the interbank loan can then be used to compensate the interbank lender.

This result has a number of policy implications. First, it implies that putting restrictions on interbank exposures might not only improve financial stability, the usual argument for such regulation, but also it can induce bank competition leading to increased lending and welfare. While the benefits of interbank lending, as a mechanism to allocate liquidity efficiently, are relatively well understood, we encourage policy makers to be open to the possibility that not all interbank lending is beneficial. Second, our model provides justification for usury laws that put limitations on the interest rate charged by lenders. If interbank trading is restricted, usury laws will not be binding because bank competition drives the rates down. If interbank trading is allowed, usury laws could be an effective policy to avoid collusion. The benefit of usury laws over restrictions on interbank lending are that interbank trading could be used for welfare-increasing trades between banks with excess funds to banks with investment opportunities. It is difficult for regulators to trace down the motives behind each interbank loan. The downside of the usury laws is that the optimal cap depends on the availability of resources. With low levels of deposits, the cap should increase. Setting a constant cap can result in either an undersupply of loans or in supply of inefficient loans.

While it is difficult to identify which interbank loans are made to reduce competition, we propose a number of empirical moments that are consistent with the use of interbank markets for collusion. The fact that banks that are geographically close to each other are more likely to trade is consistent with our model’s predictions. We propose to test the sensitivity of lending to interbank borrowing. If banks do not increase lending when
they borrow, it could mean that the loan was used by the lender as a commitment not to compete with the borrower in the market for loans.

Overall, we present what we believe to be the simplest model environment for which interbank trade can be used for collusion. With only one market for loans, one of the banks does not make any loans in order to provide interbank funds to its competitor in order to share in the monopolistic profits. If we were to allow for more than one loan market, we could generate lending by both banks. For example, if one bank can efficiently monitor loans in the east region and another bank in the west region, then both banks would be lending in equilibrium. If the first bank could monitor both in the east and in the west, then we could get a case of collusion via interbank trading together with a positive level of investment by both banks.

References


