

# Bank Mergers and Diversification: Implications for Competition Policy

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## Abstract

*This paper analyses competition and mergers among risk averse banks. We show that the correlation between the shocks to the demand for loans and the shocks to the supply of deposits induces a strategic interdependence between the two sides of the market. We characterise the role of diversification as a motive for bank mergers and analyse the consequences of mergers on loan and deposit rates. When the value of diversification is sufficiently strong, bank mergers generate an increase in the welfare of borrowers and depositors. If depositors have more correlated shocks than borrowers, bank mergers are relatively worse for depositors than for borrowers.*

**Keywords:** *risk aversion; imperfect competition; bank mergers; welfare of depositors and borrowers.*

**JEL classification:** *D43, G21, G32, G34.*

## 1. Introduction

Given the continuing consolidation trend in the banking sector, concerns are often raised about the effects of bank mergers on the competitiveness of the industry. A distinguishing feature in banking is the key role played by risk management. Banks have to control and select the risks inherent in the management of deposits and loans portfolios. Mergers may allow banks to diversify some of these risks and therefore affect the outcome of competition.

This paper formulates a simple modelling framework to analyse the role of risk and diversification in banking competition and to quantify the impact of mergers on the welfare of borrowers and depositors. The model has two main ingredients. First, banks are assumed to be risk averse or behave in a risk averse fashion. This assumption is in line with the evidence in Hughes and Mester (1998) who attribute the banks' choice of financial capital (above the cost-minimising level) to risk aversion. Risk averse banks can improve their protection against financial risks by merging with other banks. Through

mergers, banks can achieve a larger scale, increase their geographical scope, and offer a more diverse mix of financial services.<sup>1</sup> In addition, better diversified banks may take on additional risks, by holding riskier loans or reducing equity ratios (Demsetz and Strahan, 1997).

Second, banks are imperfect competitors in the markets for loans and deposits. Following the Monti-Klein framework, we model banks as financial intermediaries that grant loans and collect deposits. A limited number of banks set loan and deposit rates independently. Subsequently, borrowers and depositors endowed with different preferences choose the bank to which they supply and from which they demand funds. We extend the oligopolistic version of the Monti-Klein model of banking competition to accommodate the several types of risk that are present in the banking sector. For example, in our setting banks are subject to interbank rate risk (which affects them all) and to the default risk of a particular loan (which affects only one bank).

Our first contribution is the generalisation of the Monti-Klein model of banking competition to allow for uncertainty and risk aversion.<sup>2</sup> By assuming linear demand and supply systems and mean-variance preferences, we obtain a simple closed-form solution of the equilibrium. We show that the classic separation result between deposit and lending markets breaks down when the shocks in the loan and deposit markets are correlated. Furthermore, this setting allows us to analyse the impact of the different types of risk on the competitive behaviour of banks. For example, interbank rate risk induces banks to push deposit and loan rates in opposite directions (lower deposit rates and higher loan rates). In contrast, an increase in the expected interest rate pushes up both the optimal deposit and loan rates, as in the deterministic setting.

The second contribution is the analysis of the effects of bank mergers. Merged banks are able to diversify some of the risks and essentially reduce the risk cost associated with more borrowing or lending activity. When banks are imperfectly competitive, a cost reduction makes the merged bank more aggressive. In response to a tougher competitor, the rival banks have an incentive to cut back their activity to the benefit of the merged bank. Although rivals might offer fewer loans and collect fewer deposits, the reduction is compensated by the increased activity by the merged bank. As a result both lenders and borrowers might be better off as a result of the merger. The change in welfare for the two sides of the market crucially depends on the correlation of their respective shocks. If depositors have more correlated shocks – as when bank runs are a serious concern – bank mergers are worse for depositors than for borrowers.

This paper draws on recent developments in the industrial economics literature on the analysis of competition with risk averse firms. Asplund (2002) shows that risk-aversion induces quantity-competing firms to set lower quantities. Intuitively, risk-aversion increases the concern for low profit states (low demands or high costs) and induces the firm to perform well in those scenarios. And, indeed, both lower demands and higher costs induce firms to set lower quantities. From the technical point of view,

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<sup>1</sup> In the USA for example the ratio of equity capital (devoted to risk management) tends to be lower for larger banks (Hughes *et al.*, 1996, 2000). According to McAllister and MacManus (1993), the standard deviation of the rate of return on loans seems to fall dramatically beyond the \$1 billion mark in loan portfolios.

<sup>2</sup> See Pyle (1971) and Hart and Jaffee (1974) for early models of risk allocation by risk-averse financial intermediaries. With respect to these papers, our main innovation here is the addition of imperfect competition among intermediaries.

this paper extends the model developed by Banal-Estañol and Ottaviani (2006) to a setting with bilateral uncertainty and correlation across shocks.

In a recent paper, Carletti *et al.* (forthcoming) also analyse the impact of bank mergers on loan competition, but focus on the role of liquidity and reserve management. They build a model in which (risk-neutral) banks compete to provide long-term (deterministic) loans, while facing short-term uncertain deposit withdrawals. In their model, mergers allow banks to internally reshuffle reserves according to the liquidity shocks. As a result, merged banks are able to reduce reserve holdings and face lower financing costs and may ultimately reduce their loan rates.

The paper proceeds as follows. Section 2 introduces the model. Section 3 analyses the effects of risk aversion on bank competition. Section 4 studies the causes and consequences of bank mergers. Section 5 concludes.

## 2. Basic Model

### *Loans and deposits*

Following the oligopolistic version of the Monti-Klein model presented in Freixas and Rochet (1997), assume that  $n$  banks (indexed by  $i = 1, \dots, n$ ) compete in the market for deposits and loans. Each bank  $i$  is confronted with an (inverse) downward sloping demand for loans  $r_{l,i}(L_i, L_{-i})$  and an (inverse) upward sloping supply of deposits  $r_{d,i}(D_i, D_{-i})$ . It selects the amount of loans that it wants to offer,  $L_i$ , and the amount of deposits it wants to collect,  $D_i$ , and the loan and deposit rates adjust to equate supply and demand. Banks take into account not only the amount of loans,  $L_{-i}$ , and deposits,  $D_{-i}$ , offered by their rivals but also the effect of the quantity they offer on the rate they obtain.

The banking technology available to each bank is given by  $C_i(D_i, L_i)$ , which can be interpreted as the cost of managing a volume  $D_i$  of deposits and a volume  $L_i$  of loans. The difference between loans and deposits, the reserves,  $R_i = L_i - D_i$ , is divided into two: the cash reserves,  $T_i$ , and the net position on the interbank market,  $M_i$ . Contrary to interbank positions, cash reserves bear no interest. Hence, cash reserves are optimally chosen at the minimum level defined by the regulator,  $T_i = \alpha D_i$ , a proportion  $\alpha$  of deposits. As a result, the net position on the interbank market is given by  $M_i = (1 - \alpha)D_i - L_i$ .

Banks profits are given by

$$\pi_i = r_{l,i}(L_i, L_{-i})L_i + rM_i - r_{d,i}(D_i, D_{-i})D_i - C_i(D_i, L_i),$$

where  $r$  is the rate at which the Central Bank refinances commercial banks. For simplicity, we assume that this rate is equal to the interbank rate. Substituting the optimal net position in the interbank market,  $M_i = (1 - \alpha)D_i - L_i$ , profits are

$$\pi_i = [r_{l,i}(L_i, L_{-i}) - r]L_i + [r(1 - \alpha) - r_{d,i}(D_i, D_{-i})]D_i - C_i(D_i, L_i). \quad (1)$$

### *Uncertainty*

Different types of uncertainty are present in the banking industry. First, the interbank rate fluctuates. Therefore, it can be written as  $r = \bar{r} + \eta$  where  $\eta$  denotes the deviation

from its expected value,  $\bar{r}$ , with  $E(\eta) = 0$  and  $Var(\eta) = \sigma_\eta^2$ . Second, the demand and supply of funds might not be deterministic either. Widespread shocks, for example, may affect borrowers' or depositors' willingness to supply and demand funds. Idiosyncratic shocks on the other hand may affect borrowers' or depositors' preferences for one bank or the other. Fear of a *bank run* might generate a negative shock to a particular bank, whereas a *bank panic* may generate negative shocks correlated across the industry.

Assuming a linear demand for loans, a random intercept captures the presence of both systemic and idiosyncratic uncertainty,

$$r_{l,i}(L_i, L_{-i}) = a_l + v_{l,i} - L_i - b_l L_{-i},$$

where  $v_{l,i}$  has mean 0, variance  $\sigma_{v_l}^2$ , and correlation coefficient  $\rho_l$  with respect to  $v_{l,j}$  for any  $j \neq i$ .<sup>3</sup> As a particular example, the banks may be subject to a common shock only. This happens when  $v_{l,i} \equiv v_{l,j}$  for any  $i$  and  $j$ , i.e. when  $\rho_l = 1$ . As a second example, the banks may be subject to distributional uncertainty only,  $v_{l,i} \equiv \theta_{l,i} - \frac{1}{n} \sum_{j=1}^n \theta_{l,j}$  where  $\theta_{l,i}$  are independently identically distributed idiosyncratic shocks with mean 0 and variance  $\sigma_{\theta_l}^2$ . In this formulation, the total market demand is deterministic ( $\sum_{i=1}^n v_{l,i} \equiv 0$ ) for any number of banks  $n$ , but the allocation of this demand to the banks is uncertain.<sup>4</sup> In this second example,

$$\sigma_{v_l}^2 = \frac{n-1}{n} \sigma_{\theta_l}^2 \quad \text{and (for } n > 1) \quad \rho_l = -\frac{1}{n-1}.$$

More generally,  $v_{l,i}$  represents a shock in the willingness to pay for the particular type of loan offered by bank  $i$ .

Similarly, we allow for common and/or distributional uncertainty in the linear supply of deposits,

$$r_{d,i}(D_i, D_{-i}) = a_d + v_{d,i} + D_i + b_d D_{-i},$$

where  $v_{d,i}$  has mean 0, variance  $\sigma_{v_d}^2$ , and correlation coefficient  $\rho_d$  with respect to  $v_{d,j}$  for any  $j \neq i$ . Additionally, the demand and supply of funds in a particular bank could also be correlated. Indeed, bad news about the viability of a particular bank might not only discourage the supply of deposits but also depress the demand for loans. We denote the (symmetric) correlation coefficient of  $v_{l,i}$  and  $v_{d,i}$  for any  $i$  by  $\rho_{l,d}$ .

Finally, the cost of supplying loans and deposits might also be random due, for example, to uncertain management costs or to unpaid loans. Assuming again a linear cost function, the constant marginal costs of loan and deposit management can be written respectively as  $c_l + \gamma_{l,i}$  and  $c_d + \gamma_{d,i}$ , with  $E(\gamma_{l,i}) = E(\gamma_{d,i}) = 0$  and  $Var(\gamma_{l,i}) = \sigma_{\gamma_l}^2$  and  $Var(\gamma_{d,i}) = \sigma_{\gamma_d}^2$ .

<sup>3</sup> The parameter  $b_l \in [0, 1]$  represents the degree of product relatedness, with  $b_l = 0$  corresponding to unrelated products and  $b_l = 1$  to homogenous products. Implicitly, we are assuming that lenders not only care about the loan rate but also about other loan or bank characteristics. Linear demands for loans can be obtained from quadratic utility functions with different tastes for the different loans offered – see Banal-Estañol and Ottaviani (2006) for a detailed derivation.

<sup>4</sup> Clearly, the demand of a monopoly bank is deterministic:  $v_{l,i} \equiv 0$  for  $n = 1$ .

*Bank's objective*

A bank's profits (1) can be rewritten as

$$\pi_i = [a_l + v_{l,i} - L_i - b_l L_{-i} - (\bar{r} + \eta)]L_i - (c_l + \gamma_{l,i})L_i + [(\bar{r} + \eta)(1 - \alpha) - a_d - v_{d,i} - D_i - b_d D_{-i}]D_i - (c_d + \gamma_{d,i})D_i.$$

Notice that this expression can be reinterpreted as if it was derived from a model with uncertain demand and deterministic costs. Indeed, the demand functions can be rewritten as  $r_{l,i}(L_i, L_{-i}) = a_l + v_{l,i} - \gamma_{l,i} - L_i - b_l L_{-i}$  and  $r_{d,i}(D_i, D_{-i}) = a_d + v_{d,i} - \gamma_{d,i} - D_i - b_d D_{-i}$  and the costs as  $C_i(D_i, L_i) = c_l L_i + c_d D_i$ . Therefore, for notational simplicity, we normalise cost uncertainty by setting  $\gamma_l \equiv 0$  and  $\gamma_d \equiv 0$ . As a result,

$$\pi_i = [a_l + v_{l,i} - L_i - b_l L_{-i} - (\bar{r} + \eta)]L_i - c_l L_i + [(\bar{r} + \eta)(1 - \alpha) - a_d - v_{d,i} - D_i - b_d D_{-i}]D_i - c_d D_i.$$

Following the results of Hughes and Mester (1998), we assume that the banks are risk-averse. For simplicity, we assume that they have identical mean variance preferences over their (random) profits,  $U(\cdot) = E(\cdot) - \frac{R}{2} Var(\cdot)$ , where  $R$  is the coefficient of risk aversion.<sup>5</sup>

**3. Analysis of Competition**

Specialising the model to the case with homogenous products ( $b_d = b_l = 1$ ), each bank solves

$$\max_{L_i, D_i} E(\pi_i) - \frac{R}{2} Var(\pi_i), \text{ where}$$

$$E(\pi_i) = [a_l - L_i - L_{-i} - \bar{r}]L_i - c_l L_i + [a_d + \bar{r}(1 - \alpha) - D_i - D_{-i}]D_i - c_d D_i$$

$$Var(\pi_i) = (\sigma_{v_l}^2 + \sigma_{\eta}^2)L_i^2 + [(1 - \alpha)^2\sigma_{\eta}^2 + \sigma_{v_d}^2]D_i^2 + 2D_i L_i \rho_{l,d} \sigma_{v_l} \sigma_{v_d}, \tag{2}$$

for given expectations of the amount of loans,  $L_{-i}$ , and deposits,  $D_{-i}$ , offered by their rivals.

Our first result is that in the presence of uncertainty the loan and the deposit markets are interdependent. In the following proposition, we characterise the Nash equilibrium of this game.

*Proposition 1. In the unique equilibrium, each bank  $i = 1, \dots, n$  offers an amount of loans equal to*

$$L^* = \frac{(a_l - \bar{r} - c_l) [n + 1 + R(\sigma_{\eta}^2(1 - \alpha)^2 + \sigma_{v_d}^2)] - R\rho_{l,d}\sigma_{v_l}\sigma_{v_d} [\bar{r}(1 - \alpha) - a_d - c_d]}{[n + 1 + R(\sigma_{v_l}^2 + \sigma_{\eta}^2)][n + 1 + R(\sigma_{\eta}^2(1 - \alpha)^2 + \sigma_{v_d}^2)] - R^2\rho_{l,d}^2\sigma_{v_l}^2\sigma_{v_d}^2}$$

*and collects an amount of deposits equal to*

$$D^* = \frac{(\bar{r}(1 - \alpha) - a_d - c_d) [n + 1 + R(\sigma_{v_l}^2 + \sigma_{\eta}^2)] - R\rho_{l,d}\sigma_{v_l}\sigma_{v_d} (a_l - \bar{r} - c_l)}{[n + 1 + R(\sigma_{\eta}^2(1 - \alpha)^2 + \sigma_{v_d}^2)][n + 1 + R(\sigma_{v_l}^2 + \sigma_{\eta}^2)] - R^2\rho_{l,d}^2\sigma_{v_l}^2\sigma_{v_d}^2}.$$

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<sup>5</sup> Mean-variance preferences can be obtained from a constant absolute risk aversion (CARA) utility function with normal random shocks.

The optimal deposit rate is not independent on the loan market and the optimal loan rate is not independent of the deposit market. This result is in contrast with the classic separation result in the Monti-Klein model without uncertainty (see Freixas and Rochet, 1997). As shown by Dermine (1986), the separation result between credit and deposit markets may also break down under risk-neutrality provided that the loans and the banks themselves face default risk. Although the loan rate is independent of the deposit rate, the opposite is not true in the absence of deposit insurance. A bank can reduce deposit rates if it grants less loans because the probability of bankruptcy is also lower.

The separation result is re-established for the special case with zero correlation between loans and deposits. Substituting  $\rho_{l,d} = 0$  in the previous expressions, we obtain

$$L^* = \frac{a_l - \bar{r} - c_l}{n + 1 + R(\sigma_{v_l}^2 + \sigma_\eta^2)} \text{ and } D^* = \frac{\bar{r}(1 - \alpha) - a_d - c_d}{n + 1 + R[(1 - \alpha)^2\sigma_\eta^2 + \sigma_{v_d}^2]}. \tag{3}$$

The individual loan and deposit interest rates fluctuate with the realisation of the demands to meet the above quantities. Substituting (3) into the demand for loans, the expected loan rate, however, is symmetric,

$$E(r_{l,i}^*) = \frac{a_l[1 + R(\sigma_{v_l}^2 + \sigma_\eta^2)] + n\bar{r} + nc_l}{n + 1 + R(\sigma_{v_l}^2 + \sigma_\eta^2)}, \tag{4}$$

and substituting (3) into the demand for deposits, the expected deposit rate is

$$E(r_{d,i}^*) = \frac{n\bar{r}(1 - \alpha) + a_d[1 + R[(1 - \alpha)^2\sigma_\eta^2 + \sigma_{v_d}^2]] - nc_d}{n + 1 + R[(1 - \alpha)^2\sigma_\eta^2 + \sigma_{v_d}^2]}. \tag{5}$$

As in the deterministic setting, an increase in the expected interest rate  $\bar{r}$  pushes both the optimal deposit rate and the optimal loan rate up. The intuition, as we can see in the general profit function (1), is that increasing the expected interest rate has the same consequences as an upward shift in the demand for deposits and an upward shift in the marginal cost of loans. As a result, less loans will be offered and more deposits will be collected, as we can see in (3).

The level of interest rate uncertainty, on the other hand, affects the loan and deposit rates in opposite directions. While the deposit rate decreases, the loan rate increases with the level of uncertainty. Being risk averse, banks wish to perform relatively well in the event of a negative shock even if this hampers performance if the shock turns out to be positive. With respect to loan competition, although banks expect positive shocks to compensate the negative shocks,  $E(\eta) = 0$ , they give more weight at performing well in the event of a bad demand shock,  $\eta > 0$ , than in the event of a positive shock,  $\eta < 0$ . Similarly, they prefer to perform well in the case of a lower-than-expected demand shock,  $v_{l,i} < 0$ . Both effects induce banks to offer less loans and therefore push the loan rate upwards.

To see this, suppose that a bank faces a deterministic residual demand but an uncertain interbank rate. As illustrated in Figure 1, the interbank rate can be either high (i.e., equal to 4) or low (equal to 0) with equal probabilities. A risk neutral bank would optimally offer the optimal amount of loans (equal to 4) for the expected interbank rate (equal to 2). A bank that wishes to optimise performance in the worst case scenario, however, would select the optimal quantity for the case in which the interbank rate is high. If the bank were extremely risk averse, it would select a loan amount of 3. In general, higher

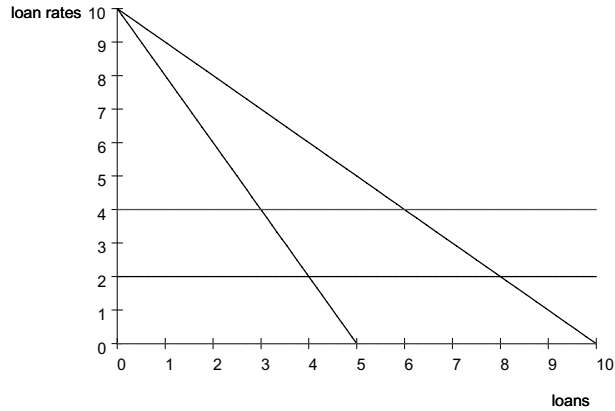


Fig. 1. Selection of optimal amount of loans in the presence of uncertainty in the interbank rate.

levels of risk aversion induce the bank to cut the level of outstanding loans, from 4 and down towards 3.<sup>6</sup>

Similarly, a bank that faces an uncertain demand for loans will also set lower quantities and therefore higher rates. Suppose, as shown in Figure 2, that the demand can be either high (i.e. with an intercept equal to 12) or low (equal to 8) with equal probabilities but interest rates are deterministic and together with marginal costs add up to 2. A risk neutral bank would offer a quantity of 4 and therefore the loan rate would fluctuate between 4 (if the demand is low) and 8 (if the demand is high). A risk averse bank, however, would select a lower quantity in order to increase profits when the demand is low.

In contrast, higher uncertainty pushes the optimal deposit rate downwards. Being risk averse, the bank wishes to perform relatively well in the event of a lower than expected interbank rate,  $\eta < 0$  (and, similarly, in the event of a higher-than-expected deposit demand shock,  $v_{d,i} > 0$ ). As we can see in Figure 3, a bank will tend to collect a quantity closer to 1 unit of deposits, the optimal deposit quantity for a low interbank rate (equal to 3), and more distant from 3 units, the optimal deposit quantity for the expected interbank rate (equal to 4). To collect a lower amount of deposits, the bank would set a lower deposit rate.

#### 4. Merger Analysis

In this section we extend our basic model to study bank mergers. Suppose that we add an additional stage in which, prior to competing in the market, a group of  $k$  banks (denoted by  $t = 1, \dots, k$ ) decide whether to merge. Following the approach of Salant *et al.* (1983), each bank compares the expected utility of merging with that of remaining independent, and agrees to merge if the former exceeds the latter. Since the merging banks are symmetric, they will unanimously agree on whether to merge or not. We are therefore checking when merging is a subgame perfect Nash equilibrium outcome.

<sup>6</sup> Equivalently, the bank would increase the loan rates above 6.

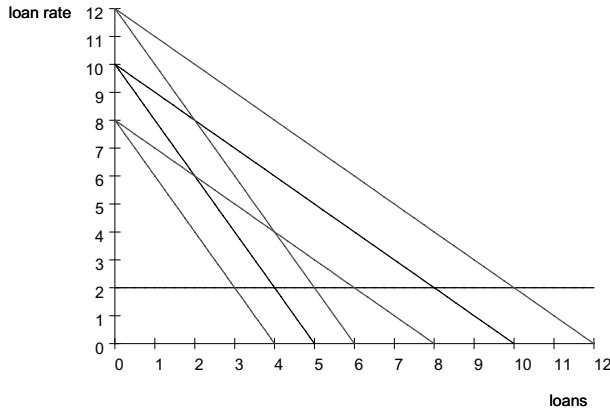


Fig. 2. Selection of optimal amount of loans in the presence of uncertainty in the demand for loans.

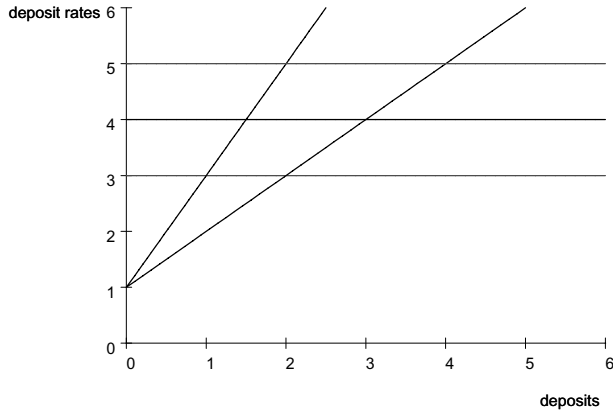


Fig. 3. Selection of optimal amount of deposits in the presence of uncertainty in the interbank rate.

4.1. Post-merger quantities

As shown in Banal-Estañol and Ottaviani (2006), the merging banks would optimally split the profits of the new company evenly, i.e. the merger should be a ‘merger of equals’.<sup>7</sup> Each of the merging parties, the insiders ( $t = 1, \dots, k$ ), wishes to select  $L_t$  and  $D_t$  such that

$$\max E \left( \frac{1}{k} \sum_{t=1}^k \pi_t \right) - \frac{R}{2} Var \left( \frac{1}{k} \sum_{t=1}^k \pi_t \right). \tag{6}$$

<sup>7</sup> Banal-Estañol and Ottaviani (2006) studies the terms of the agreement between merging firms, which should specify the allocation of fixed cash payments and shares of profits of the new company. If firms compete in quantities merging firms prefer to merge as equals, whereby the shares are evenly split and there is no fixed payment.



The remaining banks, the outsiders ( $o = k + 1, \dots, n$ ), maximize (2) as before. In the unique equilibrium the loan amounts offered are, respectively,

$$L_i^* = \frac{(a_l - \bar{r} - c_l)(S_l - 1)}{k(S_l P_l - 1)} \text{ and } L_o^* = \frac{(a_l - \bar{r} - c_l)[P_l - 1]}{(n - k)(S_l P_l - 1)}, \tag{7}$$

where  $S_l = 1 + [1 + R(\sigma_{v_l}^2 + \sigma_\eta^2)]/(n - k)$  and  $P_l = 2 + R([1 + \rho_l(k - 1)]\sigma_{v_l}^2 + k\sigma_\eta^2)/k^2$ .<sup>8</sup>

Similarly, the equilibrium deposit levels are, respectively,

$$D_i^* = \frac{(\bar{r}(1 - \alpha) - a_d - c_d)(S_d - 1)}{k(S_d P_d - 1)} \text{ and } D_o^* = \frac{(\bar{r}(1 - \alpha) - a_d - c_d)[P_d - 1]}{(n - k)(S_d P_d - 1)}, \tag{8}$$

where  $S_d = 1 + [1 + R(\sigma_{v_d}^2 + (1 - \alpha)^2\sigma_\eta^2)]/(n - k)$  and  $P_d = 2 + R[(1 + \rho_l(k - 1))\sigma_{v_l}^2 + k(1 - \alpha)^2\sigma_\eta^2]/k^2$ .

#### 4.2. Merger consequences

In this subsection, we analyse the impact of mergers on borrower and depositor welfare.<sup>9</sup> Comparing (7) and (3), the insiders offer more loans after the merger whenever

$$(1 - \rho_l)R\sigma_{v_l}^2 \geq k. \tag{9}$$

In the standard case with risk neutrality ( $R = 0$ ) or without demand risk ( $\sigma_{v_l}^2 = 0$ ), the insiders reduce production and therefore are better able to exploit their increased market power. In the presence of demand risk and risk aversion, a merger results in an increase in the risk-bearing potential of the insiders. A positive shock in one of the markets served by the merged entity may be offset by a negative shock in one of its other markets. Because of this diversification effect, the merged entity is more willing to take on risk by offering more loans.

Comparing (7) and (3), the outsiders increase their loan offers after the merger exactly whenever (9) is not satisfied. The outsiders' reaction, however, is never strong enough to compensate for the change of the insiders. The total production then increases whenever condition (9) is satisfied. Mergers bring about additional diversification gains which would not be feasible otherwise. Efficiencies gains from risk sharing are equivalent to cost synergies, as defined by Farrell and Shapiro (1990).

Similarly, comparing (8) and (3), the insiders offer more deposits after the merger whenever

$$(1 - \rho_d)R\sigma_{v_d}^2 \geq k. \tag{10}$$

As shown in Banal-Estañol and Ottaviani (2006), borrower and depositor welfare in this setting is defined by

$$CS_b = \frac{1}{2} \left( \sum_{i=1}^n L_i \right)^2 \text{ and } CS_d = \frac{1}{2} \left( \sum_{i=1}^n D_i \right)^2, \tag{11}$$

<sup>8</sup> Since  $S_l - 1 > 0$ ,  $P_l - 1 > 0$  and  $S_l P_l - 1 > 0$  all banks offer a positive amount.

<sup>9</sup> For the analysis of the impact of mergers on social welfare, see Banal-Estañol and Ottaviani (2006).

and therefore borrowers are better off when more loans are offered and borrowers are better off when more deposits are collected. Therefore, the next proposition follows straightforwardly from the previous analysis.

*Proposition 2. When firms are risk neutral, no merger increases borrower or depositor welfare. When firms are risk averse, mergers improve borrower and depositor welfare if and only if  $(1 - \rho_l)R\sigma_{v_l}^2 \geq k$  and  $(1 - \rho_d)R\sigma_{v_d}^2 \geq k$ , respectively.*

If the shocks are not perfectly correlated, for high enough levels of risk aversion, the merger reduces rates and benefits borrowers and depositors. Suppose for example that in the market for loans there is distributional uncertainty only. As we showed in Section 2, this implies that

$$\sigma_{v_l}^2 = \frac{n-1}{n}\sigma_{\theta_l}^2 \quad \text{and} \quad \rho_l = -\frac{1}{n-1}.$$

Hence, the merger benefits borrowers if and only if  $R \geq nk/(n+1)\sigma_{\theta_l}^2$ . On the other hand, if the shocks are perfectly correlated ( $\rho_l = 1$ ) then merger never increases borrower welfare.

If one has information on the relative levels of uncertainty and correlation of the demands for loans and the supplies of deposits, one could assess the relative effects of mergers to borrowers and depositors.

*Corollary 3. If depositors have more correlated shocks than borrowers, then a bank merger is worse for depositors than it is for borrowers.*

If, for example, bank runs (but not bank panics) are a serious concern then the supplies of deposits are likely to be more correlated than the demands for loans. In that case, our model predicts that a merger is more likely to increase deposit rates than loan rates and be therefore more detrimental for depositors than for borrowers.

### 4.3. Incentives to merge

In the absence of uncertainty, Salant *et al.* (1983) have shown that banks offering homogeneous loans and deposit services have limited incentives to merge. As a result of the merger the insiders become less aggressive and outsiders free ride on the insiders' attempts to raise loan rates and lower deposit rates. In uncertain markets, risk-neutral banks decide to offer and merge exactly as in models without uncertainty, with the only difference that variables are replaced by their expected values. The presence of risk aversion, however, makes merging banks more aggressive following the merger.

*Proposition 4. Mergers occur in a larger set of industry configurations for higher levels of risk aversion.*

The risk-bearing potential of merged banks is higher for any type of uncertainty. If there is perfect correlation, for example, the merged bank does not obtain any direct benefit from diversification but is nevertheless more aggressive in the product market, as if it had a superior production function (see the Appendix). The merging bank is larger and therefore better able to cope with the uncertainty present in the market. If the correlation is lower (as it is in the case of distributional uncertainty), the merging banks perform even better, because they are also able to diversify risk. This advantage

is amplified by the strategic effect on competitors, who become more reluctant to take risk.

Non-merging banks offer more loans and deposits than before the merger exactly when expected loan rates are higher and expected deposit rates are lower. Therefore, the lending and deposit activities will generate more profits whenever conditions (9) and (10) are satisfied, respectively.

## **5. Conclusion**

This paper introduces a framework for analysing the role of risk and diversification in banking competition and mergers. In our model with mean variance preferences, the willingness of an individual bank to take on an additional risky position on the deposit or loan side of the market depends on the bank's overall portfolio of positions. The twist with respect to the standard Capital Asset Pricing Model is that banks have market power, so that they take into account the effect of their positions on market prices (here, loan and deposit rates).

To illustrate the simple logic of this framework, we focus here on the case of quantity competition as in the oligopolistic version of the Monti-Klein model presented in Freixas and Rochet (1997). We obtain a closed-form characterisation of the equilibrium with a linear demand system. In this context, we show that the two sides of the market are separable provided that the shocks to the demand for loans are uncorrelated with the shocks to the supply of deposits. The welfare effects of mergers depends on the importance of diversification, which in turn depends on the variance of the shocks, their correlation and the banks' initial risk aversion. We show that bank mergers are relatively worse for depositors than for borrowers when depositors have more correlated shocks than borrowers.

Our results are consistent with Sapienza's (2002) empirical findings for Italy. In her data, mergers among banks with small market shares reduced loan rates, while mergers between large banks led to higher rates. These findings indicate that the increase in market power dominated cost synergies. Although part of these synergies may be due to operational cost savings, part might be due to risk diversification. More precisely, she finds that the small mergers' reduction in loan rates is higher when the merging banks operate in the same geographical area. If distributional uncertainty is important, the demand shocks within the same geographical area should be negatively correlated whereas the shocks across different geographical areas should not. As we show in the paper, a lower correlation is indeed more likely to induce a reduction in the loan rates.

Our setup can be extended to allow banks to compete in prices rather than in quantities. In that case, however, the behaviour in the loan and deposit market may be completely different. As shown by Asplund (2002), price-competing firms should react differently to different types of uncertainty. Risk averse firms should set higher prices if there is cost uncertainty but lower prices if there is demand uncertainty. Moreover, as shown by Banal-Estañol and Ottaviani (2006) for the case of uncorrelated shocks, banks may no longer prefer to merge as equals. With cost uncertainty, firms face a trade-off between diversification and strategic commitment and choose an asymmetric sharing rule (intermediate between takeover and merger of equals). As a consequence, the effects of bank mergers on borrower and depositor welfare may crucially depend on which type of uncertainty is more important. We leave a full investigation of this question to future research.

**References**

Asplund, M., ‘Risk-averse firms in oligopoly’, *International Journal of Industrial Organization*, Vol. 20, 2002, pp. 995–1012.

Banal-Estañol, A. and Ottaviani, M., ‘Mergers with product market risk’, *Journal of Economics & Management Strategy*, Vol. 15, 2006, pp. 577–608.

Carletti, E., Hartmann, P. and Spagnolo, G., ‘Bank mergers, competition and liquidity’, *Journal of Money, Credit, and Banking*, forthcoming.

Demsetz, R.S. and Strahan, P.E., ‘Diversification, size, and risk at bank holding companies’, *Journal of Money, Credit, and Banking*, Vol. 29, 1997, pp. 300–313.

Dermine, J., ‘Deposit rates, credit rates and bank capital’, *Journal of Banking and Finance*, Vol. 10, 1986, pp. 99–114.

Farrell, J. and Shapiro, C., ‘Horizontal mergers: an equilibrium analysis’, *American Economic Review*, Vol. 80, 1990, pp. 107–126.

Freixas, X. and Rochet, J.-C., *Microeconomics of Banking* (Cambridge and London: MIT Press, 1997).

Hart, O. and Jaffee, D., ‘On the application of portfolio theory to depository financial intermediaries’, *Review of Economic Studies*, Vol. 41, 1974, pp. 129–147.

Hughes, J.P., Lang, W., Mester, L. J. and Moon, C. G., ‘Efficient banking under interstate branching’, *Journal of Money, Credit, and Banking*, Vol. 28, 1996, pp. 1043–71.

Hughes, J. P., Lang, W., Mester, L. J. and Moon, C. G., ‘Recovering risky technologies using the almost ideal demand system: an application to US banks’, *Journal of Financial Services Research*, Vol. 18, 2000, pp. 5–27.

Hughes, J. P. and Mester, L., ‘Bank capitalization and cost: evidence of scale economies in risk management and signaling’, *Review of Economics and Statistics*, Vol. 80, 1998, pp. 314–25.

McAllister, P. H. and McManus, D. A., ‘Resolving the scale efficiency puzzle in banking’ *Journal of Banking and Finance*, Vol. 17, 1993, pp. 389–405.

Pyle, D., ‘On the theory of financial intermediation’ *Journal of Finance*, Vol. 26, 1971, pp. 737–47.

Salant, S. W., Switzer, S. and Reynolds, R. J., ‘Losses from horizontal merger: the effects of an exogenous change in industry structure on Cournot-Nash Equilibrium’, *Quarterly Journal of Economics*, Vol. 98, 1983, pp. 185–99.

Sapienza, P., ‘The effects of banking mergers on loan contracts’, *Journal of Finance*, Vol. 57, 2002, pp. 329–68.

**APPENDIX: Proof of Proposition 4**

To prove that more mergers take place when banks are more risk averse, we show that merged banks have a relatively better ‘technology’ as the risk aversion parameter increases. Here, technology refers to the costs associated with the uncertainty and risk aversion. From (2), before merging, each bank has a technology given by

$$T_{b,i} \equiv \frac{R}{2} \{ (\sigma_{v_i}^2 + \sigma_{\eta}^2) L_i^2 + [(1 - \alpha)^2 \sigma_{\eta}^2 + \sigma_{v_d}^2] D_i^2 \}$$

and therefore the merging banks combined have a technology given by  $T_b = T_{b,l} + T_{b,d}$ , where

$$T_{b,l} \equiv \frac{R}{2} (\sigma_{v_l}^2 + \sigma_{\eta}^2) \sum_{i=1}^k L_i^2 \text{ and } T_{b,d} \equiv \frac{R}{2} [(1 - \alpha)^2 \sigma_{\eta}^2 + \sigma_{v_d}^2] \sum_{i=1}^k D_i^2.$$

Substituting from (6), they have, as post-merger technology,  $T_a = T_{a,l} + T_{a,d}$ , where

$$T_{a,l} \equiv \frac{R}{2k} \left[ (\sigma_{v_l}^2 + \sigma_{\eta}^2) \sum_{i=1}^k L_i^2 + \rho_l \sigma_{v_l}^2 \sum_{t,j,t \neq j} L_t L_j \right],$$

and

$$T_{a,d} \equiv \frac{R}{2k} \left\{ [(1-\alpha)^2 \sigma_\eta^2 + \sigma_{v_d}^2] D_i^2 + \rho_l \sigma_{v_d}^2 \sum_{t,j,t \neq j} D_t D_j \right\}.$$

Suppose first that  $\rho_l = 1$ . Then

$$T_{b,l} - T_{a,l} = \frac{R}{2} \left\{ (\sigma_{v_l}^2 + \sigma_\eta^2) \sum_{i=1}^k L_i^2 - \frac{1}{k} \left[ (\sigma_{v_l}^2 + \sigma_\eta^2) \sum_{i=1}^k L_i^2 + \sigma_{v_l}^2 \sum_{t,j,t \neq j} L_t L_j \right] \right\}.$$

Rearranging we obtain

$$T_{b,l} - T_{a,l} = \frac{R}{2} \left[ \sigma_\eta^2 \frac{k-1}{k} \sum_{i=1}^k L_i^2 + \sigma_{v_l}^2 \sum_{t,j,t \neq j} (L_t - L_j)^2 \right] \geq 0.$$

Similarly, from  $T_{b,l} - T_{a,l} \geq 0$  we obtain  $T_b - T_a \geq 0$ . As we wanted to show, the technology is better after the merger and the difference increases as the risk aversion parameter increases. For lower levels of correlation,  $\rho_l \leq 1$ , the difference is even larger and it increases even more rapidly.