Financial integration, specialization and systemic risk

Falko Fecht
(Deutsche Bundesbank and European Central Bank)

Hans Peter Grüner
(University of Mannheim and CEPR, London)

Philipp Hartmann
(European Central Bank and CEPR, London)

Discussion Paper
Series 1: Economic Studies
No 23/2008

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0
Telex within Germany 41227, telex from abroad 414431

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978-3–86558–465–6 (Printversion)
ISBN 978-3–86558–466–3 (Internetversion)

This paper was presented at the 10th Bundesbank spring conference (May 2008) on “Central Banks and Globalisation“. The views expressed in the paper are those of the authors and not necessarily those of the Bundesbank.

Central Banks and Globalisation

10th Bundesbank Spring Conference
(in cooperation with the IMFS)

22-23 May 2008

Thursday, 22 May 2008

9.00 – 9.30 **Introduction**

Axel Weber *(Deutsche Bundesbank)*

Chair: Axel Weber *(Deutsche Bundesbank)*

9.30 - 10.30 **Global business cycles: convergence or decoupling?**

Speaker: Ayhan Kose *(IMF)*
Christopher Otrok *(IMF)*
Esward Prasad *(IMF)*

Discussant: Massimiliano Marcellino *(Bocconi University)*

10.30 – 10.45 **Coffee break**

10.45 – 11.45 **Absorbing German immigration: wages and employment**

Speaker: Gabriel Felbermayer *(University of Tübingen)*
Wido Geis *(ifo)*
Wilhelm Kohler *(University of Tübingen)*

Discussant: Michael Burda *(Humboldt University)*

11.45 – 13.15 **Lunch**

Chair: Stefan Gerlach *(IMFS)*

13.15 – 14.15 **Financial exchange rates and international currency**

Speaker: Philip Lane *(Trinity College Dublin)*
Jay Shambrough *(Dartmouth College)*

Discussant: Frank Warnock *(University of Virginia)*

14.15 – 14.30 **Coffee break**

14.30 – 15.30 **International Portfolios and Current Account Dynamics: The Role of Capital Accumulation**

Speaker: Robert Kollmann *(ECARES, Universite Libre de Bruxelles, University Paris XII and CEPR*)
Nicolas Coeurdacier (*London Business School*)

Discussant: Mathias Hoffmann (*University Zurich*)

15.30 – 15.45 **Coffee break**

15.45 – 16.45 **Financial globalisation and monetary policy**

Speaker: Michael Devereux *(University of British Columbia)*
Alan Sutherland *(University of St Andrews)*

Discussant: John Rogers *(Federal Reserve Board)*

16.45 – 17.00 **Coffee break**

17.00 – 18.00 **Globalization and inflation – evidence from factor augmented Phillips curve regressions**

Speaker: Sandra Eickmeier *(Deutsche Bundesbank)*
Katharina Moll *(Frankfurt University)*

Discussant: Matteo Ciccarelli (ECB)

19.30 **Dinner**

Speaker: Harold James *(Princeton University)*

Friday, 23 May 2008

Chair: Lars Jonung *(European Commission)*

10.00 – 11.00 **Globalisation of banking and the effectiveness of monetary policy**

Speaker: Linda Goldberg *(Federal Reserve Bank of New York)*
Nicolla Cetorelli *(Federal Reserve Bank of New York)*

Discussant: Claudia Buch *(University of Tübingen)*

11.00 – 11.15 **Coffee break**

11.15 – 12.15 **Foreign capital and economic growth in the first era of globalisation**

Speaker: Michael Bordo *(Rutgers University)*
Chris Meissner *(University of Cambridge)*

Discussant: Albrecht Ritschl *(London School of Economics)*

12.15 – 14.00 **Lunch**

Chair: Beatrice Weder di Mauro *(University Mainz)*

14.00 – 15.00 **Money, liquidity and financial stability**

Speaker: Franklin Allen *(University of Pennsylvania)*
Elena Carletti *(Frankfurt University)*

Discussant: Wolf Wagner *(Tilburg University)*

15.00 – 15.15 **Coffee break**

15.15 – 16.15 **International linkages and financial fragility**

Speaker: Falko Fecht *(Deutsche Bundesbank)*
Hans Peter Grüner *(University of Mannheim)*
Phillip Hartmann *(ECB)*

Discussant: Roman Inderst *(Frankfurt University & IMFS)*

16.15 – 16.30 **Coffee break**

Chair Heinz Herrmann *(Deutsche Bundesbank)*

16.30 – 17.30 **Financial globalisation and regulation**

Speaker: Xavier Freixas *(Pompeu Fabra)*

Discussant: Arnoud Boot *(University of Amsterdam)*

Abstract:

This paper studies the implications of cross-border financial integration for financial stability when banks' loan portfolios adjust endogenously. Banks can be subject to sectoral and aggregate domestic shocks. After integration they can share these risks in a complete interbank market. When banks have a comparative advantage in providing credit to certain industries, they will exploit the enhanced risk sharing opportunities through more specialization in lending. The enhanced concentration in lending does not increase risk, because a well-functioning interbank market allows to achieve the necessary diversification. The greater need for risk sharing through it increases, however, the risk of cross-border contagion. Better risk sharing and greater risk of contagion tend to offset each other and financial integration improves welfare since specialization benefits are realized.

Keywords: Financial integration, specialization, interbank market, financial contagion

JEL Classification: D61, E44, G21

Non technical summary

A key benefit of financial integration is that it improves risk sharing across borders. It reduces the impact of regional shocks on domestic consumption. Greater diversification through financial markets at the same time also allows to realize specialization benefits at the regional or firm level. When diversification of sectoral risks can be achieved through integrated financial markets regions or firms can focus on those technologies in which they have a comparative advantage.

However, the financial globalization of the recent decades has been driven to a large extent by a greater integration of interbank markets. But interbank integration not only provides greater scope for risk sharing. It also brings about the risk of cross border financial contagion. If the regional shock exceeds the risk bearing capacities of a regional bank it fails. Due to interbank credit exposures the failure of a regional bank can lead to knock-on effects across borders. Thus from a welfare perspective financial integration is only beneficial if the expected benefits from greater risk-sharing exceed the expected costs from cross-border financial contagion. In this paper we develop a theoretical model to study this trade-off.

In our model we take into account that an integrated interbank market leads to greater specialization in banks' loan portfolio and thereby increases endogenously both, the benefits from risk sharing as well as the expected costs from financial contagion. If the interbank market is not integrated, banks have to cushion sectoral shocks through diversification of their loan books. They cannot share the risk of delayed loan repayments with banks abroad. Thus it is not optimal for banks to fully exploit the greater returns from specialization in the industry in which they have a comparative advantage, because the greater concentration in lending would expose them too much to sectoral shocks. If there is an integrated interbank market available the diversification of liquidity shocks is decoupled from the lending decision of banks. It is optimal for banks to increase their investment in the high-return industry, as the greater idiosyncratic exposure to sectoral shocks can be shared with

banks abroad. So, due to specialization in lending to different sectors idiosyncratic liquidity risks of banks increase and the benefits from risk sharing endogenously rise.

At the same time, however, specialization makes banks more reliant on the liquidity provision from the interbank market. When a specialized bank is hit by a sectoral shock it is dependent on payments from the bank in the other country. If this other bank is hit by a country-specific shock itself (or has some operational problems), so that it is not in a position to make those payments, both banks will ultimately default. The first bank fails as a consequence of not receiving the expected payments, which is a form of cross-border bank contagion. In this sense integration and specialization endogenously increases contagion risk.

Assuming that country-specific (or operational) shocks are equally likely in all countries and that they are uncorrelated with sectoral shocks, we can show that the overall bank default risk before and after integration is unchanged. The greater returns of enhanced specialization are realized, however, so that the overall return of banks and ultimately also welfare increases through integration.

Of course, these results are derived under specific assumptions. In particular this model does not consider the additional effects of financial regulation and supervision, deposit insurance or a central bank acting as lender of last resort. It also abstracts from the fact that large banking crises will have stronger negative externalities on the real economy than small crises. Keeping these limitations in mind, at least one lesson may be learnt. Financial integration should not simply be resisted on stability grounds. Even though it enhances cross-border contagion risks, better risk sharing has also offsetting stability effects and allows for exploiting further benefits from specialization, potentially leading to a higher level of welfare. All these arguments should be considered.

Nicht technische Zusammenfassung

Finanzintegration verbessert die Möglichkeiten zur grenzüberschreitenden Risikoteilung. Sie reduziert hierdurch den Einfluss nationaler Schocks auf den inländischen Konsum. Bessere Diversifikationsmöglichkeiten durch grenzüberschreitende Finanzmärkte erlauben darüber hinaus, Spezialisierungsvorteile auf regionaler Ebene bzw. auf Firmenebene zu realisieren. Lassen sich sektorale Schocks auf einem integrierten Finanzmarkt diversifizieren, so können Regionen oder einzelne Firmen sich auf solche Technologien spezialisieren, in denen sie einen komparativen Vorteil haben.

Die finanzielle Globalisierung der vergangenen Jahrzehnte war allerdings zu einem Großteil durch die Integration der Interbankenmärkte getrieben. Eine finanzielle Integration über Interbankenmärkte erhöht aber nicht nur das Potential der Risikoteilung. Sie bringt gleichzeitig auch grenzüberschreitende Ansteckungsrisiken zwischen Finanzinstituten mit sich. Gerät eine Bank durch einen regionalen Schock in eine Schieflage, so können hierdurch hervorgerufene Ausfälle von Interbankkrediten Banken anderer Regionen destabilisieren und letztlich zu Dominoeffekten führen. Aus einer Wohlfahrtsperspektive ist eine Finanzintegration über den Interbankenmarkt demnach nur dann vorteilhaft, wenn die erwarteten Wohlfahrtsgewinne einer verbesserten Risikoteilung die erwarteten Wohlfahrtskosten erhöhter Ansteckungsrisiken aufwiegen. In diesem Papier entwickeln wir ein theoretisches Modell, das diesen Trade-off darstellt.

Unser Modell berücksichtigt dabei explizit, dass integrierte Interbankenmärkte zu einer verstärkten Spezialisierung im Kreditportfolio der Banken beitragen und somit endogen sowohl die Vorteile der Risikoteilung als auch die erwarteten Kosten aus Ansteckungseffekten steigen. Ist kein Interbankenmarkt verfügbar, so müssen Banken ein sektoral diversifiziertes Kreditportfolio halten, um aus verspäteten Kreditrückzahlungen erwachsende Liquiditätsrisiken abzufedern. Folglich können Banken Vorteile, die sich aus der Spezialisierung auf die Kreditvergabe an einzelne Sektoren ergeben, nicht vollständig realisieren. Ist dagegen ein integrierter Inter-

bankenmarkt verfügbar, so ist die Diversifikation von Liquiditätsrisiken unabhängig von der Kreditvergabe der Banken möglich. In diesem Fall ist es für Banken optimal, sich auf die Kreditvergabe an diejenigen Sektoren zu konzentrieren, die regional den höchsten Ertrag versprechen. Hieraus resultierende idiosynkratische Liquiditätsschocks können über den integrierten Interbankenmarkt mit Banken anderer Regionen abgesichert werden. Die Spezialisierung des Kreditportfolios der Banken führt dazu, dass idiosynkratische Liquiditätsrisiken der Banken steigen und damit endogen die Vorteile einer grenzüberschreitenden Risikoteilung zunehmen.

Gleichzeitig führt eine stärkere Spezialisierung der Kreditvergabe dazu, dass Banken in größerem Maße von der Liquiditätsbereitstellung über den Interbankenmarkt abhängig werden. Wenn eine spezialisierte Bank von einem negativen sektoralen Schock getroffen wird, benötigt sie eine Liquiditätsbereitstellung der Bank einer anderen Region, die sich auf einen anderen Sektor spezialisiert hat. Ist diese andere Bank aber zur gleichen Zeit von einem regionalen Schock betroffen oder hat sie operative Probleme, so werden letztlich beide Banken ausfallen. Die erste Bank ist zahlungsunfähig, da der erwartete Liquiditätszustrom aus dem Interbankenmarkt ausbleibt. Es kommt zu einem Ansteckungseffekt. In diesem Sinne führt die Integration der Interbankenmärkte und die einhergehende Spezialisierung endogen auch zu einem Anstieg der Ansteckungsrisiken.

Unter der Annahme, dass länderspezifische Schocks bzw. operative Probleme über die Regionen hinweg gleich wahrscheinlich sind und nicht mit sektoralen Schocks korreliert sind, zeigt sich, dass das individuelle Ausfallrisiko einzelner Banken von der Integration über Interbankenmärkte unberührt bleibt. Gleichwohl steigen durch die Spezialisierung in der Kreditvergabe die erwarteten Bankerträge und damit letztlich auch die Wohlfahrt.

Diese Resultate sind natürlich zu einem Großteil von den spezifischen Annahmen des Modells abhängig. Dies gilt insbesondere, da in dem Modell Bankenregulierung und -aufsicht, Einlagensicherung und die Zentralbank als Lender of Last Resort außer acht gelassen werden. Darüber hinaus berücksichtigt das Modell nicht,

dass typischerweise die negativen Externalitäten von umfassenden Bankenkrisen für die Realwirtschaft weit größer sind als bei regional begrenzten Bankinsolvenzen. Trotz dieser Einschränkungen zeigt dieses Modell aber, dass eine Beurteilung der Finanzintegration nicht alleine auf eine stabilitätspolitische Perspektive im engeren Sinne beschränkt werden sollte. Auch wenn die Finanzintegration Ansteckungseffekte erhöht, so verbessert sie andererseits die Risikoteilungsmöglichkeiten und erlaubt damit die Realisation von Spezialisierungsvorteilen, die letztlich zu einer Wohlfahrtssteigerung beitragen können. Beide Argumente sollten beachtet werden.

Financial Integration, Specialization, and Systemic Risk*

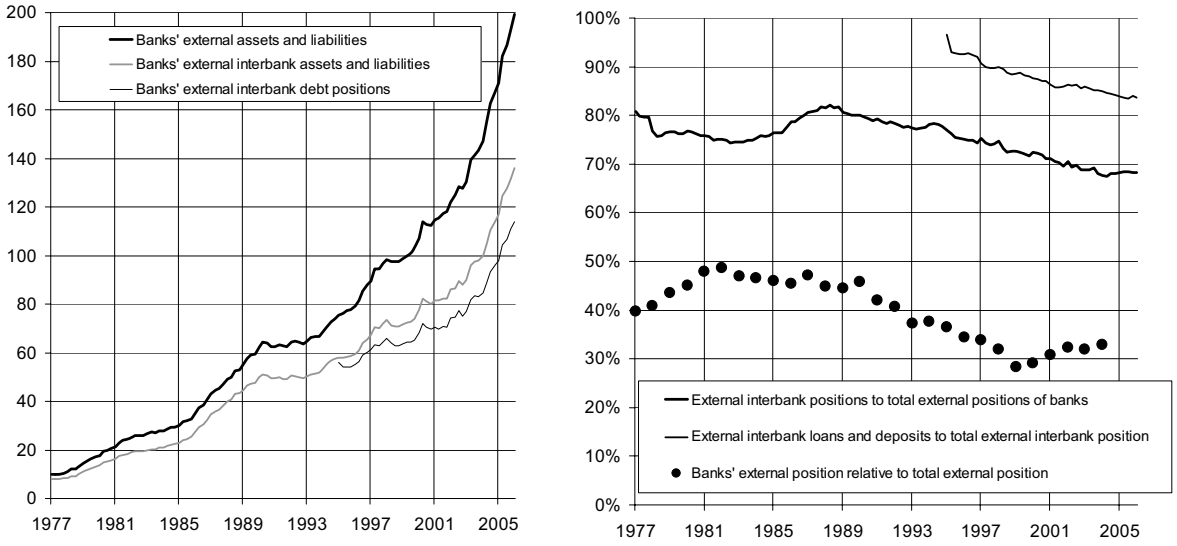
1 Introduction

Large and complex financial institutions increasingly dominate the financial systems of industrial countries. Partly to further enhance scale, partly for domestic competition policy and partly for diversifying revenue streams and risks, these financial institutions transact more and more across borders. They link the financial systems of different countries and foster international financial integration. By diversifying their risks more they improve the resilience of the international financial system against idiosyncratic shocks. At the same time, however, the risk of financial contagion is extended from the national level to the international arena. Due to the international integration a default of one such institution can now have more severe negative externalities on financial intermediaries abroad. In practice, these externalities may arise from direct exposures, from asymmetric information about them or from large failures causing liquidity dry-ups in key markets.[1] The increas-

*We are grateful to Mark Flannery, Roman Inderst, Charles Kahn, Todd Keisters, Rafael Repullo, David Skeie and Roald Versteeg for helpful comments. We also thank the participants of the CFS-ECB-BdE Conference in Madrid, the ProBanker Symposium in Maastricht, the CEUS Workshop in Vallendar, the European Economic Associations Meeting in Budapest, German Economic Association Meeting in Munich, 10th Bundesbank Spring Conference "Central Banks and Globalisation" and the seminar participants at the Bank of England, the ECB, the FED New York, the IWH in Halle, the University of Mannheim and the University of Mainz. The views expressed by the authors do not necessarily reflect those of the European Central Bank, the Deutsche Bundesbank or the Eurosystem.

[1] An early case of international financial contagion due to direct exposures was the Herstatt crisis in 1974. A more recent example of international systemic risk related to market illiquidities was the Long Term Capital Management (LTCM) crisis in 1998. For a discussion of these and many other cases, see Basel Committee on Banking Supervision (2004).

Figure 1:



ing cross-border activities and risk exposures of major financial intermediaries are particularly challenging, as the main regulatory and supervisory setups in banking, securities and insurance business remain predominantly at the national level, and therefore may not be able to effectively address cross-border contagion risk.

Theoretical studies that deal with this trade-off between the benefits from diversification and the expected costs from financial contagion focus on the integration through the interbank market, because banks remain at the core of financial systems and tend to be particularly linked among each other. For a number of reasons (large and complex financial conglomerates, trading links between different types of financial institutions, e.g., through new credit risk transfer markets, or banks' prime broker activities for hedge funds), however, the analysis carries over to other large financial intermediaries. Moreover, the last one and a half decades have witnessed exponential growth of cross-border bank activities (see figure 1). The overwhelming part of this is constituted of interbank assets and liabilities.

Previous studies of the welfare implications of integrated interbank markets, however, took the corporate lending behavior of banks as given. This implies that

the distribution of idiosyncratic shocks across regions is not affected by financial integration.[2] This assumption is problematic because one should expect that the portfolios of financial institutions react to the openness of financial markets. In order to fully evaluate the allocative effects of financial integration one needs to endogenize the loan portfolios of domestic or international banks.

In this paper we follow this idea. We analyze the welfare effects of financial integration taking into account that the improved scope for risk sharing through integrated financial markets affects banks' specialization which in turn influences the cross-country distribution of bank specific shocks. More precisely, we develop a model in which each local bank has a comparative advantage in lending to a specific sector because this sector is most productive in the respective bank's country.[3] Since the timing of loan repayments is uncertain across sectors a trade-off between specialization in lending and diversifying risks arises.

Our main results are the following: As the scope for diversification through an interbank market improves, banks can increase their lending to the most profitable sector in their region, because the need to diversify through their loan portfolio diminishes. This endogenously raises banks' exposure to specific sectoral shocks and further increases the need for diversification through the interbank market.

[2]While Allen and Gale (2004a,b) and Fecht (2004) focus on interrelations between banks through the general asset market, Allen and Gale (2000), Freixas, Parigi, and Rochet (2000), Fecht and Grüner (2006), as well as Fecht, Grüner, and Hartmann (2007) focus on the interbank deposit market. All of these studies assume a given distribution of the idiosyncratic shocks.

In contrast, two papers analyze the impact of interbank markets on banks' investment choices, focusing on moral hazard problems and the incentives for peer monitoring. Rochet and Tirole (1996) assess the incentives for peer monitoring in order to draw conclusions about the scope for a system-wide banking crisis in this context. Freixas and Holthausen (2004) discuss the implications of greater asymmetric information about foreign compared to domestic banks for the structure and integration of an interbank market. None of these two papers, however, focus on the relationship between interbank market integration and cross-border contagion.

[3]See Acharya, Hasan, and Saunders (2006) for empirical evidence of these specialization benefits in banking.

Thus, the more pronounced is the specialization in the loan book the greater is the need for risk sharing and the more reliant are regional financial institutions on a well-functioning integrated interbank market. But if banks rely to a larger extent on the interbank market to buffer liquidity shocks the risk of contagion grows. If the sector in which one bank is specialized in suffers from an adverse liquidity shock, this bank might not be able to raise the needed liquidity in the integrated interbank market, if the foreign bank is at the same time hit by a domestic shock, for instance, due to an operational problem. In that way the failure of one bank as a consequence of a severe domestic shock is transmitted over an integrated interbank market to banks across borders and might ultimately destabilize banks that were initially not affected by the shock.[4]

Two important questions are what are the effects of these implications of financial integration on overall stability and welfare. As regards financial stability, the severity of idiosyncratic risk exposure increases due to the greater specialization but the enhanced risk sharing through the interbank market more than compensates for it. In contrast, the channel for cross-border contagion further enhances banks' default risk. However, in our model the higher systemic risk is exactly offset by the lower exposure to domestic shocks. Thus while individual banks' default probability remains unaffected, the risk of a correlated banking crisis increases. As long as wide-spread banking crisis are not more costly than national banking crisis the economic welfare overall improves because of the benefits from specialization. In sum, the changes induced by financial integration on the lending behavior of banks have important implications for the relationship between integration and stability and for welfare.

There is a developing, primarily empirical literature about the benefits and costs of financial globalization and capital account liberalization. One part of this literature suggests that countries with sound macroeconomic policies, good economic

[4]It is interesting to note that this channel of interbank contagion is not based on the loss of interbank deposits as in Allen and Gale (2000) or Freixas, Parigi, and Rochet (2000).

institutions, advanced financial development and openness as well as good human capital (i.e. industrial countries and, perhaps, a few advanced emerging market countries) are able to reap the risk sharing benefits of international financial integration, whereas countries that are below certain levels for these variables (i.e. most developing and emerging market countries) are not able to benefit.[5] The small part of this literature most closely related to our work asks how financial openness or the presence of capital controls affects the likelihood of financial crises. Despite concerns sometimes raised in policy circles, there does not seem to be systematic evidence suggesting that greater financial integration increases the likelihood of crises, quite the contrary.[6] Still, particularly in developing countries weak financial supervision, contract enforcement problems and unsound macroeconomic policies may sometimes adversely interact with too fast financial liberalization and thereby contribute to financial instability.[7] There is also some evidence that cross-border contagion risks

[5]See, for example, the two recent surveys by Henry (2006) and Kose, Prasad, Rogoff, and Wei (2006). Stulz (2005) discusses the agency problems that hinder less developed countries from reaping the benefits of financial integration. Bekaert, Harvey and Lundblad (2001, 2005 and 2006) and Bekaert, Harvey, Lundblad, and Siegel (2006) find even more generally valid positive effects of equity market liberalizations. Morgan, Rime, and Strahan (2004) estimate that banking integration through the removal of branching restrictions in the United States reduced and aligned state-level business cycles, as measured by gross state product, employment and personal income growth. Matsuyama (2007) presents a broad theoretical framework.

[6]Controlling for selection bias, Glick, Guo, and Hutchison (2006) estimate that countries with fewer restrictions on capital flows experience a smaller probability of currency crises than countries that restrict capital flows more. Bonfiglioli and Mendicino (2004) find that the frequency of banking crises is about the same in countries with capital controls and restrictions on equity transactions as it is in countries without such controls and restrictions. Moreover, the adverse effects of banking crises on economic growth turn out to be less severe in countries with less restricted capital accounts. Demirguc-Kunt and Detragiache (2001) find that financial liberalizations increase the likelihood of banking crises, but they only consider domestic interest rate liberalizations and they do not look at the removal of restrictions on foreign capital. See Ferguson, Hartmann, Panetta, and Portes. (2007) for a review and similar results from estimations using de facto measures of integration rather than de jure measures of capital controls.

[7]See for example Eichengreen, Mussa, DellArriccia, Detragiache, Milesi-Ferretti, and Tweedie

among industrial countries are increasing in conjunction with the financial integration process.[8] Hence, also the available empirical research suggests that the welfare analysis of international financial integration needs to consider both efficiency and stability implications.[9]

The relationship between efficiency and stability implications of financial integration emphasized in our paper is strongly related to the one put forward in Allen and Gale (2000) and Freixas, Parigi, and Rochet (2000). They also show that financial integration through the interbank market allows to diversify regional liquidity shocks efficiently while entailing the risk of financial contagion between banks from different regions. But they do not allow for the important endogenous response of bank balance sheets, in particular specialization in lending. Moreover, while in their model liquidity shocks result from stochastic withdrawals of depositors, in our model liquidity shocks stem from uncertainty in the timing of loan repayments (similar to the assumptions underlying Diamond and Rajan (2005)). Non-performing loans are often not defaulting loans but are repaid later than expected, thereby constituting an important liquidity risk.

Our paper is also related to a literature on the relative benefits of bank diversification. Hanson, Pesaran, and Schuermann (2005) suggest that the scope for the international diversification of credit risk is substantial. Winton (1999), however, warns on theoretical grounds that reduced incentives for monitoring borrowers may offset prima facie asset diversification benefits. DeLong (2001) finds that the announcement effects of bank mergers that are focused in both activity and geography suggest more creation of stockholder value than other types of mergers. These results are also consistent with our result that greater specialization through cross-border integration and diversification through the interbank market may be welfare

(1998), Williamson and Mahar (1998) or Ishii and Habermeier (2002) for broad overviews and policy discussions.

[8]See Hartmann, Straetmans, and de Vries (2005), Degryse and Nguyen (2006) and van Lelyveld and Liedorp (2006).

[9]See also Tirole (2002) and Eichengreen (2003).

improving.

Last, the paper is related to an earlier debate about optimal currency areas. In this debate it was a widely held argument that the criteria of what constitutes an optimal currency area is endogenous. According to the main proponents of that view–Frankel and Rose (1998)–the deeper economic integration that goes along with a greater monetary integration affects the correlation of business cycles across member countries which in turn affects the costs of a common monetary policy. One important effect that these authors stress is that by reducing obstacles to international trade a monetary union 1) enables countries to capture benefits from comparative advantages whether they are due to technological differences, differences in factor endowments or whether they result from economies of scale, 2) fosters national specialization and 3) ultimately leads to less correlated business cycles.

Similarly, in a recent study Heathcote and Perri (2004) showed that in the course of financial globalization the correlation of the U.S. business cycle with the rest of the world has declined. However, they argue that financial globalization amplified an exogenous reduction in the correlation of productivity shocks by enlarging cross-border capital flows. More related to our view Kalemli-Ozcan, Sorensen, and Yosha (2003) provide evidence that indeed a deeper integration of international asset markets improves cross-regional risk sharing and leads to greater specialization in production as first supposed by Helpman and Razin (1978).

2 Assumptions

Consider a three period economy $t = 0, 1, 2$ consisting of regions $j \in \{A; B\}$. In each region there is a continuum of households with the same utility function:

$$U(c_1; c_2) = c_1 + c_2.$$

Thus households are assumed to be risk-neutral.

In $t = 1$ a fraction $q > 1/2$ of households receives the blueprint of a production

technology which produces a return $X > 1$ in $t = 2$. This investment opportunity is not publicly observable and is only available to the respective household.

In each region there is one bank operating. Apart from a storage technology that allows to transfer funds from one period to the next without paying any interest, banks have two investment technologies available, that differ in their regional return. Technology S produces a region specific return S_j for each unit invested in $t = 0$ and technology R produces a return R_j, with $X > R_j, S_j > 1$. Banks can only invest in their home region. It is uncertain when exactly the return of both technologies will be realized. Therefore banks face a liquidity risk. With probability e sector R is hit by a shock and the investments in this technology cannot be realized before $t = 2$ while the returns from technology S are realized in $t = 1$. With the same probability a sectoral shock hits sector S and technology S produces late while technology R is early. We assume that region A has an advantage in technology S while region B has the same advantage in using technology R:

$$S_B = R_A < R_B = S_A$$

On the one hand these regional advantages in the return from the two investment technology can be explained by differences in the resources available in the two regions. On the other hand it can also reflect specialization of regional banks in lending to different sectors. When liquidated before maturity the return of both technologies is $\epsilon \approx 0$.[10]

In addition to sectoral shocks, with probability f a regional shock hits either region and both technologies in the respective region produce late, while only one technology is late in the other region. We assume that the probability for such

[10]Note that our assumptions ensure for simplicity that banks can fully diversify sectoral liquidity shocks. With a portfolio that fully diversifies these shocks the cash-flows generated in $t = 1$ and in $t = 2$ are identical. To ensure that banks still have an incentive to hold liquidity we need to assume $q > 1/2$. Alternatively we could also assume that part of the returns on technology S and R is always late, i.e. only realized in $t = 2$. This would clearly not affect our results but make the notation messier.

a regional shock is close to zero. For simplicity we fix the probability that both technologies produce an early return at zero.[11] The joint probability distribution of return flows $(C_1; C_2)$ in $t = 1$ and $t = 2$ in the two regions can be summarized by the following table.

		Region A		
		$(R_A; S_A)$	$(S_A; R_A)$	$(0; S_A + R_A)$
	$(R_B; S_B)$	e	0	f
Region B	$(S_B; R_B)$	0	e	f
	$(0; S_B + R_B)$	f	f	0

Obviously,

$$2e + 4f = 1.$$

Banks can only raise funds from the households in their respective region. But since we assume that the regional banking markets are contestable markets banks are forced to offer households the deposit contract that maximizes their expected utility. A deposit contract promises a repayment d_1 to all depositors that withdraw in $t = 1$. The banks' cash-flow is not contractible but observable to depositors. If the remaining assets after repaying d_1 to impatient depositors are more then sufficient to repay the patient depositors $d_2 = d_1$ in $t = 2$ then the bank's remaining funds are distributed to the patient depositors in $t = 2$. If the bank's assets are insufficient to repay the impatient depositors d_1 and patient ones $d_2 \geq d_1$ in $t = 2$, late depositors run to be first in line to withdraw in $t = 1$.[12] We assume that patient and impatient depositors have the same chance of getting a certain position in the line.

[11] A positive probability of early returns in both sectors would not affect any of our results unless this probability is too large.

[12] Here we simply assume that banks can only use deposit contracts that do not allow for a suspension of convertibility. However, it is straightforward that a commitment problem of the bank manager à la Diamond and Rajan (2001) could be easily integrated in this setting and would endogenously derive a deposit contract including a sequential service constraint without a suspension of convertibility as the optimal contractual arrangement.

3 Optimal allocation with separate banks

In this section we study the optimal allocation given that banks do not dispose of any means to share risks across regions.

3.1 Diversified banks

First, we analyze the optimal investment portfolio and deposit contract of a bank that runs the risk of becoming illiquid if its is hit by a regional shocks, but that plans to honor the deposit contract in any other case. Without loss of generality we focus on a bank operating in region A.

Define l_0 as the fraction invested in $t = 0$ in liquidity holdings, $k = 1 - l_0$ as the fraction invested into the two production technologies, and x_A the fraction of k invested in the inferior production technology R.

Unless it is hit by a regional shock bank A can realize from each unit k of capital investment a minimum t_1-cash-flow given by

$$\Phi_1 = Min\left[R_A x_A; S_A\left(1 - x_A\right)\right]. \tag{1}$$

Given that bank A disregards the risks of a regional shock, the expression $\Phi_1 k_A$ gives the liquidity inflow from investments in the production technologies that the bank can rely on in $t = 1$ when deciding about the optimal short-term repayment on the deposit contract. Any additional liquidity inflow is only available in certain favorable states. It is not available with certainty to refinance short-term repayments. Thus if the bank wants to avoid ending up in a liquidity crisis due to sectoral shocks it will not rely on those additional funds for the anticipated short-term withdrawals. Instead it will store this extra liquidity for additional long-term repayments on deposit. Thus returns from production technologies available to refinance d_2 are given by $\Phi_2 k_A$ with

$$\Phi_2 = Max\left[R_A x_A; S_A\left(1 - x_A\right)\right]. \tag{2}$$

Thus a safe optimal deposit contract that an autarkic bank can always meet except if it is hit by a regional liquidity shock solves $(P1)$

$$(P1)\begin{cases} \max\limits_{d_1;d_2;l_0} & 2f\left(qX+(1-q)\right)l_0+(2e+2f)\left(qXd_1+(1-q)\,d_2\right) & \\ \text{s.t.} & qd_1=\Phi_1\left(1-l_0\right)+l_0 & (BC1) \\ & (1-q)\,d_2=\Phi_2\left(1-l_0\right) & (BC2) \\ & d_1\leq d_2 & (IC) \end{cases}$$

The bank maximizes depositors' expected utility where by it runs the risk that with probability $2f$ it will be hit by a regional shock. In that case the bank anticipates to have insufficient cash in $t=1$ to repay d_1 to impatient depositors. Thus it expects to be liquidated in which case it will be only able to repay on average the per capita liquidity holding l_0 to its depositors. Since in a run patient and impatient households have the same chance of receiving a repayment on their deposits the expected utility from receiving a unit repaid in that state is given by $(qX-(1-q))$. In those states in which there is only a sectoral shock (happening with prob. $2e$) or in which the other region is hit be a region shock (prob. $2f$) the bank plans to repay the promised amount d_1 to impatient and d_2 to patient depositors. Impatient depositors can use the proceeds received in $t=1$ to apply their private technology generating a return $X>1$ in $t=2$ on each unit invested, while patient depositors consume the repayment d_2 in $t=2$.

The budget constraint $(BC1)$ ensures that the funds supposed to be repaid to impatient depositors do not exceed the liquidity holding plus the t_1-cash-flow from capital investment that is realized given no regional shock in region A. $(BC2)$ provides that the cash-flow available in $t=2$ from late investment projects is sufficient to repay patient depositors. The incentive compatibility constraint (IC) ensures that patient depositors do not have an incentive to withdraw early.

Since $X>1$ the bank maximizes depositors' utility by increasing as much as possible the short-term repayment on deposits. Thus for the optimal deposit contract

(IC) holds with equality. It follows from $(BC1)$ and $(BC2)$ that

$$(1-q)\,\Phi_1\,(1-l_0)+(1-q)\,l_0=q\Phi_2\,(1-l_0)$$

Consequently, the optimal liquidity holding is

$$l_0^D=\frac{q\Phi_2-(1-q)\,\Phi_1}{q\Phi_2-(1-q)\,\Phi_1+(1-q)}.$$

Reinserting in $(BC1)$ and $(BC2)$ yields

$$d_D=d_1=d_2=\frac{\Phi_2}{q\Phi_2-(1-q)\,\Phi_1+(1-q)}. \tag{3}$$

From (1), (2), and (3) it is easy to see that for $x_A>S_A/\,(R_A+S_A)$

$$d_D=\frac{R_Ax_A}{qR_Ax_A-(1-q)\,S_A\,(1-x_A)+(1-q)}.$$

$$\frac{\partial d_D}{\partial x_A}=\frac{-\,(1-q)\,(S_A-1)\,R_A}{\left(qR_Ax_A-(1-q)\,S_A\,(1-x_A)+(1-q)\right)^2}<0.$$

It is also easy to see from (1), (2), and (3) that for $x_A<S_A/\,(R_A+S_A)$

$$d_D=\frac{S_A\,(1-x_A)}{qS_A\,(1-x_A)-(1-q)\,R_Ax_A+(1-q)}.$$

$$\frac{\partial d_D}{\partial x_A}=\frac{(R_A-1)\,S_A\,(1-q)}{qS_A\,(1-x_A)-(1-q)\,R_Ax_A+(1-q)}>0.$$

So obviously , d_D is maximized for $\hat{x}_A=S_A/\,(R_A+S_A)$. Obviously, for $x_A=\hat{x}_A$ the bank fully diversifies sectoral liquidity shocks and receives the same deterministic cash flow Φ in $t=1$ and $t=2$ given no regional shocks in region A:

$$\Phi=\Phi_1\,(\hat{x}_A)=\Phi_2\,(\hat{x}_A)=\frac{R_AS_A}{R_A+S_A}.$$

Thus investing in the portfolio $(l_0^*;\hat{x}_A)$ with

$$l_0^*=\frac{(2q-1)}{(2q-1)+(1-q)\,\Phi^{-1}}$$

the bank can offer an optimal deposit contract

$$d_D^* = \frac{1}{(2q-1) + (1-q)\,\Phi^{-1}}$$

Since $\partial\Phi/\partial(S_A/R_A) < 0$, it is easy to see that increasing benefits from specialization, i.e. a higher S_A/R_A lead to lower repayments of a diversified bank:

$$\frac{\partial d_D^*}{\partial \Phi}\frac{\partial \Phi}{\partial S/R} < 0$$

Note that $\hat{x}_A > 1/2$. Thus a portfolio with fully diversified sectoral cash flow shocks implies that bank A has to invest a larger fraction of its capital in the inferior technology R_A in order to maximize the minimum period 1 return. Obviously, the bigger the benefits from specialization, i.e. the bigger S_A/R_A, the smaller is this cash flow of a portfolio that fully diversifies sectoral shocks.

Lemma 1 *The optimal deposit contract of a bank that wants to avoid a liquidity shortage in all but those states in which it suffers from a regional shock is characterized by* $d_1 = d_2 = d_D^*$. *The repayments on this optimal deposit contract decline with increasing benefits from specialization.*

Given this maximum repayment that the bank can promise in $t = 1$ the expected utility of households in the respective regions is

$$EU^D = 2f\,(qX + (1-q))\,l_0^* + (2e + 2f)\,(qX + (1-q))\,d_D^* \tag{4}$$

It is easy to see that bank B will offer the same deposit contract and will hold the same amount of liquidity as bank A. The only difference is that bank B will invest more of its capital into technology S: $\hat{x}_B = 1 - \hat{x}_A$. Thus following this diversified strategy both banks are forced to invest the larger fraction of their capital into the technology in which they have a *dis*advantage.

3.2 Undiversified banks

Assume now that bank A follows a more risky strategy and offers a deposit contract that it can only honor if the regionally more productive technology S generates the cash-flow already in $t = 1$. This means that the bank anticipates to be liquidated not only if a regional shock hits region A but also if technology S if affected by a sectoral shock. Since the liquidation value is zero for both production technologies the portfolio decision x_A does not matter for bankruptcy returns. The portfolio decision only affects the repayment on deposits in those states in which technology S produces early returns. Since the bank can always shift resources between $t = 1$ and $t = 2$ using the storage technology it is obviously optimal for the bank to invest only in liquidity and technology S. Consequently, the optimal deposit contract here simply solves

$$(P1') \begin{cases} \max\limits_{d_1;d_2;l_0} & (e+3f)\left(qX+(1-q)\right)l_0 + (e+f)\left(qXd_1+(1-q)\,d_2\right) & \\ \text{s.t.} & qd_1 = S_A\left(1-l_1\right)\left(1-l_0\right)+l_0 & (BC1) \\ & (1-q)\,d_2 = S_A l_1\left(1-l_0\right) & (BC2) \\ & d_1 \leq d_2 & (IC) \end{cases}$$

The optimal deposit contract maximizes depositors expected utility given that it can only repay the liquidation value l_0 if sector S is hit by a sectoral shock (which happens with prob. $(e + f)$) or region A is affected by a regional shock (which happens with prob. $(2f)$). In the run that leads to the liquidation, patient and impatient depositors have the same chance of receiving their a repayment. Thus the expected utility in this case is given by the weighted average of patient and impatient depositors. Only if the sector S generates a early cash-flow and region A is not hit by a regional shock then the bank will provide the promised repayment d_1 and d_2 on deposits, whereby impatient depositors receiving d_1 have a marginal benefit of $X > 1$ from repayments, while patient depositors who receive d_2 have a marginal utility of 1.

The budget constraint $(BC1)$ in $(P1')$ states that the repayments to impatient

depositors must not exceed the liquidity holdings l_0 of bank A plus a fraction $(1 - l_1)$ of the cash-flow generated from the investment in technology S. l_1 measures the fraction of the cash-flow from capital investment that is not needed to repay impatient depositors that is rather stored in reserves for one period to refinance the payment to patient depositors. Thus $(BC2)$ requires that this stored cash-flow is sufficient for the required repayments to the patient depositors. (IC) again ensures that patient depositors do not withdraw in $t = 1$.

The bank maximizes depositors utility in those states in which it remains solvent, by repaying as much as possible to impatient depositors. Thus (IC) will hold with equality and it follows from $(BC1)$ and $(BC2)$ that

$$(1-q)\, S_A\, (1-l_1)\, (1-l_0) + (1-q)\, l_0 = q S_A l_1\, (1-l_0)\,.$$

Thus the optimal risky deposit contract is determined by

$$l_1 = (1-q)\, \frac{S_A\, (1-l_0) + l_0}{S_A\, (1-l_0)}$$

and

$$d_U = S_A\, (1-l_0) + l_0.$$

This risky strategy provides depositors with an expected utility given by

$$EU^R\, (l_0) = (e+3f)\, (qX + (1-q))\, l_0 + (e+f)\, (qX + (1-q))\, (S_A - (S_A - 1)\, l_0)\,. \tag{5}$$

Hence

$$\frac{\partial EU^R}{\partial l_0} = [(e+3f) - (e+f)\, (S_A - 1)]\, (qX + (1-q))\,.$$

Consequently, the optimal risky strategy of an autarkic bank involves $l_0 = 0$ if

$$2f - (e+f)\, (S_A - 2) < 0$$

$$\Leftrightarrow S_A > 2 + \frac{2f}{(e+f)}. \tag{6}$$

Thus assuming that (6) holds[13] then the expected utility that can be archived by the risky deposit contract $d_U^* = S_A$ is

$$EU^U = (e+f)\left(qX + (1-q)\right) S_A. \tag{7}$$

3.3 Safe banks

Alternatively the bank could also offer a deposit contract that it could honor even if it is hit by a regional shock. Obviously, in order to follow that strategy the bank has to hold sufficient liquidity to repay early withdrawals even if both technologies provide a late return. But given that it holds sufficient liquidity there is no need for the bank to invest in a diversified portfolio. Thus following this strategy bank A will choose $x_A = 0$ and offer the deposit contract that solves

$$(P1'') \begin{cases} \max\limits_{d_1;d_2;l_0} & (2e+4f)\left(qXd_1 + (1-q)\, d_2\right) & \\ \text{s.t.} & qd_1 = l_0 & (BC1) \\ & (1-q)\, d_2 = S_A\left(1-l_0\right) & (BC2) \\ & d_1 \leq d_2 & (IC) \end{cases}$$

A safe bank will always ($(2e+4f) = 1$) repay d_1 and d_2 to its impatient and patient depositors, respectively, whereby again the impatient ones have a marginal utility of $X > 1$ from each unit repaid, while patient depositors have only a marginal utility of 1. To be able to always repay d_1 the bank has to hold liquidity against the early repayments, because only these funds are available with certainty in $t = 1$. Thus $(BC1)$ in $(P1'')$ ensures that the bank holds sufficient liquidity to refinance the repayment to impatient depositors. Since the short-term repayment are always met by the liquidity holdings the bank invest all the funds that are used to refinance

[13]Note that if (6) does not hold, then the bank would prefer to invest only in liquidity ($l_0 = 1$) which implies $d = 1$ and would make the bank redundant. The expected utility in that case is

$$EU^A = (2e+4f)\left(qX + (1-q)\right)$$

.

the repayment to patient depositors in the most productive technology S. If this technology is late it does not matter since the bank needs the fund only in $t = 2$ to repay the patient depositors. If the technology generates an early cash-flow the bank will store the funds until $t = 2$. Obviously, any investment in technology R would only reduce the possible payment to patient depositors. (IC) again ensures that patient depositors keep their deposits until $t = 2$.

Taking again into account that (IC) will hold with equality it follows from $(BC1)$ and $(BC2)$ that

$$l_0^S = \frac{qS_A}{(1-q) + qS_A}$$

and

$$d_S^* = d_1 = d_2 = \frac{S_A}{(1-q) + qS_A}.$$

The expected utility from such a deposit contract is

$$EU^S = (2e + 4f)\,(qX + (1-q))\,d_S^*.$$

3.4 Optimal deposit contract

Now we turn to the question under which parameter setting the different strategies are optimal for the bank. We focus on parameter settings in which banks choose a diversified portfolio and offer d_D^*. Thus we consider cases in which

$$EU^D > EU^U \tag{8}$$

and

$$EU^D > EU^S. \tag{9}$$

Condition (8) requires that

$$(2e + 4qf)\,d_D^* > (e + f)\,S_A$$

which can be simplified to

$$\frac{2e + 4qf}{e + f} > (2q - 1)\,S_A + (1-q)\left(1 + \frac{S_A}{R_A}\right).$$

Thus separate banks prefer to diversify instead of specialize if 1) S_A is not too large and 2) the benefits from specialization (S_A/R_A) are not too large.

Condition (9) holds if

$$(2e + 4qf)\, d_D^* > (2e + 4f)\, d_S^*.$$

Reinserting d_D^* and d_S^* yields

$$\frac{(1-q)S_A^{-1} + q}{(2q-1) + (1-q)\Phi^{-1}} > \frac{e + 2f}{e + 2qf}.$$

Therefore, banks will not follow the safe strategy but rather diversify if 1) S_A is not too large and 2) because of $\partial\Phi/\partial(S_A/R_A) < 0$ if the benefits from specialization are not too large.

Thus we can summarize the findings in the following proposition:

Proposition 2 *If the advantages from specialization are not too large, then a separate bank will invest into a diversified portfolio of technology S and R. It invests the larger fraction into the inferior technology.*

4 Optimal allocation with integrated banks

In this section we first derive the constraint efficient allocation and then show to what extent this constraint efficient allocation can be implemented by an interbank market.

4.1 The constraint efficient allocation

Consider the allocation that a social planner would implement given that he also cannot observe whether a specific household has a private investment opportunity or not. Thus we look for the efficient allocation under the constraint that it has to be incentive compatible for patient households not to claim to be impatient. However, the social planner can shift resources freely between regions. Thus he will obviously

not invest in technologies R_A and S_B; he will only make use of the most productive technologies S_A and R_B, whereby $S_A = R_B$. Given that f is sufficiently low the social planer will only diversify sectoral specific shocks. Thus the constraint efficient consumption allocation that a social planner will offer solves $(P2)$

$$(P2)\begin{cases} \max\limits_{d_1;d_2;l_0} & 2f\left(qXl_0 + S_A\left(1-l_0\right)\right) + \left(2e+2f\right)\left(qXd_1 + \left(1-q\right)d_2\right) & \\ \text{s.t.} & qd_1 = S_A\left(1-l_0\right)/2 + l_0 & (BC1) \\ & \left(1-q\right)d_2 = S_A\left(1-l_0\right)/2 & (BC2) \\ & d_1 \leq d_2 & (IC) \end{cases}$$

Since it is optimal for the social planner to fully smooth sectoral cash-flow shocks, he invests half of the capital investments $(1 - l_0)$ in technology S_A and the other half in technology R_B. $(BC1)$ requires that in both regions the repayments to impatient depositors do not exceed the liquidity held by the planer per region plus half of the early cash-flow available in the economy. Given that sector S is early all cash-flow generated in the economy is produced by technology S in region A and half of these returns are transferred by the social planer to the other region, while in contrast half of the late produced cash-flow from technology R in region B is transferred to region A to be paid to the patient household in this region. Given that $S_A = R_B$ this is reflected in $(BC2)$. In case of the opposite sectoral cash-flow shock the cross-regional transfers are simply reversed. Since we are assuming that also the social planer cannot observe households' idiosyncratic liquidity shocks (IC) has again to be taken into account.

The social planer maximizes the expected utility of households in both regions. Thereby he has to take into account that he will only be able to repay the planed amounts d_1 and d_2 if the region in which the sector is located that is supposed to produce early returns is not hit by a regional shock. With prob. $2e$ there is no regional shock and with probability $2f$ there is only a regional shock in the region with the production technology that is late anyway. Thus with prob. $(2e + 2f)$ the planer can pay d_1 and d_2 to the impatient and patient households, respectively.

With prob. $2f$, however, the region A is hit by a regional shock when technology S was producing early or region B has a shock when technology R should be early. In these cases the social planer can only repay the liquidity holding to the impatient households, while he can divide the entire return on capital investment $S_A(1-l_0)$ by the $(1-q)$ patient households.[14]

Since f is assumed to be sufficiently small the planner maximizes also the short-term repayment to impatient households d_1 because it generates the maximum expected marginal utility. Thus again (IC) holds with equality at the optimal deposit contract it follows from $(BC1)$ and $(BC2)$ that

$$qS_A(1-l_0) = (1-q)S_A(1-l_0) + (1-q)2l_0.$$

Thus the optimal liquidity holding per region is

$$l_0^I = \frac{(2q-1)S_A}{2(1-q)+(2q-1)S_A},$$

and the optimal payment to patient and impatient households is

$$d_I = d_1 = d_2 = \frac{S_A}{2(1-q)+(2q-1)S_A}.$$

It is easy to see that from $S_A = R_B$, $S_A > R_A$ and $S_B < R_B$ follows that $d_I > d_D^*$ and $l_0^I > l_0^D$. Consequently, the social planer improves households' welfare compared to autarkic banks. He does not only avoid inefficient liquidation but he also fully reaps the benefits of specialization.

4.2 Implementation through an interbank market

Now assume that there is an interbank market open in $t = 1$. In this interbank market banks can trade liquidity against future cash-flow from some capital investment

[14] Thus we implicitly assume that the social planner is not forced to liquidate assets when he cannot meet the planed payment to impatient depositors. We rather assume that he suspends payments when liquidity is insufficient.

at an equilibrium interest rate. Since there is no investment alternative to the storage technology for excess liquidity in $t = 1$ (cash that is already available in $t = 1$ but is only needed in $t = 2$ to refinance the repayment to patient depositors) banks will offer any excess cash holdings in the interbank market at a riskless interest rate $i \geq 0$.

We assume that the initial liquidity holding (l_0) are publicly observable and verifiable and thus contractible in $t = 0$. This assumption can essentially be viewed as reflecting regulatory liquidity requirements.[15] However, investment portfolio (x_j), the deposit contract that banks offer their respective regional depositors and the realization of regional and sectoral liquidity shocks are not publicly observable.

Thus the interbank market is a Bayesian game with the following stages: In $t = 0$ 1) banks mutually sign a contract about their liquidity holdings, 2) individually design a deposit contract that they offer households in their region and 3) collect deposits and invest them in a portfolio of technology S and R in their region. Then in $t = 1$ liquidity shocks realize and dependent on their private liquidity shock banks offer or demand liquidity in the interbank market against repayment in $t = 2$.

It is easy to see that the cross-regional risk-sharing together with a fully specialized portfolio as derived in the previous subsection can be achieved in an equilibrium of this Bayesian game. To prove this assume first that banks offer the optimal deposit contract d_I and agreed to hold l_0^I liquid reserves. Furthermore assume that both banks are fully specialized in their respective most efficient technology. In that case if bank A (B) suffers from a liquidity shortage–either due to a sectoral shock to technology S (R) or a regional shock–it will always demand liquidity $IB_D = \left(1 - l_0^I\right) S_A/2$

[15]Note also that we take this assumption to abstract from the usual underinvestment in liquidity known from Bhattacharya and Gale (1987) and Bhattacharya and Fulghieri (1994). It is easy to see that if banks could not verify each others initial liquidity holding also in this setting banks would underinvest in liquidity and free ride on the liquidity provision of their counterparty. As our focus is to show that contagion also occurs if the interbank market is most efficient we abstract from these market inefficiencies. Fecht and Grüner (2006) show that unsecured interbank deposits are a way to eliminate this underinvestment problem.

($IB_D = \left(1 - l_0^I\right) R_B/2$) in the $t = 1$ interbank market and can promise to repay this amount at $t = 2$. If bank A (B) has excess liquidity because the technology S (R) produces cash flow already in $t = 1$ it can exactly offer $IB_S = \left(1 - l_0^I\right) S_A/2$ ($IB_S = \left(1 - l_0^I\right) R_B/2$). And banks will be willing to offer their entire excess liquidity in the market as long as they receive the same amount repaid in $t = 2$ since their alternative would be to store the excess liquidity. Thus given that banks are fully specialize the interbank market is a self revealing mechanism and ensures that banks can sustain sectoral liquidity shocks.

The questions remains whether banks have an incentive to fully specialize or not. Assume that bank A is less than fully specialized and holds a fraction $\overline{x_A} > 0$ in technology R, while bank B is fully specialized. It is easy to see that bank A cannot repay a deposit contract d_I if technology S is hit by a liquidity shock because it can only borrow $IB_D = \left(1 - l_0^I\right)(1 - x_A)S_A - d_I/2$ in the interbank market. Together with the early cash flow from technology $R\left(1 - l_0^I\right) x_A R_A$ this is insufficient to repay d_I to the impatient depositors since $R_A < S_A$. Similarly, if technology S is early and R late, the cash flow available in $t = 2$ is lower than under full specialization and insufficient to repay the patient depositors d_I. Thus a bank that is less than fully specialized can only offer a lower deposit contract than d_I. Hence, with the described interbank market available banks always have an incentive to self reveal their regional liquidity shocks (offer excess liquidity in the interbank market), will fully specialize and will offer the second best deposit contract.

With an interbank market the diversification of liquidity risks is decoupled from banks' investment decision. Since bank A only invests in technology S and bank B only in technology R while sectoral cash-flow risks are diversified with the respective interbank payments, banks in this case also offer the same deposit contract as the social planer does. Since $d_I > d_D^*$ and $l_0^I > l_0^D$ both banks therefore also provide depositors with a higher expected repayment than autarkic diversified banks.

However, it is easy to see that banks following this strategy rely on the liquidity provision through the interbank market in case the technology that they are spe-

cialized in generates returns not before $t = 2$. If, for instance, bank A does not receive IB funds in the interbank market in $t = 1$ when technology S is delayed it has insufficient fund available to repay d_I to the impatient depositors. Since banks, in contrast to the social planer, cannot suspend convertibility, a run on bank A is unavoidable and the bank is liquidated.[16] Consequently, following a specialization in lending, banks expose themselves to a liquidity risk in the interbank market. This generates the risk of spill-overs of regional liquidity shocks and cross-regional contagion. If region B is hit by a regional shock and all investments in that region repay late while also technology S is delayed in region A, bank A will collapse simply because it relies on a liquidity inflow from the interbank market due to its specialization.

These findings are summarized in the following proposition:

Proposition 3 *Financial integration through an interbank market enables banks to specialize ($x_A = 0$; $x_B = 1$) without being destabilized by sectoral shocks. However, specialization brings about the risk of contagion.*

4.3 Welfare implications

Given that financial integration and specialization brings about the risk of contagion it depends on the expected costs of contagion relative to the gains from specialization whether banks prefer an integrated interbank market or not. In the instances of financial contagion that occur with prob. $2f$ banks have insufficient liquidity in $t = 1$ to repay d_1 to impatient depositors. Both banks will be liquidated and can only repay on average the per capital liquidity holding l_0. Thus depositors expected utility under integration and specialization is given by

$$EU^I = 2f\left(qX + (1-q)\right) l_0^I + (2e + 2f)\left(qX + (1-q)\right) d_I. \tag{10}$$

Note that because banks cannot suspend convertibility an inefficient liquidation of both banks is unavoidable in case of an aggregate liquidity shortage. Thus an

[16] For a detailed explanation of this assumption see footnote 12.

integrated interbank market cannot implement the constraint efficient allocation that a social planer would achieve. Consequently, the utility that an integrated interbank market and fully specialized banks can provide is lower than the welfare that a social planer achieves because consumption is lower in case of aggregate liquidity shortages.

However, banks and depositors benefit from integration if

$$EU^I > EU^D$$

which can be rewritten as

$$2fl_0^I + (2e + 2f)\, d_I > 2fl_0^D + (2e + 2f)\, d_D^*.$$

From reinserting $\left(d_D^*, l_0^D\right)$ and $\left(d_I; l_0^I\right)$ it is obvious that this always holds since

$$(e + f) > -(2q - 1)\, f.$$

Because the probability f of regional shocks is the same in both regions in our set-up the expected welfare losses due to contagion are always overcompensated. With an integrated interbank market each banks' exposure to its own regional shock is reduced by f: Bank A, for instance, will be able to sustain a regional shock in region A as long as technology R produces early in region B. Thus an integrated interbank market enables banks to sustain some (but not all) liquidity shocks in their home region, which a diversified autarkic bank could not sustain.

Consequently, while contagion increases the probability of a banking crisis in each region by f this is completely offset by a reduction in the exposure to regional shocks in the home region. Therefore, the probability of default of a bank is unaffected by financial integration, while the expected repayments on deposits strictly increase.

Proposition 4 *Since regional shocks occur with the same probability f in both regions financial integration through an interbank market is always preferable, even though financial contagion may occur.*

5 Conclusion

When assessing the benefits from financial integration it has to be taken into account that the greater scope for diversification through financial integration may foster specialization which in turn increases the need for diversification. Thus, sticking to the status quo of cross-country correlations of shocks does not allow to assess the costs and benefits from financial integration. It underestimates the benefits but it also undervalues the risk of financial contagion. This has important empirical implications. Approaches like Imbs and Mauro (2007) and Fecht, Grüner, and Hartmann (2007) that try to assess the benefits from financial integration based on the given cross-country correlation of shocks seem to be misleading. Empirical estimates of the benefits of financial globalization should to take the endogenous impact on the correlation structure into account.

Taken at face value our model suggests that the increase in systemic risk is exactly offset by reduced exposure to domestic shocks. Thus while individual banks' default risk remains unaffected by financial integration and specialization, the risk of a widespread banking crisis clearly increases. In our model this does not affect welfare even if we took the generally observed negative externalities of banking failures into account. Financial integration always improves welfare since expected costs of banking failures remain constant while financial integration allows to reap the benefits of specialization.

In terms of policy implications, the greater contagion risk still puts pressure on policy makers to adjust supervisory approaches and structures to the geographical scope of banking activities.[17] While supervisory structures should develop to take greater account of cross-border risks our analysis also suggests that financial integration should not be resisted on stability grounds, at least not in industrial countries with relatively well-functioning interbank markets and more limited contract en-

[17]See DellArricia and Marquez (2006) for a theoretical analysis of the relationship between financial integration and supervisory structures.

forcement problems. In fact, greater specialization in lending to the most profitable sectors through better bank risk sharing may well enhance overall welfare without increasing the probability of bank failures.

References

Acharya, V. V., I. Hasan, and A. Saunders, 2006, "Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios," *Journal of Business*, 79, 1355–1412.

Allen, F., and D. Gale, 2000, "Financial Contagion," *Journal of Political Economy*, 108, 1–33.

Allen, F., and D. Gale, 2004a, "Financial Fragility, Liquidity, and Asset Prices," *Journal of the European Economic Association*, 2, 1015–1048.

Allen, F., and D. Gale, 2004b, "Financial Intermediaries and Markets," *Econometrica*, 72, 1023–1061.

Basel Committee on Banking Supervision, 2004, "Bank failures in mature economies," *Working Paper, no. 13, April*.

Bekaert, G., C. Harvey, and C. Lundblad, 2001, "Emerging equity markets and economic development," *Journal of Development Economics*, 66, 465–504.

Bekaert, G., C. Harvey, and C. Lundblad, 2005, "Does financial liberalization spur growth?," *Journal of Financial Economics*, 77, 3–55.

Bekaert, G., C. Harvey, and C. Lundblad, 2006, "Growth volatility and financial liberalization," *Journal of International Money and Finance*, 25, 370–403.

Bekaert, G., C. Harvey, C. Lundblad, and S. Siegel, 2006, "Global growth opportunities and financial integration," *Journal of Finance*, forthcoming.

Bhattacharya, S., and P. Fulghieri, 1994, "Uncertain liquidity and interbank contracting," *Economics Letters*, 44, 287–294.

Bhattacharya, S., and D. Gale, 1987, "Preference Shocks, Liquidity and Central Bank Policy," in W.Barnett, and K. Singleton (ed.), *New Approaches to Monetary Economics* . pp. 69–88, New York: Cambridge University Press.

Bonfiglioli, A., and C. Mendicino, 2004, "Financial liberalization, banking crises, and growth," SSE/EFI Working Paper Series in Economics and Finance, no. 567, October 2004.

Degryse, H., and G. Nguyen, 2006, "Interbank exposures: An empirical examination of contagion risk in the Belgian banking sector," TILEC discussion paper, no. 2006-016.

DellArricia, G., and R. Marquez, 2006, "Competition among regulators and credit market integration," *Journal of Financial Economics*, 79, 401–430.

DeLong, G., 2001, "Stockholder gains from focusing versus diversifying bank mergers," *Journal of Financial Economics*, 59, 221–252.

Demirguc-Kunt, A., and E. Detragiache, 2001, "Financial liberalization and financial fragility," in G. Caprio, P. Honohan, and J. Stiglitz (ed.), *Financial Liberalization: How Far, How Fast?*, pp. 96–122. Cambridge: Cambridge University Press.

Diamond, D., and R. Rajan, 2001, "Liquidity Risk, Liquidity Creation and Financial Fragility: A Theory of Banking," *Journal of Political Economy*, 109, 287–327.

Diamond, D. W., and R. Rajan, 2005, "Liquidity Shortages and Banking Crises," *Journal of Finance*, 60, 615–647.

Eichengreen, B., 2003, *Capital Flows and Crisis*, MIT Press.

Eichengreen, B., M. Mussa, G. DellArriccia, E. Detragiache, G. Milesi-Ferretti, and A. Tweedie, 1998, "Capital account liberalization: Theoretical and practical aspects," IMF Occasional Paper, no. 172.

Fecht, F., 2004, "On the Stability of Different Financial Systems," *Journal of the European Economic Association*, 6, 969–1014.

Fecht, F., and H. P. Grüner, 2006, "Financial Integration and Systemic Risk," CEPR Discussion Paper No. 5253.

Fecht, F., H. P. Grüner, and P. Hartmann, 2007, "The Welfare Effects of Cross Border Financial Integration," CEPR Discussion Paper No. 6311.

Ferguson, R., P. Hartmann, F. Panetta, and R. Portes., 2007, *International financial stability,*Geneva Report on the World Economy, no. 9, CEPR and International Center of Monetary and Banking Studies, forthcoming.

Frankel, J. A., and A. K. Rose, 1998, "The Endogeneity of the Optimum Currency Area," *The Economic Journal*, 108, 1009–1025.

Freixas, X., and C. Holthausen, 2004, "Interbank Market Integration under Asymmetric Information," *Review of Financial Studies*, 18, 459–490.

Freixas, X., B. Parigi, and J.-C. Rochet, 2000, "Systemic Risk, Interbank Relations, and Liquidity Provision by the Central Bank," *Journal of Money, Credit, And Banking*, 32, 611–638.

Glick, R., X. Guo, and M. Hutchison, 2006, "Currency crises, capital-account liberalization, and selection bias," *Review of Economics and Statistics*, 88, 698–714.

Hanson, S., H. Pesaran, and T. Schuermann, 2005, "Firm heterogeneity and credit risk diversification," Wharton Financial Institutions Center Working Paper, no. 5, June.

Hartmann, P., S. Straetmans, and C. de Vries, 2005, "Banking system stability: A cross-Atlantic perspective," NBER Working Paper, no. 11698, October.

Heathcote, J., and F. Perri, 2004, "Financial globalization and real regionalization," *Journal of Economic Theory*, 119, 207–243.

Helpman, E., and A. Razin, 1978, *A theory of international trade under uncertainty*, Academic Press.

Henry, P. B., 2006, "Capital account liberalization: Theory, evidence, and speculation," NBER Working Paper, no. 12698, November.

Imbs, J., and P. Mauro, 2007, "Pooling Risk Among Countries," IMF Working Paper 07/132.

Ishii, S., and K. Habermeier, 2002, "(), Capital account liberalization and financial sector stability,," IMF Occasional Paper, no. 211.

Kalemli-Ozcan, S., B. E. Sorensen, and O. Yosha, 2003, "Risk sharing and industrial specialization: Regional and international evidence," *American Economic Review*, 93, 903–918.

Kose, A., E. Prasad, K. Rogoff, and S.-J. Wei, 2006, "Financial globalization: A reappraisal forthcoming," *Journal of Economic Literature*, forthcoming.

Matsuyama, K., 2007, "Aggregate implications of credit market imperfections," paper prepared for the 22nd NBER Annual Conference on Macroeconomics, March.

Morgan, D., B. Rime, and P. Strahan, 2004, "Bank integration and state business cycles," *Quarterly Journal of Economics*, 119, 1555–1584.

Rochet, J.-C., and J. Tirole, 1996, "Interbank Lending and Systemic Risk," *Journal of Money, Credit, and Banking*, 28, 733–762.

Stulz, R., 2005, "The limits of financial globalization," *Journal of Finance*, 60, 1595–1638.

Tirole, 2002, *Financial Crisis, Liquidity and the International Monetary System*, Princeton University Press.

van Lelyveld, I., and F. Liedorp, 2006, "Interbank contagion in the Dutch banking sector: A sensitivity analysis," *International Journal of Central Banking*, 2, 99–133.

Williamson, J., and M. Mahar, 1998, *A survey on financial liberalization, Essays in International Finance, no. 211*, Princeton University.

Winton, A., 1999, "Don't put all your eggs in one basket? Diversification and specialization in lending," mimeo., University of Minnesota, September.

The following Discussion Papers have been published since 2007:

Series 1: Economic Studies

01	2007	The effect of FDI on job separation	Sascha O. Becker Marc-Andreas Mündler
02	2007	Threshold dynamics of short-term interest rates: empirical evidence and implications for the term structure	Theofanis Archontakis Wolfgang Lemke
03	2007	Price setting in the euro area: some stylised facts from individual producer price data	Dias, Dossche, Gautier Hernando, Sabbatini Stahl, Vermeulen
04	2007	Unemployment and employment protection in a unionized economy with search frictions	Nikolai Stähler
05	2007	End-user order flow and exchange rate dynamics	S. Reitz, M. A. Schmidt M. P. Taylor
06	2007	Money-based interest rate rules: lessons from German data	C. Gerberding F. Seitz, A. Worms
07	2007	Moral hazard and bail-out in fiscal federations: evidence for the German Länder	Kirsten H. Heppke-Falk Guntram B. Wolff
08	2007	An assessment of the trends in international price competitiveness among EMU countries	Christoph Fischer
09	2007	Reconsidering the role of monetary indicators for euro area inflation from a Bayesian perspective using group inclusion probabilities	Michael Scharnagl Christian Schumacher
10	2007	A note on the coefficient of determination in regression models with infinite-variance variables	Jeong-Ryeol Kurz-Kim Mico Loretan

11	2007	Exchange rate dynamics in a target zone - a heterogeneous expectations approach	Christian Bauer Paul De Grauwe, Stefan Reitz
12	2007	Money and housing - evidence for the euro area and the US	Claus Greiber Ralph Setzer
13	2007	An affine macro-finance term structure model for the euro area	Wolfgang Lemke
14	2007	Does anticipation of government spending matter? Evidence from an expectation augmented VAR	Jörn Tenhofen Guntram B. Wolff
15	2007	On-the-job search and the cyclical dynamics of the labor market	Michael Krause Thomas Lubik
16	2007	Heterogeneous expectations, learning and European inflation dynamics	Anke Weber
17	2007	Does intra-firm bargaining matter for business cycle dynamics?	Michael Krause Thomas Lubik
18	2007	Uncertainty about perceived inflation target and monetary policy	Kosuke Aoki Takeshi Kimura
19	2007	The rationality and reliability of expectations reported by British households: micro evidence from the British household panel survey	James Mitchell Martin Weale
20	2007	Money in monetary policy design under uncertainty: the Two-Pillar Phillips Curve versus ECB-style cross-checking	Günter W. Beck Volker Wieland
21	2007	Corporate marginal tax rate, tax loss carryforwards and investment functions – empirical analysis using a large German panel data set	Fred Ramb

22	2007	Volatile multinationals? Evidence from the labor demand of German firms	Claudia M. Buch Alexander Lipponer
23	2007	International investment positions and exchange rate dynamics: a dynamic panel analysis	Michael Binder Christian J. Offermanns
24	2007	Testing for contemporary fiscal policy discretion with real time data	Ulf von Kalckreuth Guntram B. Wolff
25	2007	Quantifying risk and uncertainty in macroeconomic forecasts	Malte Knüppel Karl-Heinz Tödter
26	2007	Taxing deficits to restrain government spending and foster capital accumulation	Nikolai Stähler
27	2007	Spill-over effects of monetary policy – a progress report on interest rate convergence in Europe	Michael Flad
28	2007	The timing and magnitude of exchange rate overshooting	Hoffmann Sondergaard, Westelius
29	2007	The timeless perspective vs. discretion: theory and monetary policy implications for an open economy	Alfred V. Guender
30	2007	International cooperation on innovation: empirical evidence for German and Portuguese firms	Pedro Faria Tobias Schmidt
31	2007	Simple interest rate rules with a role for money	M. Scharnagl C. Gerberding, F. Seitz
32	2007	Does Benford's law hold in economic research and forecasting?	Stefan Günnel Karl-Heinz Tödter
33	2007	The welfare effects of inflation: a cost-benefit perspective	Karl-Heinz Tödter Bernhard Manzke

34	2007	Factor-MIDAS for now- and forecasting with ragged-edge data: a model comparison for German GDP	Massimiliano Marcellino Christian Schumacher
35	2007	Monetary policy and core inflation	Michele Lenza
01	2008	Can capacity constraints explain asymmetries of the business cycle?	Malte Knüppel
02	2008	Communication, decision-making and the optimal degree of transparency of monetary policy committees	Anke Weber
03	2008	The impact of thin-capitalization rules on multinationals' financing and investment decisions	Buettner, Overesch Schreiber, Wamser
04	2008	Comparing the DSGE model with the factor model: an out-of-sample forecasting experiment	Mu-Chun Wang
05	2008	Financial markets and the current account – emerging Europe versus emerging Asia	Sabine Herrmann Adalbert Winkler
06	2008	The German sub-national government bond market: evolution, yields and liquidity	Alexander Schulz Guntram B. Wolff
07	2008	Integration of financial markets and national price levels: the role of exchange rate volatility	Mathias Hoffmann Peter Tillmann
08	2008	Business cycle evidence on firm entry	Vivien Lewis
09	2008	Panel estimation of state dependent adjustment when the target is unobserved	Ulf von Kalckreuth
10	2008	Nonlinear oil price dynamics – a tale of heterogeneous speculators?	Stefan Reitz Ulf Slopek

11	2008	Financing constraints, firm level adjustment of capital and aggregate implications	Ulf von Kalckreuth
12	2008	Sovereign bond market integration: the euro, trading platforms and globalization	Alexander Schulz Guntram B. Wolff
13	2008	Great moderation at the firm level? Unconditional versus conditional output volatility	Claudia M. Buch Jörg Döpke Kerstin Stahn
14	2008	How informative are macroeconomic risk forecasts? An examination of the Bank of England's inflation forecasts	Malte Knüppel Guido Schultefrankenfeld
15	2008	Foreign (in)direct investment and corporate taxation	Georg Wamser
16	2008	The global dimension of inflation – evidence from factor-augmented Phillips curves	Sandra Eickmeier Katharina Moll
17	2008	Global business cycles: convergence or decoupling?	M. Ayhan Kose Christopher Otrok, Ewar Prasad
18	2008	Restrictive immigration policy in Germany: pains and gains foregone?	Gabriel Felbermayr Wido Geis Wilhelm Kohler
19	2008	International portfolios, capital accumulation and foreign assets dynamics	Nicolas Coeurdacier Robert Kollmann Philippe Martin
20	2008	Financial globalization and monetary policy	Michael B. Devereux Alan Sutherland
21	2008	Banking globalization, monetary transmission and the lending channel	Nicola Cetorelli Linda S. Goldberg

22	2008	Financial exchange rates and international currency exposures	Philip R. Lane Jay C. Shambaugh
23	2008	Financial integration, specialization and systemic risk	F. Fecht, H. P. Grüner P. Hartmann

Series 2: Banking and Financial Studies

01	2007	Granularity adjustment for Basel II	Michael B. Gordy Eva Lütkebohmert
02	2007	Efficient, profitable and safe banking: an oxymoron? Evidence from a panel VAR approach	Michael Koetter Daniel Porath
03	2007	Slippery slopes of stress: ordered failure events in German banking	Thomas Kick Michael Koetter
04	2007	Open-end real estate funds in Germany – genesis and crisis	C. E. Bannier F. Fecht, M. Tyrell
05	2007	Diversification and the banks' risk-return-characteristics – evidence from loan portfolios of German banks	A. Behr, A. Kamp C. Memmel, A. Pfingsten
06	2007	How do banks adjust their capital ratios? Evidence from Germany	Christoph Memmel Peter Raupach
07	2007	Modelling dynamic portfolio risk using risk drivers of elliptical processes	Rafael Schmidt Christian Schmieder
08	2007	Time-varying contributions by the corporate bond and CDS markets to credit risk price discovery	Niko Dötz
09	2007	Banking consolidation and small business finance – empirical evidence for Germany	K. Marsch, C. Schmieder K. Forster-van Aerssen
10	2007	The quality of banking and regional growth	Hasan, Koetter, Wedow
11	2007	Welfare effects of financial integration	Fecht, Grüner, Hartmann
12	2007	The marketability of bank assets and managerial rents: implications for financial stability	Falko Fecht Wolf Wagner

13	2007	Asset correlations and credit portfolio risk – an empirical analysis	K. Düllmann, M. Scheicher C. Schmieder
14	2007	Relationship lending – empirical evidence for Germany	C. Memmel C. Schmieder, I. Stein
15	2007	Creditor concentration: an empirical investigation	S. Ongena, G.Tümer-Alkan N. von Westernhagen
16	2007	Endogenous credit derivatives and bank behaviour	Thilo Pausch
17	2007	Profitability of Western European banking systems: panel evidence on structural and cyclical determinants	Rainer Beckmann
18	2007	Estimating probabilities of default with support vector machines	W. K. Härdle R. A. Moro, D. Schäfer
01	2008	Analyzing the interest rate risk of banks using time series of accounting-based data: evidence from Germany	O. Entrop, C. Memmel M. Wilkens, A. Zeisler
02	2008	Bank mergers and the dynamics of deposit interest rates	Ben R. Craig Valeriya Dinger
03	2008	Monetary policy and bank distress: an integrated micro-macro approach	F. de Graeve T. Kick, M. Koetter
04	2008	Estimating asset correlations from stock prices or default rates – which method is superior?	K. Düllmann J. Küll, M. Kunisch
05	2008	Rollover risk in commercial paper markets and firms' debt maturity choice	Felix Thierfelder
06	2008	The success of bank mergers revisited – an assessment based on a matching strategy	Andreas Behr Frank Heid

07	2008	Which interest rate scenario is the worst one for a bank? Evidence from a tracking bank approach for German savings and cooperative banks	Christoph Memmel
08	2008	Market conditions, default risk and credit spreads	Dragon Yongjun Tang Hong Yan
09	2008	The pricing of correlated default risk: evidence from the credit derivatives market	Nikola Tarashev Haibin Zhu
10	2008	Determinants of European banks' engagement in loan securitization	Christina E. Bannier Dennis N. Hänsel
11	2008	Interaction of market and credit risk: an analysis of inter-risk correlation and risk aggregation	Klaus Böcker Martin Hillebrand
12	2008	A value at risk analysis of credit default swaps	B. Raunig, M. Scheicher
13	2008	Systemic bank risk in Brazil: an assessment of correlated market, credit, sovereign and inter-bank risk in an environment with stochastic volatilities and correlations	Theodore M. Barnhill, Jr. Marcos Rietti Souto
14	2008	Regulatory capital for market and credit risk interaction: is current regulation always conservative?	T. Breuer, M. Jandačka K. Rheinberger, M. Summer
15	2008	The implications of latent technology regimes for competition and efficiency in banking	Michael Koetter Tigran Poghosyan
16	2008	The impact of downward rating momentum on credit portfolio risk	André Güttler Peter Raupach
17	2008	Stress testing of real credit portfolios	F. Mager, C. Schmieder
18	2008	Real estate markets and bank distress	M. Koetter, T. Poghosyan

Visiting researcher at the Deutsche Bundesbank

The Deutsche Bundesbank in Frankfurt is looking for a visiting researcher. Among others under certain conditions visiting researchers have access to a wide range of data in the Bundesbank. They include micro data on firms and banks not available in the public. Visitors should prepare a research project during their stay at the Bundesbank. Candidates must hold a PhD and be engaged in the field of either macroeconomics and monetary economics, financial markets or international economics. Proposed research projects should be from these fields. The visiting term will be from 3 to 6 months. Salary is commensurate with experience.

Applicants are requested to send a CV, copies of recent papers, letters of reference and a proposal for a research project to:

Deutsche Bundesbank
Personalabteilung
Wilhelm-Epstein-Str. 14

60431 Frankfurt
GERMANY