Loan Market Competition and Bank Risk-Taking*

Wolf Wagner†
University of Cambridge and Tilburg University

March 2007

Abstract

Recent literature (Boyd and De Nicoló, 2005) has argued that competition in the loan market lowers bank risk by reducing the risk-taking incentives of borrowers. We show that the impact of loan market competition on banks is reversed if banks can adjust their loan portfolios. The reason is that when borrowers become safer, banks want to offset the effect on their balance sheet and switch to higher-risk lending. They even overcompensate the effect of safer borrowers because loan market competition erodes their franchise values and thus increases their risk-taking incentives.

JEL classification: G21, L11
Keywords: loan market competition, risk shifting, bank stability

*I thank Hendrik Hakenes for extensive discussions in the early stage of this paper.

†Department of Economics, TILEC and CentER, Tilburg University, Postbus 90153, 5000 LE Tilburg, The Netherlands. Email: wagner@uvt.nl (Tilburg) and w.wagner@cerf.cam.ac.uk (Cambridge)

1 Introduction

Competition in the banking sector is typically seen as detrimental to financial stability. The basic idea is that when banks compete intensely for deposits, interest rates fall and their franchise value is eroded. Banks have then less to lose from a default and their incentives to take on risk increase.[1] This argument has been very important in shaping banking regulation around the world, for instance in the form of competition and merger policies.

A recent influential paper by Boyd and De Nicoló (2005) has challenged this view. Boyd and De Nicoló (BdN, henceforth) start from the simple observation that when banks compete more in the deposit market, they are also likely to compete more in the loan market. Loan rates should hence decline. BdN show that this gives rise to a new channel which operates through the asset side of banks' balance sheets. First, lower loan rates raise profits for borrowers and thus make bankruptcy less likely. Moreover, for the same reason that banks choose higher risk when deposit rates increase, borrowers choose to be safer when loan rates decrease. Both effects reduce the riskiness of bank loans and thus counter the traditional channel. BdN consequently argue that the lending market should be central to future models of bank stability.

In this paper we extend the analysis of the lending channel. In BdN borrowers are implicitly assumed, through their influence on the risk of firms, to have complete control over the riskiness of banks. We argue that, while borrowers may determine the riskiness of their firms, it is banks who decide how much risk they ultimately want to take on. They do this, for example, by deciding how much to lend in total or whether or not to lend to risky industries. Banks also determine the risk of their loan portfolio through their lending standards, screening and monitoring efforts and through loan restrictions. To allow for this, we introduce in a model with a lending channel as in BdN the possibility for banks to select among different types of borrowers. Thus, we essentially allow for both a risk choice of borrowers as in BdN and a risk choice for banks.

We find that this alteration reverses the stability effect of the lending channel. The reason is as follows. Banks can be thought of as having an optimal amount of risk they want to take on, which balances higher returns when they survive with the costs of a larger probability of default. As a result, when borrowers become less risky because of lower lending rates, banks want to offset this effect on their balance sheet. In our model they do this by channeling lending to borrowers with riskier project types (for example, by

[1] See, among others, Keeley (1990), Allen and Gale (2000), Hellman, Murdock and Stiglitz (2000) and Repullo (2004).

increasing lending to high-risk industries).

In principal, as long as banks' optimal amount of risk does not change, this adjustment would perfectly neutralize the initial stability effect of safer borrowers. However, for the same reason that banks' risk-taking incentives increase when deposit rates rise, banks' desired risk-taking also increases when loan rates fall. Therefore, banks ultimately want to overcompensate the initial fall in their riskiness. Hence, allowing for banks' ability to adjust their risk, the lending channel may reinforce the deposit channel, rather than countering it.[2]

The empirical evidence on the relationship between competition in the banking sector and bank risk-taking is mixed. However, most papers do not distinguish between competition in the loan and the deposit market, and measure competition only indirectly.[3] In a recent paper, Jiménez, Lopez and Saurina (2007) develop a direct test of the lending channel by constructing a Lerner index of competition in the loan market. They find that loan market competition increases bank risk (as measured by the share of non-performing loans). This lends support to our argument that banks have an incentive to more than overcompensate any impact safer borrowers may have on their balance sheet.

We proceed as follows. In the next section we first provide a simplified exposition of the main argument. Section 3 then contains the full analysis of competition in the lending market. The final section concludes.

2 A Sketch of the Argument

Suppose there is a continuum of different types of entrepreneurs, indexed with k. Their projects either succeed and give a positive return, or fail and return nothing. Entrepreneurs can set the risk of their projects (denoted with s), where a higher s is associated with a lower probability of project success p. The project requires one unit of funds. Entrepreneurs have no funds of their own and have to borrow from a bank at an interest rate r.

An entrepreneur's risk choice s depends on two factors: the loan rate r and his type k. A higher loan rate causes him to increase project risk. This is because larger interest

[2] Other recent literature has extended the lending channel in different directions. Martínez and Repullo (2006) show that competition in the loan market may undermine bank stability by reducing banks' margins. They demonstrate that this can give rise to a U-shaped relation between competition and stability. Boyd, De Nicolo and Jalal (2006) study the empirical consequences of banks investing also in safe assets (besides loans). Hakenes and Schnabel (2007) find that competition in the lending market may induce banks to alter the correlation of the loans in their portfolio, with the effect potentially going either way.

[3] Nevertheless, the majority of the papers seem to support the traditional view of a negative relationship between competition and stability. For an overview of the empirical work see, for example, Boyd, De Nicoló and Jalal (2006) and Jiménez, Lopez and Saurina (2007).

payments reduce the entrepreneur's pay-off from success but do not affect his pay-off when the project fails (since he then defaults). Therefore he suffers less from the failure of the project and hence has an incentive to choose more risk. The new element we consider is that his risk choice also depends on his type k, where the convention is that a higher k is associated with more risk s. One can think of this heterogeneity in risk choices as being the result of entrepreneurs differing with respect to the risk-return trade-off of their projects or their risk preferences.

The timing is as follows. A bank first selects an entrepreneur k and sets the loan rate r. The loan rate depends on the level of concentration in the banking sector (which we denote with c) such that the bank can set a higher loan rate when the banking sector is more concentrated (less competitive). Next, the entrepreneur chooses risk s (which is unobservable). Afterwards, the bank raises funds at rate r^D through deposits to finance the loan. The bank's return when the entrepreneur's project survives is hence $r - r^D$. When the project fails, the entrepreneur cannot pay back. The bank then defaults and its pay-off is zero. Hence, the bank's overall expected return is

$$\pi = (r - r^D)p(s). \tag{1}$$

We first demonstrate the argument of BdN. Their result obtains for a given k. The riskiness of the bank is then solely determined by the entrepreneur's risk choice s. An increase in competition in the banking sector lowers the interest rate r the bank can charge. This in turn raises the entrepreneur's gains from project success and causes him to choose lower risk (s declines), which improves the stability of the bank.

Suppose now that the bank can choose among the entrepreneurs. For a selected type k, the loan rate r the bank can charge is determined by the level of concentration. Thus, also the entrepreneur's risk choice s (which depends on k and r) is determined. Hence, one can alternatively view the bank's problem as one of choosing an optimal s through an appropriate selection of k. In particular, one may consider a function $k(s)$ which gives the k that has to be selected by the bank in order to obtain a risk choice of s. Since entrepreneurs with higher k choose higher risk, we have $k'(s) > 0$ (primes denote total derivatives with respect to induced risk s). There is also a function $r(s)$, which gives the interest rate that corresponds to a risk choice s (and thus an entrepreneur $k(s)$).

For a bank that optimizes over s, we can rewrite its return as

$$\pi(s) = (r(s) - r^D)p(s). \tag{2}$$

and its first order condition is

$$r'(s)p(s) = (r(s) - r^D)(-p_s) \tag{3}$$

(where subindices denote partial derivatives). The left hand side of (3) represents the bank's marginal benefits from higher risk s. They arise because high entrepreneurial risk is associated with high interest rates ($r'(s) > 0$) and thus large gains for the bank when the project succeeds. The right hand side gives us the marginal costs of risk. When the bank induces a higher s (by choosing a higher k) the likelihood of project success is reduced ($p_s < 0$). Hence, there are less states in which the bank receives the payoff $r(s) - r^D$.

The impact of competition is as follows. As before, competition reduces the interest rate r, hence $r(s)$ falls. This lowers the bank's return from project success ($r(s) - r^D$ falls) and reduces the bank's marginal costs of risk-taking (the right hand side of (3) declines). Bank's risk-taking incentives (for a given s) thus increase. Hence, the bank will respond with inducing a higher s, which is achieved by switching to more risky entrepreneurs.

3 The Model in Detail

Our model is based on BdN but there are also differences. As already mentioned, we introduce the possibility for banks to choose between different types of entrepreneurs (but entrepreneurs still determine the risk level of their projects, as in BdN). Moreover, we shut down the traditional channel by assuming that interest rates in the deposit market are given. We can thus isolate the effect of competition in the lending market (incorporating the traditional channel would only strengthen our results). It also serves to simplify the analysis by allowing us to keep the number of projects financed by a bank constant. Finally, we model competition differently. In BdN increased competition is due to an increase in the number of banks that compete in a Cournot fashion. Since we have a continuum of entrepreneur types here (rather than a single type as in BdN), this setup would pose some technical difficulties because banks would then play Cournot in a large number of (interacting) markets. Instead, we model more intense competition through declining switching costs for entrepreneurs when they want to move to another bank.

3.1 Setup

There are two dates (0 and 1) and three classes of agents: depositors, entrepreneurs and banks. All agents are risk neutral. Depositors are insured, so their required interest rate is risk-insensitive. Hence a bank can raise funds at a constant rate r^D (this rate may also include a (flat) deposit insurance premium). Entrepreneur-types k are from a continuum $[k_{\min}, k_{\max}]$. An entrepreneur k's project pays in the case of success $s - k$, and zero otherwise. The probability of success is given by $p(s)$ with $p_s < 0$. Entrepreneurs can choose s, that is the risk of the project. The following conditions on $p(s)$ ensure concavity of the entrepreneur's problem: $p(0) = 1$, $p(\overline{s}) = 0$ and $p_s < 0$, $p_{s,s} < 0$ on $s \in [0, \overline{s}]$. Because of lower benefits in the case of project success, an entrepreneur with higher k, ceteris paribus, chooses higher risk s.[4,5] The projects in BdN would obtain if k were the same for all entrepreneurs (and specifically set to zero).

There is a single bank which has the capacity to process one loan application (for example because of limited screening capacities). Without processing the loan application, repayment on the loan would be zero. The bank can thus only finance one entrepreneur. At an intermediate stage, there is potential entry by another bank who can make a competing loan offer for the entrepreneur.[6] If the entrepreneur switches banks at this stage, he incurs costs $c > 0$.

The timing of the model can be summarized as follows. At date 0, the bank chooses an entrepreneur k and processes his loan application. The bank subsequently makes a loan offer r to the entrepreneur. Afterwards, the potential entrant (seeing the offer of the bank) can make a competing offer $\widetilde{r}$ (this can be interpreted as entrepreneurs 'shopping around' with their first loan offer). The entrepreneur then decides which offer to take and chooses risk s. At the last stage, the winning bank raises one unit of deposits at rate r^D. At date 1, the state of nature realizes. When the project fails, the entrepreneur, and as a result also the bank, default. When the project succeeds, returns are consumed by the respective agents.

3.2 Solution

We solve the model backwards. The last decision is the entrepreneur's risk choice. Given loan rate r and his type k, he chooses s to maximize the expected pay-off from the project net of the interest rate payment

$$(s - k - r)p(s). \tag{4}$$

Note that potential switching costs c are sunk at the time and do not affect the optimal s. The corresponding first order condition is

$$p + (s - k - r)p_s = 0. \tag{5}$$

[4] Note that the expected return on a project is declining in k (for a given s). Thus, our setup allows for a natural bias against selecting higher risk entrepreneurs when competition increases.

[5] An alternative interpretation of k is that it is the part of an entrepreneur's project risk that can be influenced through the loan contract (for example, through covenants and collateral). Yet another interpretation is that k stands for (lower) monitoring and screening efforts.

[6] Equivalently, there could be many banks (each having limited loan processing capacities) which compete for each others' customers.

We write $s = s(r, k)$ to indicate the dependence of the entrepreneur's choice of s on r and k. From $p_s < 0$ and $p_{s,s} < 0$ it follows that $\frac{ds(r,k)}{dr} \geq 0$ and $\frac{ds(r,k)}{dk} > 0$, that is risk increases both in r and k.

In the preceding stage, the entrepreneur chooses whether to switch to the entrant. Given switching costs c he stays at his bank if

$$(s(r) - k - r)p(s(r)) \geq (s(\widetilde{r}) - k - \widetilde{r})p(s(\widetilde{r})) - c \tag{6}$$

i.e., if his pay-off from staying is not below the pay-off from accepting the entrant's offer and incurring the switching costs.

In the second stage, loan rates are set. The lowest interest rate the entrant can set without making a loss is $\widetilde{r} = r^D$, that is to offer the deposit rate. We denote with $s^D = s(r^D)$ an entrepreneur's risk choice when the loan rate is r^D, and with u^D his resulting pay-off (gross of any switching costs). From (4) and (5), s^D and u^D are defined by

$$p(s^D) + (s^D - k - r^D)p_s(s^D) = 0 \tag{7}$$

$$u^D := (s^D - k - r^D)p(s^D). \tag{8}$$

Thus, the entrant can offer the entrepreneur a (net) pay-off of up to $u^D - c$. Therefore, the maximum interest rate r the (incumbent) bank can set without losing the entrepreneur fulfills

$$(s - k - r)p(s) = u^D - c \tag{9}$$

Recall that $s = s(r)$, that is the loan rate affects the entrepreneur's risk choice. In principal, it may hence be optimal for the bank to set an interest rate lower than this maximum one. However, we assume that this is not the case because competition from the entrant would then not be binding.[7]

Finally, in the first stage the bank selects the type of entrepreneur it wants to finance. Specifically, it chooses k to maximize its expected returns

$$\pi = (r - r^D)p(s) \tag{10}$$

subject to r and s fulfilling (5) and (9). Note that although k has no direct influence on profits, it has an indirect one through the interest rate r and the risk choice s. In the case of s it can be seen from (5) that k affects s both directly, and indirectly through the impact of k on r.

[7] Note that competition always becomes binding when c is sufficiently small because the maximum interest rate then becomes close to r^D.

3.3 Competition and Bank Risk-Taking

To analyze the impact of competition it is useful to restate the bank's optimization problem. Since a bank's choice of k maps into a risk choice s, we can also consider the bank's problem as one of choosing s in order to maximize π. The entrepreneur who needs to be selected to induce a certain s, and the interest rate that results from this choice, are implicitly defined by (5) and (9). We write $k(s)$ and $r(s)$ in the following to indicate the k and r that correspond to a risk choice s.

Consider now the impact of a small change in (induced) risk on bank's equity, i.e., the bank's marginal gains from risk-taking. From (10) we have

$$\pi'(s) = r'(s)p + (r - r^D)p_s. \tag{11}$$

We want to show that a reduction in c (that is, an increase in competition) raises risk-taking s. For this we derive that the bank's marginal risk-taking gains $\pi'(s)$ at a given $s = \overline{s}$ increase when c falls. This amounts to showing that if the bank following a reduction in c (hypothetically) adjusts k such that its previous risk level $\overline{s}$ is restored, its risk-taking gains are still higher than before the reduction in c. From this it follows that a bank implements an s that is higher than the one that was optimal before the reduction in c.

Formally, we have to show that $\frac{d\pi'(\overline{s})}{dc} < 0$. From (11) we get

$$\frac{d\pi'(\overline{s})}{dc} = \frac{dr'(\overline{s})}{dc}p(\overline{s}) + \frac{dr(\overline{s})}{dc}p_s(\overline{s}). \tag{12}$$

since $d(p(\overline{s}))/dc = 0$ and $d(p_s(\overline{s}))/dc = 0$.

Lemma 1 *We have* $\frac{dr'(\overline{s})}{dc} = 0$ *and* $\frac{dr(\overline{s})}{dc} = \frac{1}{p(s^D)} > 0$.

Proof. *1.* $\frac{dr'(\overline{s})}{dc} = 0$*: Rearranging the entrepreneur's first order condition (equation 5) for* r *gives*

$$r = s - k + \frac{p}{p_s}. \tag{13}$$

Taking the total derivative with respect to s *yields*

$$r'(s) = 1 - k'(s) + \frac{p_s^2 - pp_{s,s}}{p_s^2}. \tag{14}$$

The total derivative of (14) with respect to c *(holding* s *constant at* $\overline{s}$*, that is,* k *implicitly changes) is*

$$\frac{dr'(\overline{s})}{dc} = -\frac{dk'(\overline{s})}{dc}. \tag{15}$$

Combining the entrepreneur's first order condition (5) and the interest rate determination equation (9) to eliminate $s - k - r$ *and solving for* u^D *gives*

$$u^D = -\frac{p^2}{p_s} + c. \tag{16}$$

Totally differentiating (16) with respect to s gives

$$u_k^D k'(s) = \frac{-2pp_s^2 + p^2 p_{s,s}}{p_s^2}. \tag{17}$$

Since $u_k^D = -p(s^D)$ *(from 8) we get for* $k'(s)$ *that*

$$k'(s) = \frac{-2pp_s^2 + p^2 p_{s,s}}{-p(s^D)p_s^2}. \tag{18}$$

Note that $k'(s) > 0$ *(since* $p_{s,s} < 0$*), confirming that when the bank wants to induce more risk, it has to pick an entrepreneur with higher* k*. It follows from (18) that* $\frac{dk'(\overline{s})}{dc} = 0$ *and hence from (15) that* $\frac{dr'(\overline{s})}{dc} = 0$*.*

2. $\frac{dr(\overline{s})}{dc} = \frac{1}{p(s^D)}$*: Taking the total derivative of (13) with respect to* c *(holding* s *constant) gives*

$$\frac{dr(\overline{s})}{dc} = -\frac{dk(\overline{s})}{dc}. \tag{19}$$

Totally differentiating (16) with respect to c *(again, holding* s *constant) yields*

$$u_k^D \frac{dk(\overline{s})}{dc} = 1. \tag{20}$$

Solving for $\frac{dk(\overline{s})}{dc}$*, inserting into (19) and using* $u_k^D = -p(s^D)$ *we obtain* $\frac{dr(\overline{s})}{dc} = \frac{1}{p(s^D)}$*.* ■

Hence we have with (12) that $\frac{d\pi'(\overline{s})}{dc} < 0$, that is risk-taking increases when competition intensifies. The reason is that competition leaves the bank's marginal benefits of risk unaffected ($\frac{dr'(\overline{s})}{dc}p(\overline{s}) = 0$) but reduces its marginal costs ($\frac{dr(\overline{s})}{dc}p(s) > 0$). The latter is because a lower c erodes the bank's monopoly power and forces it to reduce the interest rate r, which in turn makes risk-taking more desirable.

4 Conclusions

Understanding the relationship between competition and banking stability is of paramount importance for designing banking regulation and may ultimately help to mitigate the risk of financial crises. The traditional view has held that competition in the banking sector is detrimental for stability since it tends to increase deposit rates and thus erodes the franchise value of banks. Recent literature has challenged this view and has emphasized that there is a counteracting channel, which operates through the loan market. The argument is that competition among banks tends to reduce loan rates, which makes borrowers safer precisely for the same reason that banks become riskier when deposit rates rise.

In this paper we have shown that when banks have control over their risk-taking, the stability impact of lending market competition reverses. This is because banks have an optimal amount of risk they want to hold and thus want to offset the impact of safer borrowers on their balance sheet by taking on more risk. Since competition in the loan market at the same time erodes banks' franchise values, they even want to overcompensate the impact of safer borrowers because their risk-taking incentives increase.

Banks arguably have plenty of opportunities to modify their risk-taking. They may direct lending to riskier projects (as in our model) but may also raise risk through various other channels, such as by weakening lending standards, reducing monitoring and screening efforts or lowering loan restrictions. There are also many ways for banks to adjust their risk beyond their loan portfolios. For example, they can invest more in risky (non-loan) assets or increase leverage. We thus conclude that under plausible conditions the lending channel may reinforce the adverse impact of deposit market competition on stability, rather than countering it. Recent empirical work supports this view by showing that lending market competition increases bank risk, suggesting that banks more than offset any potential effect safer borrowers may have on their balance sheet.

References

[1] Allen, F. and D. Gale: 2000, *Comparing Financial Systems.* Cambridge, MA: MIT Press.

[2] Boyd, J. and G. De Nicoló: 2005, 'The Theory of Bank Risk Taking and Competition Revisited'. *Journal of Finance* **60**, 1329–1343.

[3] Boyd, J., G. De Nicoló, and A. Jalal: 2007, 'Bank Risk-Taking and Competition Revisited: New Theory and New Evidence'. *IMF Working Paper No. 06/297.*

[4] Hakenes, H., I. Schnabel: 2007, 'Bank Competition and Capital Regulation'. *mimeo, Max Planck Institute Bonn.*

[5] Hellman, T., K. Murdock, and J. Stiglitz: 2000, 'Liberalization, Moral Hazard in Banking, and Prudential Regulation: Are Capital Requirements Enough?'. *American Economic Review* **90**, 147–165.

[6] Jimenéz, G., J. Lopez, and J. Saurina: 2007, 'How Does Competition Impact Bank Risk Taking?'. *mimeo, Federal Reserve Bank of San Francisco.*

[7] Keeley, M.: 1990, 'Deposit Insurance, Risk and Market Power in Banking'. *American Economic Review* **80**, 1183–1200.

[8] Martínez, D. and R. Repullo: 2006, 'Does Competition Reduce the Risk of Bank Failure?'. *mimeo, CEMFI Madrid.*

[9] Repullo, R.: 2004, 'Capital Requirements, Market Power, and Risk-Taking in Banking'. *Journal of Financial Intermediation* **13**, 156–182.