

Nitschka, Thomas

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## Banking sectors' international interconnectedness: Implications for consumption risk sharing in Europe

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# **Banking sectors' international interconnectedness: Implications for consumption risk sharing in Europe**

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## **Abstract**

Cross-border asset and liability holdings allow countries to insulate their consumption streams from idiosyncratic output shocks, i.e. consumption risk sharing. More cross-border asset holdings are associated with more risk sharing. By contrast, a bank's interconnectedness is regarded as an indicator of its exposure to systemic risk. International interbank asset holdings could hence positively or negatively affect international consumption risk sharing. This paper provides evidence in favour of the latter hypothesis. A country's ability to achieve consumption risk sharing decreases if banks located in that country are strongly linked to other countries' banks.

**JEL:** E2, F15, G15

**Keywords:** banking sector, cross-border assets, consumption risk sharing, interconnectedness, systemic risk

# 1 Introduction

The past two decades witnessed a tremendous increase in cross-border asset holdings (Lane and Milesi-Ferretti, 2007) which helped countries to diversify macroeconomic risk. Countries with relatively large cross-border asset holdings achieve more risk sharing, i.e. they better insulate their idiosyncratic consumption growth from idiosyncratic output shocks, than countries with little cross-border asset holdings (Sørensen et al., 2007; Artis and Hoffmann, 2008). This evidence suggests that cross-border asset holdings are beneficial for risk sharing.

The recent crisis, however, has focused attention to the identification of systemic risk in the financial system and systemically relevant institutions such as banks. A recent study of the Bank for International Settlements clearly highlights that interconnectedness is one of the most important signals of importance for the financial system (BIS, 2009). The more interconnected a bank is with other banks, the more it is exposed to systemic risk in the banking sector.

Hence, on the one hand, cross-border asset holdings of banks could be associated with better diversification of risk. They could just reflect another instance of cross-border linkages between countries that proved beneficial for international risk sharing. On the other hand, they could expose countries to systemic risk in the international financial system which could negatively affect countries' abilities to share consumption risk internationally.

This paper provides an account of the impact of banks' cross-border asset and liability holdings on international risk sharing among a sample of nine European countries for the time period from 1980Q1 to 2009Q4. It constructs a measure of banks' international interconnectedness and uses the panel regression approach introduced by Sørensen et al. (2007) to show that the international interconnectedness with banks in other countries negatively affects the European countries' ability to achieve consumption risk sharing.

The BIS locational banking statistics are the starting point for the construction of banking sectors' international interconnectedness that follows the approach of Lane and Milesi-Ferretti (2001, 2007) to obtain a measure of financial integration.

The evidence presented in this paper suggests that there is no material impact of banks' cross-border assets and liabilities on international risk sharing when regarding assets and liabilities against all sectors. However, the distinction between non-bank and bank sector matters. Banks' cross-border assets and liabilities vis-à-vis non-banks do not have any significant impact on international risk sharing, neither economically nor statistically. But this is not true for interbank cross-border assets and liabilities. Countries whose banks are more internationally intertwined with banks located in the rest-of-the-world achieve about 10% less risk sharing than countries whose banks are less internationally connected with other banks. This finding is statistically significant and robust to controls of the aggregate business cycle and asset price cycle and is not just driven by the recent crisis period.

This paper thus contributes to recent literature concerned with the role of banks and lending in regional and international risk sharing. While bank lending and borrowing is important in intranational risk sharing (see e.g. Hoffmann and Shcherbakova, 2010 and the literature surveyed therein), the role of credit in general (Sørensen and Yosha, 1998) and bank loans for international risk sharing appears to be limited. Fratzscher and Imbs (2009) show that banks' foreign loans only marginally significantly help to diversify consumption risk internationally over the period from 1999 to 2003. A high share of foreign bank loans in a country's international investment position even seems to increase the susceptibility of idiosyncratic consumption risk to idiosyncratic income shocks. Taking a more long-run view and incorporating information about all assets and liabilities, this paper complements and confirms Fratzscher and Imbs (2009).

Hoffmann and Nitschka (2010) highlight that domestic lending contributed to international risk sharing given that it is related to securitization of mortgage related debt and hence the

opportunity to trade country-specific risk. Consistent with this finding, Leibrecht and Scharler (2009) show that marketability of risks rather than the size or importance of the banking sector in a country matters for international risk sharing.

The remainder of the paper is organized as follows. Section 2 describes the data and the measure of banks' interconnectedness used in this study. Section 3 briefly introduces the econometric specification. Section 4 presents the empirical results. Finally, section 5 concludes.

## **2 Measure of banks' international interconnectedness and data**

The first part of this section provides information about the construction of the measure of banks' international connectedness used in this paper. The second part informs about the country sample, sample period and data employed to construct the international interconnectedness measure and to estimate the impact of banks' international interconnectedness on international consumption risk sharing.

### **2.1 Measure of banks' international interconnectedness**

The construction of the measure of banks' international interconnectedness follows the approach of Lane and Milesi-Ferretti (2001, 2003, 2007) to measure financial integration.

I define country  $k$  banking sector's interconnectedness as  $ic_t^{k,X} = \left( \frac{A+L}{GDP} \right)_t^{k,X}$  where  $A$  denotes country  $k$  banking sector's asset holdings vis-à-vis the rest-of-the-world,  $L$  is the respective liability counterpart and  $X$  represents the sectoral distinction, i.e. all sectors, bank sector or non-bank sector.

Figure 1 shows the evolution of  $ic_t^X$  over time, i.e. the aggregate amount of cross-border asset and liability holdings relative to the sum of GDPs and distinguished by the counterparty sector. The solid line illustrates the evolution of the interconnectedness measure vis-à-vis all sectors, the dashed line the respective measure with regard to counterparties in the bank sector and finally, the dotted line refers to interconnectedness vis-à-vis the non-bank sector. It is

clearly evident that banks' international links started to increase strongly in the mid-1990s. This is true for assets and liabilities vis-à-vis all sectors. Moreover, figure 1 highlights that banks' balance sheet claims and liabilities vis-à-vis other banks dominate their international links. The non-bank sector is less important in this respect.

[about here: Figure 1]

## 2.2 Data

### *Banks' cross-border assets and liabilities*

Data on banks' gross cross-border assets and liabilities is from the BIS locational banking statistics which is freely available on the BIS website [www.bis.org](http://www.bis.org). More specifically, the paper uses quarterly gross on-balance sheet asset and liabilities from table 2a „External positions of banks in individual reporting countries vis-à-vis all sectors in all currencies“ and table 2b „External positions of banks in individual reporting countries vis-à-vis all non-bank sector in all currencies“ to calculate a measure of bank sectors' international interconnectedness vis-à-vis the non-bank and bank sector.

The locational banking statistics reports cross-border data on the basis of residence of the bank. Both domestically and foreign owned banking offices in the reporting countries report gross cross-border asset and liabilities on an unconsolidated basis, i.e. cross-border holdings vis-à-vis own affiliates are also included in the recorded asset and liability holdings. The differences between positions of tables 2a and 2b can be attributed to assets and liabilities vis-à-vis the bank sector.

As described in Papaioannou (2009), the BIS collects quarterly balance sheet data on cross-border assets and liabilities vis-à-vis more than 150 countries from banks' located in the reporting area (41 countries). These assets and liabilities take the form of bank deposits, loans and debt securities but also equity. They are measured on immediate borrower basis as they

are typically reported on balance sheets.<sup>1</sup> The guidelines to the BIS locational banking statistics, freely available on the BIS website, provide more detailed information

#### *Countries and sample period*

The countries under study are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom. The sample period runs from the first quarter of 1980 to the fourth quarter of 2009.

#### *Consumption and GDP*

Quarterly, real consumption and real GDP p.c. are calculated from the IMF's Financial Statistics. Aggregate consumption and GDP are obtained by normalizing price indices of all countries to 100 in 1998Q4 and translating GDP of each country in 1998Q4 euro values following Sørensen et al. (2007).

#### *Measure of international asset price swings*

In the empirical assessments of the role of banks' interconnectedness, I control for swings in global asset prices as Hoffmann and Shcherbakova (2010) show that risk sharing among federal states in the United States varies with asset price swings.

They use short-run variations of the U.S. consumption-wealth ratio, *cay*, as measure of asset price variations since Lettau and Ludvigson (2001) show that *cay* predicts returns on the U.S. stock market. Guo (2006) and Nitschka (2010b) provide evidence for the predictive power of *cay* not only for U.S. but also foreign stock market returns. Hence, this paper uses *cay* as measure of international asset price changes. This data can be obtained from Martin Lettau's website <http://faculty.haas.berkeley.edu/lettau>.

Controlling for global asset price movements is particularly important in this context. Adrian and Shin (2010) show that in a world of mark-to-market accounting asset price movements are immediately reflected in banks' balance sheets. Banks' active balance sheet management leads to procyclical leverage not only of the individual institution but the whole banking

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<sup>1</sup> Suppose A gives a loan to B that is guaranteed by C. On immediate borrower basis, this transaction is reported as exposure of A to B. On ultimate risk basis, this transaction is reported as exposure of A to C.

system. Leverage is associated with systemic risk (Adrian and Brunnermeier, 2009). Hence, global asset price movements also affect risks associated with interbank links as examined in this paper.

### *Measure of countries' financial integration*

Finally, as a robustness check, I also assess if financial integration, measured by countries' cross-border asset and liability holdings, improves risk sharing among the countries under consideration in this paper. This paper uses the updated version of the Lane and Milesi-Ferretti database for that purpose and constructs the financial integration measure as suggested in Lane and Milesi-Ferretti (2007). The Lane and Milesi-Ferretti data is freely available on Philip Lane's website <http://www.philiplane.org>. It is, however, important to note that this data is only available at annual frequency up to 2007 while the BIS data is reported at the quarterly frequency.

### **3 Econometric specification**

The empirical results of this paper are based on the consumption risk sharing regression proposed by Sørensen et al. (2007):

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k \quad (1)$$

where  $\Delta \tilde{c}_t^k$  is idiosyncratic consumption growth of country  $k$  at time  $t$  and  $\Delta \tilde{y}_t^k$  idiosyncratic GDP growth respectively. Asdrubali et al. (1996) as well as Sørensen and Yosha (1998) show that  $1 - \beta_U$  can be interpreted as measure of consumption risk sharing as  $\beta_U$  typically varies between 0 and 1. An estimate of 0 reflects that idiosyncratic consumption growth is independent from idiosyncratic GDP growth, such that risk sharing is perfect. All diversifiable, idiosyncratic risks are actually diversified. Only global, common, shocks affect consumption. Conversely, an estimate of  $\beta_U = 1$  is tantamount to saying that no idiosyncratic risks are diversified away. All idiosyncratic GDP shocks have a direct impact on consumption.



Following Sørensen et al., 2007, I allow  $\beta_U$  to vary with country-specific and time-variant characteristics by parameterizing

$$\beta_U(t) = \beta_0 + \beta_1 i\tilde{c}_t^{k,X} + \beta_2 cay_t + \beta_3 trend \quad (2)$$

with  $i\tilde{c}_t^{k,X}$  the measure of the interconnectedness of banks in country k as described above but relative to the cross-sectional average at each point in time. It thus reflects if cross-border assets and liabilities of banks in country k are above or below the average across countries in the sample.

As described above, X represents the sectoral distinction, i.e. all sectors, bank sector or non-bank sector.. To proxy for growth in cross-border assets in general, the regressions include also an interaction of *trend*, denoting a time trend, with idiosyncratic GDP. The variable *cay* represents short-run variations in the U.S. consumption-wealth ratio and serves to control for risk premia on asset markets since Lettau and Ludvigson (2001) provide evidence for the predictive power of *cay* when faced with U.S. stock market excess returns. Hoffmann and Shcherbakova (2010) highlight that interregional consumption risk sharing in the U.S. varies with fluctuations in asset prices as reflected in *cay*. Hoffmann and Nitschka (2008) and Nitschka (2010a) use *cay* to stress that the same reasoning pertains to international consumption risk sharing as well since U.S. *cay* also predicts foreign stock market returns (Guo, 2006; Nitschka 2010b).

In addition, all regressions control for aggregate GDP growth in case banks' cross-border asset and liability holdings are a function of the aggregate business cycle, and additionally include all the uninteracted terms. Moreover, I control for country- and time-specific fixed effects in the regressions.

## 4 Empirical results

### 4.1 Baseline results

The baseline results of this paper are obtained from equation (1) using the parameterization in equation (2). Banks' international interconnectedness is measured by the sum of their cross-border assets and liabilities divided by GDP of their residence country. Table 1 summarizes the results.

Panel A presents the results if we regard the interconnectedness of banks in country  $k$  vis-à-vis the rest-of-the-world and all sectors. Line 1 of panel A gives the estimate of the regression of idiosyncratic consumption growth on idiosyncratic GDP and the interaction of GDP with the interconnectedness measure only. Focusing just on the estimate of  $\beta_0$  alone, about 82% of consumption risk among the countries under study remains uninsured. The interaction term of interconnectedness is positive and significant meaning that the more cross-border linkages of banks' in a particular country, the worse its diversification of consumption risk. Controlling additionally for a time trend, however, the interaction term of interconnectedness is still positive but insignificant as the second line of panel A shows. Adding the interaction with  $cay$  to control for asset price fluctuations does not alter this observation. This interaction term itself is positive but insignificantly different from zero.

Panel B of table 1 displays the corresponding baseline regression estimates if only banks' asset and liabilities vis-à-vis the non-bank sectors are regarded. Irrespective of the particular specification of the baseline regressions, the interaction term of banks' interconnectedness with GDP growth is always positive but insignificant at conventional significance levels.

Panel C of table 1, however, paints a different picture. Panel C reports the baseline regression results when just interbank cross-border asset and liability holdings are considered. Here the interaction term of interbank interconnectedness is clearly positive, varying between 0.12 and 0.14, and statistically significant with robust t-statistics conveniently higher than two. In words, the more banks in a particular country are linked with banks in the rest-of-the-world, the less consumption risk sharing is achieved by these countries. According to the estimates in panel C of table 1, European countries with highly internationally connected banking sectors

face idiosyncratic consumption streams that are more than 10% more volatile than those of countries with less internationally intertwined banks.

**[about here: Table 1]**

This finding is consistent with the impression left by the BIS guidance to identify systemically important financial institutions (BIS, 2009). The more interconnected a bank sector in a particular country is, the less risk sharing it achieves. This finding could be driven by interbank cross-holdings of assets and liabilities because they expose countries to the systemic risk in the international banking system rather than helping to diversify risk.

This evidence might be explained against the backdrop of Adrian and Shin (2010) and Adrian and Brunnermeier (2009). Adrian and Shin (2010) show that mark-to-market accounting leads to the reflection of asset price movements in banks' balance sheets. As banks manage their balance sheets actively, this leads to procyclical leverage not only at the level of an individual institution but also at the level of the whole banking system. The fact that mark-to-market accounting pertains to large parts of all banks' balance sheets then leads to the observation that banks behave similarly. Leverage, in turn, is associated with systemic risk (Adrian and Brunnermeier, 2009). The risk in the banking system varies with banks' balance sheet adjustment that are similar internationally. Hence, cross-border interbank links do not provide a diversification benefit but rather the opposite. This reasoning might explain the consumption risk sharing pattern presented in table 1.

## **4.2 Robustness Checks**

### *4.2.1 Asset or liability based measure of bank sectors' interconnectedness*

The results reported in table 1 rely on the use of a measure of interconnectedness that relates both gross cross-border asset and liabilities holdings of bank sectors to GDP of the respective country. This section assesses if the distinction between pure asset or pure liabilities measures of bank sectors' interconnectedness alters any of the main conclusion drawn above.

The paper uses the same regression specification as above but separately examines a pure asset and a pure liability measure of interconnectedness. Table 2 presents the results for the asset-based measure, table 3 delivers the corresponding results for the liability-based measure. In sum, the regression estimates presented in the two tables confirm the conclusions drawn from table 1. Countries with bank sectors that are relatively tightly linked with other countries' bank sectors share less risk internationally. Banks' links with the non-bank sector do not influence risk sharing. Admittedly, the statistical significance of the estimates deteriorates slightly when controlling for a time trend interaction and the interaction of cay with idiosyncratic GDP. The liability-based measure of interconnectedness is then only significant at the 90% confidence level, the asset-based measures turns out to be marginally insignificant at that confidence level.

**[about here: Table 2]**

**[about here: Table 3]**

#### *4.2.2 Impact of recent crisis period?*

Banks' international interconnectedness exposes their host countries to systemic risk that diminishes these countries' abilities to diversify their idiosyncratic consumption risks. This interpretation of the results presented in tables 1 to 3, however, could be the outcome of the recent crisis. It is possible that it does not pertain to earlier periods. Bank sector interconnectedness could have contributed to better risk sharing before the crisis but helped to spread risks during the crisis. Hoffmann and Nitschka (2010) show that the securitization of mortgage-related risks via mortgage-backed securities improved international risk sharing. But they also provide evidence for time-variation of this beneficial impact of securitization on international risks sharing. In 2008, this beneficial impact ceased to exist.

To assess if a similar logic applies to the present context, I run the baseline regression focused on international interbank linkages for the time period from 1980Q1 to 2006Q4 thus excluding the current crisis period. Table 4 presents the results for all varieties of

interconnectedness measures, i.e. assets and liabilities (A+L), assets only (A) and liabilities only (L).

**[about here: Table 4]**

Irrespective of the concrete measure of interconnectedness, it is apparent that the interaction term with idiosyncratic GDP is positive and statistically significant at the 95% confidence level. The finding that interbank cross-border asset and liability holdings decrease countries' ability to share consumption risks internationally is hence not driven by the latest crisis period. It is rather a long-run observation among the European countries under study.

*4.2.3 Main results dependent on single countries?*

Since the sample under consideration consists of only nine countries, it is possible that single countries materially affect the main results presented so far. This could be particularly true for countries that host a lot of foreign banks since the BIS locational statistics reports banks' international claims based on the residence and not on the nationality of a bank. A German bank branch in the UK, for instance, is included in the interconnectedness measure of banks in the UK.

I try to evaluate this possibility by subsequently taking out one of the sample countries and run the baseline regressions presented in table 1. It turns out that none of the countries alone is responsible for the regression results that lead to the main conclusion that banks' interconnectedness diminishes its host countries' ability of consumption risk sharing.

For the sake of brevity, table 5 only reports the regression results when the UK is excluded from the sample. Dropping other countries produces qualitatively similar results which are not reported but available upon request.

**[about here: Table 5]**

As in the previous subsection, table 5 concentrates on the interconnectedness vis-à-vis the banking sector and reports the results from the final baseline regression, taking into account interaction with a time trend and *cay*. Apparently, leaving the UK out of the sample leaves the

main results largely unaffected. Irrespective of the variety of the interconnectedness measure the main conclusions prevail.

#### 4.2.4 *Does financial integration improve risk sharing among the sample countries at all?*

As highlighted in the introduction, banks' cross-border assets and liabilities are certainly part of the financial integration that we have witnessed over the past decades. This financial globalization is highlighted by Lane and Milesi-Ferretti (2001, 2003, 2007) who show that cross-border asset and liabilities holdings really took off in the end 1980s. This increased financial integration, international interconnectedness of countries, has improved countries' ability to share risks internationally (Sørensen et al., 2007; Artis and Hoffmann, 2008).

The main results of this paper rather leave the impression that relatively strong international linkages of banks resident in a particular country lower its ability to diversify its consumption risk. One possible explanation for this finding could be that financial integration, as measured by countries' cross-border assets and liabilities, did not lead to improved risk sharing among the sample countries at all. To gauge the plausibility of this argument, I run the simple baseline regression (1) and parameterize

$$\beta_U(t) = \beta_0 + \beta_1 gfa_t^{k,x} + \beta_2 trend \quad (3)$$

with  $gfa_t^k = \left( \frac{FA + FL}{GDP} \right)_t^k$  the global financial integration measure proposed by Lane and Milesi-Ferretti (2001) where "FA" refers to country k gross foreign assets and "FL" to country k gross foreign liabilities respectively. This measure is constructed for the time period from 1980 to 2007 based on the update of the Lane and Milesi-Ferretti (2007) dataset which is freely available on Philip Lane's website. Please note also that the data is measured at the annual frequency. As the BIS data is reported at the quarterly frequency, this does not allow to run a horse race between the two measures without employing any interpolation techniques that could blur the evidence. Despite the limitation in this respect, the regression results displayed in table 6 allow highlighting that indeed financial integration is beneficial for risk

sharing confirming Sørensen et al. (2007) and Artis and Hoffmann (2008). The interaction coefficient of the financial integration measure with idiosyncratic GDP growth is negative but marginally insignificant at conventional significance levels. The t-statistic is around 1.5 irrespective if I control for the interaction of a time trend with GDP. Even though the interaction coefficient of the financial integration measure is marginally insignificant, this evidence highlights that the main results of this paper are unlikely due to the fact that cross-border asset holdings in general are bad for risk sharing among the countries under study. By contrast, the evidence in table 6 together with the baseline results displayed in table 1 rather stress the main conclusion of this paper. Countries' general cross-border asset holdings have different implications for consumption risk sharing than international interbank asset holdings.

**[about here: Table 6]**

## **5 Conclusions**

In general, cross-border assets and liabilities have contributed to international consumption risk sharing over the past two decades. At the same time, however, banks' interconnectedness is associated with exposure to risk in the financial system. The more interconnected a bank is with other banks, the more it is prone to systemic risk in the banking sector. Hence, the role of banks' cross-border assets and liabilities in international consumption risk sharing is not clear a priori.

Banks' international links with other banks could improve risk sharing as they are one instance of cross-border assets and liabilities that improved the diversification of risk internationally. This hypothesis is not supported by the evidence presented in this paper. Banks' international ties with other banks rather diminish the ability of their residence countries to diversify risk internationally. This finding is in line with the notion that interbank linkages are associated with systemic risk. Countries with highly internationally connected

banks achieve less risk sharing than countries with relatively little interbank connections. Banks' international interconnectedness is associated with macroeconomic costs. Hence, regulatory initiatives aimed at limiting interbank linkages can be justified from a macroeconomic point of view. Banks with strong international links to banks located in different countries create macroeconomic costs in terms of higher sensitivity of idiosyncratic consumption growth to idiosyncratic output shocks.

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## Tables

**Table 1: Banks' interconnectedness (assets and liabilities) and international risk sharing**

$\beta_0:$	$\beta_1:$	$\beta_2:$	$\beta_3:$
1	$ic_t^k$	<i>trend</i>	$cay_t$
Panel A: Interconnectedness vis-à-vis all sectors			
0.82 * (24.44)	0.08 * (2.28)		
0.81 * (22.83)	0.06 (1.68)	-0.00 (-1.71)	
0.81 * (21.09)	0.07 (1.59)	-0.00 (-1.70)	-1.07 (-0.53)
Panel B: Interconnectedness vis-à-vis non-bank sector			
0.82 * (23.11)	0.04 (0.74)		
0.81 * (22.73)	0.01 (0.17)	-0.00 * (-2.32)	
0.81 * (20.87)	0.01 (0.21)	-0.00 * (-2.12)	-0.24 (-0.12)
Panel C: Interconnectedness vis-à-vis bank sector			
0.82 * (24.80)	0.14 * (2.59)		
0.81 * (23.19)	0.12 * (2.12)	-0.00 (-1.61)	

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**Table 1 continued**

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0.81*	0.12*	−0.00	−0.70
(21.64)	(2.12)	(−1.58)	(−0.39)

Notes: Table 1 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 i \tilde{c}_t^{k,X} + \beta_2 cay_t + \beta_3 trend$$

where  $i \tilde{c}_t^{k,X}$  represents country k banks' international interconnectedness, measured as the sum of gross cross-border assets and liabilities relative to GDP, vis-à-vis sector X (all sectors, non-banks, banks) in other countries. Short-run fluctuations in the U.S. consumption-wealth ratio, *cay*, are included in the estimation as a proxy for global asset market swings. Finally, *trend* denotes a time trend. Robust t-statistics appear below the estimates in parenthesis. Significant values at the 95 percent confidence level are marked with \*. The sample period runs from the first quarter of 1980 to the fourth quarter of 2009. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom.

**Table 2: Banks' interconnectedness (assets) and international risk sharing**

$\beta_0:$	$\beta_1:$	$\beta_2:$	$\beta_3:$
1	$ic_t^k$	<i>trend</i>	$cay_t$
Panel A: Interconnectedness vis-à-vis all sectors			
0.82 * (23.75)	0.12 (1.84)		
0.81 * (22.61)	0.07 (1.13)	-0.00 * (-1.99)	
0.81 * (20.63)	0.08 (1.09)	-0.00 (-1.91)	-0.74 (-0.36)
Panel B: Interconnectedness vis-à-vis non-bank sector			
0.82 * (23.10)	0.07 (0.80)		
0.81 * (22.74)	-0.01 (-0.07)	-0.00 * (-2.30)	
0.81 * (20.76)	-0.00 (-0.03)	-0.00 * (-2.12)	-0.13 (-0.07)
Panel C: Interconnectedness vis-à-vis bank sector			
0.82 * (24.50)	0.25 * (2.09)		
0.81 * (23.02)	0.18 (1.52)	-0.00 (-1.81)	
0.81 * (21.17)	0.19 (1.58)	-0.00 (-1.46)	0.73 (0.41)

Notes: Table 2 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 \tilde{ic}_t^{k,X} + \beta_2 cay_t + \beta_3 trend$$

where  $\tilde{ic}_t^{k,X}$  represents country k banks' international interconnectedness, measured as gross cross-border assets relative to GDP, vis-à-vis sector X (all sectors, non-banks, banks) in other countries. Short-run fluctuations in the U.S. consumption-wealth ratio,  $cay$ , are included in the estimation as a proxy for global asset market swings. Finally,  $trend$  denotes a time trend. Robust t-statistics appear below the estimates in parenthesis. Significant values at the 95 percent confidence level are marked with \*. The sample period runs from the first quarter of 1980 to the fourth quarter of 2009. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom.

**Table 3: Banks' interconnectedness (liabilities) and international risk sharing**

$\beta_0:$	$\beta_1:$	$\beta_2:$	$\beta_3:$
1	$ic_t^k$	<i>trend</i>	$cay_t$
Panel A: Interconnectedness vis-à-vis all sectors			
0.82 * (24.60)	0.16 (2.18)		
0.81 * (23.20)	0.13 (1.75)	-0.00 (-1.82)	
0.81 * (21.66)	0.14 (1.74)	-0.00 (-1.81)	-0.93 (-0.48)
Panel B: Interconnectedness vis-à-vis non-bank sector			
0.82 * (23.08)	0.07 (0.60)		
0.81 * (22.74)	0.05 (0.46)	-0.00 * (-2.37)	
0.81 * (20.96)	0.05 (0.48)	-0.00 * (-2.15)	-0.29 (-0.18)
Panel C: Interconnectedness vis-à-vis bank sector			
0.82 * (24.33)	0.16 * (2.23)		
0.81 * (23.16)	0.12 (1.86)	-0.00 * (-1.96)	
0.81 * (21.63)	0.13 (1.85)	-0.00 (-1.86)	-0.51 (-0.27)

Notes: Table 3 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 i\tilde{c}_t^{k.X} + \beta_2 cay_t + \beta_3 trend$$

where  $i\tilde{c}_t^{k.X}$  represents country k banks' international interconnectedness, measured as the sum of gross cross-border liabilities relative to GDP, vis-à-vis sector X (all sectors, non-banks, banks) in other countries. Short-run fluctuations in the U.S. consumption-wealth ratio, *cay*, are included in the estimation as a proxy for global asset market swings. Finally, *trend* denotes a time trend. Robust t-statistics appear below the estimates in parenthesis. Significant values at the 95 percent confidence level are marked with \*. The sample period runs from the first quarter of 1980 to the fourth quarter of 2009. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom.

**Table 4: Banks' interconnectedness vis-à-vis banking sector  
and international risk sharing (1980Q1 – 2006Q4)**

	$\beta_0:$	$\beta_1:$	$\beta_2:$	$\beta_3:$
	1	$ic_t^k$	<i>trend</i>	<i>cay_t</i>
A+L	0.83 * (19.20)	0.20 * (3.16)	-0.00 (-0.50)	-1.09 (-0.53)
A	0.82 * (18.72)	0.38 * (2.65)	0.00 (0.23)	1.89 (0.98)
L	0.83 * (19.08)	0.20 * (2.18)	-0.00 (-1.08)	-0.89 (-0.42)

Notes: Table 4 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 i\tilde{c}_t^{k,X} + \beta_2 cay_t + \beta_3 trend$$

where  $i\tilde{c}_t^{k,X}$  represents country k banks' international interconnectedness, measured as the sum of gross cross-border assets and liabilities relative to GDP as well as assets and liabilities only, vis-à-vis sector X (all sectors, non-banks, banks) in other countries. Short-run fluctuations in the U.S. consumption-wealth ratio, *cay*, are included in the estimation as a proxy for global asset market swings. Finally, *trend* denotes a time trend. Robust t-statistics appear below the estimates in parenthesis. Significant values at the 95 percent confidence level are marked with \*. The sample period runs from the first quarter of 1980 to the fourth quarter of 2006. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom.



**Table 5: Banks' interconnectedness vis-à-vis banking sector  
and international risk sharing (leaving out UK)**

	$\beta_0:$	$\beta_1:$	$\beta_2:$	$\beta_3:$
	1	$ic_t^k$	<i>trend</i>	<i>cay_t</i>
A+L	0.79 * (17.95)	0.14 * (2.25)	-0.00 (-1.91)	-0.08 (-0.04)
A	0.79 * (17.45)	0.28 * (2.17)	-0.00 (-1.80)	-0.04 (-0.02)
L	0.79 * (17.99)	0.16 * (2.03)	-0.00 (-2.05)	0.02 (0.01)

Notes: Table 5 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 ic_t^{k,X} + \beta_2 cay_t + \beta_3 trend$$

where  $ic_t^{k,X}$  represents country k banks' international interconnectedness, measured as the sum of gross cross-border assets and liabilities relative to GDP as well as assets and liabilities only, vis-à-vis sector X (all sectors, non-banks, banks) in other countries. Short-run fluctuations in the U.S. consumption-wealth ratio, *cay*, are included in the estimation as a proxy for global asset market swings. Finally, *trend* denotes a time trend. Robust t-statistics appear below the estimates in parenthesis. Significant values at the 95 percent confidence level are marked with \*. The sample period runs from the first quarter of 1980 to the fourth quarter of 2006. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands and Sweden.

**Table 6: Financial integration  
and international risk sharing**

$\beta_0:$	$\beta_1:$	$\beta_2:$
1	$f_t^k$	<i>trend</i>
1.17 * (10.33)	- 0.11 (-1.54)	
1.18 * (10.06)	- 0.11 (-1.52)	0.00 (0.06)

Notes: Table 6 provides estimates from the regression

$$\Delta \tilde{c}_t^k = \beta_U(t) \times \Delta \tilde{y}_t^k + \mu + \delta^k + \tau_t + \varepsilon_t^k$$

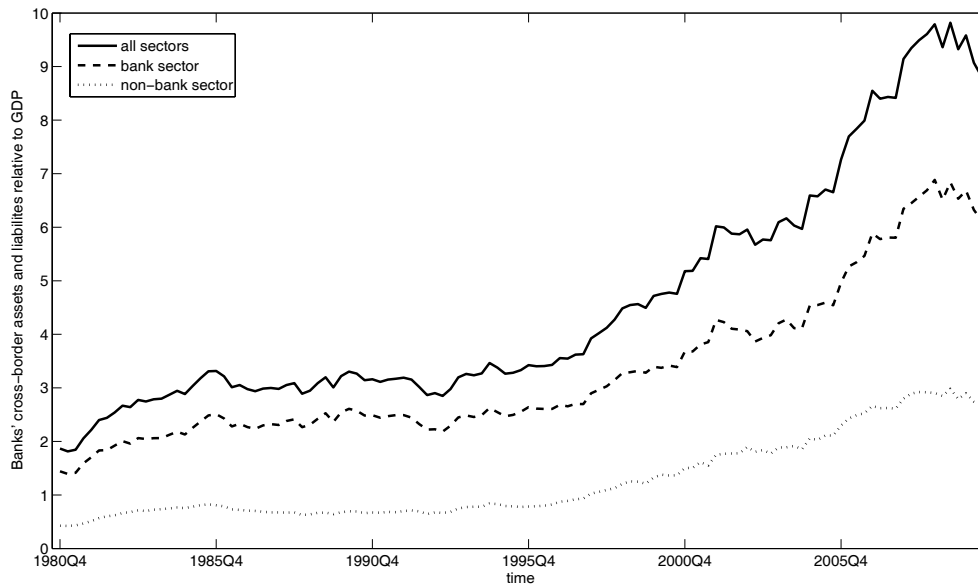
with the parameterization

$$\beta_U(t) = \beta_0 + \beta_1 gfa_t^{k,x} + \beta_2 trend \quad (3)$$

with  $gfa_t^k = \left( \frac{FA + FL}{GDP} \right)_t$  the global financial integration measure proposed by Lane and Milesi-Ferretti

(2001) where “FA” refers to country k gross foreign assets and “FL” to country k gross foreign liabilities respectively. Significant values at the 95 percent confidence level are marked with \*. Data is annual and the sample period runs from the 1980 to 2007. The countries included in the sample are Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom.

## Figures



**Figure 1:** This figure gives an optical impression of the evolution of average interconnectedness of banking sectors with different sectors across the sample countries Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom over the period from 1980 to 2009. Country k banking sector's interconnectedness

is defined as  $ic_t^{k,X} = \left( \frac{A+L}{GDP} \right)_t^{k,X}$  where A denotes country k banking sector's asset holdings

vis-à-vis the reporting area, L is the respective liability counterpart and X represents the sectoral distinction, i.e. all sectors (solid line), bank sector (dashed line) or non-bank sector (dotted line).