Collateral pledging in the credit market

Diego Ciccia

Abstract

This paper* presents a simple model of moral hazard in the loan market. Specifically, I analyze and compare the cases of a single monopoly bank and many competitive lenders as loan providers. I derive optimal loan quantities and collateral requirements. I show that collateralization and credit market concentration are negatively related. Namely, a monopoly bank supplies unsecured debt, whereas competitive lenders may impose collateral requirements. I also show that a monopoly bank does not require collateral regardless of loan size. Conversely, there exists a threshold in competitive loan markets above which lenders supply only secured credit. I test the prediction that collateral and concentration are negatively related using archival data of Italian commercial and pledge banks' yearly financial reports. I present evidence of a discontinuity in market concentration of commercial banks after the 1936 banking law and I estimate the consequent change in collateral. I find that the increase of collateral in commercial banks after 1936 relative to pledge banks is statistically significant. I also test for dynamic effects and address potential limitations deriving from the use of financial reports as data source†.

Keywords: Credit markets, debt contracts, imperfect information.

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† I uploaded a Stata replication package to a GitHub repository (https://github.com/DiegoCiccia/WSReplication). The package includes a script that replicates all the tables and figures from the empirical section of this paper and a dataset from the *Archivio Storico del Credito Italiano*. I am thankful to Paolo Piselli and the Statistical Office of Bank of Italy for giving me permission to upload the dataset.

1 Introduction

Secured credit is a pervasive instrument of corporate and business finance (La Porta et al., 1998; Berger and Udell, 1990; Banerjee and Blickle, 2016). Nonetheless, collateral requirements are likely to differ depending on the characteristics of borrowers, lenders and credit markets (Rahman et al., 2017). Several factors could affect their presence and size in credit contracts (Jimenez et al., 2006b): macroeconomic conditions (business cycle, institutional background), borrower-related features (credit quality, age, ownership, management), lender-related features (type, location, specialization), characteristics of the borrower-lender relationship (duration, scope), loan features (size, type) and credit market conditions. This paper builds on the last category and focuses on market concentration as a determinant of collateral.

I present a theoretical model that investigates how the structure of the loan market affects the likelihood of secured credit. Specifically, I argue that collateral requirements are decreasing in market concentration. Besanko and Thakor (1987) were the first to point out that banks acting as price-setting monopolists could supply unsecured credit, while competitive lenders resort to collateralized debt. I differ from them in that I consider a model of the credit market under asymmetric information where potential borrowers are not different in terms of their *ex ante* credit risk. Entrepreneurs are endowed with some collateralizable wealth and apply for secured debt to start up a business venture. The project output depends on the funds acquired and effort exerted by the borrower, which is not observable nor negotiable by banks. When borrowers exert high (low) effort, lenders earn a net positive (negative) return from financing the project. Effort choice is affected by contractual terms, as in mainstream models of the credit market under moral hazard (Aghion and Bolton, 1997; Ghosh et al., 2000). I analyze this setting under two opposite market structures. Firstly, I take the case of a single institution supplying credit, then I shift to several lenders competing for loans. In the first case, the banking market is called "monopolistic", in the second, "competitive". I derive equilibria in both cases. I show that lenders set minimum collateral requirements in a monopolistic loan market. In particular, borrowers secure non-collateralized credit independently of loan size and starting wealth. Conversely, I demonstrate that there exists a loan size threshold in perfectly competitive markets above which collateral is required.

I take the prediction of a negative relation between the use of collateral and concentration to the data. I use financial reports from Natoli et al. (2016) to estimate a simple DiD model. I focus on commercial and pledge banks and exploit the discontinuity in market concentration experienced by the former after the 1936 banking law to estimate the corresponding change in collateral accounted in yearly reports. I find that the concentration of commercial banks has significantly decreased after 1936, while collateral has significantly increased relative to pledge banks. I also test for long run effects of this policy and address potential limitations.

The importance of collateral in loan contracts is backed by suggestive credit market statistics. Berger and Udell (1990) report that almost 70% of U.S. commercial and industrial loans are collateralized. According to Black et al. (1996), collateral requirements exceed the amount of financing in roughly 85% of UK business loans. Banerjee and Blickle (2016) report that 62% of Spanish, French and Italian respondents to the ECB *Survey on the Access to Finance of Enterprises* (SAFE) have posted collateral on their latest credit application[1]. In the 1993 edition of the U.S. *National Survey of Small Business Finances* (NSSBF), more than 63% of respondents reported that they have pledged real estate, equipment, inventory or other assets to access credit lines. Interestingly, 14% of respondents who applied for credit and were denied reported that they have been turned down due to insufficient collateral.

The use of collateral in credit contracts is related to its multifaceted nature. Firstly, collateral mitigates the cost of debt due to the reduction of agency costs (Jensen and Meckling, 1976). The prospect of default prevents borrowers from shifting collateralized loans to riskier projects, hence the likelihood of asset substitution is reduced. Secondly, collateral requirements are effective screening instruments (Bester, 1985; Besanko and Thakor, 1987). Borrowers with high probability of default find it costly to pledge collateral in exchange for a lower interest rate, which allows imperfectly informed lenders to distinguish safe from risky projects[2]. Lastly, financing through secured debt may affect positively the market value of equity (Scott, 1977). Secured creditors have high-ranked claims over pledges assets, which means that other claimants may be unable to enforce their rights upon bankruptcy. If most assets are pledged as collateral, the probability that bankruptcy costs will be effectively paid is low. This constitutes a benefit for shareholders, which are able to limit the outflow of wealth to unsecured creditors.

While the widespread use of secured debt is explained by many models and supported by empirical evidence, the relation between market power and collateral remains quite a divisive topic (Steijvers et al., 2010). Some empirical studies support the hypothesis that market power increases the likelihood of collateralization (Hainz et al., 2013; Rahman et al., 2017), while others suggest polar opposite results (Harhoff and Körting, 1998; Chakraborty and Hu, 2006; Jimenez et al., 2006a,b; Hanedar et al., 2014). Uncertainty about the concentration-collateral nexus is partially attributable to differences in data sources and identification strategies to measure market power. Hainz et al. (2013) use *Dealscan* data and show that the likelihood of secured debt increases with the degree of banking concentration, as measured by the Lerner index. They also perform robustness checks using the national asset share of the three biggest banks as a measure of competition[3] and obtain similar results. Rahman et al. (2017) use credit data from the 2012-14 World Bank *Business Environment and Enterprise Performance Survey* (BEEPS) to examine collateral requirements of Central European Small Medium Enterprises (SMEs). They show that collateralization is increasing in market concentration as measured by asset share of the three main national banks. Interestingly, no effect is found when competition is proxied by the number of bank branches per 100,000 adults. Hanedar et al. (2014) use 2002-2005 BEEPS data and focus on SMEs from less-developed countries and transition

[1] It is worthwhile to notice that this figure refers to businesses with less than 50 employees, while only 46% of larger firms reported that collateral was required in their last financing application. This gap is consistent with theoretical contributions (Chan and Kanatas, 1985) and empirical studies (Dennis et al., 2000) showing that firm size and collateralization are inversely related.

[2] If collateral is used as a screening device, safe borrowers end up pledging more collateral. However, secured debt may generate adverse selection consequences, that is, tighter collateral requirements may increase the riskiness of financed projects (Stiglitz and Weiss, 1981).

[3] As in Beck et al. (2000).

economies from Eastern Europe and Central Asia. Differently from Rahman et al. (2017), they show that neither size nor presence of collateral are affected by market concentration as measured by asset share of the three main national banks. Jimenez et al. (2006b) use 1984-2002 Credit Register data of *Banco de España* to test several hypotheses about the determinants of collateral. They show that collateralization is negatively affected by market concentration as measured by the Herfindahl-Hirschman index (HHI) at the province-year level. Jimenez et al. (2006a) use the same data and validate the HHI as a proxy of market concentration by showing that high levels of HHI are associated with high levels of yearly Lerner index. Chakraborty and Hu (2006) use 1993 NSSBF data to check whether duration and scope of the bank-borrower relationship affect collateralization in line-of-credit and non-line-of-credit loans. They show that the number of borrowing sources affects positively the probability of pledging collateral when line-of-credit and non-line-of-credit loans data are pooled, while the effect is not statistically significant when considered separately. Harhoff and Körting (1998) use German SMEs survey data similar to NSSBF in terms of design and questions. They show that probability of pledging collateral to obtain line-of-credit financing is increasing in the number of lenders.

The paper is organized as follows. Section 2 presents the theoretical model. Specifically, section 2.1 builds the setting, section 2.2 models the equilibrium contract with a monopoly bank and section 2.3 with competitive lenders. Section 3 presents empirical tests of the predictions from Section 2. In particular, section 3.1 discusses the background and features of the data, section 3.2 displays descriptive statistics, section 3.3 shows estimation results and section 3.4 addresses potential limitations of the empirical analysis. Section 4 concludes.

2 Theoretical model

2.1 Setup

A risk neutral entrepreneur or firm seeks outside financing to set up some production project. This agent owns some starting, illiquid wealth W that cannot be invested in the project. The endowment can be partially or entirely pledged as collateral to secure financing. The potential output of the project depends on the effort exerted by the entrepreneur as well as the financing L received. The (monetary value of the) output is increasing and strictly concave in L. Once the loan is secured, the agent can either exert high, e_A, or low, e_B, effort. The output produced is $y_i = y_i(L)$ if agent exerts effort e_i, with $i = A, B$. In the presence of high (low) effort, the project succeeds with probability p_A (p_B), yielding output y_A (y_B), and it fails with probability $1 - p_A$ ($1 - p_B$), yielding nothing. Assume that $y_A < y_B$, $p_A > p_B$ and $p_A y_A > L > p_B y_B$. To put it differently, the project is financially viable (that is, production exceeds *on average* financing) only under high effort. Nonetheless, the highest payoff is gained when the project succeeds even though the agent has exerted low effort. Throughout the paper, we use the functional forms $y_A = AL^\alpha$ and $y_B = BL^\alpha$, with $A < B$ and $\alpha \in (0.1)$. As in Reito (2011), assume that the borrower can designate the fraction $\lambda \in [0, 1]$ of wealth W that can be *at most* pledged as collateral. This setting can be traced back to several instances in corporate finance. An entrepreneur can establish a *sole shareholder company* and limit claims from business creditors to the goods transfered under the firm's domain. Moreover, companies often carry out their operations using *earmarked capital*. Using this legal arrangement, a firm circumscribes the amount of wealth that can be destined to a specific project. Notice that, in either case, the main aim of the borrowers is to limit the amount of resources which can be seized by creditors, thus little to no concern is paid to wealth taxation or other causes which could justify asset separation. The remainder $(1-\lambda)W$ is destined to other unproductive activities, bearing no financial return.

A risk neutral lender supplies the loan L via a financial contract (R, C), where $R = R(L)$ is the repayment (principal plus interests) and $C = C(L)$ is collateral. The borrower is able to liquidate the former if the project succeds, while the lender seizes the latter if the project fails. The objective functions of both agents depend on the contract (R, C), as well as L and e_i. The expected payoff of the lender from offering the contract is $V_i = V(R, C, L, e_i) = p_i R + (1-p_i)C - L$, while the expected payoff of the borrower is $U_i = U(R, C, L, e_i) = p_i(y_i - R) - (1-p_i)C + \lambda W$, for $i = A, B$. The borrower requires financing only if the contract bears a non negative expected return, that is

$$U_i \geq \lambda W \text{ for } i = A, B. \tag{PC}$$

The lender cannot observe nor negotiate the effort choice of the borrower. Yet, the borrower chooses high effort if the following constraint is satisfied:

$$R \leq \left(\frac{p_A A - p_B B}{p_A - p_B}\right) L^\alpha + C = \overline{R} + C \tag{IC}$$

where $\overline{R} = L^\alpha(p_A A - p_B B)/(p_A - p_B)$. If (IC) holds, (PC) reduces to $U_A \geq \lambda W$. Lastly, if (PC) and (IC) are both satisfied, the sum of the objective functions V_A and U_A is $p_A y_A - L$, which is maximized at $L^S = (\alpha p_A A)^{\frac{1}{1-\alpha}}$. One can show that this is also the equilibrium loan size supplied by both monopolistic and perfectly competitive lenders with perfect information. In this case, (IC) is always satisfied, since the lender observes effort exertion. As a result, the loan supply function of a monopoly lender maximizes V_A subject to (PC):

$$\arg\max_L \; V_A \; = \arg\max_L \; p_A R + (1-p_A)C - L \;\; s.t. \; R = y_A - \frac{1-p_A}{p_A} C. \tag{1}$$

Conversely, competitive lenders break even and supply the loan quantity that maximizes the borrower's payoff:

$$\arg\max_L \; U_A \; = \; \arg\max_L p_A(y_A - R) - (1-p_A)C + \lambda W \;\; s.t. \; R = \frac{L}{p_A} - \frac{1-p_A}{p_A} C. \tag{2}$$

Both (1) and (2) reduce to the unconstrained maximization problem

$$\arg\max_L \;\; p_A A L^\alpha - L \tag{3}$$

which is solved for $L = L^S$.

2.2 Monopoly lender

Price setting lenders extract all the surplus from the loan contract. As a result, the equilibrium contract (R^M, C^M) will satisfy both (PC) and (IC) at equality, since any other (R, C) would not be consistent with profit maximization. The resulting contract is $(R^M, C^M) = (\overline{R} + C^M, \min\{p_A(y_A - \overline{R}), \lambda W\})$, where the second item comes from the fact that the collateral pledged cannot exceed λW. Valuing the objective functions V_A and U_A at (R^M, C^M) yields:

$$(U_A, V_A) = \begin{cases} (\lambda W, p_A y_A - L) & \text{if} \quad p_A(y_A - \overline{R}) < \lambda W; \\ (p_A y_A - p_A\overline{R}, p_A\overline{R} + \lambda W - L) & \text{if} \quad p_A(y_A - \overline{R}) > \lambda W. \end{cases} \tag{4}$$

One can show that $p_A(y_A - \overline{R})$ is a increasing and concave function of L, for $L \geq 0$. Also, for $L \geq 0$, $L \mapsto p_A(y_A - \overline{R})$ is continuous, non negative and has range $\mathbb{R}^+$. Hence, since W is fixed and $\lambda \in [0, 1]$, there exists some loan size L^P at which $p_A(y_A - \overline{R}) = \lambda W$. Specifically,

$$L^P = \left[\frac{\lambda W(p_A - p_B)}{p_A p_B(B - A)}\right]^{\frac{1}{\alpha}}. \tag{5}$$

Notice that, at $L = L^P$, both branches of Equation (4) are equal. The first branch of V_A from Equation (4) is maximized at $L = L^S$, while the second branch is maximized at

$$L^M = \arg\max_L \; p_A\overline{R} + \lambda W - L = \left[p_A\frac{(p_A A - p_B B)}{p_A - p_B}\alpha\right]^{\frac{1}{1-\alpha}}. \tag{6}$$

One can show that $L^M < L^S$ from the fact that, if A replaces B in Equation (6), L^M reduces to L^S and $B > A$. Instead, L^P could be greater or lower than L^M.

Even with a monopoly lender, the borrower affects (R^M, C^M) through λ. From a game theoretic perspective, this interaction is a sequential, one-shot game à la Stackelberg. In fact, the borrower chooses λ and the lender offers a credit contract based on the first move. It is possible to work out a solution to this game through backward induction. Up to this point, we have characterized the optimal contract for a fixed λ. Making λ endogenous completes the induction process and yields the solution.

Proposition 1. *The optimal strategy for the borrower is $\lambda^* = 0$.*

Proof. Recall that the choice of λ affects the value of L^P. There are two relevant scenarios[4], i.e. $L^M > L^P$ and $L^M < L^P$. Each of them is analyzed separately.

(i) $L^M > L^P$. Start from V_A valued at L^P. Since $L \mapsto p_A y_A - L$ is continuous in L and reaches a global maximum at L^S, it holds that, at $L^P < L^M < L^S$, the first derivative is positive. As a result,

[4] There are two other pontentially relevant cases, $L^M = L^P$ and $L^P > L^S$. Nonetheless, one can show that they are conducive to the same solution as the aforementioned scenarios. I sketched the proof for the latter case at the end of the proof.

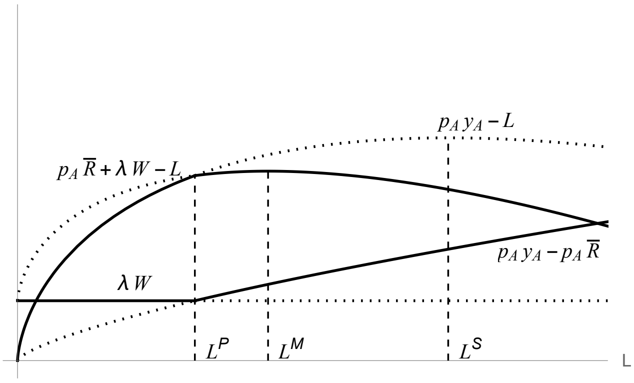

Figure 1: (i) $L^M > L^P$

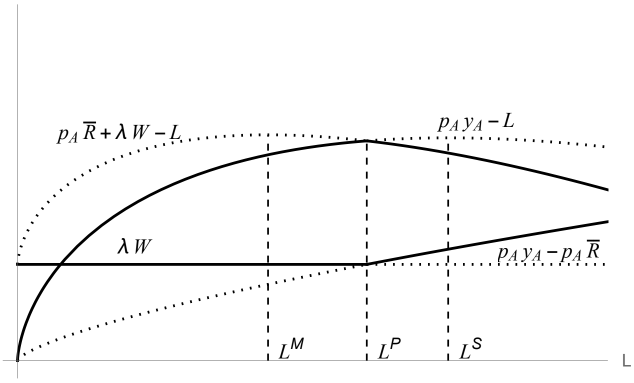

Figure 2: (ii) $L^M < L^P$

$p_A y_A - L$ is still increasing in the neighborhood of L^P and setting $L < L^P$ would yield a lower expected profit. Instead, the branch $p_A\overline{R} + \lambda W - L$ is maximized at $L = L^M$, thus the lender is better off increasing L from L^P to L^M. Increasing L past L^M would yield lower profits. Thus, the optimum choice is to supply $L = L^M$.

(ii) $L^M < L^P$. Start from V_A valued at L^P. The lender is worse off decreasing L below L^P, since $L \mapsto p_A y_A - L$ is increasing in L up to L^S. At the same time, the lender is not better off increasing L past L^P, since $L \mapsto p_A\overline{R} + \lambda W - L$ is decreasing in L for $L > L^M$. Thus, the optimum choice is to supply $L = L^P$.

Therefore, the lender supplies $\max\{L^M, L^P\}$. Notice that at $L = L^M$, $p_A y_A - p_A\overline{R} > \lambda W$, that is, the payoff of the borrower is greater that the participation level. The comparative payoff of the borrower from the lender choosing L^M over L^P is maximized at

$$\lambda^* = \underset{\lambda, L = L^M}{\arg\max}\ p_A(AL^\alpha - \overline{R}) - \lambda W = 0 \tag{7}$$

Since $L^P = 0$ if $\lambda = 0$, the lender will always supply L^M. Therefore, $\lambda^* = 0$ is the optimal strategy for the borrower. ■

A marginal case that was purposely kept off the previous proof is $L^P > L^S$, as in Figure 3. Starting from V_A valued at L^P, the lender is better off decreasing L from L^P to L^S, where the second branch of her payoff function is maximized. At L^S, as in L^M, the borrower attains $p_A y_A - p_A\overline{R} > \lambda W$ beyond the participation level as long as $\lambda = 0$. Thus, her optimal strategy is again $\lambda^* = 0$. However, the lender now supplies $L^S > L^M$. Hence, the following lemma:

Lemma 1. *The loan supply function by the monopolistic lender is*

$$L^* = \begin{cases} L^M & \textit{if} \quad L^P < L^S; \\ L^S & \textit{if} \quad L^P \geq L^S. \end{cases} \tag{8}$$

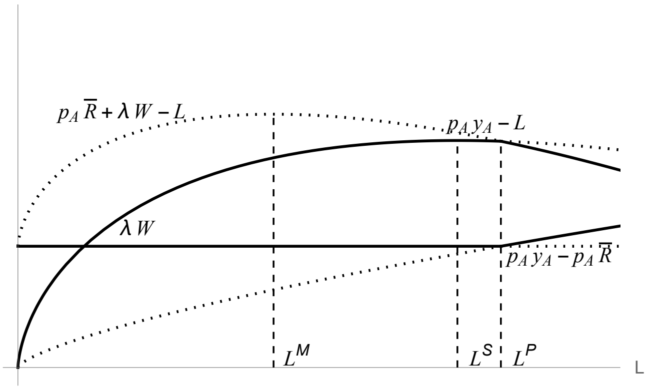

Figure 3: (iii) $L^P > L^S$

and the equilibrium contract is $(R^M, C^M) = (\overline{R}^*, \varnothing)$*, where* $\overline{R}^*$ *is* $\overline{R}$ *valued at* L^*.

This solution has an interesting economic interpretation. In a monopoly, the borrower's wealth affects only the loan size. If W is high, then L^P may range above L^M and even L^S for high values of λ. The choice between L^M and L^S depends only on the range of L^P, which ultimately depends on W. Both agents are better off in L^S than in L^M. However, the former is not always a potential outcome. Only when W is high enough to have that $L^P > L^S$ for some value of λ, the second branch of Equation 8 becomes relevant[5]. Nonetheless, since both outcomes are independent of collateral, the equilibrium loan contract is unsecured.

2.3 Perfectly competitive lenders

If there are many lenders acting as price takers, each of them breaks even on every contract. The borrower is able to seize all the surplus arising from the loan. In this setting, the equilibrium loan contract (R^{PC}, C^{PC}) satisfies (PC), (IC) and the "zero-profit" constraint:

$$V_A = 0 \iff R = \frac{L}{p_A} - \frac{1 - p_A}{p_A} C. \tag{ZPC}$$

Adding (ZPC) makes (PC) slack, as the following Lemma shows.

Lemma 2. (IC) *and* (ZPC) *imply* (PC).

Proof. If (IC) holds, (PC) reduces to $U_A \geq \lambda W$. Plugging the right hand side of (ZPC) in $U_A \geq \lambda W$ yields $p_A y_A \geq L$, which is always true by assumption. ∎

Using Lemma 2, one could derive the equilibrium loan quantity that maximizes $L \mapsto U_A$ subject to (ZPC) and check if it satisfies (IC). As for the first step,

$$L^S = \arg\max_L \; p_A y_A - L + \lambda W \tag{9}$$

[5] Notice also that, *ceteris paribus*, the borrower is never better off *increasing* λ, since (7) is decreasing in λ.

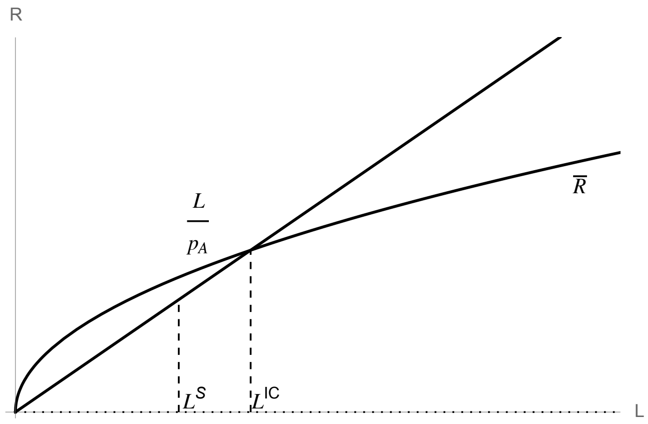

Figure 4: $L^S \in (0, L^{IC}]$

where the objective function of previous display is U_A after plugging the right hand side of (ZPC). As for the second step, it is not possible to directly check whether L^S satisfies (IC) as long as C is unknown. If the borrower replicates the same strategy as in the monopoly case, $C^{PC} = 0$. This reduces (IC) and (ZPC) to $R \leq \overline{R}$ and $R = L/p_A$, respectively. The boundary of the former (latter) is a continuous, increasing and concave (linear) function of L, hence there exists some $L \in \mathbb{R}^+$ where they intersect. Namely, they cross at

$$L^{IC} = \left[\frac{p_A(p_A A - p_B B)}{p_A - p_B}\right]^{\frac{1}{1-\alpha}}. \tag{10}$$

It is ambiguous whether L^{IC} is lower or greater than L^S. Dividing L^{IC} by L^S yields

$$\left(\frac{p_A A - p_B B}{p_A A - p_B A}\right) \times \left(\frac{1}{\alpha}\right)$$

where the first term is lower than 1 and the second term is greater than 1. As a result, L^S may fall in two ranges.

(i) $L^S \in (0, L^{IC}]$. Recall that the boundary of $R \leq \overline{R}$ is concave in L and crosses with $L \mapsto L/p_A$ for $L \in \{0, L^{IC}\}$. It follows that $\overline{R}$ valued at $L = L^S$ is always greater than L^S/p_A if $L^S \in (0, L^{IC}]$. To put it differently, the repayment for L^S consistent with (ZPC) satisfies (IC) without any collateral requirement in this range. Thus, the equilibrium contract is $(R^{PC}, C^{PC}) = (L^S/p_A, \varnothing)$ if $L^S \leq L^{IC}$.

(ii) $L^S \in (L^{IC}, \infty)$. Conversely, within this range the repayment for L^S consistent with (ZPC) lies outside the boundary of (IC), as in the left panel of Figure 5. In this case, loan contracts are feasible only with collateral requirements. In fact, adding collateral raises the upper bound of (IC) while lowering the repayment consistent with (ZPC) for any value of L. The value of $C^{PC} \neq 0$ should be consistent with both (IC) and (ZPC). From (ZPC), $C^{PC} = (L - p_A R)/(1 - p_A)$. Plugging (IC) yields

$$C^{PC} \geq L - p_A \overline{R} \tag{11}$$

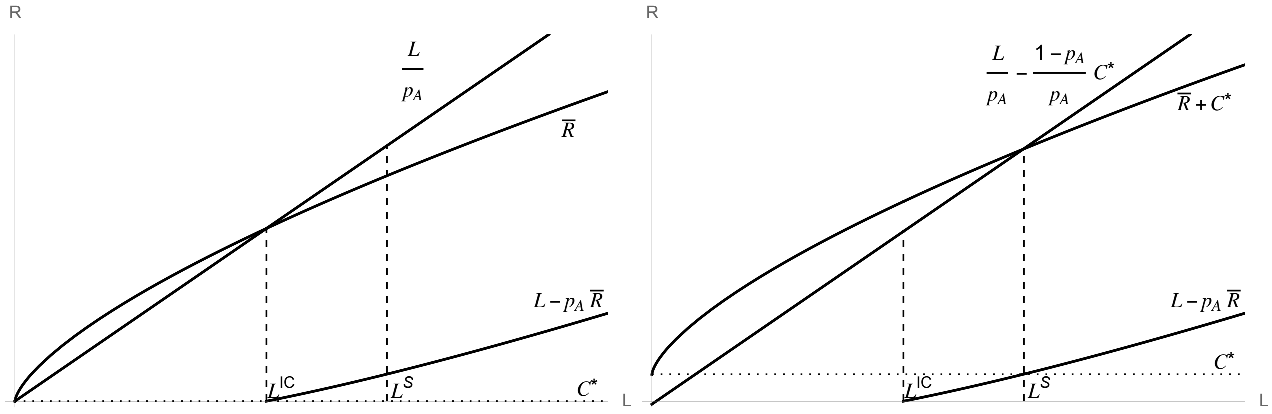

Figure 5: $L^S \in (L^{IC}, \infty)$.

which is a positive function of L for $L > L^{IC}$. The lower boundary of (11) valued at $L = L^S$ is the collateral requirement that makes this loan quantity consistent with both (IC) and (ZPC).

One can show that the contract $(R^{PC}, C^{PC}) = (\overline{R}(1-p_A)+L, L-p_A\overline{R})$ valued at $L = L^S$ satisfies both constraints at equality. Notice that the borrower necessarily pledges collateral in this scenario. Therefore, $\lambda^* = (L - p_A\overline{R})/W \neq 0$ valued at $L = L^S$ for $L^S \in (L^{IC}, \infty)$. The following proposition sums up the case of perfectly competitive lenders.

Proposition 2. *The optimal contract supplied by a perfectly competitive lender is*

$$(R^{PC}, C^{PC}) = \left(\frac{L}{p_A} - \frac{1-p_A}{p_A}C^*, C^*\right)$$

where $C^* = \max\{\varnothing, L - p_A\overline{R}\}$ *and* $L = L^S$.

Proposition 2 implies that perfectly competitive lenders may require collateral. Conversely, Proposition 1 stated that a monopoly lender provides only unsecured debt. This is consistent with empirical evidence showing that market concentration reduces the use of collateral (Jimenez et al., 2006b). Lastly, it could be the case that $L - p_A\overline{R}$ valued at $L = L^S$ is greater than W. In this scenario, the highest level of L consistent with both (IC) and (ZPC) is lower than L^S. Thus, the borrower gets rationed, as the lender can at most supply a loan level $L \in (L^{IC}, L^S)$ even with $C^{PC} = W$. Nonetheless, the optimal value of λ remains $\lambda^* = 1$. The objective function in (9) is increasing in L, which is, in this case, increasing in λ. Notice that this does not change the main result of Proposition 2, since there is a strictly positive collateral requirement.

3 Empirical evidence

Propositions 1 and 2 can be combined into a single, testable prediction: market concentration and collateral use are negatively related. In this section, I test this hypothesis on archival data. I consider the case of commercial and pledge banks and show that the former experienced a sudden drop in concentration after the passing of the 1936 law. To this extent, I use a simple DiD model to estimate the corresponding variation in collateral.

3.1 Data

Natoli et al. (2016) collected balance sheet data, geographical indications and classification codes of Italian banks from 1890 to 1973 in a single comprehensive panel. I differ from most of the related research discussed above since the vast majority of empirical studies about secured debt are based on cross-sectional survey data. Differently from surveys, balance sheet data are affected by accounting rules. Also, it is unfeasible to infer the composition of individual loan contracts from reported accounts. Apart from these limitations, financial reports are very useful to assess the change in aggregated accounts between important reforms of the credit market.

To this end, I use credit data at the bank level to study the co-movements of collateral before and after the promulgation of the 1936 banking law. This reform (*Regio Decreto 375/1936*) stemmed from to the financial crysis of the early 1930s and was meant to corroborate the supervision apparatus of Italian banks. The core objective of the 1936 banking law was to increase the stability of the financial system. This was accomplished by setting binding limits to the operating activities of local and national banks. Specifically, credit institutions were separated between short and long term loan providers. Also, the new banking law imposed geographical limits on the ability to extend credit, which often resulted in impaired competition. This reform completed the renovation of Italian banking law initiated in 1893 with the establishment of the Bank of Italy and resumed in 1926 with the first commercial banking regulation.

The 1936 banking law changed the legal framework of banking institutions. However, the reform affected differentially the Italian lending market. While national banks could open new branches and operate in major cities, local banks could expand within the boundaries of the province where they operated before the passing of the law. The different treatment of small and large credit institutions affected also their ability to grow, as documented by Guiso et al. (2006). Another consequence of this divide was the heterogeneity in market structures across the Italian banking market. Areas with a prevalence of small, local banks were characterized by less concentrated lending markets than central cities, where big national banks operated (Ciari and De Bonis, 2011).

The exogenous variation induced by the 1936 banking law can be exploited to assess to which extent changes in market concentration affect the use of collateral. To this end, I proxy collateral using the total of the active section of *Conti d'Ordine*. This account is obsolete and cannot be found anymore in modern financial reports. It accommodated security deposits, obligations and valuables of third parties in deposit. I take the natural logarithm of this account to reduce its dimensionality. The use of yearly reports hinders the possibility of leveraging individual contract details to compute *Lerner* indices. As a result, I resort to the *Herfindahl-Hirschman* Index (HHI) at the year-category level as a measure of market concentration. I use yearly total assets as a proxy of market share for the computation of HHI.

The pervasiveness of the 1936 policy differed across bank categories. Here, I take the case of commercial

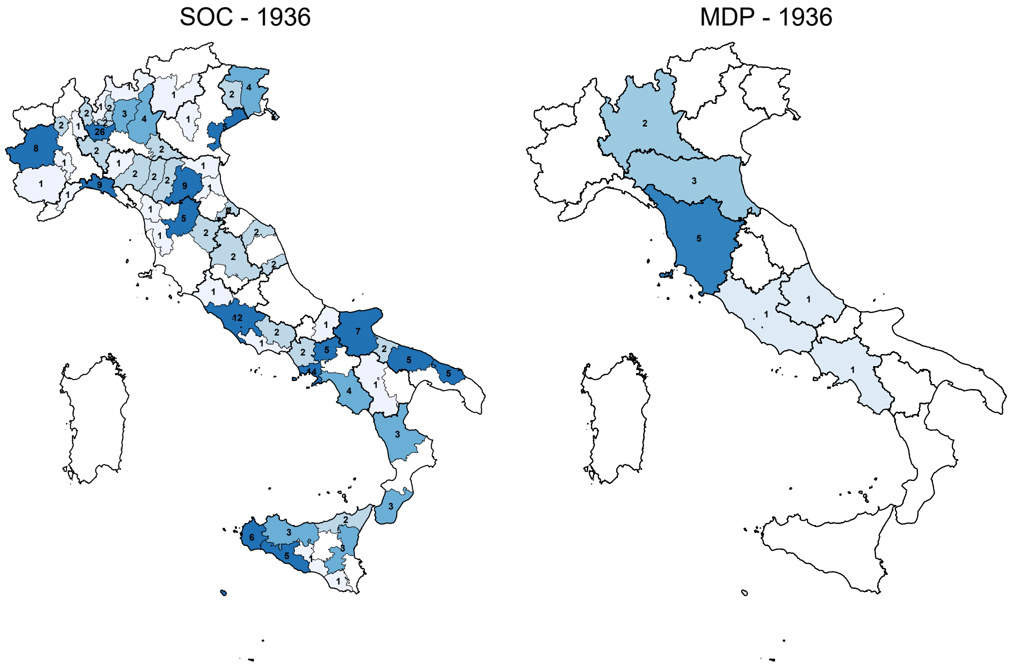

Figure 6: Geographical distribution of commercial banks (left) and first class pledge banks (right) in 1936. Boundaries are adjusted to the limits of the jurisdiction of each category after the 1936 banking law, that is, provinces for commercial banks, regions for pledge banks. Numbers in provinces/regions indicate how many credit institutions operating in that area belong to the category specified in the title.

banks (*Società Ordinarie di Credito*, SOC) and first class pledge banks (*Monti di Pietà*, MDP). I show that these two categories are comparable to a certain extent. Banks belonging to the former class are often small, local lenders. The 1936 reform restricted the boundaries of their activities to the province where they operated in 1936. The left panel of Figure 6 shows that their distribution across the Italian territory was quite scattered. Most of Italian provinces hosted at least one commercial bank, and many accommodated more than five institutions at once. On the other hand, first class pledge banks were institutions that supplied secured credit. Their commercial characterization was quite mixed, because this category initially included charitable institutions that operated in the loan market with the aim of limiting predatory lending. In 1898, they were officially recognized by the law among the institutions that could hold deposits. As a result, many pledge banks caught up with other commercial credit suppliers in terms of functions and market share. Starting from 1923, pledge banks could be referred to as "*first class*" if the Ministry of the Industry and the Interior ascertained that they had achieved interest-bearing deposits comparable to those of ordinary credit institutions. Because of this restrictive prerequisite, first class pledge banks were very few and quite sparse around the Italian territory, as the right panel of Figure 6 shows. Nonetheless, the 1936 reform was very lenient about their competition constraints, as pledge and savings banks were evened out. Savings banks were the only type of credit institutions that could expand within the *region* where they operated before the reform. Guiso et al. (2006) discusses the political reasons behind this preferential treatment.

3.2 Descriptive statistics

In what follows, I study differential trends of commercial and pledge banks with the aim of analyzing the impact of market concentration on the use of collateral. I initially focusing on the 1928-1948 period. This 20-year span is purposely not centered at the year 1936 for two reasons. First, I start from 1928 as to limit the lagging effect due to the 1926 banking law. The final version of this reform was actually passed in November 1926 after many rounds of drafting (Molteni and Pellegrino, 2022). As a result, short run adjustments of the lending market to the constraints introduced with this policy reasonably lasted until the following year. Second, I extend the time window until 1948 to balance the interwar period (1940-1945) with the first years of the Italian post-war recovery (1946 - 1948).

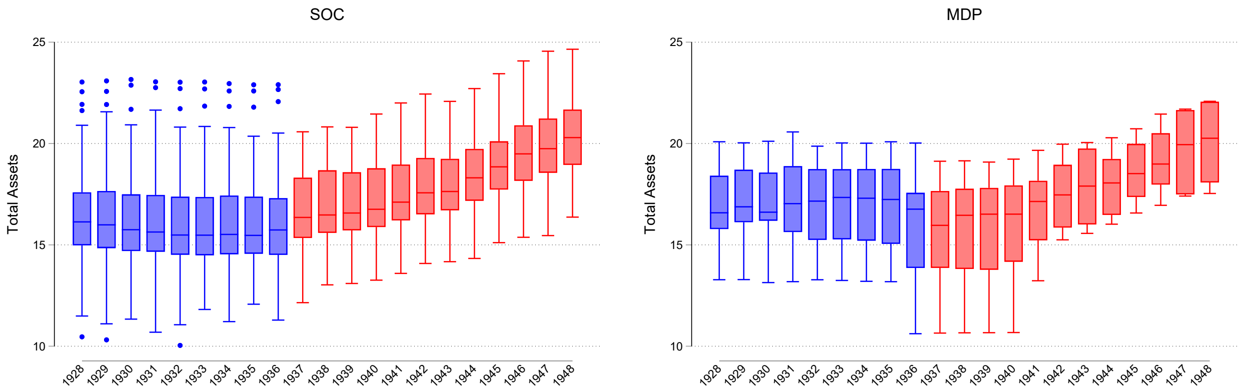

Figure 7: Total assets of commercial (left) and pledge (right) banks, 1928-1948. Both figures report box-and-whisker plots in logarithmic scale. Summary boxes in years before 1936 (including) are reported in blue. Summary boxes after 1936 are reported in red.

Figure 7 compares the growth of commercial and pledge banks as proxied by their total assets in the 1928-1948 window. Both panels display upward sloping trends, with median size generally increasing between consecutive years. Conversely, the range is decreasing in time, although only slightly in the case of commercial banks. In both cases, the distribution as a whole shifts upwards, with top and bottom percentiles exhibiting higher and higher total assets. These facts combined indicate that commercial and pledge banks have grown bigger and more homogenous. In addition to similar trends, their interquartile distribution are partially overlapping both before and after 1936. Nonetheless, they differ in terms of upper and lower quartile width as well as outliers.

Table 1 showcases other dimensions across which commercial and pledge bank differed. The first row refines the conclusions from Figure 7, in that commercial banks grew bigger than pledge banks after the 1936 reform. The next rows show that commercial banks have more equity (row 2) and liquidity (row 3) per unit of total assets. Moreover, pledge banks supply more long term loans (row 4) and invest more in real estate (row 5). Unsurprisingly, first class pledge banks have higher return on equity (row 6). The second-last row suggests that the commercial banks are more competitive than their counterpart, and the difference in concentration widens after the passing of the 1936 reform. Instead, the last row shows that on average pledge banks secure more collateral than commercial lenders. However, this gap becomes not significantly

	SOC	MDP	$\Delta_{1928-1948}$	$\Delta_{1937-1948}$
Assets	16.94	17.29	-0.35**	0.57**
Equity ratio	0.17	0.09	0.08***	0.03**
Liquidity ratio	0.09	0.07	0.02**	0.05***
Mortgages ratio	0.01	0.08	-0.07***	-0.09***
Real estate ratio	0.03	0.04	-0.02***	-0.01***
ROE	0.14	0.28	-0.14	-0.34***
HHI	0.10	0.31	-0.21***	-0.27***
Collateral	15.94	16.73	-0.80***	0.18
N	3,642	201		

Table 1: Two-way t tests. The first and second columns report averages in the 1928-1948 window of row variables within commercial and pledge banks, respectively. The third column reports the difference between the means. The fourth column reports the difference between the means computed in the 1937-1948 window. Assets and collateral means are computed averaging the natural logarithm of their total. Equity, liquidity, mortgages and real estate are scaled by total assets. ROE is computed by scaling profits and losses by total equity. HHI is computed using total assets. The last row reports the number of banks belonging to each category in the 1928-1948 window. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$.

different from zero after 1936.

The fact that the difference in collateral closes while the gap in terms of concentration widens could suggest that collateral and concentration are negatively related. Figure 8 shows more accurately the differential trends experienced by commercial and pledge banks in the 1928-1948 window. The left panel displays a remarkable discontinuity in commercial banks' HHI around 1936. Concentration plummets after the reform and remains stationary afterwards. This change of pattern does not affect pledge banks, whose concentration index moves around similar trends across the whole window. More interestingly, HHI trends before and after the introduction of the policy are reasonably parallel[6]. Therefore, commercial banks suffered a negative shock after 1936 that offset quite permanently their degree of concentration relative to pledge banks. On the other hand, while collateral trends are also fairly parallel[7] before 1936, the period after was characterized by a sudden spike for the commercial banks. As the fourth row of Table 1 shows, the gap in terms of collateral vanished right after the passing of 1936 banking law.

3.3 Estimation

Building on the descriptive evidence presented so far, I show and discuss the results from a DiD estimation of the effect of competition on the use of collateral. The use of DiD stems from the fact that only commercial banks experience a sudden decrease in their degree of concentration after 1936. To this extent, I quantify the differentials across categories and periods in terms of HHI and collateral. The former estimation ensures the existence of the "treatment" and yields indications about its economic and statistic significance. The

[6] The slopes of commercial and pledge banks' pre-1936 trends are 0.007^{***} and 0.006^{**}, respectively. The slopes of commercial and pledge banks' post-1936 trends are 0.0017^{**} and 0.0019, respectively. HHIs are computed at the yearly level, hence small sample bias is a concern. Nonetheless, the F statistics from a test of the equality between pre-1936 and post-1936 slopes are 0.29 and 0.15, respectively. Neither of them is significant.

[7] The slopes of commercial and pledge banks' pre-1936 trends are 0.046^{**} and 0.037, respectively. The F statistics from a test of the equality between pre-1936 slopes is 0.52 and it is not significant. I will perform a more robust test of parallel trends in the following paragraphs.

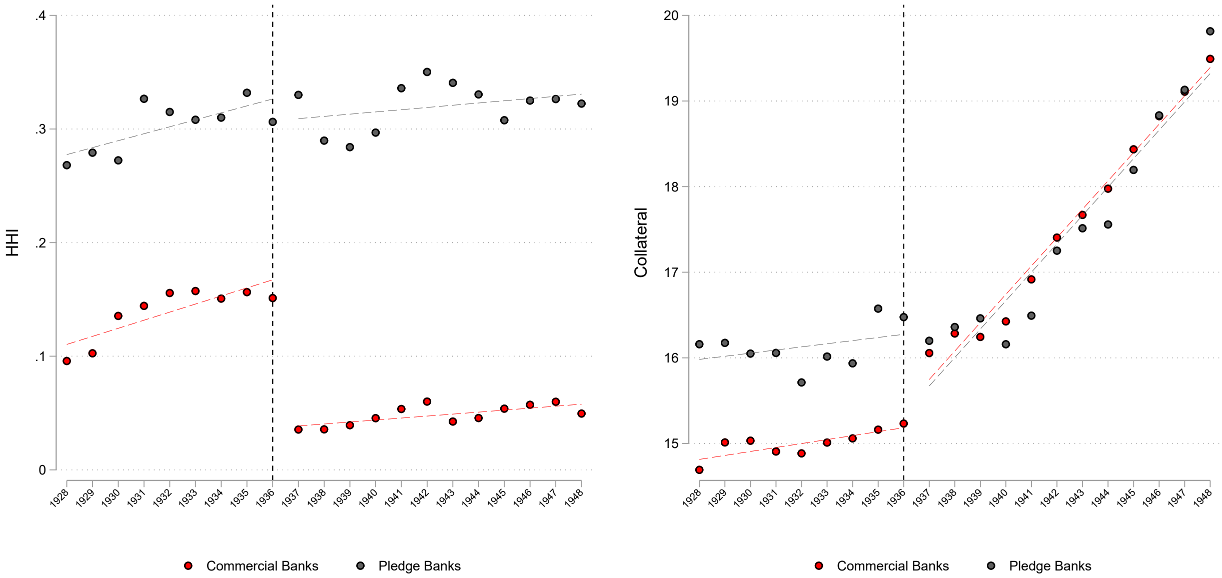

Figure 8: Herfindahl-Hirschman index (left) and average collateral (right) of commercial (red) and pledge (gray) banks, 1928-1948. Collateral is averaged after taking the natural logarithm of its total. Means are computed at the year-category level. Linear trends added below scatter points.

latter quantifies the effect from being exposed to a sudden decrease of market concentration. To this end, I estimate the following model:

$$y_{ict} = \alpha + \theta 1\{t > 1936\} + \gamma 1\{c = SOC\} + \beta 1\{t > 1936\} 1\{c = SOC\} + \varepsilon_{ict} \tag{12}$$

where y_{ict} is the dependent variable valued at the i bank of category c in year t and ε_{ict} is the residual. Notice that HHI varies within c and t, while collateral varies within i, c and t.

Table 2 shows the results from the estimation of model (12). First, I test the baseline model, then I add province fixed effects and covariates. I control for the WWII period to absorb the effect of the war economy on the banking market. I also use accounting ratios that could proxy bank-specific financial constraints potentially correlated with collateral clauses. Columns (1)-(3) validate and quantify the change in market concentration experienced by commercial banks after 1936. After controls and province fixed effects, the negative difference between trends of market concentration across commercial and pledge banks remains around 10 base points. Conversely, columns (4)-(6) showcase the estimates with collateral as dependent variable. To the most demanding of the specifications above, commercial banks increased their collateral accounts by 1.05% after 1936. This figure crucially hinges on the assumption of parallel trends before the

	(1) HHI	(2) HHI	(3) HHI	(4) Collateral	(5) Collateral	(6) Collateral
SOC	-0.164***	-0.164***	-0.164***	-1.360**	-2.094***	-1.340***
	(0.00146)	(0.00168)	(0.00238)	(0.591)	(0.428)	(0.407)
After 1936	0.0193***	0.0188***	0.0162***	1.040	0.497	0.791*
	(0.00204)	(0.00222)	(0.00243)	(0.697)	(0.572)	(0.471)
SOC $\times$ After 1936	-0.106***	-0.106***	-0.106***	1.540**	1.805***	1.046**
	(0.00198)	(0.00212)	(0.00228)	(0.702)	(0.587)	(0.503)
WWII			0.00464***			-0.262***
			(0.000346)			(0.0482)
Equity ratio			0.00363			-5.720***
			(0.00349)			(0.804)
Liquidity ratio			0.0172***			0.135
			(0.00305)			(0.729)
Mortgages ratio			0.0103			0.301
			(0.0117)			(0.715)
Real estate ratio			0.0222***			-0.0185
			(0.00455)			(1.496)
ROE			0.000418***			-0.00170
			(0.0000742)			(0.0133)
Observations	3800	3797	3721	3800	3797	3721
Province FE	No	Yes	Yes	No	Yes	Yes

Table 2: DiD estimation, 1928-1948. Standard errors clustered at the province level. Collateral in logarithmic scale. WWII indicates the period 1940-1945 when Italy was at war. The Kingdom of Italy surrendered unconditionally in 1943. However, the campaign to liberate Italy from German occupation lasted until 1945. Equity, liquidity, mortgages and real estate are scaled by total assets. ROE is computed by scaling profits and losses by total equity. $^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$.

intervention. To this end, I test this assumption using the following model:

$$\begin{aligned} Coll_{ict} = \alpha + \sum_{t'=1927}^{1936} \theta_{t'} 1\{t = t'\} + \gamma 1\{c = SOC\} \\ + \sum_{t'=1927}^{1936} \beta_{t'} 1\{t = t'\} 1\{c = SOC\} + \Delta' X_{ict} + \varepsilon_{ict} \end{aligned} \tag{13}$$

I test the joint hypothesis that all the coefficients on interaction terms of model (13) are equal to zero using the specification from column (6) of Table 2 and keeping $t = 1936$ as reference period. I find $F_{8,81} = 1.09$ $(Prob > F = 0.3768)$. Therefore, I do not reject the null hypothesis of parallel trends. Figure 9 showcases event study estimates of model (13) extended to the end of 1928-1948 window. All coefficients before 1936 are not statistically different from zero, which supports the parallel trends assumption. Moreover, dynamic effects suggest that the effect of the policy on the use of collateral has plateaued a few years after 1936.

Figure 9 also displays a negative trend for dynamic effects at the end of the 1928-1948 window. To this extent, it could be plausible that the effects of the policy exhausted after a few years. I address long run consequences of this policy by increasing the length of the post-1936 period until 1973, that is, the

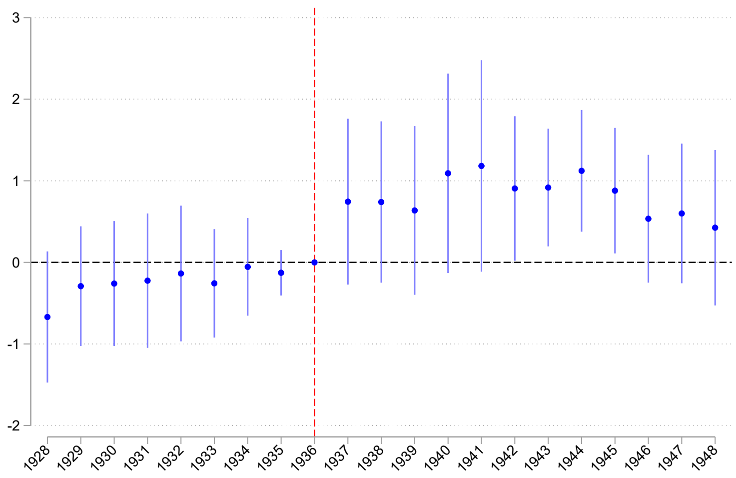

Figure 9: Event study plot. 95% confidence intervals for the coefficients on the interaction between year and commercial bank group. Natural logarithm of total collateral as dependent variable. Same specification as column (6) of Table 2.

most recent year in Natoli et al. (2016) data. Figure 10 shows that trends of market concentration are no longer parallel after 1936. Market concentration of pledge banks moves around a downward path. Most interestingly, trends of collateral cross, as the series of commercial and pledge banks almost overlap for a few periods.

These descriptive results may suggest less clear cut DiD estimates. Table 3 showcases how model (12) holds with a larger *post* period. Columns (1)-(3) show that the drop in concentration is still statistically significant, although the estimates are smaller (in absolute value) than in the 1928-1948 window. Columns (4)-(6) also present smaller and less significant estimates than Table 2. In the most demanding specification, the DiD coefficient on collateral is no longer significant. Lastly, I repeat the event study exercise in the 1928-1973 window. As expected, Figure 11 shows that the dynamic effects from the policy slowly fade out, to the point that they are not statistically significant starting from 1950.

3.4 Potential limitations

The evidence presented so far suggests that commercial banks found themselves in a more competitive environment after the passing of 1936 banking law and raised collateral clauses relative to pledge banks, that were reasonably unaffected by the policy. This conclusion holds after controlling for proxies of the financial soundness of banks, as well as time, group and province fixed effects. Nonetheless, the identification strategy is constrained by a few limitations. Specifically, I discuss hereafter two potential weaknesses of the analysis above: the nature of the data and the measurement of market competition.

First, the use of financial reports affects the granularity of the data. Yearly accounts are the final result from the aggregation of economic transactions. In the theoretical model, I modeled how a single contract could be affected by the competition level in the lenders' market. To this extent, I drew conclusions related to loan quantities and collateral requirements. Financial reports aggregate these outcomes and display their

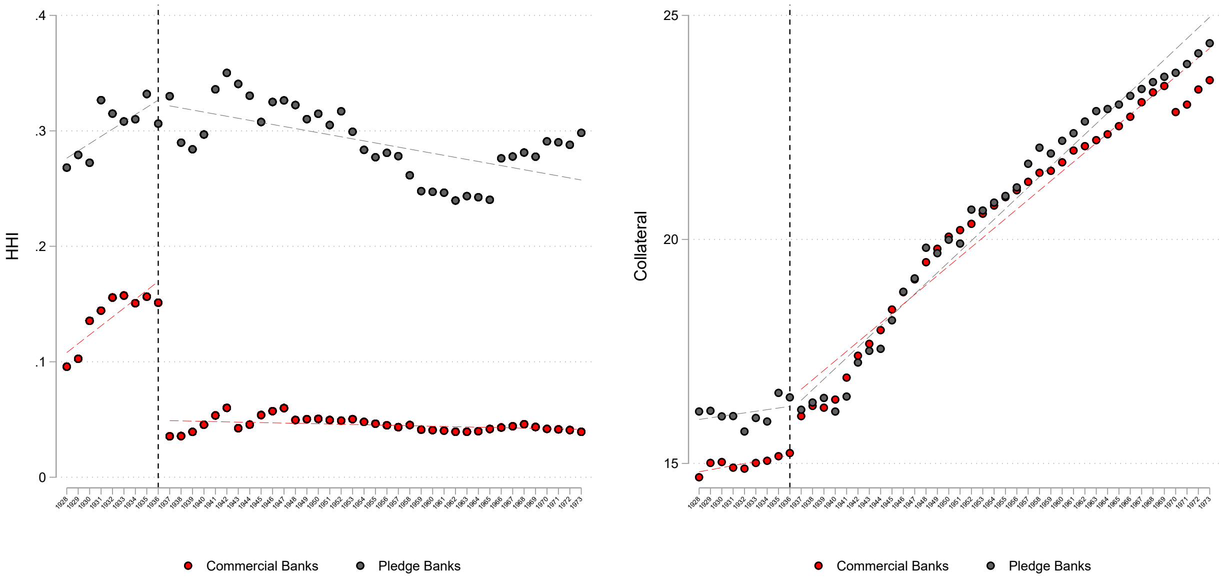

Figure 10: Herfindahl-Hirschman index (left) and average collateral (right) of commercial (red) and pledge (gray) banks, 1928-1973. Collateral is averaged after taking the natural logarithm of its total. Means are computed at the year-category level. Linear trends added below scatter points.

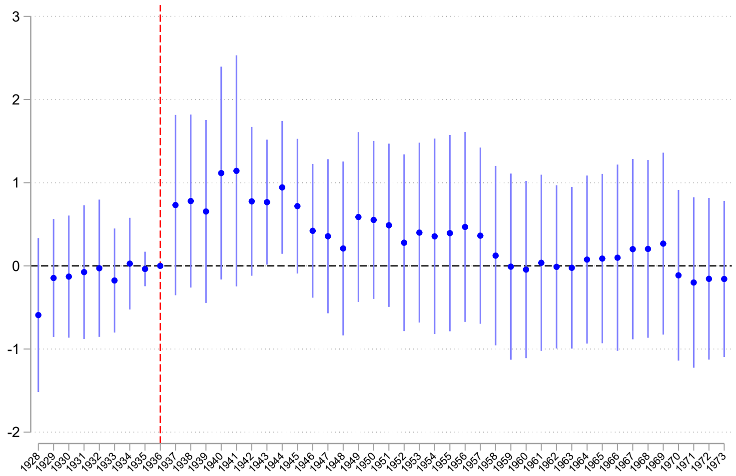

Figure 11: Event study plot. 95% confidence intervals for the coefficients on the interaction between year and commercial bank group. Natural logarithm of total collateral as dependent variable. Same specification as column (6) of Table 2.

totals in separate accounts. As a result, it is impossible to discern the features of credit lines that ultimately add up to the balance from financing operations. Despite this issue, the panel structure of Natoli et al. (2016) data allows for tests of serial correlation and causality. To this end, I implement a two-way Granger (1969) test with the aim of assessing whether concentration precedes collateral in commercial banks' yearly reports

	(1) HHI	(2) HHI	(3) HHI	(4) Collateral	(5) Collateral	(6) Collateral
SOC	-0.164***	-0.164***	-0.166***	-1.360**	-2.036***	-0.633
	(0.00146)	(0.00167)	(0.00210)	(0.591)	(0.435)	(0.454)
After 1936	-0.00870***	-0.00692**	-0.00789**	4.199***	3.732***	4.070***
	(0.00278)	(0.00310)	(0.00304)	(0.670)	(0.554)	(0.463)
SOC × After 1936	-0.0813***	-0.0835***	-0.0829***	1.372*	1.521**	0.572
	(0.00279)	(0.00313)	(0.00296)	(0.702)	(0.611)	(0.499)
WWII			0.00764***			-3.293***
			(0.000727)			(0.114)
Equity ratio			0.00695**			-8.153***
			(0.00287)			(0.704)
Liquidity ratio			0.00905**			-0.0876
			(0.00373)			(0.996)
Mortgages ratio			-0.0110			4.268***
			(0.00950)			(1.395)
Real estate ratio			0.0174***			0.945
			(0.00446)			(1.637)
ROE			0.000508***			-0.0295
			(0.000139)			(0.0296)
Observations	7055	7051	6973	7055	7051	6973
Province FE	No	Yes	Yes	No	Yes	Yes

Table 3: Long run DiD estimation, 1928-1973. Standard errors clustered at the province level. Collateral in logarithmic scale. WWII indicates the period 1940-1945 when Italy was at war. The Kingdom of Italy surrendered unconditionally in 1943. However, the campaign to liberate Italy from German occupation lasted until 1945. Equity, liquidity, mortgages and real estate are scaled by total assets. ROE is computed by scaling profits and losses by total equity. $^{*}p < 0.10, ^{**}p < 0.05, ^{***}p < 0.01$.

between 1928 and 1948. I use the following model:

$$y_{it} = \alpha + \beta_0 x_{it} + \sum_{\ell=1}^{5} \beta_\ell x_{it-\ell} + \sum_{\ell=1}^{5} \beta_\ell y_{it-\ell} + \varepsilon_{it} \tag{14}$$

where I swap x_{it} and y_{it} between collateral and HHI to assess both directions of causality. Table 4 shows the results from the estimation of model (14). Columns (1)-(2) display results with only first order lags and the same controls as in Table 2. Columns (3)-(4) add second to first order lags. Estimates for β_0 are all statistically significant at the 1%. Moreover, the negative sign is in line with the prediction that market concentration and collateral are negatively related. The F statistics of the joint tests of the dependent variable and its lags from columns (3) and (4) are $F_{6,70} = 20.24^{***}$ and $F_{6,70} = 3.64^{***}$. Even though the former is greater than the latter, I reject both null hypotheses. This means that it cannot be ascertained from this data whether collateral changes because of the movements of HHI, or HHI because of collateral.

Second, HHI may not be a suitable proxy of market power. I have already mentioned that financial reports are not indicative of the conditions of individual contracts and the resulting data cannot be leveraged to compute variations of the Lerner index. Therefore, I resorted to HHI. The validity of index of concentration as measures of market power has been critiqued over the last decades. Carbó-Valverde et al. (2009) tests

	(1) Collateral	(2) HHI	(3) Collateral	(4) HHI
HHI	-1.396***		-1.135**	
	(0.437)		(0.535)	
Collateral		-0.00223***		-0.00319**
		(0.000700)		(0.00158)
Observations	3360	3360	2079	2079
Dep. var. t -1	Yes	Yes	Yes	Yes
Indep. var. t - 1	Yes	Yes	Yes	Yes
Dep. var. t - 2 to t - 5	No	No	Yes	Yes
Indep. var. t - 2 to t - 5	No	No	Yes	Yes
WWII	Yes	Yes	Yes	Yes
Financial ratios	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes

Table 4: Granger causality, 1928-1948, commercial banks. Lag zero coefficients. Standard errors clustered at the province level. Collateral in logarithmic scale. WWII indicates the period 1940-1945 when Italy was at war. The Kingdom of Italy surrendered unconditionally in 1943. However, the campaign to liberate Italy from German occupation lasted until 1945. Financial ratios include equity, liquidity, mortgages and real estate, that are scaled by total assets, and ROE, which is computed by scaling profits and losses by total equity. $^{*}p < 0.10, ^{**} p < 0.05, ^{***} p < 0.01$.

both HHI and Lerner index as measures of market power and finds that the latter is a more consistent proxy of competition. This result follows many other contributions addressing the the potential flaws in measuring market power using concentration indexes (Rhoades, 1995; Jackson, 1997).

4 Conclusions

Secured credit is a crucial source of funding (Hanedar et al., 2014; Rahman et al., 2017). In this paper, I examine a driver of secured debt by taking up the case of market power as a determinant of collateral. I present a model of moral hazard in the credit market, with a wealth-constrained entrepreneur seeking finance to start up a project. Optimal financing contracts are derived considering monopolistic and competitive credit markets. I find that secured loans are more likely when the credit market is competitive, that is, collateralization and bank concentration are negatively related (Jimenez et al., 2006a,b; Chakraborty and Hu, 2006; Harhoff and Körting, 1998).

The monopoly lender designs the loan contract as to extract all the surplus while promoting high effort exertion. The borrower's best response is to pledge the minimum part of the starting wealth as collateral. The amount of unsecured loan obtained under monopoly is lower than the funds supplied by competitive lenders. Yet, in the latter case, the borrower might pledge collateral in order to receive first best financing. This occurs since the incentive compatible repayment may not suffice to yield non-negative profits. Due to asymmetric information, the competitive repayment is designed to promote high effort. However, the incentive compatible debt may be lower than the breakeven level. In this case, the borrower makes up for the difference by pledging collateral. If the loan quantity is low enough to ensure the incentive compatibility of the zero profit repayment, the competitive loan contract is provided without requiring collateral, as in the monopoly case. Overall, the borrower's net payoff from accessing banking credit is positive regardless of the market structure.

I test the negative correlation between collateral and market power using archival data from Natoli et al. (2016). I compare their evolution in commercial and pledge banks operating in the Italian market between 1928 and 1948. I find that the concentration index of the former banks suddenly drops after the promulgation of the 1936 banking law. I use this discontinuity to estimate a DiD model. I find that total collateral increases in the financial reports of commercial banks after 1936. Although I argue that there are limitations in inferring the direction of causality, the results suggest that there is a positive correlation between the use of collateral and competition in the lending market.

In the theoretical model, the scenario where the project fails receives positive probability, either $1 - p_A$ or $1 - p_B$ depending on effort exertion. In this case, the borrower is assumed to bear only the cost of collateral seizure. Other default costs are ignored by design. Similarly, the data I use prevents the analysis of borrowers' individual defaults. To this end, there is potential for future research to delve into the relationship between market power and probability of default.

In a monopolistic credit market the entrepreneur is able to secure financing independently from illiquid wealth. Instead, collateral requirements of competitive lenders may even exceed the borrower's seizable property. As in Besanko and Thakor (1987), competition may cause credit rationing, in the sense that first best loans may not be provided due to collateral shortage. Because of this, the borrower's payoff may be comparatively lower in competition relative to monopoly. Therefore, a feasible policy could be a collateral subsidy to rationed borrowers. In the absence of public intervention, this case may result in a competitive outcome where both lenders and borrowers are worse off relative to the monopoly case.

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