

Inter-bank exposures and systemic risk

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Systemic risk is the primary reason for public interest in the financial sector. Although an essential part of the public interest, little has been done to assess the risk of contagion in banking systems. Since June 1999 the Riksbank have the four major Swedish banks report their largest counterparty exposures quarterly. The purpose of this article is to present to which extent the Swedish banks are exposed to direct contagion from potential failures of their counterparties and how the authorities should consider this problem.

Background

Sweden underwent a severe banking crisis in the early 1990's. One of the experiences of the crisis was that the authorities were ill-prepared to deal with this type of situation, both with regard to crisis management and crisis prevention. After the crisis, in the mid 1990's, the Riksbank started to develop a new framework for what its role as a non-supervisory central bank should be regarding financial stability.

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The starting point for this framework was that the central bank role, as well as other public interest in the financial sector, was built upon the existence of systemic risk.

Without dwelling too much on the concept of systemic risk, it can be said that it exists because of the combination of two important factors. Firstly, the financial sector in general and the payment system in particular is very important for the functioning of the economy. A breakdown of the financial system will most likely cause substantial socio-economic costs. Secondly, the financial system, especially the banking system, is vulnerable to exter-



nal shocks. Basically, depositors relate this to the fact that banks fund illiquid loans with liquid deposits, which make them vulnerable to loss of depositor trust, which may lead to withdrawal of funds. Moreover, financial problems in one bank may spread to other banks and lead to losses and consequential failures of other banks (contagion). This combination of high probable social costs of failure and high fragility in the banking system is the main motive for regulating banks, according to the Banking Law Commission, which was set up with the purpose of reforming bank regulation in Sweden after the crisis.¹

Risk of contagion between banks is thus an important element of systemic risk. Contagion in the banking system can typically be divided into *direct* and *indirect* contagion. Direct contagion arises because banks are financially exposed to one another, both through the payment system and through other types of positions such as outright loans, derivatives, repurchase agreements et cetera. Indirect contagion can arise mainly through two channels. Firstly, markets may expect that direct contagion effects exist, even where this is not the case. Secondly, if one bank is struck by financial problems, markets may expect that other banks in the same system will be hit by the same problem.

Although risk of contagion is crucial as a motive for a public interest in banking systems, it is striking how little this is reflected in regulatory systems. Regulation and supervision are to a very large extent directed at avoiding the failure of individual banks rather than the failure of the system as a whole.² Even if indirect contagion may be hard to influence by regulation or supervision, that should not be the case when it comes to direct contagion. In the area of payment systems, the main focus of the authorities is on the possible contagion effects that may arise due to the construction of the system. A large majority of developed countries have during the 1990's been focused on using Real Time Gross Settlement (RTGS) and delivery versus payment (DvP) mechanisms for making payment and settlement systems robust to individual bank failures and diminishing direct contagion effects through the system. However, little attention has been paid to the contagion effects arising outside of the payment system. Many of the relevant inter-bank mar-

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It is striking how little risk of contagion is reflected in regulatory systems.

¹ The Commission's proposal is presently under consideration by the Government. For a brief description of the proposal, see Lind & Molin (1999).

² See Acharya (2001) for a discussion on the scope for directing bank regulation to systemic risk rather than individual banks.

kets have grown substantially during the 1990's, making other types of inter-bank exposures potentially larger.

The most obvious way for authorities to limit direct contagion effects would be to set regulatory limits for the size of the exposures.

large exposures, but these are mainly set up in order to limit concentrations in banks' lending portfolios. In the EU regulatory framework, banks are not allowed to have individual counterparty exposures that are larger than 25 per cent of their capital base. However, exposures between financial institutions that are shorter term than one year are exempted from these rules.³ It is common to regard the need for banks to take on large exposures between each other as an unavoidable part of their business. The direct contagion effects are often considered as natural.

In the field of research there is nothing covering all inter-bank exposures simply because no data is available.

In the field of research, the lack of data has been a general obstacle. Some work has been done on empirical measurement of contagion risks⁴, but to our knowledge there is nothing covering all inter-bank exposures, simply because data is not available. The lack of data is naturally connected to the low interest of this issue in the regulatory system. If supervisors do not demand reporting of these exposures, no reporting data that can be used for research will be available. The banks' incentives to do research themselves or provide data to outsiders are weak. Data on counterparties is normally not given freely, as this would disclose important information on the business of the bank. The incentives for banks to show the exposure to direct contagion effects may be weak, since this exposure may be one reason why the authorities may protect them in a crisis. Another reason for the lack of data in this area is simply that banks may not have felt any call to show this type of data, either from investors or supervisory authorities.

When developing the new financial stability framework at the Riksbank and trying to focus on systemic risk, the gap between the emphasis on contagion in theory on the one hand and the lack of regulatory initiatives or empirical research

³ Individual countries may have stricter rules than this, but according to a brief survey of some EU countries made by the Swedish Financial Supervisory Authority, no country did so. One country followed inter-bank credit limits regularly.

⁴ See for instance Furfine (1999).



on the other hand were identified as a major area of concern. The Riksbank therefore wanted to develop an empirical base for estimating the effects of direct contagion. Even though the Riksbank is a non-supervisory central bank, it has a quite unique opportunity to collect information directly from financial institutions, since the Riksbank has a legal right to demand any information from Swedish financial institutions. This article describes the kind of data that has been collected with the objective of analysing direct contagion effects, as well as presenting some quantitative results and drawing some conclusions as to how public authorities could deal with direct contagion.

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Measurement of direct contagion

This section describes some of the issues that were important when the reporting of inter-bank exposures was developed at the Riksbank. In terms of procedure, the design of reporting was set up after a quite thorough investigation into what kinds of exposures Swedish banks had, what risks different types of exposures lead to, how variable these exposures were over time et cetera. This investigation was carried out in autumn 1998 and the reporting began in summer 1999.

The problem of direct contagion is normally seen as the risk that a failure of one bank will lead to credit losses for other banks that are so great that their solvency is also threatened – if one bank falls, other will follow like dominoes. To answer the question “How large could the losses be for other banks if one bank fails?” was the objective for the Riksbank when measuring direct contagion. This reflects only the solvency effect of a bank failure on other banks. A failure of a bank may also have liquidity impacts on other banks. The focus of the Riksbank’s analysis and measurement of direct contagion has been on the solvency effect, which is reflected in the kinds of exposure that have been measured. However, the available data is also used for approximating effects on liquidity (see section “Liquidity impact” pages 35–36).

The problem of direct contagion is normally seen as the risk that if one bank falls, other will follow like dominoes.

The willingness of banks to take on large exposures is quite dependent on the maturity. Banks may consider that it is quite likely that they would get at least some information in advance if an important counterparty was about to fail. If the time to maturity is only one day or a couple of days, it would be possible to

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expected to induce much greater losses than a prolonged failure. In the payment system area, the focus is normally on the instantaneous failure of a bank. Inter-bank exposures are often of very short maturity. Inter-bank deposits, for instance, are pre-dominantly overnight, at least in Sweden. As it may be difficult to measure intra-day exposures globally⁵ in large banks, the Riksbank chose to measure all overnight exposures, to investigate what would happen if one bank were to fail from one day to another. Although a failure of a large bank from one day to another is an unlikely event, it does happen, the failure of Barings probably being the most prominent example.

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Sweden has a concentrated banking system – four large banks cover at least 80 per cent of the system. Because of its focus on systemic risk, the Riksbank concentrates its analysis on these four banks. Contagion could in general be expected to be a bigger problem in a concentrated system, since the large banks have fewer alternatives to deal with in the inter-bank markets. As it is predominantly the failure of one of these four banks that could pose a systemic threat to the Swedish banking system, the measurement of direct contagion was conducted through the largest exposures of these four major banks. As reporting is costly for the banks, it was considered to be unnecessary to require all banks to do this special reporting.

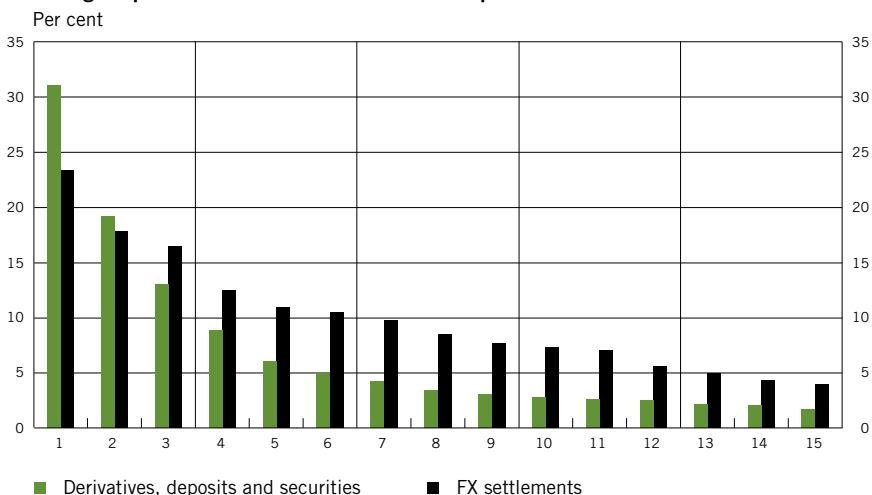
The reporting requirements cover the fifteen largest individual exposures.

The reporting requirements cover the fifteen largest individual exposures. The reasoning behind this is that there should be few counterparties to whom banks are willing to take exposures large enough to threaten their solvency. This hypothesis has been confirmed by data (see figure 1). The size of exposures drops rapidly from the largest to the fifteenth largest counterparty. The fifteenth largest counterparty exposure is never of such a size that the failure of that counterparty would threaten the exposed bank.

⁵ “Globally” here refers to all business lines and all geographical locations in which a bank is active. Banks generally do not have information systems that collect financial exposures on a real time basis. The exposures are controlled by the setting of credit limits globally on particular counterparties, limits that then are distributed to different business units which may deal with that particular counterparty.



Figure 1. Swedish banks' concentration to the fifteen largest counterparties; average exposures in relation to total Tier 1 capital



Source: The Riksbank.


One issue that was important when setting up the reporting requirements was what kind of exposures should be covered. As the purpose was to analyse what the effects on solvency would be if one of the largest counterparties failed from one day to another, the focus was decided to be on exposures containing full principal credit risk. This means that the ranking was based upon uncollateralised exposures. To exclude collateralised exposures is reasonable since one of the most commonly used instruments on the Swedish inter-bank market is repurchase agreements with government bonds as the underlying assets. In most cases, there would be no losses on these repurchase agreements if a counterparty fails. If these exposures were not excluded, they would risk dominating the data. However, collateralised exposures are reported as memo items to the fifteen largest counterparties, although they do not comprise the basis for the ranking.⁶

The uncollateralised credit exposures that give rise to the size ranking are uncollateralised lending, holdings of securities issued by counterparties and the credit element of

Exposures containing full principal credit risk should be covered in the reporting requirements.

Outstanding foreign exchange settlement exposures are included in the reporting.

⁶ See Annex 1, reporting tables for further information.



derivative exposures.⁷ However, full principal credit risk can also arise because of settlement exposures, if the payments and settlement systems are not constructed to provide for payment versus payment (PvP) or DvP mechanisms. Swedish payment and settlement systems provide for such mechanisms, except for foreign exchange (FX) settlement. FX settlement gives rise to a full principal credit exposure lasting on average two days. Outstanding FX settlement exposures are therefore included in the reporting. As these exposures are sometimes substantial compared to other exposures, they are not included in the size ranking of the counterparties, in order not to dominate the ranking. The fifteen largest FX settlement exposures are instead ranked separately. By putting the two ranking lists together, the largest counterparties both including and excluding FX settlement exposures can then be established.

In addition to the ranking of the largest individual exposures, the banks' total exposures within each respective area have been listed, in order to give a picture of the total size of inter-bank exposures and how concentrated these markets are.

The reporting also includes the names of each of the counterparties. This is useful for two reasons in particular. By having the names of the counterparties, the Riksbank can see if a failure of one bank will affect several of the Swedish banks. The names also make it possible to analyse second round effects of contagion, that is, to construct scenarios with possible chain effects from defaults. The reporting also covers counterparties that are not financial institutions, even though it was expected that it would be mainly financial institutions to which the banks had very large exposures. This expectation has been confirmed; financial institutions dominate the ranking list, although from time to time non-financial companies are included on the lists, as well as financial companies.

The banks generally do not have information systems that collect financial exposures on a real time basis or near real time basis. The exposures are controlled by the setting of credit limits globally on particular counterparties, limits that are then distributed to different business units which may deal with that particular counterparty. To collect the actual exposures and rank them is quite burdensome and time consuming for the banks.

As the kinds of exposures that are covered in this reporting are highly variable, it would in principle be interesting to get more frequent reporting. In order

⁷ This means the positive market value of derivatives positions that a bank has against a particular counterparty. The relevant contracts are OTC-derivatives rather than exchange traded derivatives, as these exposures are normally secured. Banks often have contracts of both positive and negative value with a particular counterparty. These contracts can be netted against each other if the parties adopt netting agreements. Therefore, both gross and netted exposures are reported.



not to impose an undue burden on the banks, the Riksbank has limited the requirement to quarterly reporting. The reports are taken in

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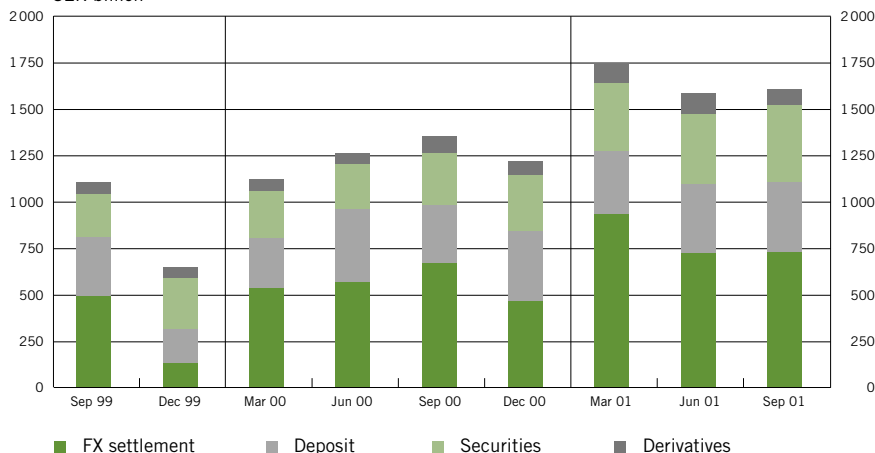
for the end of the quarter, so that they coincide with the dates for financial statements, where actual exposures have to be collected globally within each institution anyway. The low frequency of reporting and the particular dates are of course a limitation for the analysis. Exposures can be expected to vary greatly from one day to another, and they are probably lower at the end of quarters, since the banks in general do not like to show larger balance sheets than necessary. The Riksbank thus sees the reported exposures as indications of what size the exposures might be, rather than exact figures that are valid over time.

Reported counterparty and foreign exchange exposures

OVERALL SIZE OF EXPOSURES

The overall size of the reported exposures is approximately SEK 1,600 billion during 2001 for the four major Swedish banks.⁸ This is a slight increase on the previous year.

Figure 2. Reported counterparty exposures by the four major Swedish banks
SEK billion



Source: The Riksbank.

⁸ Reported exposures of SEK 1,600 billion can be compared to the Swedish GDP of approximately SEK 2,000 billion.

The largest exposures are in the foreign exchange settlement segment.

The largest exposures are in the foreign exchange settlement segment, with these exposures normally making up between SEK 490 to 730 billion of the total exposures. Deposits have varied between SEK 273–378 billion and securities between SEK 228–414 billion. Derivative exposure is the smallest class of exposures and has over the years increased from around SEK 60 billion to a high of SEK 110 billion and is now at SEK 87 billion. At the turn of the millennium the exposure levels were much lower, which is the result of very low levels of exposure to FX settlement and lower than normal exposure to deposits.

COUNTERPARTY RATING

One method of assessing credit standing is to study Standard & Poor's and Moody's credit ratings.

One method of assessing credit standing is to study Standard & Poor's and Moody's credit ratings for the respective counterparties, as the Riksbank has no internal function for making credit assessments of banks.

The Swedish banks' counterparties have high credit ratings, the average rating is A+/A1.

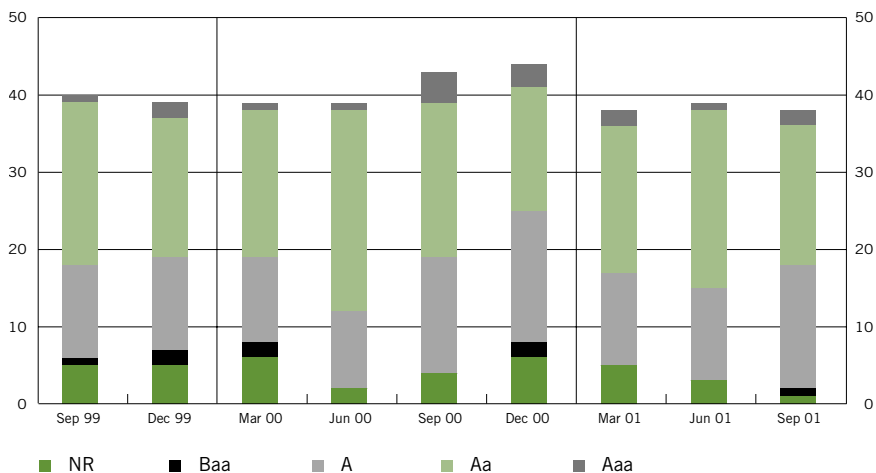
Possibly the banks' foremost means of controlling counterparty risks is to mainly expose themselves to counterparties with high credit standing and to set limitations for exposures. The Swedish banks' counterparties have high credit ratings, according to the counterparty statistics. The average credit rating is A+/A1, which corresponds well to the ratings of the Swedish banks. The average credit rating has been at this level since the reports started in 1999.⁹ The banks are largely exposed to counterparties with credit rating A or higher (see figure 3). There are counterparties with Baa ratings or with no rating from either S&P or Moody's. Counterparties lacking a public rating do not necessarily comprise greater credit risks than those with a rating, since the lack of credit rating could simply mean that they do not borrow directly in the market. Counterparties with no public rating from the rating agencies are normally well known by the banks that are exposed to them. The counterparties' relatively good credit standing indicates a low probability of a sudden default among the counterparties.

Generally, the counterparties used by the Swedish banks are internationally

⁹ The data was first reported for June 1999, in this article data from September 1999 and forward is included, as the data from June does not fully correspond to the data reported later.



Figure 3. Number of counterparties by rating category



Sources: The Riksbank, Moody's and Standard & Poor's.

active foreign financial companies, Swedish and Nordic banking groups and some Swedish large and mid-sized non-financial companies.¹⁰

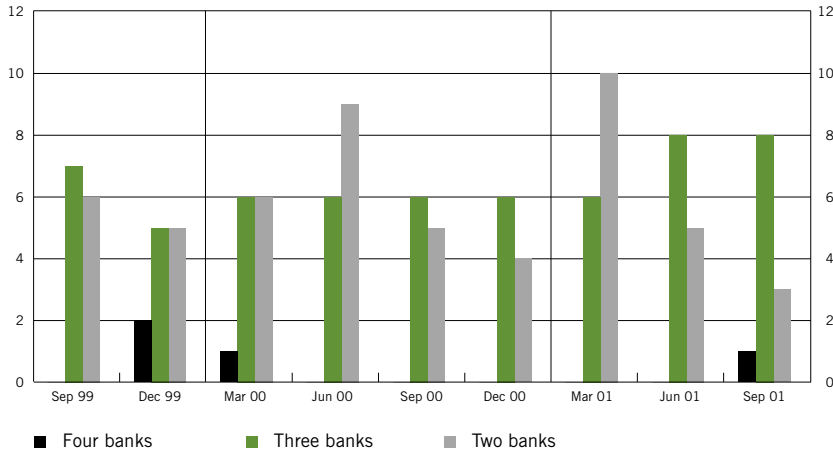
This confirms what we have seen in our work on credit risk management in the Swedish banks, that is that the Swedish banks actively manage which counterparties they do business with. Normally, limits on exposures are set through the use of ratings on the potential counterparties, either from rating agencies or internal ratings.

The four reporting banks rank their exposures from the largest to number fifteen, as they report the fifteen largest exposures as described above. The maximum possible number of counterparties on each reporting occasion for the four major banks is, thus, 60. Since September 1999 the number of counterparties used by the banks has varied between 38 and 44 (see figure 3). The banks have little (or no) knowledge of which counterparties the other banks use regularly, and have no knowledge of which banks their competitors are exposed to at present. The number of counterparties reported by the banks indicates that the name concentration is not as big a problem as could have been assumed. The fact that the reported counterparties do not add up to 60 implies that there are counterparties to which more than one Swedish bank is exposed.

The fact that more than one major Swedish bank might be exposed to the

¹⁰ Counterparties reported by a major Swedish bank can, of course, include one or more of the other major Swedish banks.

Figure 4. Number of Swedish banks exposed to the same counterparty



Note: As an example, in December 1999 there were two counterparties to which all four major Swedish banks were exposed. In March 2000 there was only one counterparty to which all four banks were exposed.

Source: The Riksbank.

There are a number of counterparties to which two or three of the Swedish banks are exposed at any given time.

are a number of counterparties to which two or three of the Swedish banks are exposed at any given time (see figure 4). The few counterparties shared by all four of the banks are not a major source of concern as they are normally highly rated counterparties to which the banks have lower levels of exposure. The counterparties shared by three of the banks deserve more attention, as this group normally includes several of the Swedish banks, and possibly could include some financial companies with lower credit ratings.

same counterparty is a possible source of risk concentration in the banking system. There are few counterparties to which all four of the banks are exposed at any time, but there

DIRECT CONTAGION EFFECTS WITHIN THE SWEDISH BANKING SYSTEM

A loss big enough to lead to the Tier 1 capital of the bank falling below the required level of 4 per cent is assumed to constitute a default.

losses that their capital was reduced below the statutory levels or to such a level of

In the event of a default in one of the Swedish banks, there is a slight risk of a subsequent failure of another Swedish bank. A subsequent default could occur if one or several of the Swedish banks suffered such large

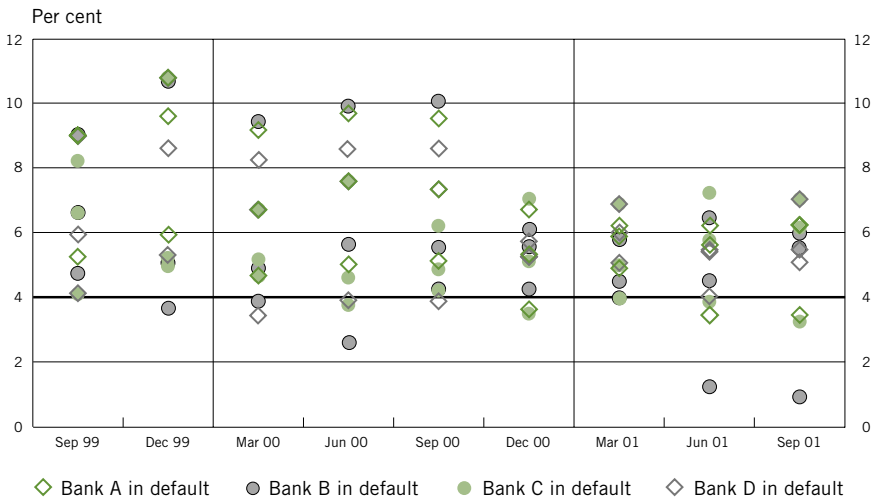
capital that the bank could not refinance itself in the market. In this paper, a loss big enough to lead to the Tier 1 capital of the bank falling below the required level of 4 per cent is assumed to constitute a default. This is probably a quite conservative threshold.

Since September 1999 there have been a number of cases where a Swedish bank has had such substantial exposures towards another Swedish bank that there has been direct risk of contagion, if one of these counterparties had defaulted. In such cases it is only if almost the whole of the exposed amount were to be lost that the exposed banks' capital would actually decline sufficiently for a direct contagion to occur. The Tier 1 capital ratios of the Swedish banks have declined over the studied time period. The Tier 1 capital ratios were high during the first half of the studied time period as some Swedish banks were in the process of merging or taking over other banks. Higher initial capital ratios give the banks stronger resilience to losses from counterparty exposures. The shift in Tier 1 capital ratios can clearly be seen in figure 5. The shift occurs between September and December 2000.

The Tier 1 capital ratios were high during the first half of the studied time period.

With the reported counterparty exposures and the Tier 1 capital ratios of the

Figure 5. Tier 1 capital in the Swedish banks after a major Swedish bank has defaulted, assuming no recoveries

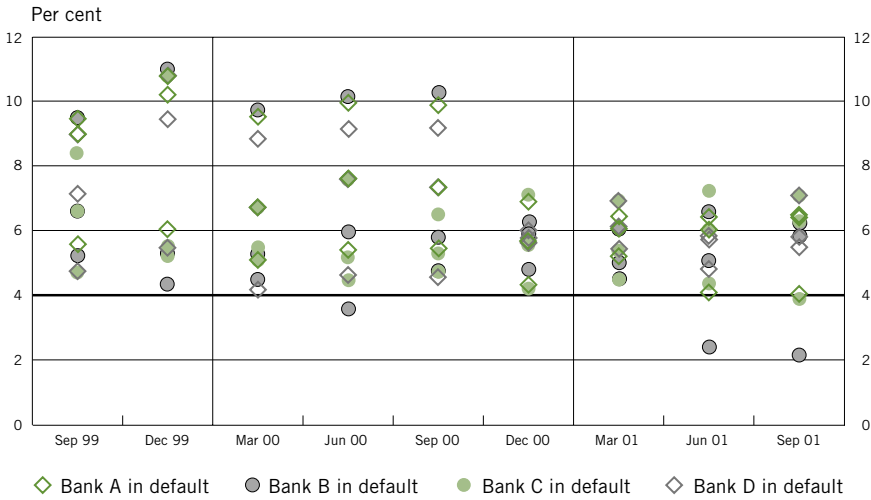


Note: Figures 5 and 6 illustrate the Tier 1 capital ratios in the three surviving Swedish banks after one of the other Swedish banks has defaulted, e.g. the lowest capital ratio would have been the effect of bank C being in default.

Source: The Riksbank.

Swedish banks there have been 16 cases where the exposed bank's Tier 1 capital ratio would have fallen below the statutory 4 per cent level if one of the other Swedish banks defaulted (see figure 5). The total number of reported counterparty exposures is to date 108 cases. These 16 cases occur assuming no recovery at all, or a full loss of the total exposed amount. Assuming no recovery at all is, of course, a very conservative assumption by all standards. If we assume that the losses at default are only 75 per cent of the exposed amounts, or a 25 per cent recovery, the number of cases where the Tier 1 capital ratio falls below 4 per cent would be only 4 (see figure 6).

Figure 6. Tier 1 capital in the Swedish banks after a major Swedish bank has defaulted, assuming 25 per cent recoveries



Source: The Riksbank.

Depending on which of the Swedish banks defaults the risk of direct contagion varies.

The severity of the losses also seems to increase during the latter part of the time period for which data is available. This is the effect of decreases in the Tier 1 capital ratios of

all of the Swedish banks, but also of higher levels of exposure between some of the Swedish banks. The main observation from the effects on direct contagion in the Swedish inter-bank markets is that there is a potential for large losses by some Swedish banks if other Swedish banks default. The likelihood of a direct contagion in the Swedish banking system is dependent on which of the banks defaults, as there are links between the Swedish banks. Depending on which of the Swedish banks defaults the risk of direct contagion varies, as the exposures major

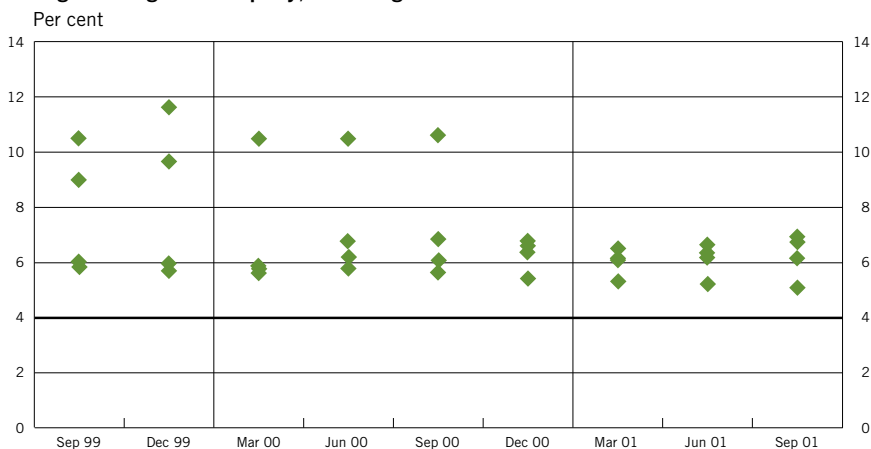


banks allow themselves to other banks differ quite substantially. In the event of a counterparty default occurring, it is only major losses with low degrees of recovery that would lead to contagion from one Swedish bank to another, almost regardless of which bank defaults. The risk of contagion effects between the banks is thus relatively slight, even though a few would definitely constitute very severe losses to some of the banks, even forcing the exposed bank into default.

DIRECT CONTAGION FROM ABROAD

We conclude that the risk of contagion within the Swedish banking system is relatively slight. There could of course be other channels from which direct contagion effects might hit the Swedish banking system. One such channel is the foreign counterparties to which the major Swedish banks are exposed.

Figure 7. Tier 1 capital in the Swedish banks after losing their largest foreign counterparty, assuming no recoveries



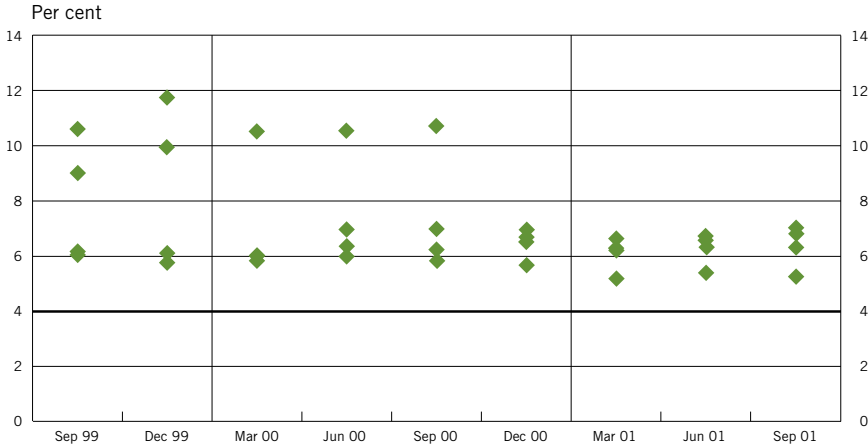
Source: The Riksbank.

The effects on the Swedish banks if their largest foreign counterparty defaulted could possibly become a threat to financial stability. We have observed the Tier 1 capital ratios for the Swedish banks after their largest foreign counterparty has defaulted. In figure 7 the capital ratios are calculated for the Swedish banks assuming a full loss of the exposed amounts and in figure 8 we allow for a 25 per cent recovery. There are no instances when the capital ratio falls below the statutory 4 per cent level. The effects on the system from foreign

The effects on the system from foreign counterparties seem to be smaller than from the domestic counterparties.

counterparties thus seem to be smaller than the effects from the domestic counterparties. The foreign counterparties in these calculations are based on the same form of ranking as in the section on domestic exposures above.

Figure 8. Tier 1 capital in the Swedish banks after losing their largest foreign counterparty, assuming 25 per cent recoveries



Source: The Riksbank.

The possibility of direct contagion effects from foreign counterparties is very slight for the Swedish banking system.

The severity of the losses on the capital ratios of the Swedish banks are also less for the foreign counterparties than for the Swedish counterparties. There is a less severe effect with regard to both the number of cases where capital ratios fall below 4 per cent and to the actual capital ratios. We can only conclude that the possibility of direct contagion effects from foreign counterparties is very slight for the Swedish banking system.

DIRECT CONTAGION FROM FOREIGN EXCHANGE SETTLEMENT

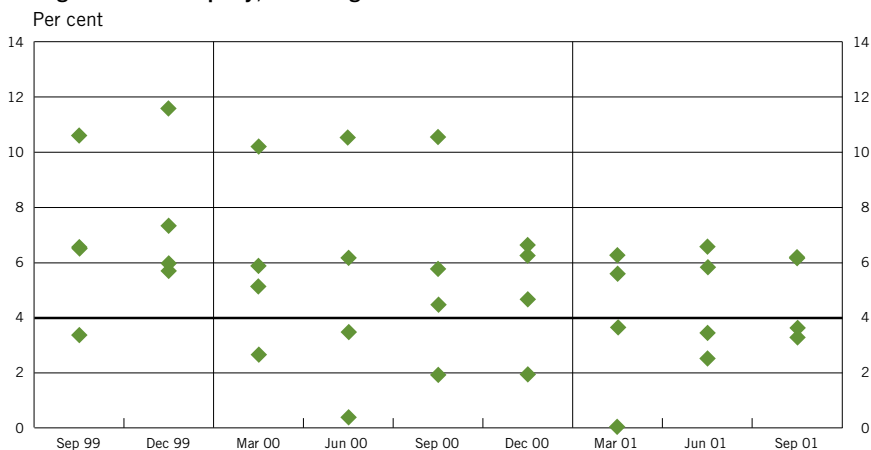
FX settlement exposure accounts for almost half of the total exposures, which makes them a likely channel for direct contagion.

FX settlement exposure accounts for almost half of the total exposures reported by the banks, which makes these exposures a likely channel for direct contagion. The effects on the Swedish banks of losing the largest FX settlement exposures are calculated below. The counterparties in this case are Swedish and Nordic banks, large Swedish non-financial companies and some foreign financial companies.



The findings from the calculated Tier 1 capital ratios in the Swedish banks after losing their largest FX exposures are that no fewer than 12 cases where the capital ratios fall below the 4 per cent threshold can be observed, assuming no recoveries. Assuming 25 per cent recovery on the FX exposures limits the number of cases where the capital ratio falls below the statutory level to 6. The number of cases where the capital ratios fall below the statutory level when assuming 25 per cent recovery decreases less than in the calculations above. This is the effect of the fact that the losses incurred by the FX settlement exposures are larger than the losses above.

Figure 9. Tier 1 capital ratios in the Swedish banks after losing their largest FX counterparty, assuming no recoveries



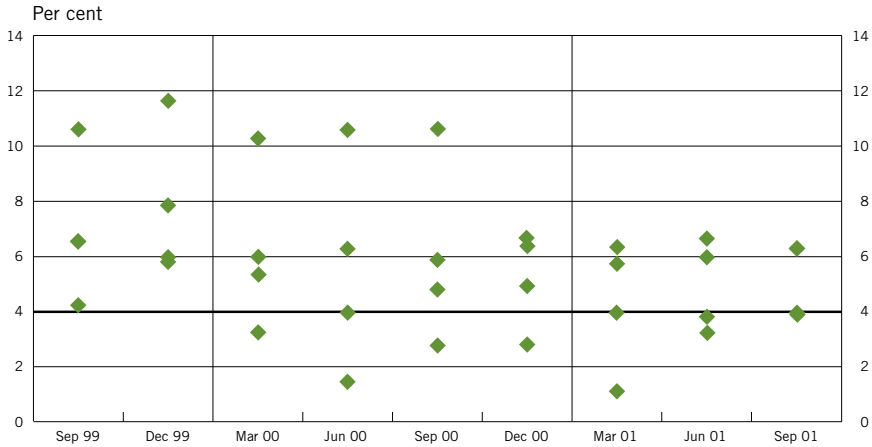
Source: The Riksbank.

The size of the foreign exchange settlement exposures differs markedly between the four major Swedish banks, as was the case with the size of the exposures in the Swedish inter-

The size of the foreign exchange settlement exposures differs between the four major Swedish banks.

bank market. The banks most at risk from the FX settlement exposures are not the same banks as the ones most at risk from exposures to other Swedish banks. The fact that different banks have large exposures in the Swedish inter-bank market and the FX settlement market reduces the risk for direct contagion from one specific counterparty to several Swedish banks at the same time as the Swedish banks are vulnerable to defaults from different counterparties.

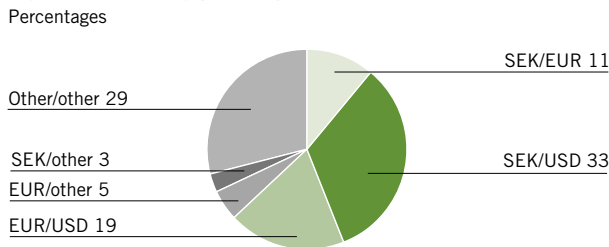
Figure 10. Tier 1 capital ratios in the Swedish banks after losing their largest FX counterparty, assuming 25 per cent recoveries



Source: The Riksbank.

The risk of sequential direct contagion is a consequence of the possibility of one bank losing substantial amounts from the default of a foreign counterparty, the effect being that the bank defaults. The default of the first Swedish bank could then trigger another round of defaults among the Swedish banks. This is the worst scenario from a direct contagion perspective for the stability of the Swedish financial system.


Figure 11. Currency pairs September 2001



Source: The Riksbank.

The effects of exposures in FX settlement are possibly the most severe ones when looking at direct contagion for the Swedish banks.

The effects of exposures in FX settlement are possibly the most severe ones when looking at direct contagion for the Swedish banks. The size of the effects of defaults will diminish when foreign exchange settlement starts us-



ing payment versus payment mechanisms within the CLS Bank. The Swedish krona will not be one of the original currencies in CLS, but there are beneficial effects of trading USD/EUR on a payment versus payment basis (see figure 11). The EUR/USD exposures reported by the Swedish banks account for 19 per cent of the total exposures or SEK 125 billion in exposures. The effects of the krona being traded in the same way can also be assessed from figure 11; the exposures including the krona and one of the original currencies are at least 63 per cent of the total exposures and could possibly be an even larger part of the total.¹¹ The effects of PvP in foreign exchange settlements would also diminish the exposure levels in the domestic inter-bank market and to the foreign counterparties, as these markets also include FX settlement exposures to some extent.

LIQUIDITY IMPACT

This far, the focus of the analysis of direct contagion has been on the solvency effect (that is the size of the loan loss) on the Swedish banks, should one of their major counterparties default. A sudden default of a major counterparty would also comprise a

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liquidity effect, since the repayments of the relevant claims on that counterparty would not occur. The potential liquidity impact on banks from counterparty exposures is difficult to estimate, as the Riksbank's report does not cover the duration of the exposures. One can assume that the majority of the exposures have very short duration, but those of securities and derivatives could potentially be quite long. We therefore make the assumption that we can approximate the effects on the exposed banks' liquidity of a counterparty default by looking at the FX settlement and deposit classes of exposures. FX settlement exposures typically endure for a maximum of two days. According to a survey of the Swedish banks in 1998, the major part of the inter-bank deposits in the Swedish banks are overnight and very few mature in more than one month. When assessing the liquidity effect of banks, it thus does not seem overwhelmingly conservative to assume that the total exposure in FX settlement and deposits to a single counterparty will be due for payment at very short notice.

Assessing the liquidity impact has so far not been part of the on going work at the Riksbank, but will be included in the future. Here, only a very simple calculation of the liquidity impact will be made. The methods for doing this could

¹¹ Adding the exposures that are known to include SEK, USD, EUR (11 % + 33 % + 19 % = 63 %).

probably be enhanced significantly. The effects on the liquidity of the Swedish banks have been calculated by comparing the exposure in deposits and FX settlement with data on unutilised collateral in the payment system, the RIX system. These calculations have been made for the other major Swedish banks and for the largest FX settlement counterparty as reported by the banks. The full loss from a counterparty is related to the unused collateral in the payment system. If the loss is larger than the posted unused collateral it is indicated in table 1 below as a liquidity effect. The severity of the liquidity shortage varied considerably between the six cases.

Table 1. Liquidity effects on the Swedish banks on 30 September 2001

Affected bank	Failing bank				
	Bank A	Bank B	Bank C	Bank D	Largest FX counterparty
Bank A	–				
Bank B		–			
Bank C		Liquidity effect	–		Liquidity effect
Bank D	Liquidity effect	Liquidity effect	Liquidity effect	–	Liquidity effect

Source: The Riksbank.

The results in table 1 are only indicative of the possible liquidity effects, as the calculations are for one specific date. The calculations also do not take into account the fact that collateral in the Swedish payment system can be posted within minutes. Selling of other liquid assets by the bank could also mitigate the liquidity effects. Another opportunity is to borrow funds from other institutions, but in a situation where another Swedish bank has failed, this may be difficult since lenders may be reluctant to provide liquidity to a bank within the same system.

It is a good sign that liquidity effects are not observed for all banks with this conservative approach.

This very limited approach makes it hard to draw conclusions. However, to only take into account the collateral that is posted in the RIX system, which is readily available for

immediate borrowing, is a very conservative approach. A very limited conclusion may be that it is a good sign that liquidity effects are not observed for all banks with this conservative approach.

Counterparty credit risk mitigation

Inter-bank credit exposures are often thought of as being a necessary result of banking business, that is that there is not much that can be done about these exposures by the banks. Especially in a concentrated banking system like the Swedish system, this is a common perception. In this section, the available methods for counterparty credit risk mitigation are briefly discussed, showing that there are ways of diminishing counterparty credit exposures.

There are ways of diminishing counterparty credit exposures.

The most obvious credit risk mitigation technique is of course the setting of *credit limits*. There are substantial differences between the Swedish banks as to how large exposures they are willing to accept to their counterparties. This indicates that it is possible to set conservative credit limits, especially since these patterns are consistent over time in our data. In order to have conservative credit limits, it may be necessary to have an extensive network of counterparties, in order to *diversify* the counterparty credit risk by using different counterparties, that is name diversification.

The most obvious credit risk mitigation technique is the setting of *credit limits*.

Swedish banks do not in general see FX settlement exposures as ordinary credit exposures. Before 1998, the banks did not in general have any systems for limiting these exposures. Since then, all the four large Swedish banks have introduced *FX settlement limits*. These are limit systems that are separate from the ordinary credit limit systems. It could be discussed whether these normal credit limits and FX settlement limits should be integrated, in order to have better control over total credit exposures within the bank.

All four large Swedish banks have introduced *FX settlement limits*.

The most important way of limiting FX settlement exposures is of course the introduction of a *PvP mechanism* for FX settlement. The creation of CLS Bank is naturally a major step, which will decrease settlement exposures substantially. For the Swedish banks, however, the effect will not be that big initially, since the Swedish krona is not one of the original member currencies and a major part of Swedish banks' FX positions involve the krona (see figure 11).

The most important way of limiting FX settlement exposures is the introduction of a *PvP mechanism* for FX settlement.

As banks take on positions against each other on either side of the balance sheet, the scope for *netting* of these exposures is important. Both positive and negative positions against the same counterparty could be netted, particularly in de-

As banks take on positions against each other on either side of the balance sheet, the scope for *netting* of these exposures is important.

Another obvious credit risk mitigation technique is the use of *collateral*.

Another obvious credit risk mitigation technique is the use of *collateral*. The most apparent area for this is financing, where banks can choose to lend to one another with uncollateralised deposits or with collateralised transactions, in Sweden that is mainly done through repurchase agreements. Collateral is of course costly, and banks are not likely to always hold a sufficient amount of securities that can be used as collateral for all transactions. Another area where the use of collateral is growing is in derivative trading. This applies especially to dealing in derivatives with long maturities, where posting collateral can be a very attractive way of hedging counterparty risk.

rivative positions. Master agreements¹² that allow for netting of derivative positions are commonly used by the Swedish banks and their most important counterparties in these markets. With respect to the positions reported to the Riksbank, netting reduces the credit positions with on average 55 to 60 per cent for the fifteen largest counterparties. It is more uncertain whether other kinds of exposures could be netted against each other in case of a failure.

Policy conclusions

A reduction of inter-bank exposures between the large Swedish banks is desirable in order to limit the risk of direct contagion.

Sweden has a concentrated banking system, with four large banks covering at least 80 per cent of the system, like in many other small countries. This is one reason to expect large inter-bank exposures within these systems, as banks may have few other alternatives than to deal with each other in the inter-bank markets. Data on inter-bank exposures shows that internal direct contagion effects are less than might have been expected in the Swedish banking system. In most cases where one of the four banks fails, the other banks will not suffer direct losses that would reduce their Tier 1 capital ratio below the regulatory level. However, this could occur on some occasions, according to the data set. Moreover, the exposures are measured at the end of quarters, so they are probably underestimated compared to exposures at peak levels, particularly in intra-day exposures. There-

¹² Master agreements in this context are derivatives contracts that are developed by industry organisations such as International Swaps and Derivatives Association (ISDA), which allow for a standardised treatment of several derivatives deals between two counterparties, for instance regulating netting opportunities.

fore, a reduction of inter-bank exposures between the large Swedish banks is desirable in order to limit the risk of direct contagion within the Swedish system.

The risk for direct contagion from abroad mainly arises from exposures on foreign exchange settlement exposures. There are a number of cases where a failure by a

The introduction of PvP mechanisms in foreign exchange settlement is a major advancement in risk reduction.


foreign counterparty has the effect that one of the Swedish banks is hit by a loss that makes their Tier 1 capital ratio decrease below the regulatory level. If FX settlement exposures are excluded, there are no cases where a Swedish bank will suffer a loss from abroad that leads to a Tier 1 capital ratio that is too low. The introduction of PvP mechanisms in foreign exchange settlement through CLS Bank is a major advancement in risk reduction for banks active in the foreign exchange market.

The Swedish banks show substantial differences with respect to how large individual exposures they are prepared to have to their counterparties. This indicates that it should be possible to reduce inter-bank exposures even in a concentrated banking system. It also leads to the conclusion that banks with large exposures in the inter-bank market are the ones we need to observe more closely.

The main mechanisms for decreasing the size of exposures between banks is to diversify exposures to more counterparties, to use collateralised instruments when possible, to adopt netting and to use clearing and settlement systems that provide for DvP or PvP when available. Many of the markets where large exposures arise for the Swedish banks are international markets, where the concentrated national banking system does not pose an obstacle to the diversification to a larger number of counterparties.

Mechanisms for decreasing the size of exposures between banks are to diversify exposures, to use collateral, to adopt netting and to use clearing and settlement systems that provide for DvP or PvP.

The Swedish banks are universal banks that do not differ particularly from other large international banks. There is no reason to believe that banks in other countries differ substantially from the Swedish banks with respect to exposure to direct contagion. The large differences with respect to the size of the largest exposures between the Swedish banks suggest, however, that there may be significant differences in individual banks' exposure to direct contagion effects. One element that may lead to a larger exposure within the Swedish system compared to other countries is the substantial holdings of mortgage backed bonds in the Swedish banks. Most of the mortgage institutions are subsidiaries to the Swedish banks and are thus seen as part of the banks in the context of contagion.



The large Swedish banks have relatively high ratings and must in general be seen as rather risk conscious. The observation that banks take on so large exposures that they may not fulfil capital adequacy rules if there is a large loss on one of these exposures suggests that the banks see a sudden failure of an important counterparty as an extremely unlikely event. The reason behind this is probably not merely the actual probability of the event occurring, but also expectations that the authorities would not allow a sudden failure of an important bank. The fact that this kind of expectations exist is confirmed by the discussions that the Riksbank has had with the banks.

Moral hazard seems to be present with respect to exposure towards direct contagion.

Moral hazard thus seems to be present with respect to the exposure towards direct contagion. As the fear of contagion is one of the most obvious reasons for public authorities to intervene, it is hard to see that there are incentives for banks to decrease these exposures. To some extent they are actually protected by the existence of risks of direct contagion, as these make government intervention more likely. Consequently, this can be seen as a market failure, which makes it reasonable to question whether there is scope for regulation in this area.

Monitoring credit limits can be an alternative to measuring the actual exposures.

In Sweden, the Riksbank has had discussions with the supervisory authority (FSA) on whether the rules on large exposures should be sharpened, in order to also take into account short-term inter-bank exposures. The conclusion has been not to do so at this stage. The reason is that the regulatory system is developed internationally, particularly within the EU. The level playing field argument makes it difficult to suggest stricter rules for national banks than what is required by the EU system. It therefore seems more natural to bring up the issue in international discussions. However, the large focus on Basle II, where these issues are not discussed, has made this quite difficult. Another reason not to introduce new rules at this stage is the creation of CLS Bank. As quite a large portion of the contagion effects arises from FX settlement exposures, the total exposure to direct contagion might diminish substantially with the introduction of CLS. Instead of introducing stricter regulations, the Riksbank and the FSA jointly will increase the monitoring of banks' counterparty and settlement risk management, in particular the setting of credit limits. Monitoring credit limits can be an alternative to measuring the actual exposures the way the Riksbank does it, especially since this may be less burdensome for the banks involved and since the limits reveal the maximum exposure that the banks are willing to accept.



Another alternative to posing stricter rules on large exposures is to consider whether it is possible to increase transparency in this area. If banks had to show their exposure to single counterparties in some form (of course without giving out the names of the counterparties), this ought to benefit the banks' investors, as it indicates the banks' capability of managing their risks. This information could be used to raise the required return on their investment or to drive down the size of the exposures depending on the risk appetite of the investors.

In this article the focus has been on the work carried out by the Riksbank. The methodology used by the Riksbank to monitor inter-bank counterparty exposures is one possible approach to monitoring the exposures in the banking system, the most notable deficiency of this approach being the infrequent reporting. The workload, as discussed above, placed on the banks by the reporting requirements does not make it possible for the Riksbank to require more frequent reports. An alternative approach, which might make it possible to receive more frequent reports, might be to have the banks report their credit limits on major counterparties as these possibly vary less over time. When the limits are known to the Riksbank the banks would merely need to report how much of these limits were used at any given time. This approach might be more in line with the internal reports of the banks and thereby prove less burdensome for the banks. On the other hand, individual limits reveal even more of the banks' business strategy than actual exposures, and banks may be even more reluctant to reveal this information.

Another alternative to posing stricter rules on large exposures is to consider whether it is possible to increase transparency.

An alternative approach might be to have the banks report their credit limits on major counterparties.

Appendix

	Counterparty	Derivatives	Securities	Deposits		Total	FX settlement	Stock loans	Repurchase agreements	Other collateralised loans	Exposures to companies within the same group
				Gross	Net						
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
Total											



	Counterparty	SEK/EUR	SEK/USD	EUR/USD	EUR/Other	SEK/Other	Other/Other	Total
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
Total 15								
Total								



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