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Financial consolidation and liquidity: prudential regulation and/or competition policy?

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Editorial

On May 17-18, 2004 the National Bank of Belgium hosted a Conference on *"Efficiency and stability in an evolving financial system"*. Papers presented at this conference are made available to a broader audience in the NBB Working Paper Series (www.nbb.be).

Abstract

A model of loan rate competition with liquidity provision by banks is used to study bank mergers. Both loan rate competition and liquidity needs are seen to be "localised" phenomena. This allows for tracing down the effects of particular types of bank mergers. As such, we contrast the effects of "revenue base enhancing" mergers with the effects of mergers "for market power". The optimal post merger loan rate and risk management decisions are derived. The fundamental trade-off between stability and efficiency is often present, indicating that the approval of bank mergers induces difficult policy choices.

JEL-code : D 43, G 21, L 40 en G 28

Keywords: Bank Mergers, Merger Review Process, Liquidity, Loan Rates

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1. INTRODUCTION

Over the last decade, consolidation within the EU-financial services industry has been enhanced by deregulation, the EMU, new technologies with increased sunk costs, increased price competition and decreased product differentiation, see Heremans and Van Cayseele (1996), Heremans and Van Cayseele (1998), Gual (1999), Berger et. al. (1999) and Van Cayseele and Degryse (2000). The resulting outcome is often a very concentrated banking market, see ECB (2000) or Group of Ten (2001).

In such a concentrated banking market, concerns for the existence of market power vis-à-vis borrowers and depositors are justified. Also, the changes in liquidity management and funding induced by this consolidation wave evidently raise concerns regarding financial stability. More in particular when merged banks should decide to lower their precautions against liquidity shocks in view of a liquidity pool being created within the group, both individual banks and the system as a whole could become less stable.

If bank mergers invariantly increased market power and reduced precautionary actions taken within the banking system, the policy conclusions would be straight forward. Both the antitrust authority and the regulator in charge of prudential control would oppose consolidation. Unfortunately for policy making, bank mergers in reality also can reduce loan rates because of efficiency gains. Or the merged entity could have more firewalls against liquidity shocks. Therefore, it could well be that some interesting but difficult trade-offs between competition policy and prudential regulation occur.

Carletti and Hartmann (2002a) surveyed the competition stability nexus in banking and indicate that the widely accepted trade-off between competition and stability does not hold in general. They also show that in order to reach appropriate conclusions, one needs models that are able to address the effect of bank mergers on competition and liquidity directly.

In order to analyse the market power and liquidity implications of bank mergers directly, Carletti, Hartmann and Spagnolo (2002b), henceforth (CHS), extended the Deneckere-Davidson model, see Deneckere and Davidson (1985). This approach has many advantages and discloses interesting insights regarding the consequences of bank mergers. For a more detailed discussion, see section 2 below. Regarding the approach, the supermodularity of the loan rate competition game ensures the desire to engage in merger activity. An

additional advantage to the merging parties comes from gains on operating costs. Hence the model used incorporates some of the incentives to merge that are around in reality.

Any particular merger however will not incorporate all of the above incentives to the same extent. In practice, a distinction is often made between cost efficient versus revenue exchanging mergers, see HSBC James Capel (1997) for example. In line with the academic literature (for a survey, see Hunter and Wall (1989)), the present paper distinguishes between mergers that:

a. increase market power;
b. improve liquidity management by enhancing the revenue basis;
c. improve on operational cost efficiencies.

To illustrate the potential importance of the distinction between a and b type mergers, consider an economy with two manufacturing sectors, e.g. textiles and machinery, and four banks denoted by A, B, C and D. Due to specialisation in banking, a firm in the textile industry can borrow from bank A or B, while a firm in the manufacturing of machinery can apply for a loan at bank C or D. Clearly, when A and B merge, these banks can monopolize lending to the textile industry and exploit their market power to squeeze rent out of firms. But at the same time, when a particular firm in the textile industry needs credit and liquidity, probably other textile manufacturers will ask for the same. So increased market power comes at the cost of a worsening of the liquidity demand exposure.

In contrast, when A decides to merge with D, no market power results as a textile manufacturer can turn to B and a manufacturer of machinery to C instead of asking a loan from the merged group. If in addition liquidity demand in textiles and machinery is uncorrelated or negatively correlated, a merger between A and D will improve the liquidity position and funding of the group.

The maintained assumption in the present paper therefore is that sources of market power are equally sources of increased liquidity risk. Or the proximity in tastes (or sectoral specialization of the financial services industry) accounts for the elimination of substitutes in case of a merger between “adjacent” banks (which therefore is a cause of market power) but entails at the same time a positive correlation of liquidity demands.

In a subordinate way, we investigate mergers that create operational efficiencies, that is the mergers of type c above. We therefore consider a few types of bank mergers. The first type is motivated by an increase in market power over borrowers in a particular area or sector of

the economy. Such a merger allows the exploitation of market power but doesn't shelter the merged bank from the impact of a shock. A sub case of this type of merger incorporates operational cost savings that are typically documented for banks operating on the same revenue basis.

The second type has precisely the opposite characteristics: it combines borrowing to firms in entirely different activities, allowing the latter to turn to other banks, but improves upon the liquidity management possibilities of the group. As such, an interesting side product of the present paper is that not only the advantages to the merging banks of increased market power are determined endogenously, but also the cost efficiencies realised by a particular type of merger. Or in contrast to merger scenario's that arise from an exogenously determined decrease in operating cost, we incorporate cost savings resulting from a better pooling of reserves within a group. Since this merger type involves spreading activities over more regions or sectors, it would be classified in the management literature as a revenue enchanging merger. These mergers do not allow most of the time for operational cost savings, so a sub case incorporating these is not of much interest.

In order to explore the implications of correlated preferences for particular bank locations by borrowing firms asking for liquidity, we introduce a simple model of localized loan competition with liquidity shocks originating in the real part of the economy, see section 3 below. It turns out that some of the various types of mergers induce particular trade-offs between competition and stability, whereas others don't. By looking at the type of environment that is conducive to a particular type of merger, one could argue in favour of one of the very many organisations of the review process for bank mergers that are observed for the G-7 industrialised countries, as documented in Carletti and Hartmann (2002a). We will indicate which environments "rationalize" some of the particular organisations of merger review observed in reality.

The fourth section indicates how the maintained assumption put forward in the present paper can be extended to obtain other interesting models of banking competition and liquidity demand. An attempt to endogenize some elements of the interbank market is made, there by trying to shed light on the relative position of competition policy and prudential regulation. A final section concludes, see section 5. Before all of this, we provide a brief and directional survey of the relevant literature. This in order to indicate the importance of accounting for links between sources of market power and liquidity risk and to point out the similarities and differences between the present contribution and others.

2. SURVEY OF THE LITERATURE

There is a substantial literature on competition and mergers in banking, and a massive literature on the economics of competition in general. We however only discuss the contributions which are important to justify the present paper in subsection 2a below. There is an equally important and rapidly growing literature on financial crises, contagion, fragility, ….. . Also here only the elements of importance to this paper are represented, see subsection 2b below. Finally, regarding the combination of competition policy and prudential regulation issues, the contribution by CHS is seminal. Subsection 2c takes a closer look at that model.

2.a. Mergers, banking competition and antitrust issues

Over the last decade, few if any models of demand systems with equal cross price-elasticities of demand have been used for policy purposes. In such models, a price increase of a product or set of products due to a merger increases the sales of every other brand in the relevant market by the same percentage. In order to avoid such an unrealistic outcome, either the cross elasticities are estimated (as in the antitrust logit model, see Werden and Froeb (1994)), or a theoretical model of discrete consumer choice is written down and used for merger simulation purposes after calibration, see Werden and Froeb (2002)

It seems therefore appropriate to focus on mergers in banking markets where competition is localized, this in line with a long tradition of these models in the banking literature, see e.g. Matutes and Padilla (1994), Chiappori, Perez-Castrillo and Verdier (1995), Bouckaert and Degryse (1995) and Schargrodsky and Sturzenegger (2000). Recently, also empirical research more and more indicates the importance of distance in banking competition, see Degryse and Ongena (2003). The basic "Salop" type of specification of tastes used in the above references, see Salop (1979), therefore also will be the point of departure in the next section.

A final but important development comes out of the literature on competition policy and merger approval. It concerns the information that can be derived from parties proposing a *particular* merger in a world where many such operations are conceivable. The idea is that the proposed merger will be the one that yields the highest increase in profits to the merging parties. In some cases, this will be the most harmful to consumers, hence

'tougher" approval standards might be warranted, see Lyons (2002). In the present context, when different merger "types" are conceivable, i.e. mergers that increase market power and others that decrease the costs of liquidity management, it is worthwhile investigating the parameter values for which an efficiency-enhancing versus a loan rate increasing merger will be proposed. And taking the argument even one step further, one could argue that in the presence of a Central Bank that can influence particular parameters, the mergers that will be proposed should be investigated especially from an antitrust perspective. For the prudential regulator could always influence the market by particular interest rate instruments that it controls, stimulating particular merger types instead of others. We will investigate this line of argumentation in section 4 since it is a first step in modelling the interbanking market more completely.

2.b. Banks as liquidity providers and prudential regulation

The existence of banks as providers of liquidity is central to modern banking theory. In their seminal papers, Bryant (1980) and Diamond and Dybvig (1983) showed how banks can facilitate long term investment by providing demandable deposits to otherwise (possibly) impatient agents. They equally show how a particular equilibrium of the game involves a bank run, where both patient and inpatient depositors withdraw their holdings. More recently, some articles (e.g. Diamond and Rajan (2001) and Kashyap, Rajan and Stein (2002) have indicated that banks also provide liquidity to borrowers. If the liquidity demands on both sides of the balance are to some extent negatively correlated, important synergies can be exploited from a single buffer stock of liquid assets. These synergies allow banks to provide liquidity cheaper than any other "single product" operator in the market, and hence economies of scope existing in the production of liquidity constitute an additional explanation for the emergence of banks.

Along the same likes, Saidenberg and Strahan (1999) have recently documented interesting facts that both provide evidence in favour of the novel theory of banking by Kashyap, Rajan and Stein, and that allow for a re-interpretation of the present model. More in particular, Saidenberg and Strahan show that in periods of turmoil, rising interest rates reflect the increased uncertainty in the market. They further show, documented by empirical observations, that this well may lead to increased bank borrowing going hand in hand with more depositors turning to banks for providing a safe haven to their funds. The reason for firms to borrow more against their credit lines with banks follows from the higher interest rates paid on their securities placed in the open market in periods of turmoil.

If turmoil in one region then is independent or negatively corrected with the stability of another region or industry, an environment which closely resembles the one modelled below is in place.

There however exists an even simpler scenario for explaining the liquidity needs considered in the present paper. Suppose firms who experience a boom need cash instantaneously. This because they know inventories will not suffice to supply all that is demanded, while additional investments in equipment, storage facilities, a.s.o. also need to be made. Suppose firms foresee that a boom will realize, because the country in which they operate will organise the European Championship of a certain sport activity. It is however not known yet whether the infrastructure of one region or the other will be used. (Alternatively, firms know the country is which they operate has experienced an important growth in income, yet it is unclear whether the money will be spent on foreign travel (when the domestic weather conditions are bad) or cocooning (when the summer in the country turns out to be a success)).

Firms in order to meet demand will invariantly turn to their banks to open credit lines. Banks who compete with each other offer rates that need to the paid when credit is taken up. The boom then either realizes in one region (sector) or the other, and loan activity increases there.

In order to fund the loans when they realize, banks will secure core deposits to meet part of the loan demand, before hand. Once the loans realize, additional funding will be obtained either from a Lender of Last Resort or through the interbank market. This scenario is the one described in the managerial economic literature on banking, see for example Koch (1995) who explains that liquidity problems occur because of net deposit outflows which are mostly predictable. But:

> *"Still, some outflows are totally unexpected. Management often does not know whether customers will reinvest maturing CDs and keep the funds with the bank, or with draw them.* ***Management also cannot predict when loan customers will borrow against open credit lines.*** *This uncertainly increases the risk that a bank may not have adequate sources of funds available to meet payment requirements".*

Both elements mentioned are key to the model that will be presented below, since it includes the bank paying for core deposits to assure that a minimum of liquidity can be met by the bank when loans realize, whereas the liquidity deficits arise from firms borrowing against open credit lines.

Also Dewatripont and Tirole (1994) indicate how the notion of liquidity is strongly related to commitments taken by the bank. They explain that:

> *"**It may, for instance, be the case that many borrowers make simultaneous use of their credit lines with the bank.** It may also happen that a number of long-time borrowers request new loans and that the bank feels obligated to grant them for fear of letting the competition in."*

Finally, Allen and Gale (2000) have investigated the possibility for banks to insure against liquidity risks by holding interregional claims on other banks. This of course opens the door to financial contagion, a situation where a run at some bank triggers runs at other banks too. Such spillovers might be confined to the boundaries of a nation, but due to further globalisation and cross-border mergers, the contagion risk more and more becomes an international threat, see Heremans (2002) or Degryse and Nguyen (2003). The present paper investigates the "disconnected incomplete market structure" introduced by Allen and Gale, o.c., page 15. It considers interregional mergers as a substitute for interbank market contracts and as such incorporates some of the ideas put forward in the literature on contagion.

2.c. Bank mergers, competition and liquidity

As mentioned before, CHS (2002b) investigate the consequences of bank mergers on competition and liquidity management, hence combining some of the concerns addressed in subsections 2.a. and 2.b. above. They start from a game with Bertrand competition in loan rates, and with product differentiation regarding the loan contracts offered by banks. Deneckere and Davidson (1985) showed that for this particular model, incentives to merge out of market power reasons exist. Van Cayseele (2002) moreover shows that in this model, post merger entry is neither likely to discipline the merger so as to eliminate the advantages in terms of profit increases to the merging parties, nor to make up for the losses to consumers. The model presented in section 3 below departs from the same idea of investigating loan rate competition between banks in a model of Bertrand competition with product differentiation.

But as argued already, tastes are local rather than global, or preferences are "Kaldorean" rather than "Chamberlinean". Another difference mentioned already is that liquidity shocks are not confined to the depositors of a bank (each bank facing a liquidity shock stochastic in size), but instead they affect all borrowers in a particular region (or industry) of the

economy. While CHS consider no correlation or negative correlation between the post merger liquidity risks, here the shock either perfectly correlates in a positive or a negative way, according to the particular merger operation chosen.

A final difference with CHS concerns the balance sheet of the competing banks. In CHS, the focus is on the size of reserves held in liquid assets which don't pay any rent. This as opposed to loans for which banks have determined a loan rate in the presence of competitors who also did this. Both reserves and loans then are matched by attracting deposits which are paid a deposit rate. The fraction of impatient depositors withdraw their holdings, and if this volume is in excess of the liquid assets the banks hold in terms of reserves, the bank refinances itself in the interbanking market.

In the present model, the focus is on the management of the liabilities side of the balance sheet whereas the liquidity needs come from the asset side of the balance. On the asset side, by determining the loan rate in the presence of competitors, the volume of credit lines is fixed.

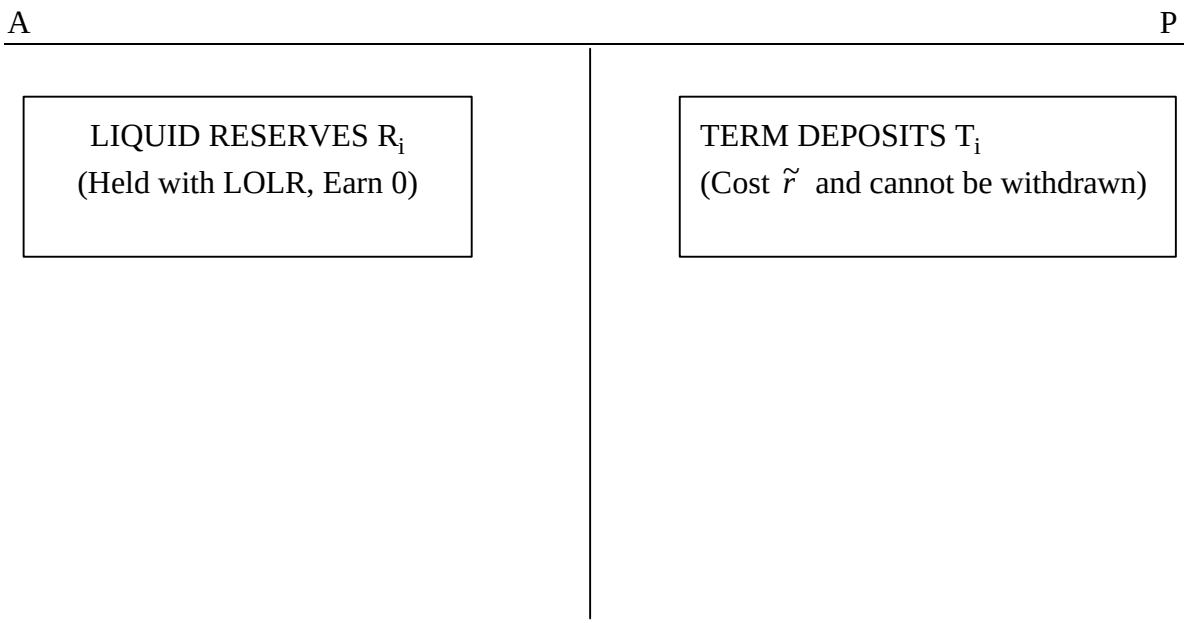
When firms start borrowing against these liquidity commitments made by banks, first the core deposits that have been secured by paying an interest rate will be exhausted. Afterwards, the bank will seek additional funding with the Lender Of Last Resort (LOLR).

Whenever the firms in the region (sector) in which the bank is active do not need cash, they will not borrow against the open credit lines. In which case the bank will transfer the core deposits it has attracted in the form of interest bearing time deposits to the LOLR, in terms of liquidity held in reserves.

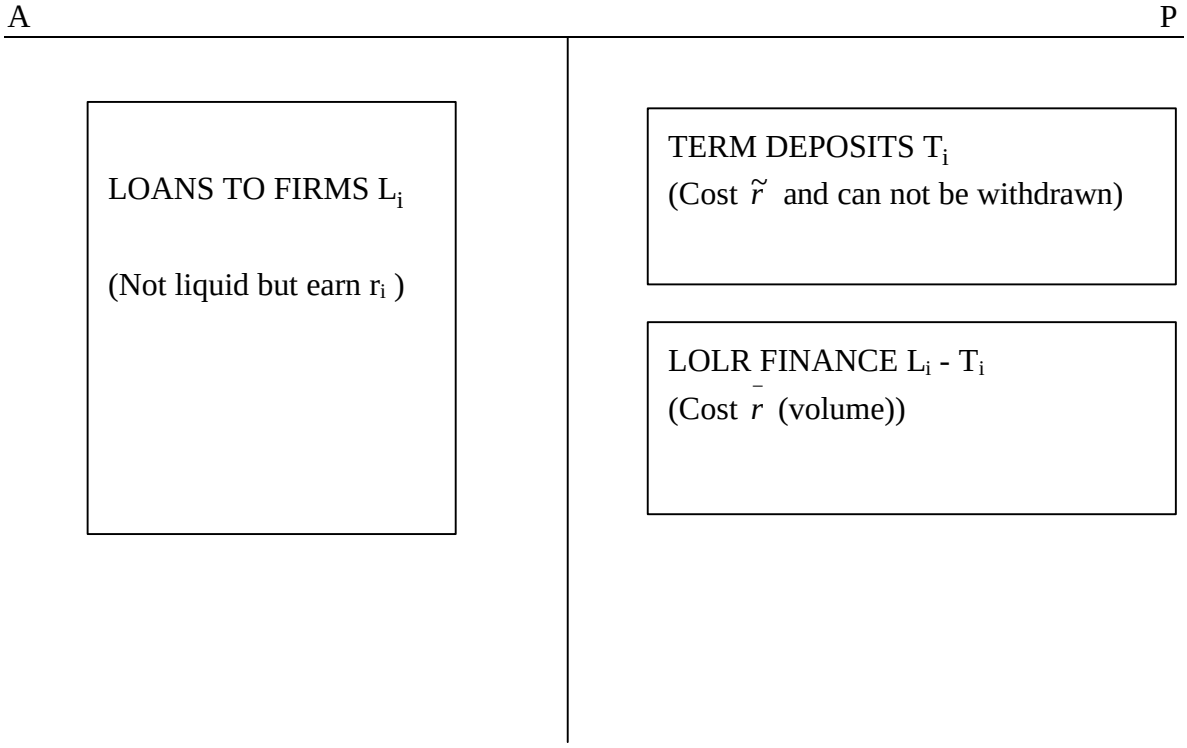
It is assumed that there is but a single LOLR who therefore can exert monopoly power to banks who seek additional funding, as well as monopsony power vis-a-vis banks who have accumulated liquidity for which they have no use. The balance sheet for bank i in region (sector) s then will depend on the state of the economy that realizes there. In figure 1, the possible outcomes are represented. Besides indicating where liquidity needs come from, this figure is helpful in getting acquainted with the notation used in the next section.

Figure 1: Balance sheets of bank i in region s

a) Economy is depressed in region s



b) Economy booms it region s



In the present model, the cost of obtaining additional funding depends on the volume of funds needed in a positive way. This could reflect the pricing policy of the LOLR, see section 4. In an alternative interpretation it could be a correction on the value of the loan portfolio of which some loans need to be sold off at important discounts in order to obtain the necessary funding.

Both in CHS and the present model, the rates paid for attracting deposits are given exogenously. Both CHS and the present model investigate the implications of mergers on two dimensions. First there is the aspect of market power. Both papers focus on the so-called “unilateral effects”, that is the non-cooperative equilibria of the one shot games are compared before and after merger. The increased market power is reflected in higher price cost margins or spreads between loan and deposit rates. (The policy analysis in the present paper also introduces the SSNIP-test in merger review, which nowadays is used often in the appraisal of mergers by several competition authorities. A more detailed discussion of the SSNIP-concept is provided below).

Second, the impact of the merger on liquidity is investigated in CHS by computing the probability that aggregate demand for liquidity exceeds aggregate reserves. The average size of the shortage is computed both in CHS and the present model as an indicator for the post-merger stability of the system as compared to the status quo without merger. The following table summarizes the similarities and differences of both models, while figure 2 highlights the most important differences in terms of how the assumptions made link up to the existing literature on banking competition and liquidity management.

Table 1: Similarities and Differences between the CHS model and the Present

	CHS	Present model
Loan Rates	Banks compete globally for loans	Banks compete locally for credit lines
Deposit Rates	Given exogenously	Given exogenously
Operational Costs	CRS, given exogenously. Can decrease as result of merger	CRS, given exogenously. Can decrease as result of merger
Additional Funding	Refunding on interbank market at exogenous rates	Additional funding with LOLR at exogenous rates, except in section 4
Liquidity Needs: Causes	Withdrawal of deposits. Idiosyncratic at bank level	Borrowing against credit lines. Idiosyncratic at regional level
Correlation of Needs	Independent or negative	Positive or negative depending on location
Stability Target	Average Liquidity Shortage on Interbank market	Average Liquidity Shortage that the LOLR has to put up
Competition Policy Target	Post Merger Loan Rates	Post Merger Loan Rates, formalised in SSNIP

CRS: Constant Returns to Scale

Figure 2: Position in the Literature of the Different Models

		TASTES	
		Chamberlinean	Kaldorian
LIQUIDITY SHOCKS	Liabilities Side of Balance Sheet: depositors withdraw	**CHS**	
	Asset Side of Balance Sheet: Borrowing firms take up credit		**Present Model**

The comparison in table 1 above indicates how both models are alike is many respects. There are however some differences too, and these will explain for different outcomes. An opportunity made available by the particular way of modelling here is the possibility to endogenously determine the size of a cost advantage associated with a particular merger. Whereas CHS distinguish between an operating cost (which decreases after merger hence capturing some scale effect) and "flat rate borrowing" on the interbanking market, we focus on LOLR lending at increasing rates in the volume of funds needed. This implies that mergers that enhance liquidity management possibilities entail endogenous cost savings. These are not present in merger operations that bring together banks operating in the same region or sector. The latter on the other hand have the advantage to increase market power and to potentially reduce operating costs. This introduces the trade-off in merger motivation that allows for the endogenization of the merger type that will come about .

In terms of the criteria used for merger evaluation, a decrease resp. an increase in the loan rate is an indication of reduced resp. increased market power. Regarding the liquidity demand on the system, the yardstick to compare pre-merger with post-merger outcomes is defined as the Expected Liquidity Shortage (*ELS*). This is the expected volume of funds that the Central Bank as a Lender of Last Resort (LOLR) has to create on top of the liquid reserves it has from the banks in the depressed region, in order to meet the liquidity needs of the banks in the booming region. A formal definition is given in the next section.

3. A SIMPLE MODEL OF SPATIAL COMPETITION IN A BANKING MARKET WITH LIQUIDITY SHOCKS

While the model presented and analysed in this section is simple, it has the advantage that it can cope with the research questions that have been raised in the previous section. As such it allows for the analysis of the implications of *particular* mergers in which some of them are driven by market power motives while others try to increase efficiency in liquidity risk management. It further allows to investigate which merger type is preferred, given the environment.

In the next subsection, the assumptions underlying the model are specified and the criteria used for policy analysis are explained. Then the model is analysed and the results are stated in the format of propositions. Finally, an indication of which particular organisation of the merger review process is likely to clear particular types of mergers is provided, as a conclusion to our analysis.

3.a. The model: assumptions

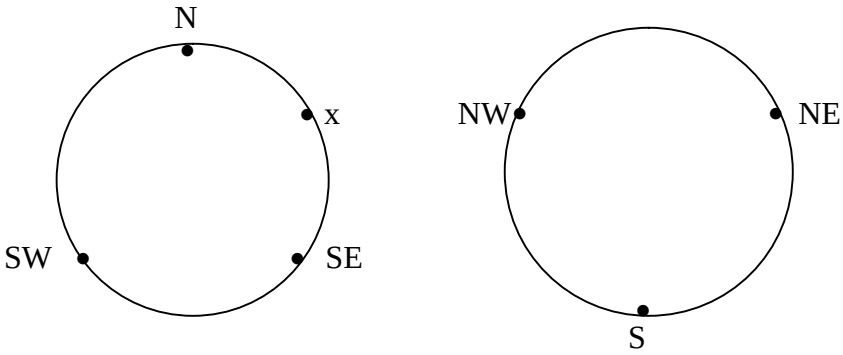
We consider an economy with 6 banks. (This easily can be extended to an economy with N banks). The economy consists of 2 distinct regions (or industries). Regions induce a gap in the chain of substitution in that firms (borrowers) located in one region of the economy will never consider obtaining a loan from a bank located in another region of the economy. This might reflect a pronounced specialization in monitoring loans, as suggested by the delegated monitoring theory of the nature of the bank, see Diamond (1984).

Within each region, firms a priori could consider opening a credit line with each of the 3 banks. (We assume banks split equally between regions which has the advantage that regions are symmetric while competition within each region still is “global”). Credit lines carry fixed limits against which firms can borrow, provided they pay the loan rate agreed upon. We normalize their size, setting them equal to 1. But since firms are uniformly distributed along a circle of length 3, and banks are equidistantly spread along the circle, in practice each and every firm will consider at most 2 banks to borrow from.

To save on notation, especially in later sections, we assume that in the Northern region, one bank is located at 0 degrees, and called the “North” bank. The “North” bank is in every

respect exactly the same as any other bank in this region. The other banks in the Northern region are located at resp. 120 and 240 degrees and called the South East and South West bank. In the Southern Region of the economy, the constituting bank in terminological aspect is the “South” bank, located at 180 degrees. The banks in this region are located at resp. 60 and 300 degrees, and called the North East and North West bank. See also figure 3.

Figure 3: Market Structure



Any firm located at x, i.e. between two banks, say the one located at 0 degrees and the one located at 120 degrees, derives indirect utility $v-(r_N+tx)$ when borrowing form the bank located at 0 degrees (the “North” bank) while it obtains $v-(r_{SE}+t(1-x))$ when borrowing from the bank located at 120 degrees (the “South East” bank).

In the above formula’s, t stands for a travelling cost firms incur per unit of distance travelled, and r_N and r_{SE} for resp. the interest rate charged by the North and South East bank. The reservation value v is assumed sufficiently high so as to keep the market covered at all times. The firm located at x will be indifferent between contracting with the North and South East bank when:

$$r_N+tx=r_{SE}+t(1-x) \tag{1}$$

This implies bank N will have a market share of

$$2x=(r_{SE}-r_N)/t+1 \tag{2}$$

Banks are affected by regional liquidity shocks. Whenever a liquidity shock hits a region, all open credit lines are used to borrow against. So if a shock hits the Northern region, banks N, SE and SW are confronted with all firms asking for liquidity. A shock either hits the Northern or the Southern region. This implies a perfect and positive correlation of liquidity shocks for banks N, SE and SW, and a perfectly negative correlation for liquidity shocks of the forementioned banks and banks S, NE and NW. To start, we assume that a shock comes up for sure, hence all banks are effected by liquidity demands up to the entire volume of open credit lines by probability θ if located in the North and $(1-q)$ if located in the South.[1]

Against these shocks, banks can insure by attracting term deposits T at rent $\tilde{r}$. In case of a liquidity shock, loans realize against open credit lines and banks will turn to the LOLR to obtain liquidity in excess of what they already have as the result of having attracted time deposits. We assume that the rate paid is an increasing function of the amount of liquidity needed, or $\bar{r}\,' > 0$. When a volume of liquidity equal to *y* is borrowed from the LOLR, the total cost of this operation is then given by:

$$\bar{r}(y)y \tag{3}$$

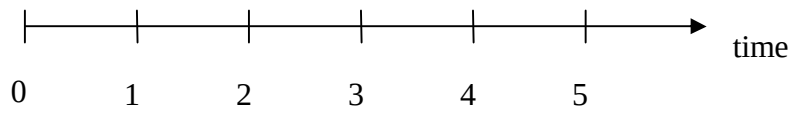
where $\bar{r}$ is an increasing function of y. In particular, we assume $\bar{r}(y) = \bar{r}y$.

On the other side of its balance sheet, the LOLR can exploit its monopsony power to attract the term deposits that have been collected by the banks in the region where liquidity is not needed at 0 cost. Or banks which secure term deposits before loans realize, have no alternative use for the liquidity built up, than to leave it as no interest bearing reserves with the Central Bank.

The time line for the model used therefore is given by figure 4 below.

[1] If θ differs from ½, an asymmetry between regions is introduced. Including a probability of a shock $p \in (0,1)$ in order to incorporate the possibility that shocks are less frequent, doesn't change the results.

Figure 4: Time Line of Decisions



1: Banks announce loan rates and secure term deposits.

2: Firms decide on identity of bank to open credit line.

3: State of the economy realizes.

4: Firms in the booming region lend against open credit lines.

5: Banks in booming region seek additional funding with LOLR while banks in the depressed region transfer funds to the LOLR.

Given all these assumptions, the profit functions to bank $i \in \{N, SE, SW\}$ is given by:

$$\Pi_i = q(r_i - c)\left(\frac{r_j - r_i}{t} + 1\right) - \tilde{r}T_i - q\bar{r}\left(\frac{r_j - r_i}{t} + 1 - T_i\right)\left(\frac{r_j - r_i}{t} + 1 - T_i\right) \quad (4)$$

where j ≠ i.[2]

Whereas for k ∈ {S, NE, NW}, expected profits are:

$$\Pi_k = (1-q)(r_k - c)\left(\frac{r_l - r_k}{t} + 1\right) - \tilde{r}T_k - (1-q)\bar{r}\left(\frac{r_l - r_k}{t} + 1 - T_k\right)\left(\frac{r_l - r_k}{t} + 1 - T_k\right) \quad (5)$$

Where k?l[3] and c is a constant per unit cost for processing loans.

Regarding the criteria used for policy making, the stability criterion used is the Expected Shortage of Liquidity (*ELS*). This is equal to the amount borrowed against credit lines which is not covered by the term deposits with the banks in the region which is hit by the liquidity shock minus the liquidity that can be transferred from the region which is not hit by the shock. Formally:

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[2] In fact, j = SE = SW when i = N, while j = N =SW when i = SE, a.s.o.

[3] In line with footnote 2,we have that l = NE, NW when k = S, a.s.o.

$$ELS = q\left[3(L_N - T_N) - 3T_S\right] + (1-q)\left[3(L_S - T_S) - 3T_N\right] = 3\left[q\,L_N + (1-q)L_S - T_N - T_S\right] \qquad (6)$$

where the subscripts N and S have been used to denote the equilibrium amount of credit given by a bank in the North and the South, as well as the equilibrium levels of terms deposits held, respectively. Given that within each region, banks are symmetric, (6) further reduces to: $ELS = 3\left[1 - T_N - T_S\right]$. When $q = 1/2$, regions and hence banks are symmetric in every respect and $ELS = 3L - 6T = 3 - 6T$.

In terms of competition policy, post merger loan rates are compared to the pre-merger levels. As an alternative, one could look at spreads (loan-deposit rate) or margins (loan rate-operational cost). The advantage of comparing price levels is that the link with the so-called SSNIP test is immediate. SSNIP denotes a "Small but Significant and Non-transitory Increase in Price" above the prevailing level. It was introduced by the US Department of Justice in 1984 in the context of the horizontal merger guidelines, see U.S. DOJ (1984).

The underlying idea is that a market structure that is to come about after a merger is compared with a hypothetical market structure. The latter includes the group of products such that a hypothetical profit maximising firm, if it had control over these products, would increase prices by a certain percentage. Although purely arbitrary, the usual critical level of this price increase is fixed at 5 per cent. If it turns out that the set of products or services in the merger coincides or exceeds the set defined by the hypothetical group, the operation should be forbidden, for most likely it will raise prices by more than 5 per cent.

In the present context therefore, if we denote by r_M the loan rate charged by the merged bank, and compare it to the rate charged before under the Status Quo or SQ, the SSNIP5-test is violated whenever:

$$100\left(r_M - r_{SQ}\right) > 5\,r_{SQ} \qquad (7)$$

3.b. The model: analysis and results

In this subsection, we first characterise the Nash Equilibrium in pure strategies for the loan rate competition game before any merger takes place. As in CHS, this outcome is denoted by the "Status Quo". Initially, shocks are a-symmetric. But it turns out below that with symmetry of the liquidity shocks, making regions the same in every respect, the best

outcome in terms of loan rates and liquidity shortages prevails. Hence a symmetric environment seems a natural point of departure. In section 4, asymmetric extensions are discussed in more detail.

Next, mergers are considered. In the present model, many different "types" of mergers can occur. One type comes about when a bank merges with another bank located in the same region. Since there are only 3 banks present in each region, such a merger involves the going together of 2 "adjacent" banks. Rather than using the adjective "adjacent", which indicates that the operation takes place between two nearby competitors, we will denote this merger type by the adjective "intraregional". This has the advantage that it points to the fact that such a merger will be hit by a liquidity shock on the combined volume of its deposits.

As opposed to an intraregional merger, one has "interregional" (or in an extended context, again see section 4, "cross-border") mergers. Here, the operation does not bring under control a rival in the sense of a bank competing for the same pool of firms. The operation instead combines two "remote" banks, both in the sense of being distant as an alternative for the firms and not being affected by the same liquidity shock.

In addition to the two "main" merger types, i.e. the intraregional or "within" and the interregional or "between" merger, two other merger types are analysed. One is the "within" merger which triggers operational cost efficiencies, the other is a "giga" merger which involves more than 2 banks.

After having analysed the outcome of all these merger operations, we ask whether they would be cleared by merger review. The answer to this question depends on the particular setup of the merger review process, and hence a correspondence between the different roles played by the different regulators and the mergers that will realise is given.

3.b.1. The Status Quo (SQ)

Given equation (4), it is easy to show the following:

Proposition 3.1: Before any merger activity, each bank in the Northern Region charges in equilibrium a loan rate $r_N^{SQ} = t + c + \tilde{r}/q$ and attracts core deposits $T_N^{SQ} = 1 - \frac{\tilde{r}}{2q\bar{r}}$. In the Southern Region, the equilibrium loan rate and deposits respectively are $r_S^{SQ} = t + c + \tilde{r}/(1-q)$ and $T_S^{SQ} = 1 - \frac{\tilde{r}}{2(1-q)\bar{r}}$. Profits are equal to $\Pi_N^{SQ} = qt + \frac{\tilde{r}^2}{4q\bar{r}}$ and $\Pi_S^{SQ} = (1-q)t + \frac{\tilde{r}^2}{4(1-q)\bar{r}}$. Expected Liquidity Shortage is given by $ELS^{SQ} = \frac{3\tilde{r}}{2q(1-q)\bar{r}} - 3$

Proof: By differentiating equation (4) w.r.t. r_i and T_i, one obtains the two first order conditions (F.O.C.'s) for bank i. By substituting the expression obtained for T_i by solving the second F.O.C. into the first F.O.C., one obtains that $q(r - r_i) + q\,t - q\,(r_i - c) + \tilde{r} = 0$. Invoking symmetry, it is easy to show that r_{SQ} is equal to the expression given in proposition 3.1. In order to obtain the equilibrium level of the core (term) deposits attracted, the second F.O.C. can be rewritten as the derivative of the product of the pricing function and the volume needed to fill liquidity *y*. By solving, the expression for T_N^{SQ} follows. A similar argument is followed to obtain the expressions for the equilibrium loan rate and term deposits with the banks in the Southern Region. The expression for *ELS* follows from substituting the expressions for T_N^{SQ} and T_S^{SQ} in (7).

Corollary 3.1.1. The average loan rate paid by borrowing firms, since both regions are equal in size, is equal to $\bar{P} = t + c + \tilde{r}\left(\frac{1}{2q} + \frac{1}{2(1-q)}\right)$. It then is easy to show that both $\bar{P}$ and *ELS* attain a minimum when $q = 1/2$, since the first order derivative w.r.t. q of both $\bar{P}$ and *ELS* vanish $q = 1/2$ at while the second order derivative is positive. Therefore, full symmetry induces the best outcome both for stability and allocative efficiency. From now on, we will focus on the fully symmetric case.

Corollary 3.1.2. When $q = 1/2$, the equilibrium values for the Status Quo become:

$$r^{SQ} = t + c + 2\tilde{r} \tag{8}$$

$$T^{SQ} = 1 - \frac{\tilde{r}}{\bar{r}} \tag{9}$$

$$ELS^{SQ} = 6\frac{\tilde{r}}{\bar{r}} - 3 \tag{10}$$

$$\Pi^{SQ} = \frac{1}{2}\left(t + \frac{\tilde{r}^2}{\bar{r}} \right) \tag{11}$$

These are the benchmark values against which the different mergers will be compared.

Corollary 3.1.3. The different parameters in the model have different implications on each of the targets. As such, increases in *t* always reduce consumer surplus due to higher loan rates, increases in $\bar{r}$ always reduce *ELS*. But *t* does not affect *ELS* and $\bar{r}$ does not influence consumer surplus. The term deposit rate $\tilde{r}$ on the other hand interferes always with both consumer surplus and *ELS*. By this we mean that an increase in $\tilde{r}$ reduces both consumer surplus and increases *ELS* in the status quo situation, after a "between" merger, as well as after a "within" merger. So regarding the substitutability of loan offers between banks, banking relationships, and other factors that influence *t*, it seems appropriate to have the antitrust authority as the relevant policy maker. Interbank market competition, as well as lender of last resort relationships which affect $\bar{r}$ are by the same argument better monitored by the prudential regulator. This is quite evident as the "natural" supervisors for the parameters typically are the ones mentioned. But *both* authorities have a keen interest in monitoring competition in term deposit rates, since fiercer competition, perhaps leading to higher rates will worsen both the loan rate and *ELS*.

Hence, the organisation of policy making in this Status Quo environment is fairly simple. Since certain parameters of the environment affect the competition policy target, others affect the stability target and still others affect both targets but in the same direction, there

can be few if any conflicts of interest between the regulators. This conclusion however changes as mergers come into the picture, as will become clear immediately.

3.b.2. Intraregional mergers or mergers "Within"

When say N and SE merge, they will charge r_M at each location. This brings about a duopoly where the merged entity M operates the N and SE branch, competing with a single branch bank located at SW. The respective profit functions are:

$$\Pi_M^{WITHIN} = \frac{1}{2}(r_M - c)\left(\frac{r_{SW} - r_M}{t} + 2\right) - \tilde{r}T_M - \frac{1}{2}\bar{r}\left(\frac{r_{SW} - r_M}{t} + 2 - T_M\right)^2 \qquad (12)$$

and

$\Pi_{OUTSIDER} = \Pi_{SW} = \Pi_i$ as given by equation (4), after substituting r_M for r_j.

It then is possible to show:

Proposition 3.2. After an intraregional merger, the merged entity charges a loan rate equal to $r_M = \frac{5t + 3c + 6\tilde{r}}{3}$ and holds term deposits given by $T_M = \frac{5}{3} - \frac{\tilde{r}}{\bar{r}}$. The bank remaining outside the merger charges $r_o = \frac{4t + 3c + 6\tilde{r}}{3}$ and holds term deposits equal to $\frac{4}{3} - \frac{\tilde{r}}{\bar{r}}$. Banks in the Southern Region charge rates and hold term deposits given by corollary 3.1.2. Equilibrium profits to the merged bank are given by $\prod_M = \frac{25t}{18} + \frac{\tilde{r}^2}{2\bar{r}}$ and *ELS* is equal to $5\frac{\tilde{r}}{\bar{r}} - 3$.

Proof: By differentiating equation (4) (appropriately changing subscripts to denote that the bank remaining outside the merger is involved) and equation (12) w.r.t. both the loan rates and the term deposits, one obtains 4 F.O.C.'s. By substituting for T_M from the second F.O.C. of the merged party into the first F.O.C. of the same entity, one obtains an expression for r_M in which only r_O is present. Similarly, substituting for T_O in the first F.O.C. for the outside party, by replacing the equilibrium value, yields an expression for r_O in which only r_M prevails. Solving the

system of reaction functions $[r_O(r_M), r_M(r_O)]$ for a Nash Equilibrium in loan rates yields the results stated above.

Equilibrium term deposits are derived by substituting in the F.O.C.'s for the respective equilibrium values of r_M and r_O, and *ELS* is found by computing net liquidity exposures times the probability that they realize.

Corollary 3.2.1. It is easy to show that after a "within" merger, the loan rate of both the merged entity and the bank remaining outside the merger increase. Also term deposits increase. Whereas in the other region, everything remains as in the Status Quo. As a result, the price level increases while the expected liquidity shortages decrease. Hence a "within" merger imposes a trade-off upon policy in that the economy looses from a competition policy viewpoint, but wins from a prudential regulatory viewpoint.

Corollary 3.2.2. The merged entity violates SSNIP5 whenever $t > \frac{3c}{37} + \frac{6\tilde{r}}{37}$ (13)

Corollary 3.2.3. It is easy to show that the post merger profits of the merged entity exceed both those of the outsider and the Status Quo, implying that if banks get the opportunity to merge, they will do so.

3.b.3. Interregional mergers or mergers "Between"

When a bank from the Northern Region, say N, merges with a bank from the Southern Region, say S, nothing changes immediately for any of the rivals. For the merging parties, only the cost side is affected for revenues are simply twice of what was obtained in the Status Quo. The profit function for the merged entity reads (instead of M we use m to indicate the values for the "between" merger).

$$\Pi_m^{BETWEEN} = (r_m - c)\left(\frac{r_i - r_m}{t} + 1\right) - \tilde{r}T_m - \bar{r}\left(\frac{r_i - r_m}{t} + 1 - T_m\right)^2 \quad (14)$$

whereas Π_i is given by (4).

It then is easy to show:

Proposition 3.3. After an interregional merger, the merged entity charges a loan rate given by $r_m = \frac{5t + 5c + 7\tilde{r}}{5}$ and holds term deposits $T_m = 1 + \frac{2\tilde{r}}{5t} - \frac{\tilde{r}}{2\bar{r}}$. The banks remaining outside the merger charge $r_o = \frac{5t + 5c + 9\tilde{r}}{5}$ and keep term deposits equal to $T_o = 1 - \frac{1}{5}\frac{\tilde{r}}{t} - \frac{\tilde{r}}{\bar{r}}$. Equilibrium profits to the merged entity become $\Pi_m = t + \frac{4\tilde{r}^2}{25t} + \frac{4}{5}\tilde{r} + \frac{\tilde{r}^2}{4\bar{r}}$. *ELS* is found again by computing the expected volume of net liquidity needed, with the outcome that $ELS = \frac{9\tilde{r}}{2\bar{r}} + \frac{2\tilde{r}}{5t} - 2$.

Proof: By differentiating equations (14) and (4), and substituting for the equilibrium expressions for term deposits that are obtained from the second set of F.O.C.'s into the first set of F.O.C.'s. Note however that banks remaining outside the merger will be facing rates charged by a merged entity at one side of their location, while they will face rates by another outsider on the other side of their location. Therefore, solving the appropriate system of reaction functions, one obtains the results for the loan rates. Equilibrium term deposits follow from substituting the loan rates in the second F.O.C.'s. Further substitution into *ELS* yields the desired results.

Corollary 3.3.1. It is easy to show that after a "between" merger has taken place, the loan rates of both the merged entity and outsiders decrease. But at the same time the term deposit holdings decrease. As a result, the price level decreases but expected liquidity shortages become more pronounced. Hence also a "between" merger imposes a trade-off upon policy in that the economy wins in terms of competitiveness but losses in terms of stability.

Corollary 3.3.2. It is easy to show that the post merger profits of the merged entity exceed again both these of the outsider and the Status Quo, again implying that if banks get the opportunity to engage in a "between" merger, they will.

3.b.4. Interregional mergers with operational cost efficiencies

In this subsection, we reconsider "within" mergers but now take into account that they may trigger cost savings. Suppose when N and SE merge, they can reduce the operational cost to 0. Not only will the merged entity now possess more market power, loans when they realize will be produced in a cheaper way compared to the situation for the remaining competitor in the Northern Region. The respective profit functions are:

$$\Pi_{M(c=0)}^{WITHIN} = \frac{1}{2} r_M \left(\frac{r_{SW} - r_M}{t} + 2 \right) - \tilde{r} T_M - \frac{1}{2} \bar{r} \left(\frac{r_{SW} - r_M}{t} + 2 - T_M \right)^2 \quad (15)$$

and

$\Pi_{OUTSIDER} = \Pi_{SW} = \Pi_i$ as given by equation (4), after substituting r_M for r_i.

The following proposition then can be shown:

Proposition 3.4. After an intraregional merger with operational cost savings, the merged entity charges a loan rate equal to $r_M = \frac{5t + c + 6\tilde{r}}{3}$ and holds term deposits given by $T_M = \frac{5}{3} - \frac{\bar{r}}{\bar{r}}$. The bank remaining outside the merger charges $r_o = \frac{4t + 2c + 6\tilde{r}}{3}$ and holds term deposits equal to $\frac{4}{3} - \frac{\tilde{r}}{\bar{r}}$. Banks in the Southern Region charge rates and hold term deposits given by corollary 3.1.2. Equilibrium profits to the merged entity are given by $\Pi_{M(c=0)}^{WITHIN} = \frac{1}{2t}\left(\frac{5t + c}{3} \right)^2 + \frac{2\tilde{r}c}{9t} - \frac{\bar{r}c^2}{18t^2} + \frac{\tilde{r}^2}{2\bar{r}}$. *ELS* is equal to $\frac{5\tilde{r}}{\bar{r}} - 3$.

Proof: Along the same lines as the proof of proposition 3.2.

Corollary 3.4.1. After a "within" merger with operational cost reductions, it will depend on the magnitude of the cost reduction whether or not post merger equilibrium prices increase or decrease. If t < c, or bank credit lines are not too differentiated products, the post merger equilibrium is characterised by a decrease in loan rates and an increase in term deposits. Hence the economy wins both from a competition and stability angle.

Corollary 3.4.2. Post merger profits of the merged entity are clearly higher than both the profits of the outsider and profits before merger, so the incentives to engage in a within merger with cost reductions are present.

3.b.5. Giga mergers

Until now, only mergers involving two parties have been considered. Somehow, "universal" banks have been the result of consolidation within certain boundaries going hand in hand with concentration across these boundaries. The resulting entities are characterised both by "scale" economies, implying substantial sales volumes within regions, and scope economies, implying an "omnipresence" of activities. In this sub-section, we investigate the implication of the creation of such a large bank. More in particular, we investigate a merger of N, SE, S and NW. Only SW and NE then remain as independent competitors. The profit function for the giga-bank becomes:

$$\Pi^{GIGA} = (r_G - c)\left(\frac{r_{SW} - r_G}{t} + 2\right) - \tilde{r}T_G - \bar{r}\left(\frac{r_{SW} - r_G}{t} + 2 - T_G\right)^2 \qquad (16)$$

While profits to SW and NE are again given by equation (4), susbtitutiong appropriately for r_G.

The following proposition then can be shown:

Proposition 3.5. After a giga merger, the "large" bank changes $r_G = \frac{5t + 3c + 4\tilde{r}}{3}$ and holds term deposits $T_G = \frac{\tilde{r}}{2\bar{r}}$. The outsider banks SW and NE charge loan rates $\frac{4t + 3c + 5\tilde{r}}{3}$ and holds reserves $T_O = \frac{4}{3} - \frac{\tilde{r}}{3t} - \frac{\tilde{r}}{\bar{r}}$. Profits to the

giga merger are $\Pi^{GIGA} = \frac{25t}{9} + \frac{10\tilde{r}}{9} + \frac{\tilde{r}^2}{9t} + \frac{\tilde{r}^2}{4\bar{r}}$ while *ELS* becomes $\frac{5\tilde{r}}{2\bar{r}} - \frac{4}{3} + \frac{\tilde{r}}{3t}$.

Proof: A combination of the approach used to prove resp. propositions 3.2. and 3.3. can be applied in a straight forward way.

Corollary 3.5.1. "Giga" mergers may increase or decrease post merger loan rates. "Giga" mergers may increase or decrease *ELS*.

Corollary 3.5.2. A "giga" merger increases the profits for the merged entity both w.r.t. the Status Quo and post merge outsider profits.

Corollary 3.5.1. deserves some comments. Although mergers which only involve two parties, such as the "between" and "within" mergers considered above, introduced policy trade-offs for sure, this may not be the case for a larger operation. In order to illustrate this, consider the case where $t = \tilde{r} = 4/7\bar{r}$. It is easy to show that vis-à-vis the Status Quo, neither the loan rate charged by the "giga" merger nor *ELS* will change. Also the rates charged by the outsiders will be equal to those charged in the Status Quo, and hence the antitrust authority will clear the operation. So as far as loan rates and ELS economy-wide is considered, the post-merger outcome coincides with the Status Quo.

Intuitively, this can be explained by the important cost savings that compensate for the increase in market power. A "giga" merger involves the same market power as a within merger (except for 2 regions now being affected), but this increase in market power easily can be offset by the important cost savings due to improved liquidity management possibilities who pertain to much larger entities (2 banks in the North can now benefit from the excess liquidity in the South).

This certainly is a remarkable finding, indicating that merger operations double in size than others should be cleared, as compared to the latter. In order to show this in more detail, we next turn to an inventory of the mergers that would be cleared, given that the review process is structured in a particular way.

3.c. The model: policy implications

Four merger types have been reviewed. For the two most typical cases, i.e. the "within" and "between" merger, it was indicated that a policy trade-off inevitably is present. For the other two cases, i.e. the "within" merger with cost decreases and the "giga" merger, everything depends on the values the parameters take.

The organisation of the merger review process therefore is critical in order to determine which mergers will get approved. Regarding the practical organisation of this process, Carletti and Hartmann (2002a) show that there exists a wide divergence among the different countries they screened. A priori, a good starting point to investigate the organisation of a review process where different decision makers are involved is the framework introduced by Sah and Stiglitz (1986). The distinction made there is between an organisation in which agents can get their project approved when they are cleared by two (all) supervisors, versus one in which it is sufficient to obtain clearance by any single supervisor. The first case is defined to be a hierarchy, which is to be seen here in the sense of introducing projects with the lower supervisor, and then, if he agrees to put the project on the desk of a higher authority, to get it approved there. In a polyarchy on the contrary it is sufficient to obtain the approval of any supervisor.

Needless to say that, given the trade-offs that have been documented in the previous section, a polyarchy is not a very useful organisation of the merger review process to consider analyzing in detail since it will clear any operation that is proposed. Therefore, it seems much more interesting to introduce a one stop shop principle, indicating that either competition policy or prudential regulation dictates whether or not an operation is cleared. And then to contrast this organisation of the merger review process to a hierarchy where both authorities have to agree. In doing so, we refer to the solution where bank mergers are exempted from the general competition law and placed under the responsibility of the prudential regulation as the "Exemption" approach. Whereas for these countries in which bank mergers resort under the general competition law, we use the terminology "General Rule". Table 2 then summarizes the findings of the previous section by indicating whether or not, or depending or which conditions, a particular merger will be accepted given a specific organisation of the merger review process.

Table 2: Merger Review Organisation and Merger Type: Which organisation clears which merger

	HIERARCHY	EXEMPTION	GENERAL RULE
WITHIN	Block	Clear	Block
BETWEEN	Block	Block	Clear
WITHIN WITH COST DECREASE	Clear if $t < c$	Clear	Clear if $t < c$
GIGA	Clear if $t < \tilde{r}$ and if condition A is satisfied	Clear if condition A is satisfied	Clear if $t < \tilde{r}$

Condition $A: 21\tilde{r}t > 10\bar{r}t + 2\bar{r}\tilde{r}$

In order to use the insights of the table above to explain why particular countries have chosen for a particular organisation of the merger review process, it is clear that particular parameter values play a crucial role. Under the "general rule", countries will clear "between" (revenue enhancing mergers) as well us a number of other operations provided that bank credit lines are not too heterogonous products. Where countries exempt the merger review process from the general competition rule, it is clear that they favour "domestic" consolidation. As a matter of fact, they impose tougher standards on a "giga" merger than on a "within" merger, although from the perspective of the borrowing firms, the relevant market structure is pretty much the same.

4. EXTENSIONS

The present model is a fairly simple one and hence still many extensions are conceivable. Besides changing particular assumptions, the more interesting extensions undoubtedly will come from keeping the model in its current set up but taking it to catch different market structures as well as different assumptions regarding the origin and impact of the liquidity shock. We start with discussing the latter and then move into considering two changes to the market structure. A final extension involves charging the policy environment.

4.a. Origins and implications of liquidity shocks

The present model has liquidity demand originating from commitments that realize on the asset side of the balance sheet. In the classical taste for liquidity à la Bryant-Diamond-Dybvig, the preference for liquidity is due to impatient depositors. The transformation of the duration of the different claims puts the bank in a vulnerable position. When the bad equilibrium of a coordination game between depositors realizes, a bank run pushes the financial intermediary into insolvency.

The maintained assumption in this paper, viz. the idea that sources of market power and cost efficiency gains cannot be separated from liquidity issues, can nicely be introduced in the classical model with a taste for liquidity by depositors. This could be done along the lines set out by Temzelides (1996), who investigates the impact of local interaction on bank panics in a repeated version of the Diamond-Dybvig model. His findings, that bank runs spread first among banks in the same geographic location before moving throughout the entire population clearly could be used to restate the maintained assumption in a different setting.

A competing theory of bank runs is due to Gorton (1985) and Calomiris and Kahn (1991). Here, bank runs are the result of asymmetric information between depositors and the financial services industry. While the latter know that some players, i.e. banks became insolvent due to real shocks (firms are unable to pay back their loans), depositors don't know which banks are affected. Since insolvent banks abscond with the remainings of their assets, depositors withdraw their holdings form *all* banks. Recent empirical studies, see e.g. Carlson (2002) or Dwyer and Hafer (2001) try to disentangle the real world shocks with asymmetric explanation from the "impatient preferences" model. This approach to

liquidity shocks however can be incorporated also in a very easy and logical way. If it is assumed that the public knows that some firm in a particular sector or region failed, but it is unclear which firm precisely, or for the matter which particular bank firm relationship exists, they will run on all banks in the same region or sector. ("They could be all in it").

In order to incorporate this origin of banking panics into the present model, the profit functions have to be adjusted in order to incorporate the possibility that loans are not paid back. Rather than focussing on credit line competition, the model then investigates competition for loans with depositors who are afraid that the loan portfolio might turn bad and that they then hold claims on an insolvent bank. When moving from the Status Quo to an analysis of particular merger types, two additional changes need to be made. First, larger entities, i.e. merged banks might be bailed out. If this is the case, a merger has the additional competitive advantage that runs can be avoided, at the expense of increasing moral hazard problems of course.

Second, when interregional mergers take place, a run on the banks in the North could also trigger a run on a particular bank in the South, namely the one engaged in a merger with a bank in the North. So if depositors are aware of the pattern of mergers that took place, they will withdraw their depositors from a bank in the South, for they know this bank is merged with a bank in the North that could be insolvent. Since it is rational to run on every bank in the North, it is equally rational to run on the South branch of the merged entity.

This last consideration mitigates the incentives to merge in the sense that an interregional merger might not lead to the desired liquidity management improvements. Whether or not this is the case will depend among other things on the information that depositors have regarding the mergers that took place between banks in different regions and whether or not a bailout policy is in place.

In any event, liquidity shocks of a different origin certainly offer perspectives for further researching the maintained hypothesis, along the lines just described. The practical development and analysis of the models is deferred to future research.

4.b. Market structure: LOLR-behavior

Another extension that is important to consider involves the explicit role that could be played by the LOLR. In the analysis of the previous section, the LOLR takes the surplus liquidity in the depressed region, at 0 cost, exploiting its monopsony power, to provide the additional funds needed in the other region. The price of these funds is an upward sloping function of the volume of funds needed. It could be interesting to endogenize this function, for example by deriving it from the optional control problem that a Central Bank solves when it controls inflation, eventually together with an output goal.

In any event, the revenues that are collected from providing funds to the banks in the booming region should enter this objective function as a profit. At the same time, to the extent that additional funds are needed on top of the liquidity generated in the other region, money creation is needed. This then will trigger inflation which enters the objective function with a penalty factor.

Instead of extending the role of the LOLR to solving an optimal control problem, a simpler exercise then can be made. When focussing on merger implications, a linear function for the costs of additional funds obtained from the LOLR has been used, viz. $\bar{r}(y) = \bar{r}.y$. When the LOLR has to determine the value of the parameter $\bar{r}$, what would it pick? And how does this choice affect the direction that is given to the M&A market?

In order to analyze these questions, notice that the objective function of the LOLR should include the profits made on providing additional funds minus a penalty for the money that is created in this process. For the moment, we assume that the LOLR takes the Status Quo as given, and does not take into account the direction given to the M&A market. Hence a simple objective function for the symmetric shock case considered in the previous section could be:

$$\underset{\bar{r}}{Max}\, 3\bar{r}\left[1-\left(1-\frac{\tilde{r}}{\bar{r}}\right)\right]^2-\frac{1}{g}\left[3\left(1-\left(1-\frac{\tilde{r}}{\bar{r}}\right)\right)-3\left(1-\frac{\tilde{r}}{\bar{r}}\right)\right]^g \qquad (17)$$

or equivalently

$$\underset{\bar{r}}{Max}\, 3\bar{r}\left(\frac{\tilde{r}}{\bar{r}}\right)^2-\frac{1}{g}\left(6\frac{\tilde{r}}{\bar{r}}-3\right)^g \qquad (18)$$

It is easy to see that for $\gamma = 2$, this expression is maximised when $\bar{r} = \frac{12\tilde{r}}{6+\tilde{r}}$ (19)

By comparing the post merger equilibrium profits of both a "between" and "within" merger, it then equally becomes possible to endogenize the merger type that will emerge. More in particular, only the profits of the "within" merger depended on $\bar{r}$, which now can be expressed in $\tilde{r}$. Therefore, it is easy to show that a "within" merger will be preferred to a "between" merger when $\Pi^{WITHIN} > \Pi^{BETWEEN} \Leftrightarrow \frac{7t}{18} + \frac{\tilde{r}(6+\tilde{r})}{48} > \frac{4\tilde{r}^2}{25t} + \frac{4}{5}\tilde{r}$, which is equivalent to $t > \left(\frac{243}{280} - \frac{3}{112}r + \frac{3}{560}\left(40850 - 1620r + 25r^2\right)^{1/2} \right) r$ (20)

It then becomes possible to state:

Proposition 4.1. When the LOLR chooses $\bar{r}$ so as to maximise an objective function that takes into account both the revenues from the LOLR activity and an inflation target, while $\tilde{r}$ is distributed uniformely over the unit interval and *t* is distributed uniformely over the interval [0, 1.89], the market will propose 49,44% of "within" mergers against 50,55% of "between" mergers.

Proof: When equation (20) is written as an equality, it traces a curve in the $(t, \tilde{r})$-space. All points which lie above this curve represent realizations of $\tilde{r}$ and *t* which favour "within" mergers over "between" mergers, whereas the opposite holds for points below the curve. Since the distributional assumptions make every point equally probable, the area under the curve can be used to represent the share of "between" mergers. Integrating equation (20) as an equality over the unit interval yields an area equal to .96 whereas the total area equals 1.89. This yields the percentages mentioned.

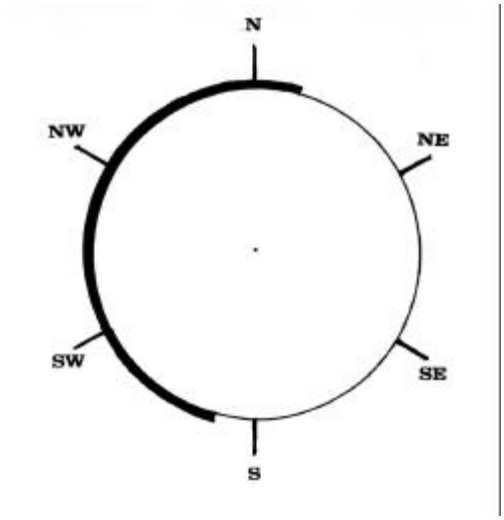
Corollary 4.1.1. Few if any direction to the M&A market is given by an LOLR who chooses $\bar{r}$ in the way just described. When a simple markup rule $\bar{r} = 1.25\tilde{r}$ would be followed, the outcome would be nearly the same, since it is easily verified that the share of "within" mergers would be 49,99%.

When the LOLR determines $\bar{r}$ as a Stackelberg leader before mergers realize, the situation becomes a different one. Since "between" mergers both bring increased revenues and more liquidity creation, while "within" mergers do the opposite, the LOLR has to balance the costs and benefits of each scenario, taking into account the probability that they realize. This is a complex problem which is left for future research.

4.c. Market structure: increased contagion possibilities

One market structure that is also different from the present and that merits investigation is the "incomplete market structure", see Allen and Gale (2000), p. 13, as opposed to the "disconnected" version studied in the previous section. In order to investigate mergers in this new setting, the two regions must be brought together into one region which can be represented by a circle of length 6, on which 6 banks are spaced with equal distance among them. The liquidity shock again affects several banks, but rather than affecting always the same cluster of 3 banks, the shock "moves" along the circle, each time having a different starting point, and extending 180 degrees in clockwise sense. As such, each bank can be in a cluster with every other bank. Figure 4 illustrates this market structure.

Figure 4: An Incomplete Market Structure
(A thick line shows the banks affected by increased liquidity demand)



While the analysis is more involved and the results extend beyond the scope of the present paper, similar trade-offs to those documented in the previous section show up in the analysis. Especially when the liquidity shock does not extend over an arc of 120 degrees, opposite banks know that when they merge, they never will be affected by the same liquidity shock. Again mergers out of different motives then must be considered. Mergers with nearby banks again create market power, but the probability of being hit by the same liquidity shock is present. On the other hand, a merger with a remote bank, as in the model of section 3 above, allows for an improved scope in managing long term funding. As such, the results are qualitatively similar to those obtained in the present paper, see Van Cayseele (2004).

4.d. Regions as Nations

A final series of extensions could involve the re-interpretation of regions as nations, each having the same or a different policy mix. Now the appropriate organisation of decision making should be the Sah-Stiglitz hierarchy since in order to obtain clearance, the merger has to be approved by the relevant authority in each country. This will lead to clearcut differences in outcomes as compared to the outcome where both authorities operated on the some jurisdiction.

To show this, it is important to notice that at least 3 different organisations of the merger review process need to be looked at when 2 countries are involved. In fact, these are:

- Both countries have bank mergers following the general competition rule.
- Both countries exempt merger review from the competition law and let the prudential regulator decide.
- One country follows the general competition law while the other exempts. Without loss of generality, we assume that the Northern country follows the general rule while the South exempts.

Regarding the different merger operations that can be screened, we now have to distinguish between “within” mergers according to the country in which the consolidation takes place. As such, we will consider “within N” and “within S” mergers, next to the “between” and “giga” operations.

When the general rule applies to both countries, it is clear that none of the "within" mergers will pass. "Between" mergers will be cleared while for "giga" mergers, it will depend on whether $t < \tilde{r}$. When both countries on the other hand exempt bank mergers from the monitoring of competition authorities, the "between" merger will be blocked while the "within" operations will pass. The "giga" merger will be cleared when "condition A" holds, see above.

Finally, consider settings where a different policy mix prevails between the two countries. If for example the Northern Country focuses on competition policy, while the Southern Country on stability issues, only within border mergers in the South will be cleared. To see why this is the case, consider a "within" merger in the North. It will be blocked by the antitrust authority. Next consider a "between", or in this case a cross-border merger. The prudential regulator in the South will oppose to it. Hence by elimination only the "within" merger in the Southern Country will realize. When "within" mergers are characterized by sufficient gains in operational costs, now also the Northern Country will start approving these operations. "Between" mergers remain blocked by the prudential regulator in the Southern Country. Finally, the "giga" merger will only clear when both condition A and $t < \tilde{r}$ hold, as if policy was organised as a hierarchy within one and the same country, i.e. the setting considered in the previous section. Table 3 below summarizes most of these findings. It also includes still another case, namely a "between" type of merger, but the operation taking place between countries who are differentially affected by liquidity demand. We first explain intuitively why a separate analysis has to be done for this particular case. Then we state our findings in the format of a proposition.

When countries are differentially affected by liquidity demand, "within" merger operations don't change the policy outcomes since all consequences of these operations remain within the countries' boundaries. Therefore, all entries for the two first rows of table 3 remain the same. When "between" or "giga" mergers taken place however, banks who in the Status Quo operated in a country with a low probability of facing the need of getting additional funding, now will operate in a country with a higher probability of a liquidity shortage. Although the terminology is not appropriate to the present context, one could describe it as one where a particular bank, involved in a "between" operation, leaves to some extent the "safe" territory of the home market to compete in a foreign, more "dangerous" environment. Clearly the terminology is not adequate for there are no "safe" and "dangerous" countries in the present model, only countries characterised by a higher probability of facing liquidity shortages. In addition, we know that banks take more

precautions by attracting term deposits when an increased probability of facing additional liquidity needs prevails.

Nonetheless, the underlying idea of "contamination" of one country by another as the result of a "between" merger is worthwhile to pursue. Therefore, we will analyse the outcome of a "between" merger when $q > 1/2$, i.e. the Northern country has more change to face an uprise in economic activity. Since we assumed that the Northern country also is the one which sticks to the general rule, we have the following situation. The Southern country which is worried for stability, and therefore has exempted the bank merger review process from the general competition policy rule now faces a merger between one of the banks it monitors, and a bank that operates in another country where the probability of needing liquidity is more pronounced.

Before stating the outcome of such a "between" merger, it is necessary to note a few changes, both regarding the policy target and the objective functions of the players. More in particular, the definition of Expected Liquidity Shortages changes when an environment of regions is abandoned to analyse a world of countries. There now are 2 LOLR's, and more important, the liquidity which is not needed in the country which remains depressed cannot be used to fund the increased economic activity in the other country.

At the same time, antitrust authorities will investigate whether or not a merger operation increases the price level in the particular country that they monitor. And more important, the Status Quo will be characterised by different loan rates across countries. The Status Quo values for the loan rates charged and deposits in the Northern resp. Southern country are given by proposition 3.1, while the objective function for then merged entity reads:

$$\begin{aligned}\Pi_{u(q\neq 1/2)}^{BETWEEN} = & q(r_u - c)\left(\frac{r_N - r_u}{t}\right) + (1-q)(r_u - c)\left(\frac{r_S - r_u}{t} + 1\right) \\ & - q\bar{r}\left[\frac{r_N - r_u}{t} + 1 - T_u\right]^2 - (1-q)\bar{r}\left[\frac{r_S - r_u}{t} + 1 - T_u\right]^2 \\ & - \tilde{r}T_u\end{aligned} \tag{21}$$

The objective functions of the other players both in the Southern and Northern countries again can be found by making the appropriate substitutions in equation (4).

It then becomes possible to state.

Proposition 4.2: After an interregional merger between banks operating in different countries, moreover characterised by different probabilities of needing additional funds, the merged entity changes a loan rate equal to $r_u = t + c + \frac{7}{5}\tilde{r}$ and holds term deposits $T_u = \frac{2}{5}\frac{\tilde{r}}{t} + 1 - \frac{\tilde{r}}{2\bar{r}}$ whereas the corresponding equilibrium values for the banks remaining outside the merger are given by:

$$r_N = t + c + \tilde{r}\left(\frac{10+7q}{15q}\right)$$

$$r_S = t + c + \tilde{r}\left(\frac{17-7q}{15(1-q)}\right)$$

$$T_N = 1 - \frac{\tilde{r}}{2q\bar{r}}$$

$$T_S = 1 - \frac{\tilde{r}}{2(1-q)\bar{r}} \ .$$

ELS differs from country to country and is equal to

$$ELS_N = \left(\frac{2-4q}{3t}\right)\tilde{r} + \left(\frac{2+q}{2\bar{r}}\right)\tilde{r}$$

and

$$ELS_S = \left(\frac{4q-2}{3t}\right)\tilde{r} + \left(\frac{3-q}{2\bar{r}}\right)\tilde{r}$$

Proof: Following the same algorithm used in proving the previous propositions, taking into account the appropriate definitions of ELS.

Corollary 4.2.1. Consider the case $1/2 < q < 5/7$. Then $r^{SQ} > r_N > r_u$ and hence the antitrust authority which needs to clear the merger in the Northern country approves. If at the same time, $\bar{r} < \frac{4}{5}t$, it will be the case that $ELS_S < ELS_S^{SQ}$ and therefore the merger will also be approved by the Southern country where the prudential regulator welcomes the decreased expected shortage in liquidity. Therefore, the merger will also be cleared in both countries when S exempts and N follows the general rule.

Corollary 4.2.2. Neither the antitrust authority in the Northern Country nor the antitrust authority in the Southern Country will block the merger when $q < \frac{5}{7}$. It is easy to prove that as soon as q exceeds $\frac{2}{7}$, $r_S < r_S^{SQ}$. By assumption, $q > 1/2$ and hence this condition is satisfied. We also know that $q < \frac{5}{7}$ guarantees $r_N < r_N^{SQ}$ and hence the merger will be approved everywhere when both countries follow the general rule.

Finally, we can state:

Corollary 4.2.3. It is easy to prove that $ELS_N < ELS_N^{SQ}$ always holds. Corollary 4.2.1. states $ELS_S < ELS_S^{SQ}$ holds under particular conditions. Hence if these conditions are satisfied, the merger will be cleared by both countries when they exempt the merger review process from the general rule.

The results stated in corollaries 4.2.1., 4.2.2. and 4.2.3. are included in the last row of table 3, which also summarizes previous findings.

Comparing the outcome of the merger review process when countries rather than regions are the relevant entities in which the different banks operate reveals some interesting and novel elements. When the review process is exempted form the general rule, either in one country with 2 regions or in both countries of the economy, outcomes are the same. In each case, “within” mergers are cleared and “between” mergers are blocked. “Giga” mergers are cleared under the same conditions. The same conclusion goes when either the general rule prevails in one country with two regions or when each country chooses to follow this policy line.

Differences however emerge when countries follow a different policy rule. This situation can best be compared to the hierarchical organisation of merger review when two regions within a country are involved. Indeed, given the sovereignty of states, “between” mergers will only be cleared when both countries approve, while “within” mergers need to be cleared only by the authorities of the country in which they take place. Clearly then if one country chooses to exempt the merger review process from the general competition rule, this opens the possibility to clear “within” operations. In addition, some “between” mergers will be cleared if liquidity needs are asymmetric. This might come as a surprise given the possibility that with differences in liquidity needs, the country which faces

relatively less liquidity shocks might fear "contamination". Yet, when the shocks are not too asymmetric and additional funding with LOLR is not too expensive, a "between" merger will get cleared.

When bank mergers are involved, countries when designing antitrust policies certainly take into account the possibility of cross-border mergers, see Van Cayseele and Smets (1995). And accordingly they will pick the policy regime which favours their preferred outcome. As before, when preferences are against cross-border consolidation and both countries exempt the merger review process from the general competition rule, concentration will take place mostly on the domestic market, increasing loan rates. When the country who faces most of the time a liquidity shortage however chooses to stick with the general competition rule, cross-border consolidation stands a chance. Undoubtedly, these issues need further exploration as globalisation only will force the financial services industry more and more into cross-border activities, if only to follow their clients.

Table 3: Merger Review Organisation (Column) and Merger Type (Row): Which Organisation Clears which Merger when different Countries are Involved?

	EXEMPTION IN BOTH COUNTRIES	GENERAL RULE IN BOTH COUNTRIES	EXEMPTION IN S WITH GENERAL RULE IN N
WITHIN N	Clear	Block	Block
WITHIN S	Clear	Block	Clear
BETWEEN	Block	Clear	Block
GIGA	Clear if condition A is satisfied	Clear if $t < \tilde{r}$	Clear if $t < \tilde{r}$ and condition A is satisfied
BETWEEN $(q > 1/2)$	Clear if $q < \frac{5}{7}$ and $\bar{r} < \frac{4}{5}t$	Clear if $q < \frac{5}{7}$	Clear if $q < \frac{5}{7}$ and $\bar{r} < \frac{4}{5}t$

Condition $A: 21\tilde{r}t > 10\bar{r}t + 2\bar{r}\tilde{r}$

5. CONCLUSIONS

How should a country structure the merger review process when the merging firms are banks? In reality, a variety of answers have been given to this question since different organisational settings co-exist. The present paper argues that this is the result of mergers not being alike, and hence having different implications for allocative efficiency and stability.

In order to show this, a simple model of localized banking competition was analyzed. Given that the same factors that lead to market power after a merger imply that the merged entity is more affected by liquidity needs, mergers for different motivations will exist. More in particular, there will be mergers that do not aim at the creation of market power but instead try to improve upon liquidity management by using funding obtained in one region to cover up for liquidity demand originating in another region.

In contrast, mergers out of market power motives raise interest rates, but reduce the expected liquidity demand on the LOLR or the central bank. Or they yield opposite effects as compared to mergers out of funding efficiency reasons, which raise the expected liquidity demand on the system, but reduce interest rates.

Given these policy trade-offs, there is no straightforward way to organise the merger review process. If for example one requires that merger operations are cleared by both the antitrust authority and the prudential regulator, none of the simple merger types will pass the review process. But this implies that potentially large gains, for example in growth due to reduced interest rates, are foregone. If on the other hand one allows that mergers take place if clearance is obtained by either the antitrust authority or the prudential regulator, intraregional mergers will present their case for the prudential regulatory and obtain approval, while interregional merger will appeal to the antitrust regulator, and also obtain approval. But this implies that potentially large costs are inflicted upon the economy. Hence, the optimal solution to organise merger review in the banking industry is unlikely to be either a Sah-Stiglitz hierarchy, or polyarchy. Instead, a one stop shop principle, where one authority reviews the merger and decides, then is more appropriate.

This is precisely what one observes most of the time in reality, where a variety of organizational schemes seem to co-exist. Of course, the particular choice of the one authority that then is in charge for clearing the operation will reflect the relative weight put

on the preference for allocative efficiency versus stability in the welfare objective of the country. A first conclusion that follows from the analysis therefore reads:

1° **When bank mergers are exempted from the general competition rule and placed under the supervision of the prudential regulator, mergers between regions or sectors will tend to be blocked.** Implicitly therefore, countries who have chosen to exempt bank merger review from the general competition law reveal some preference for consolidation taking place within the boundaries of the regions or sectors in which the banks are active. When taken to an international setting, countries who have chosen for exemption induce domestic consolidation, disfavouring cross-border consolidation.

Besides exposing the presence of these policy trade-offs, the maintained assumption also reveals other, often less expected results. A second conclusion that follows from the analysis indeed is:

2° **The detrimental effects of bank merger are not necessarily linear in merger size.** Or a larger operation can be better than a smaller one. In the present model, this occurs because a giga merger (which takes together two within mergers in a between operation), can combine the advantage of the more outspoken precautionary provisions of the within operation with the cost efficiencies of the between merger. Of course, it is equally conceivable that a giga merger combines the disadvantages of "between" and "within" mergers, and as a matter of fact, for some parameter values this actually is the case. It remains nonetheless true that judging by mere inspection of the size of the operation, where larger is put equal to worse, is likely to lead to serious mistakes.

The initial model is a fairly simple one, and therefore a few extension were made. These also yielded conclusions, although sometimes much more preliminary. As such, it became clear that:

3° **Many other economic environments offer arguments in favour of keeping the maintained assumption as the appropriate one.** That is the same sources that lead to market power also will bring a positive correlation of liquidity needs. This also will be the case when the "disconnected" market structure is left for the "connected but incomplete" market structure.

Extending the analysis by modelling the interbank market is extremely important to shed further light on the optimal organization of the bank merger review process. A temptative endaveour in that direction was taken by endogenising LOLR-behaviour. It turns out that:

4° **One of the most "neutral"** (in the sense of not offering incentives to strongly favour stability enhancing mergers over mergers that improve on allocative efficiency, or vice versa) **approaches an LOLR can take is when the objective function used to determine the refinancing rate in the sum of revenues minus a penalty for inflation created.** When the LOLR takes into account the possibility to direct the bank merger process, and targets for instance a similar objective function, but after mergers have taken place, this might change.

Finally, when countries decide on the way they want to organize the merger review process for banks, they certainly will take into account that "cross-border" mergers will emerge. Cross-border mergers are much like the "between" merger operations that capture the revenue enhancing motive for merger activity. Hence a re-interpretation of the policy conclusions seemed indicated. But since countries are sovereign nations, the merger needs to be cleared twice, or a Sah-Stiglitz hierarchy now is the inevitable structure for the merger review process. It then turns out that:

5° **The conclusions regarding the mergers that will get approved or blocked are robust to the re-interpretation of regions as nations, provided that countries have the same preferences, i.e. they both exempt merger review from the general rule, or don't exempt.** When countries however have different preferences regarding allocative efficiency and stability, some "within" and "between" mergers that would be clocked if they were reviewed by authorities operating in a hierarchical fashion within a single country now will be cleared. This will be the case for intraregional mergers in a country that has exempted merger review for the general competition rule. This will also be the case for interregional mergers in environments where countries are asymmetric regarding expected liquidity shortages.

Undoubtedly, the model presented in this paper only offers an initial framework for analyzing the impact of bank mergers. The inclination therefore is towards methodology and less optimism should prevail when simple policy prescriptions are expected when further extensions will be considered. The reason is that the present model sometimes is already involved and yet does not include:

- the mitigation of moral hazard/adverse selection problems as the result of merger activity;
- the possibilities of contagion through an interbank market;
- the possibly changed dynamic competition strategies regarding bank relationships after mergers;
- as well as other issues.

The appropriate overall conclusion therefore seems that the many different causes that could lead to instability of the banking system all deserve further investigation, for otherwise it will be hard to understand precisely what drives the mixed evidence regarding the relationship between concentration and stability of the financial system that is observed in reality, see Beck e.a. (2003).

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