Interconnectedness of the Irish banking sector with the global financial system

Niamh Hallissey[1]

Abstract

Financial innovation and closer integration of international financial systems have created an environment where banks are highly connected, with each other and with the global financial system. These connections can have both positive and negative effects and understanding these interlinkages is an important area of focus for policymakers. While a full understanding of the connections within the wider financial system is constrained by a lack of complete data, regulatory data sources for the banking sector provide a wealth of information which can be used to analyse the interlinkages of this sector. This article examines a number of regulatory data sources to assess how interconnected Irish-authorised banks (both domestic and international) are with the financial system. It finds that banks with a domestic retail focus have much lower levels of interconnectedness with the financial sector than the internationally-focussed foreign-owned banks, at least partly due to the intragroup exposures of the latter. An analysis of the network of bilateral interbank credit exposures using available data shows that this network is relatively sparse, with just a few key hubs, all of which are large global banks. However, the available data do not capture all exposures and future data collection enhancements will be important for further analysis.

1 The author is a senior economist in the Financial Stability Division. The views expressed are solely the views of the author and are not necessarily those held by the Central Bank of Ireland or the European System of Central Banks. I would like to acknowledge Ellen Ryan for excellent research assistance, John Staunton, Anna Lalor and Brian Golden for expert advice on data, and Mark Cassidy, Adrian Varley and an anonymous referee for very helpful comments. Any remaining errors are my own.

Introduction

The global financial crisis has starkly illustrated the importance of looking at the interconnectedness of the financial system, as shocks in one part of the system can reverberate and have a sizable impact on the stability of institutions and markets around the world. Interconnectedness can arise in several ways. Transactions between entities create a multiplicity of 'financial networks', many of which are opaque. Interconnectedness can also arise in a more indirect fashion, namely through exposure to common risk factors. Connections within the financial system bring many benefits through improving risk sharing and allowing for the absorption of small shocks. However, financial systems tend to be 'robust-yet-fragile', in that connections act as a shock-absorber for smaller shocks but after a certain level of interconnectedness act as shock-amplifiers.

Given their importance and links to the real economy, banks are a key component of many financial networks. Banks can be connected through direct counterparty exposures on the asset side, through funding networks, through the payments system or through common exposures to a certain sector or asset class. The high levels of interconnectedness between these institutions mean that the failure or distress of important banks can lead to contagion across the system. This in turn can have severe consequences for the real economy.

As such, monitoring and analysing these interlinkages is very important and there are several approaches and data sources that can be used to do this. It is important to have the full picture when looking at interconnectivity in order to gain a true understanding of systemic risk. However, in many cases, complete datasets are unavailable.

This article examines the interconnectedness of the banking sector in Ireland. Section 1 briefly introduces the concept of interconnectedness and methodologies which can be used to assess it. Section 2 examines the different data sources, while Section 3 looks at direct interbank credit exposures of the Irish banks and Section 4 discusses indirect interconnectedness through common exposures. Section 5 examines some non-banking data to complement the banking regulatory data and Section 6 concludes.

1. Interconnectedness

Interconnectedness and how it affects financial stability

Financial system interconnectedness arises through the many complex transactions and relationships between institutions. Recent events have shown the need for regular and thorough assessment of these interlinkages. The most direct form of interconnectedness consists of bilateral exposures between institutions. This form of interconnectedness brings with it many positive effects, allowing for diversification of risk and helping smaller shocks to be absorbed by the system. However, connections between institutions can also act as transmission channels for the propagation of shocks across the system.

While it is difficult to estimate the optimal level of interconnectedness, there are some findings in the literature which are of interest. Allen and Gale (2000), using a network structure involving four banks, show that the spread of contagion through direct linkages in financial systems depends on the level of interconnectedness between banks. They find that complete networks, where every institution is connected to every other institution, are more stable than incomplete networks. However, completeness is not a feature of most financial networks.

Gai and Kapadia (2010) find that financial systems tend to be 'robust-yet-fragile' in that connections act as a shock-absorber for smaller shocks but, after a certain tipping point, interconnections act as shock-amplifiers, spreading risk and leading to an impact disproportionate to the size of the initial shock. Sachs (2010) finds that financial stability depends not only on the completeness and

interconnectedness of the network of interbank exposures but also on the distribution of the exposures within the system. In addition, the paper finds that systems with a high degree of asset concentration among core banks are more unstable than networks with banks of homogeneous size that form their links randomly. Battiston et al. (2011) find that a highly connected network can amplify the effect of an initial negative shock.

One empirical study, by Čihák et al. (2011), uses model simulations and econometric estimates based on a world-wide dataset to find that the relationship between the stability of a country's banking sector and its interconnectedness varies according to the level of interconnectedness. For banking sectors which are not as connected with the global banking sector, they find that increases in interconnectedness are associated with a reduced probability of a banking crisis. Once interconnectedness reaches a certain level, further increases in interconnectedness can increase the probability of a banking crisis. When the interconnectedness reaches close to complete network, interconnectedness starts again reducing the likelihood of crisis. Thus, after a certain point, the advantages of increased interconnectedness become less clear. Čihák et al. (2011) do not consider the drivers of interconnectedness, which can be symptomatic of a specific risk rather than the underlying cause.

As well as the significance of the level of interconnectedness, a further finding of Čihák et al. (2011) is that it is important to distinguish whether the cross-border interlinkages arise primarily from banks' asset or liabilities side. They find that the impact of changes in interconnectedness on banking system fragility is more significant for the liability-side than for asset-side interconnectedness. Langfield et al. (2014) also distinguish between types of interconnectedness in their analysis of interbank connections in key markets. They find that network structure varies depending on whether interbank exposures (assets) or interbank funding are being considered. Network structure also varies within different asset classes (e.g. derivatives, repos, unsecured lending, etc.).

Indirect interconnectedness is also a potential channel for contagion. Indirect linkages can arise from a concentration of common exposures, vulnerability to common shocks, market perceptions of risk, fire sales and informational contagion (Arregui et al., 2013). These factors can be as important as direct exposures during a crisis.

Tools for assessing interconnectedness

The need to monitor and analyse interconnections is very clear. There are several approaches and data sources that have been used to do this. One approach uses market data such as asset prices to estimate interlinkages among financial institutions. Under this approach, methodologies such as CoVaR, distress spillover indicators and probability of default models can be used to identify common risk factors and trace how distress affects different institutions (see Blancher, 2013 for further details). These measures are forward-looking but the early-warning capacity of some of these indicators is at best a few months ahead of the actual crisis events (Arsov et al., 2013). Another approach, known as network analysis, involves looking at balance sheet linkages on both the asset and the liability side to understand how shocks would propagate throughout the system. This approach maps the financial system as a set of nodes connected by links, representing financial relationships between the system's various entities. Network analysis can be used to identify important nodes, be they countries, sectors, or individual institutions, in a given system and provides an analytical framework for assessing the risks posed by interconnectedness. Network analysis allows for a more precise quantification of interconnectedness through network property measures such as density and concentration. Research on financial interlinkages using network analysis has grown rapidly over recent years. Newman (2010) provides a

good introduction to network analysis and describes common network metrics to analyse the stability of a particular network and its key nodes. This analysis can be carried out on a static basis, where the network structure is described using topological indicators, or on a dynamic basis which takes a more forward-looking perspective to see how a shock would propagate through the system and to assess channels of contagion (ESRB, 2013).

Research on interbank networks suggests a number of common themes in the structure of these networks. For example, national interbank networks tend to have a small number of central nodes and many less significant nodes, known as a core-periphery structure. This has been confirmed for several national interbank systems and remains stable over time, as discussed in ESRB (2013). However, Langfield et al. (2014) find that the strength of this core-periphery structure varies significantly by asset class.

2. Data sources

There are a number of data sources which can be used to assess interconnectedness. These include aggregate country level data, such as the Bank for International Settlements (BIS) international banking statistics, or more granular supervisory datasets. Limitations exist in both cases. Aggregation by country can hide important vulnerabilities at an individual bank level and international banking group structures can cause distortions to the data. Supervisory data can be used to give a more detailed breakdown of exposures by sector and by country, and for the relevant legal entity to a country. In addition, there are some supervisory data on banks' bilateral exposures. However, these data are only available nationally, and unless both counterparties are located in the same country only one side of any transaction will be captured. Payments systems data can also be used to assess interconnectedness between institutions by using algorithms to identify interbank transactions (Furfine, 1999). Gaffney (forthcoming) uses these data for the Irish payments system to investigate the activities of Irish banks in the market for interbank lending between 2008 and 2015.

Complete datasets are rare, but it is important to have as full a picture as possible when looking at interconnectivity. Gauthier et al. (2010) finds that the picture of systemic risk derived from analysis of interbank deposits is significantly different to one based on all interbank exposures including cross-shareholdings and derivatives. As mentioned above, Langfield et al. (2014) also finds that network structure varies according to asset class. Incomplete data can result in an underestimation of systemic risk; this further highlights the need for improved data. New sources of data over the coming year will be beneficial in filling at least some of these gaps.

BIS data

The most common and widely available source of data on cross-border banking sector interconnectedness is the international banking statistics from the BIS. These data are aggregated at the level of national banking systems and track developments in banks' foreign positions and cross-country financial linkages. There are two different datasets: the BIS consolidated banking statistics (CBS) and the BIS locational banking statistics (LBS). The CBS focus on banks headquartered in the reporting country and track their consolidated gross claims and other exposures to individual countries and sectors. This dataset is available on an immediate borrower basis (based on the country of the first counterparty exposure) and an ultimate risk basis (based on the country where the final risk resides). The LBS focus on all banking offices resident in the reporting country and track the unconsolidated cross-border positions and the local positions in foreign currencies of these banks. This dataset is available by residency and by nationality (according to the country where the bank is headquartered). Coates et al. (2015) discusses these datasets and highlights coverage and methodological issues for these data series in Ireland and warns that care must be taken in drawing conclusions from the BIS published

series without an understanding of the underlying factors. The BIS data are the only publically available source of cross-border banking data and are widely used in research on the subject of banking interconnectedness (see, for example, Nimoiu and Reyes, 2013).

Banking regulatory data

Data collected for supervisory reporting purposes can be used to identify systemic risks that arise from common exposures, interbank linkages, and funding concentrations.[2] The large exposures data return can be used to look at interlinkages between banks and other counterparties. A large exposure is defined as an exposure that is 10 per cent or more of a bank's eligible capital base and each bank authorised in Ireland must report these on a quarterly basis.[3] These exposures are mainly on the asset side of the balance sheet. The current regulatory limit on large exposures to a single counterparty or a group of connected counterparties is 25 per cent of a bank's capital. However, the banking regulations allow for a number of exemptions to the large exposures limits, including sovereign exposures and exposures with certain parental guarantees. The large exposure reporting requirements vary by whether a bank falls under the definition of "parent institution in a Member State". These banks report more detail than the other institutions, including every exposure which is greater than €300 million but less than 10 per cent of the institution's eligible capital. The current large exposures return has been collected since Q1 2014 and similar data on large exposures were collected pre-CRR using a different scope and level of detail.

While the large exposures returns provide information on interlinkages through asset exposures, future developments in regulatory data for the banking sector will enhance the data available to look at the interconnectedness on the liabilities of these institutions. Additional data templates for the supervisory review of banks which are being finalised by the EU Commission will include the top 10 largest counterparties or group of connected clients from which funding obtained exceeds a threshold of 1 per cent of total liabilities. These data will provide more information on the funding network of these banks.

Non-bank regulatory data sources

The banking regulatory data provide much information on the interconnectedness of the Irish banks with the global financial system. These data can be supplemented with data from other financial sectors to give a fuller picture of the interconnectedness of the Irish banking sector. The insurance and the non-bank financial intermediary sectors (together called other financial institutions (OFIs) for the purposes of this paper) are of particular interest in this regard. Existing regulatory data sources include detailed data on the asset and liability exposures of non-bank financial intermediaries. The Irish-resident non-bank financial intermediary sector is large in size relative to the domestic economy and covers a wide range of entities and activities. Money market funds (MMFs), investment funds (IFs) and financial vehicle corporations (FVCs) comprise most of the entities in this sector (see Godfrey and Golden, 2012). Data on derivative markets collected under the European Market Infrastructure Regulation (EMIR) can also be used to examine interconnectedness between banks and other counterparties in these particular markets. Research using these data (Kenny et al., 2015) finds significant interconnectedness and concentration in the Irish credit default swap market.

New data sources for the non-banking sectors will also become available over the coming year, reflecting global and domestic initiatives to fill data gaps. Some special purpose vehicles (SPVs) were not reporting granular data to the Central Bank but are now required to submit the same quarterly reporting as

2 For further detail on the reporting requirements for credit institutions in Ireland see http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Pages/reporting.aspx

3 See Articles 387-403 of the Capital Requirements Regulation (CRR) 575/2013 and http://www.eba.europa.eu/regulation-and-policy/large-exposures for details of the large exposures regime. Eligible capital is defined as Tier 1 capital and Tier 2 capital capped at a reducing percentage of Tier 1 capital that will fall to 33 per cent by 1 January 2017.

FVCs (Godfrey et al., 2015). These data can be used to assess the interconnectedness of these vehicles with the regulated banking sector. In addition to these data, detailed aggregate data on the exposure of insurers, including to other parts of the financial sector, will become available in 2016 under the new Solvency II reporting regime.[4] These new data will complement the banking data in assessing financial sector interconnectedness.

3. Direct credit exposures

The most direct form of connections between banks and the rest of the financial system are bilateral credit transactions, most commonly through loans but also through derivatives, guarantees, debt or equity holdings, etc. The large exposures data return can be used to look at these connections. While the large exposures data do not give a complete picture on the direct connections between banks and other institutions, they do highlight exposures which, due to their size relative to capital, pose a risk to the bank. Large exposures are defined relative to capital, so the widespread increase in capital levels since the crisis will also reduce the number of reported large exposures, all else being equal.

There are two ways of analysing the bilateral exposures data. The first is to consider only the large exposures (i.e. any exposure greater than 10 per cent of that institution's capital). This has the benefit of consistency across banks as all banks report large exposures. The Irish banks reported €223 billion of large exposures as at June 2015, which compares to around €480 billion in total assets for the same banks. Section 3.1 considers the large exposures and describes these data. The second approach is to consider all the reported data, which includes large exposures and other reported exposures by consolidated-reporting banks, as is used in section 3.2 for the network analysis. This has the benefit of greater coverage of exposures, but is not consistent as the number of credit exposures a bank has could be driven by its reporting requirements. While there are a large number of additional exposures captured under the second approach (383 compared to 228 large exposures), the value of the additional exposures is proportionally smaller, at €31 billion. Thus, from this particular dataset, there is coverage of around half of banks' assets. Considering approximately a third of the banks' assets are in mortgages to households, this constitutes a reasonable coverage of bilateral exposures.

3.1 Banks' bilateral large exposures

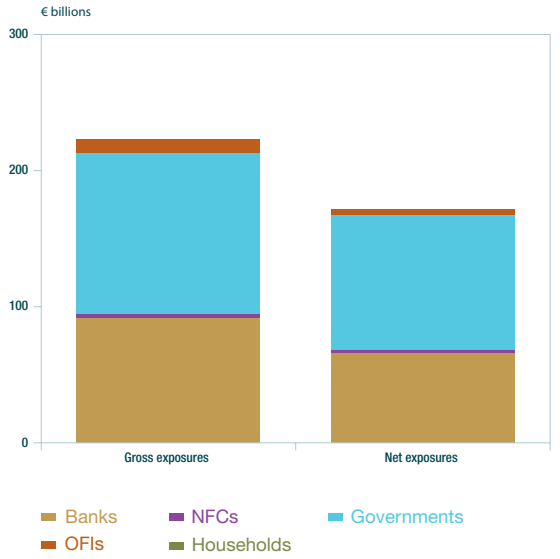
Data as at June 2015

The Irish banks reported €223 billion of large exposures as at June 2015 on a gross basis and €171 billion on a net basis (Chart 1), where net exposures refer to gross exposures after eligible credit risk mitigation (CRM).[5] Of these, large exposures are primarily to sovereigns, at over 50 (60) per cent of gross (net) exposures. Exposures to other credit institutions are also common, with around 40 per cent of gross and net exposures to this sector. Less than 5 per cent of exposures are to financial corporations other than credit institutions (OFIs). As can be seen from Charts 2 and 3, sovereign large exposures are dominated by exposures to Ireland, with nearly €60 billion of Irish sovereign large exposures as at June 2015, while the interbank large exposures are more diversified with very little Irish exposure (only €50 million at June 2015). Of the interbank large exposures, €26 billion originate from Italian domiciled counterparties, with the US and the UK also featuring in the top five. These countries reflect to a large degree the business models and intragroup connections of foreign subsidiaries located in Ireland. The large exposures return also provides a breakdown of the exposure by instrument type (e.g. debt (which includes debt securities and loans and advances), equity, derivatives, loan commitments, guarantees, etc.) and by whether it is on or off-balance-sheet. For the Irish banking system, 85 per cent of the interbank large exposures are in the form of debt instruments (Chart 4).

4 For more detail see: http://www.centralbank.ie/regulation/industry-sectors/insurance-companies/solvency2/Pages/default.aspx

5 CRM techniques may have three different effects in the large exposures regime: Substitution effect; funded credit protection other than substitution effect; and real estate treatment.

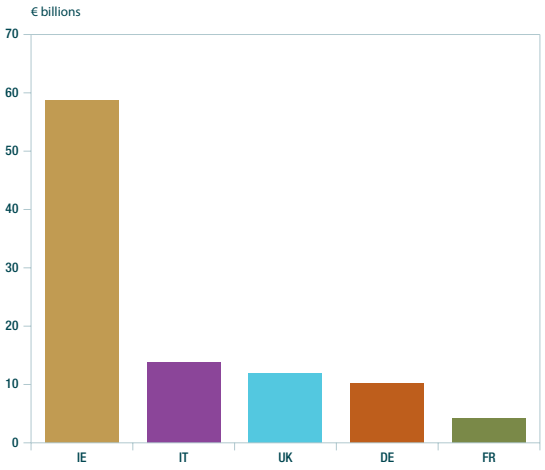
Chart 1: Gross and net reported bilateral large exposures by sector



Source: Central Bank data as at June 2015.

Note: Large exposures refer to exposures greater than 10 per cent of a bank's capital.

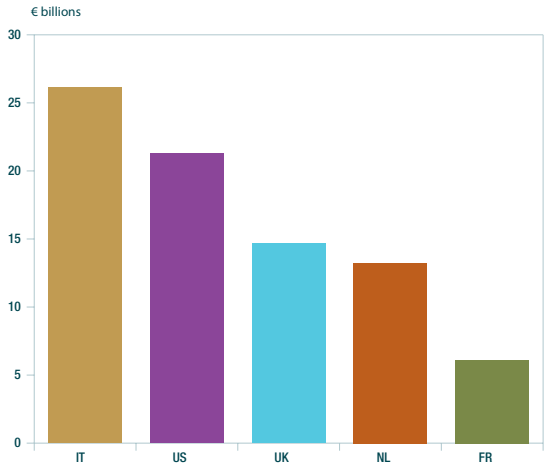
Chart 2: Gross sovereign large exposures by country of counterparty – top 5



Source: Central Bank data as at June 2015.

Note: Large exposures refer to exposures greater than 10 per cent of a bank's capital.

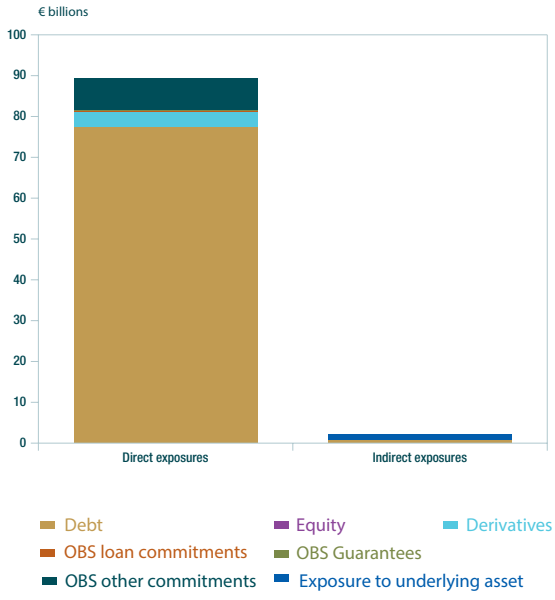
Chart 3: Gross interbank large exposures by country of counterparty – top 5



Source: Central Bank data as at June 2015.

Note: Large exposures refer to exposures greater than 10 per cent of a bank's capital.

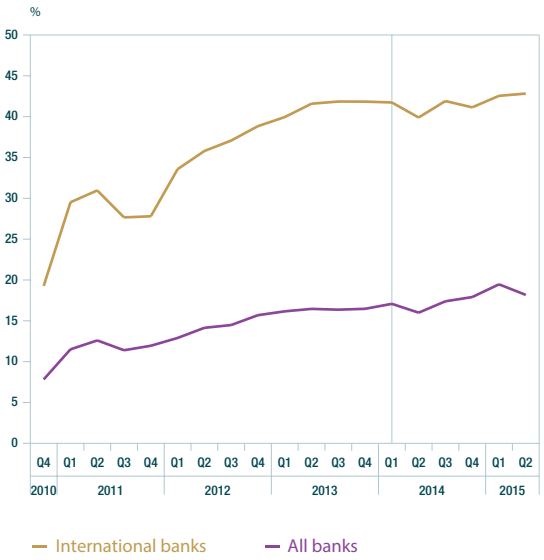
Chart 4: Breakdown by instrument for gross interbank large exposures



Source: Central Bank data as at June 2015.

Notes: Large exposures refer to exposures greater than 10 per cent of a bank's capital. Debt instruments include debt securities and loans and advances. OBS refers to off-balance sheet exposures.

Chart 5: Gross interbank large exposures relative to total assets (% assets)



Source: Central Bank data as at June 2015.

Notes: Data are for a continuous sample of banks. Line indicates data change from Q1 2014.

Chart 6: Net interbank large exposures after exemptions relative to total assets (% assets)

Source: Central Bank data as at June 2015.

Notes: Data are for a continuous sample of banks. Line indicates data change from Q1 2014.

Data over time

It is also useful to consider the behaviour of these exposures over time. Reported interbank large exposures for the Irish banks tend to be volatile, partly due to swings in intragroup lending by the international banks. One way of smoothing for these factors is compare the figures to total assets of the banks to take into account deleveraging over the period, and to look at the net large exposures after exemptions, as intragroup transactions are largely exempt under the large exposures regime. Gross interbank large exposures amounted to 18 per cent of total assets at June 2015, having increased from 12 per cent in 2011 (Chart 5). Internationally-focussed foreign-owned banks have a much higher proportion of interbank large exposures at 43 per cent and are consistently higher over the time period. This reflects high levels of intragroup transactions. As intragroup lending is exempted in the large exposures regime, the net interbank large exposures after exemptions give an indication of the magnitude of intragroup transactions.[6] After intragroup and other exempted exposures are removed, interbank large exposures for the internationally-focussed banks comprised only 2.2 per cent of total assets, compared to 1.5 per cent for all banks, and the difference between the two has fallen in recent quarters (Chart 6).

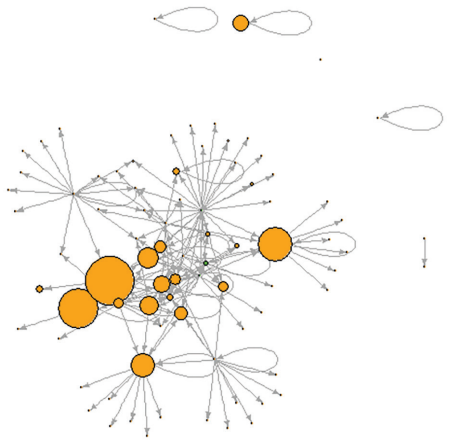
3.2 Interbank connections as a network

There are many different types of financial networks and these networks can vary according to asset class. For example, the network of derivative connections looks very different to the network of interbank lending. The large exposures data represent the network of credit exposures of the Irish-authorised banks.[7] The nodes here represent banks and the links between banks, known as edges, represent a credit exposure from bank A to bank B. This network is known as a directed network, i.e. the links go in one specific direction and a link going from A to B is different from a link going from B to A. As the

6 Other factors are also behind the change between gross exposures and net exposures after exemptions, including collateral held. However, exempted exposures are the biggest driver in the difference between the two.

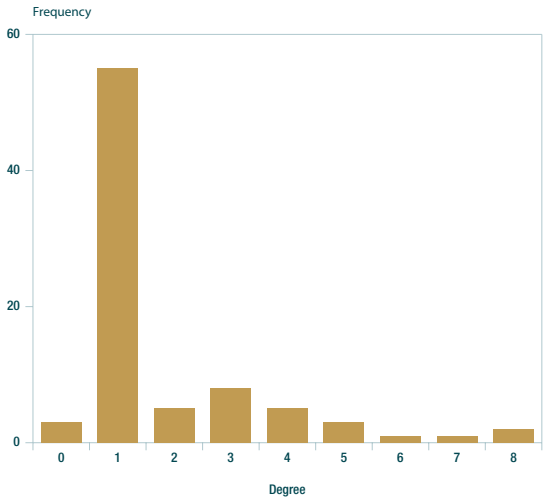
7 This is only a partial network as not all interbank credit exposures are reported for all banks.

Chart 7: Gross bilateral interbank exposures of the Irish banks



Source: Central Bank data and calculations as at June 2015.
Notes: Node size represents the sum of all exposures to that bank. The largest gross exposure is €14bn.

Chart 8: Histogram of in-degree



Source: Central Bank data and calculations as at June 2015.

number of edges from a bank is driven partly by its reporting requirements as discussed in Section 2, it is the number of edges to a bank which are of most interest.[8]

The first step in analysing the structure of a network is to visualise it. Chart 7 shows this network for all gross credit exposures between banks, with the size of the node representing the sum of all exposures to that bank. From simply looking at this network, we can see that it is relatively sparse, with some nodes which are not connected to other nodes. This could reflect the diversified nature of the Irish financial system. However, it is important to note that these data reflect only one side of the interbank transactions – the asset side - and we do not know what the exposures of non-Irish domiciled banks are back to these institutions. For this reason, this does not show the full level of interconnectedness but does give us a picture of the credit linkages.

Network analysis allows us to go further than just the visualisation of networks, and there are a wide range of measures and metrics which can be used to understand the data further. One simple metric is the degree of a node, which is the number of edges attached to it. As this is a directed network, the in-degree of a node shows how many banks are exposed to that node / bank and the out-degree shows how many credit exposures a bank has. For this network, the in-degree is of most interest, as the out-degree is driven by the reporting requirements of a given institution. The distribution of the in-degree is shown in Chart 8. This shows that the majority of banks are the recipient of one credit exposure from other banks, with the mean in-degree just under 2. However, there are some banks which are more connected. The maximum in-degree is 8 and this occurs twice, i.e. there are 2 banks which are connected to 8 other banks in the sample. This is a property of many networks (as discussed in Section 1), which often contain a small but significant number of nodes with much higher degree than others. In financial networks, such hubs can indicate systemically important institutions which play a central role in certain markets. Macroprudential policy recognises the importance of these nodes through the global systemically important institutions (G-SII) framework, which identifies these important institutions and requires them to hold additional capital in

8 This is because different types of banks must report different levels of detail in the large exposures return.

recognition of the greater impact the failure one of these institutions would have. The 5 highest connected banks in the Irish interbank credit network of June 2015 were all identified as G-SIIs at this time.

Another important concept in networks is that of distance. Some banks are isolated and not connected to others, as can be seen in Chart 7. For the banks which are connected, the diameter of the network or the 'longest shortest path' in the network is 6. This means that there are a maximum of 6 connections from one bank to any other bank that is connected to that network.

In summary, an examination of the network of interbank credit exposures using the available data shows that this network is relatively sparse, with just a few key hubs, the most connected of which are large international institutions, as at June 2015. At this date, a maximum of 6 connections from one bank to any other bank are observed. However, this network neither captures all credit exposures nor captures any funding exposures. The literature highlights the need for complete datasets and the difference in network properties across different markets.

4. Asset and liability concentration

Analysing direct counterparty credit exposures of the Irish banks is only one method for looking at the interconnectedness of the sector. As discussed earlier, indirect interconnectedness can arise from a concentration of common exposures, arising from similar business models or regulatory factors, or from other factors such as fire sales and contagion (Arregui et al., 2013). The Irish experience in the lead-up to the crash testifies to this, as the main domestic banks all increased their exposure to the real estate sector to generate returns in the pre-crisis period, resulting in a similar profile of credit risk across the system. These exposures take a long time to unwind and asset concentration was further increased by the deleveraging programme for non-core assets which the banks had to undertake as part of the PCAR 2011.[9] Concentration of funding sources is another potential source of systemic risk and this was also evident in Ireland as banks expanded their loan books using cheap wholesale funding. As well as further fuelling the asset bubble, this resulted in a similar profile of funding risk for the Irish banks.

Common exposures can be examined using regulatory data and can be considered on both the asset and liability side of the balance sheet. It is interesting to look at this for both domestically-focussed institutions[10] and for the internationally-focussed, other foreign-owned resident banks[11] in Ireland. Total assets of the former were €305 billion and of the latter were €176 billion as at June 2015. While the domestically-focussed institutions' business models are focussed on the Irish retail and corporate sectors, the internationally-focussed foreign-owned institutions have a range of different business models.

Given the importance of the domestic banks' asset and liability profiles, these are regularly discussed in the Central Bank's biannual Macro-Financial Review[12] and are monitored by the Central Bank on an on-going basis. The risks to individual banks arising from common exposures are assessed through on-going supervision and addressed through supervisory measures such as credit concentration risk capital charges and liquidity requirements.

4.1 Asset concentration

Asset concentration can be on the basis of type of counterparty, type of exposure, or country of exposure. Banks' asset positions are dominated by loans and advances, which represent about two thirds of their assets. The following analysis considers the breakdown

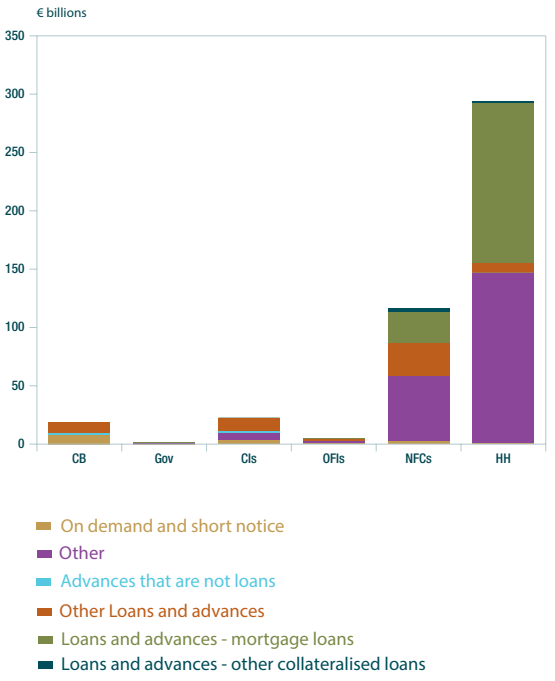
9 For more detail see: http://www.centralbank.ie/regulation/industry-sectors/credit-institutions/documents/the%20financial%20measures%20programme%20report.pdf

10 The domestically-focussed banks are AIB, BOI, PTSB, Ulster Bank Ireland and KBC Bank Ireland.

11 This includes all non-domestically focussed foreign-owned resident banks authorised in Ireland.

12 http://www.centralbank.ie/publications/Pages/MacroFinancialReviews.aspx

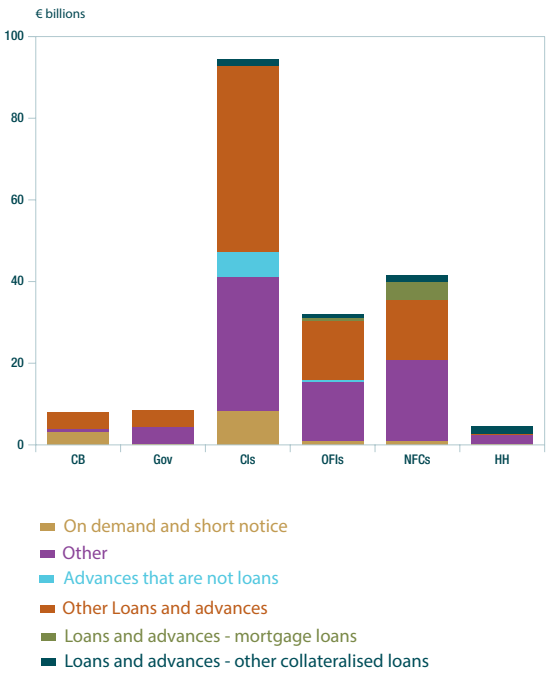
Chart 9: Loans and advances by product and counterparty type for the domestically-focussed banks



Source: Central Bank data as at June 2015.

Notes: CB = Central Bank, CIs = credit institutions, OFIs = other financial corporations, NFCs = non-financial corporates, HH = households. Other includes credit card debt, trade receivables, finance leases, debit balances with contractually fixed maturities or terms that are not included in other items.

Chart 10: Loans and advances by product and counterparty type for the internationally-focussed banks



Source: Central Bank data as at June 2015.

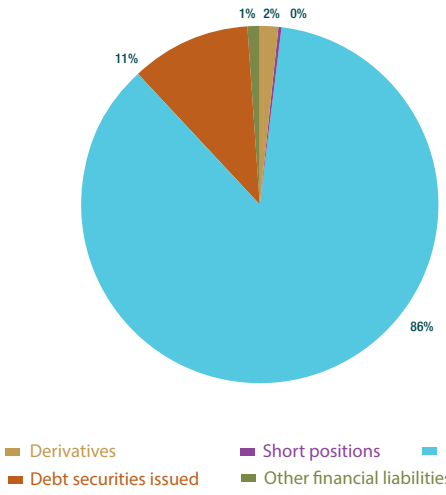
Notes: CB = Central Bank, CIs = credit institutions, OFIs = other financial corporations, NFCs = non-financial corporates, HH = households. Other includes credit card debt, trade receivables, finance leases, debit balances with contractually fixed maturities or terms that are not included in other items.

of loans by counterparty type.[13] The same analysis on banks' financial assets shows similar trends. Chart 9 shows the breakdown of the loan books of the domestically-focussed banks by product and by counterparty type. These banks are heavily exposed to the household sector, which accounts for two thirds of exposures. One third of overall exposures at June 2015 were mortgage loans to households and a further 30 per cent were 'other' loans to households. Non-financial corporates (NFCs) account for a further quarter of exposures as at June 2015. This concentration of loans in mortgages, consumer and NFC lending is not a surprise and reflects the post-crisis business models of the domestically-focussed banks. Chart 10 shows this breakdown for the internationally-focussed (foreign-owned resident) banks and shows a very different asset profile. These banks have negligible exposures to households and much higher exposures to other banks, with over half of all loans and advances extended to other credit institutions and a further 17 per cent to OFIs. Thus, a simple analysis of counterparty exposures on the asset side would imply that internationally-focussed banks are more interconnected with the financial system than the domestically-focussed banks. These data do not distinguish whether the exposures to credit institutions are intragroup transactions.

Regulatory data also allow for an examination of the breakdown of lending to NFCs by economic sectors. Domestically-focussed banks had total NFC loans of €64 billion and internationally-focussed €32 billion at June 2015. Almost half of lending by the domestically-focussed banks to NFCs is to the construction and real estate sectors. This sector is also a large component of internationally-focussed banks' exposures (around a third of lending), although the euro amount is much lower given the smaller overall NFC loan book. The internationally-focussed banks have higher concentration of lending in

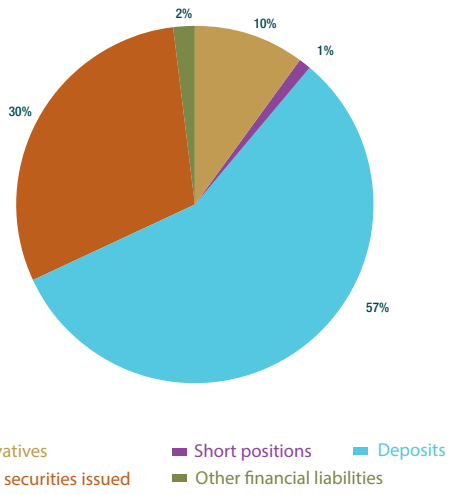
13 See https://www.eba.europa.eu/documents/10180/359626/Annex+V_Instructions_FINREP.docx/26727402-6339-4c33-bb5a-d8e659c27371 for definitions of each counterparty type.

Chart 11: Domestic banks - breakdown of financial liabilities



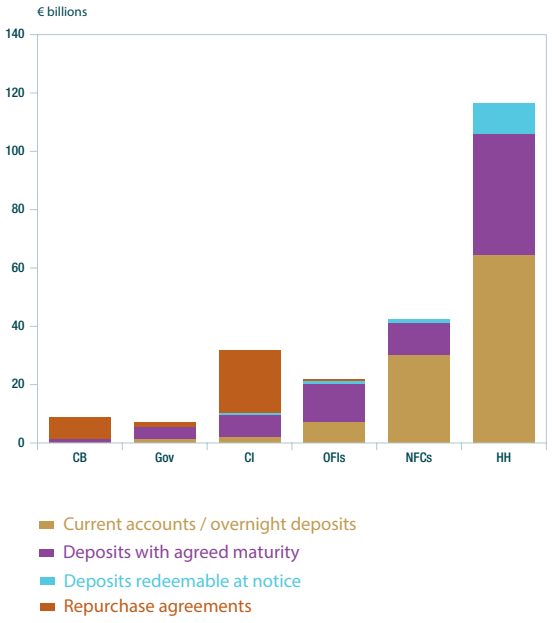
Source: Central Bank data as at June 2015.

Chart 12: Internationally-focussed banks - breakdown of financial liabilities



Source: Central Bank data as at June 2015.

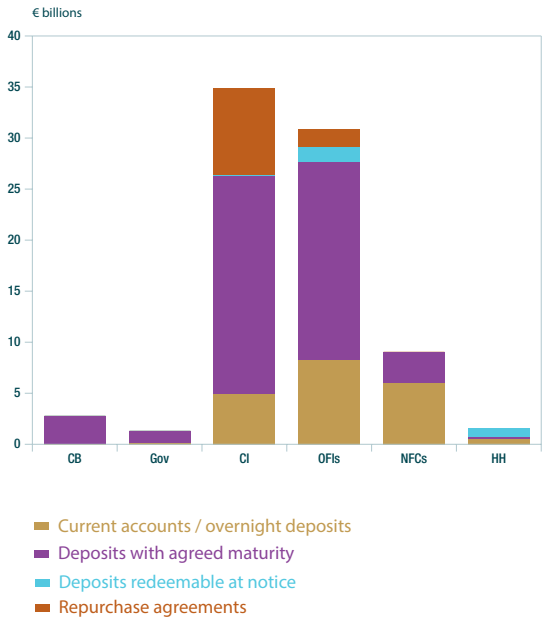
Chart 13: Domestic banks: breakdown of deposit liabilities by product and by counterparty sector



Source: Central Bank data as at June 2015.

Notes: CB = Central Bank, CIs = credit institutions, OFIs = other financial corporations, NFCs = non-financial corporates, HH = households. Other includes credit card debt, trade receivables, finance leases, debit balances with contractually fixed maturities or terms that are not included in other items.

Chart 14: Internationally-focussed banks: breakdown of deposit liabilities by product and by counterparty



Source: Central Bank data as at June 2015.

Notes: CB = Central Bank, CIs = credit institutions, OFIs = other financial corporations, NFCs = non-financial corporates, HH = households. Other includes credit card debt, trade receivables, finance leases, debit balances with contractually fixed maturities or terms that are not included in other items.

Chart 15: Gross OFI exposures of the Irish banks

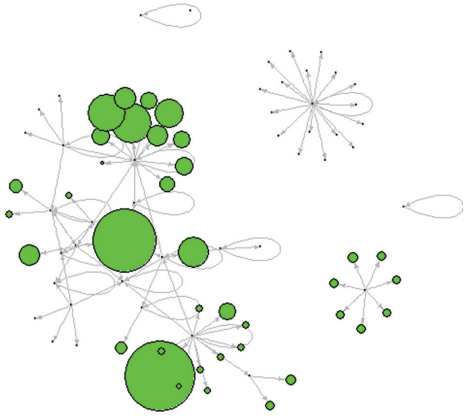
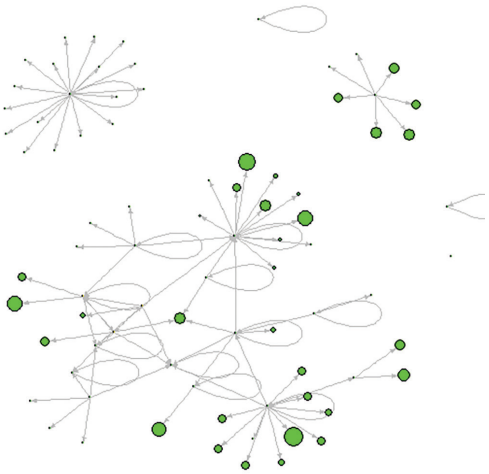


Chart 16: Net OFI exposures of the Irish banks



Source: Central Bank data and calculations as at June 2015.
Notes: Node size represents the sum of all exposures to that OFI and nodes are scaled by the same factor in both charts. Largest gross exposure is €1.8bn (€0.01bn net for the same exposure).

the manufacturing and other services sectors (21 per cent and 27 per cent respectively compared to 8 per cent and 12 per cent for the domestically-focussed banks). While the pre-crisis risk profile of the Irish banking sector has changed in many and significant ways, these banks are still highly exposed to common risks in the real estate market, particularly the domestically-focussed banks.

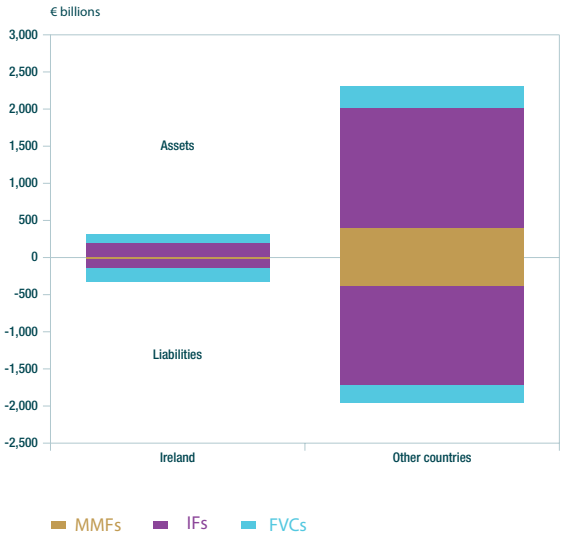
4.2 Liability concentration

Regulatory data also allow for a detailed examination of the sources of banks' funding, which has been an important area of focus for banking supervisors since the crisis. Charts 11 and 12 illustrate the reliance of the Irish banking system on deposit funding, in particular the domestically-focussed banks. Deposits comprised 86 per cent of domestic banks' financial liabilities and 57 per cent of internationally-focussed banks at June 2015. This warrants further exploration and charts 13 and 14 show the breakdown of deposit liabilities by type of deposit and by counterparty. Similar to the asset side of the balance sheet, there is a clear difference between the domestically-focussed banks and the internationally-focussed banks, with the domestically-focussed banks' deposit funding primarily from households and corporates with only 14 per cent from other banks. In contrast, the majority of the internationally-focussed banks' deposit funding comes from other credit institutions and OFIs (over 80 per cent together). In addition, debt securities comprise almost a third of internationally-focussed banks' funding and only 11 per cent of the domestic banks' (Charts 11 and 12). This further illustrates the higher level of interconnectedness of the internationally-focussed foreign-owned banks with the financial system compared to the domestic banks, whose interconnectedness is perhaps more indirect and as a result of a high level of common exposures, particularly to the household, NFC, and real estate sectors.

5. Interconnectedness with other financial institutions

It is also possible to use the banking regulatory data to look at the network between the Irish credit institutions and financial corporations other than credit institutions (OFIs) (Charts 15 and 16). This network is sparser than the interbank network, gross exposures tend to be much smaller, and there is higher credit risk

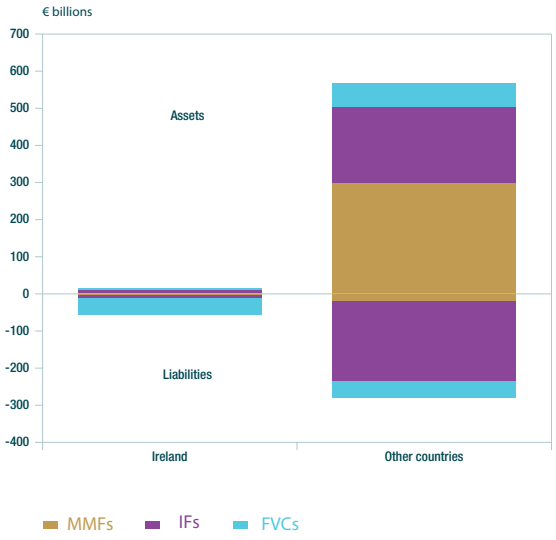
Chart 17: Asset and liability breakdown of MMFs, IFs, and FVCs for Ireland and for all other countries



Source: Central Bank data as at June 2015.

Note: MMFs = money market funds,
IFs = investment funds, and
FVCs = financial vehicle corporations

Chart 18: Asset and liability breakdown of exposure to banks of MMFs, IFs, and FVCs for Ireland and for all other countries



Source: Central Bank data as at June 2015.

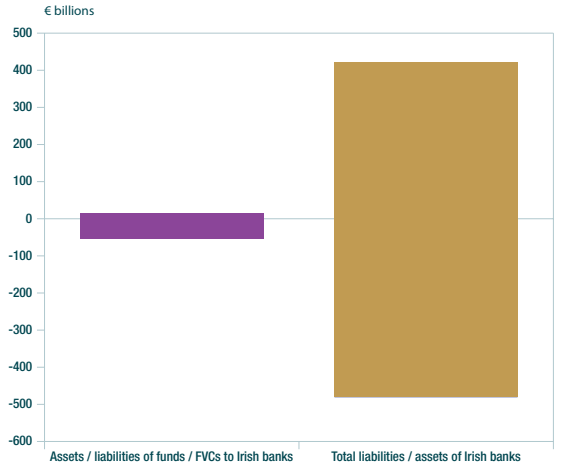
Note: MMFs = money market funds,
IFs = investment funds, and
FVCs = financial vehicle corporations

mitigation. However, it is not possible to draw any meaningful conclusions from this network as we do not have information regarding connections between these OFIs or the connections from OFIs to the banks.

The banking regulatory data can be supplemented with data from other financial sectors to give a more complete picture of the interconnectedness of the Irish banking sector. Chart 17 shows the breakdown of the assets and liabilities of the Irish resident funds (including MMFs) and FVCs (which are one component of the OFI sector) by Irish and all other country exposures. These entities are not heavily exposed to Ireland, with only around 10 per cent of assets / liabilities in the domestic economy. These asset exposures are largely accounted for by cross-share/unit holdings in other Irish resident funds or FVCs and deposits with foreign-owned resident banks or other funds. When looking at the holdings of these entities in the banking sector, Irish banks comprise a small proportion of overall banking sector exposures with only 2 per cent of banking sector assets located in Ireland and 17 per cent of liabilities (Chart 18). The higher Irish liability exposure is due to retained securitisations of some of the Irish banks, which come under the FVC reporting, while within funds the liability exposure to Irish banks may partly reflect foreign-owned resident bank nominee accounts on behalf of clients. FVCs hold very little Irish banking sector assets (approximately €4 billion at this date). MMFs have very little Irish banking sector asset / liabilities and IFs hold about €10 billion assets and liabilities.

As the funds / FVC sector in Ireland is quite large, it is also useful to consider these numbers relative to the size of the Irish banking sector. Chart 19 shows the exposure of these entities to the Irish banking sector for both assets and liabilities, comparing this to the total liabilities / assets of the Irish banking sector. Comparing the liabilities of these entities to the assets of the Irish banking sector gives an indication of how much exposure the banks have to the Irish funds / FVC sector. These entities have a combined asset holding in Irish banks of nearly €15 billion compared to a total liability position of the banking sector of €420 billion. The funds / FVCs have a combined liability position of €55 billion to the Irish banking sector compared to total assets of €480 billion for the sector.

Chart 19: Asset / liability exposure of funds / FVCs to Irish banks compared to the total liability / assets of the Irish banks



Source: Central Bank data as at June 2015.

Note: MMFs = money market funds,
IFs = investment funds, and
FVCs = financial vehicle corporations

The examination of the reporting data of the Irish resident funds and FVCs for information on Irish banking sector interconnectedness shows only a moderate amount of exposure of these OFIs to the Irish banks and at least part of this exposure reflects deposits or nominee accounts on behalf of clients. This is an interesting finding when considering the interconnectedness of the Irish banking sector to the global financial system and these data are regularly monitored to track any changes in these positions which could indicate an increase in this interconnectedness. Insurers and SPVs are other components of the OFI sector and, until now, there has been less data available on connections between these institutions and the banking sector. Solvency II data and the extension of Central Bank quarterly reporting requirements to SPVs will increase the data available to analyse interconnectedness of non-banks with the banking sector and will add significantly to our understanding of this area.

6. Conclusion

Interconnectedness in the financial system can have both positive and negative effects and a full understanding of these is important for policymakers. Theoretical evidence suggests that connections can act as shock-absorbers for smaller shocks but for larger shocks, can act as shock-amplifiers. In addition, the level and the distribution of connections are also important. Due to gaps in the data, empirical evidence on the optimal level of interconnectedness is limited. However, there is some evidence that the stability of a country's banking sector is related to its interconnectedness in a non-linear fashion and that after a certain point, the advantages of increased interconnectedness become less clear. In addition, the type of interconnectedness and whether it is on the asset or liability side is also important. Network analysis is a common approach to analysing interconnectedness and studies have shown that national interbank networks tend to have a core-periphery structure, although the strength of this structure varies by asset class.

This paper uses granular and aggregate regulatory data to examine the interconnectedness of the Irish banking system with the global financial system. These data show the importance of assessing interconnectedness for different groups of banks, as the banks with a domestic retail focus have a very different profile of interconnectedness with the global financial sector than the internationally-focussed foreign-owned banks. The domestically-focussed banks' interbank large exposures are much lower than the internationally-focussed banks relative to the size of their assets, at least partly due to the intragroup exposures of the latter. The internationally-focussed banks have a large proportion of their assets and liabilities with other credit institutions, compared to the domestically-focussed banks which are primarily exposed to households

and corporates. Both types of bank have a large proportion of their corporate lending with the real estate and construction sectors and the domestically-focussed banks in particular remain vulnerable to shocks in these sectors.

An examination of the network of interbank credit exposures using the available data shows that this network is relatively sparse, with just a few key hubs, the most connected of which were on the list of global systemically important institutions as at June 2015. However, this network neither captures all credit exposures nor captures any funding exposures. The literature highlights the need for complete datasets and the difference in network properties across different markets.

Banks' interconnectedness with other (non-bank) financial institutions is also examined. Again, internationally-focussed banks are much more exposed to these institutions, both on the asset and liability side. There are not sufficient data to map a meaningful network of interbank and OFI credit exposures. However, an examination of regulatory data from the Irish resident funds shows that these institutions do not have a large exposure to the Irish banking sector, either in terms of their own size or relative to the size of the Irish banking sector. Detailed data on the exposures of the Irish insurance sector and Irish resident SPVs will be available in 2016 and these data will help develop the picture of the interconnectedness of the Irish financial system with the global financial system.

References

Allen, F., and D. Gale (2000), "Financial Contagion," Journal of Political Economy, University of Chicago Press, vol. 108(1), pp. 1–33, February.

Arregui, N., Norat, M. Pancorbo, A., and J. Scarlata (2013), "Addressing interconnectedness: concepts and prudential tools", IMF Working Paper WP/13/199.

Arsov, I., Canetti, E., Kodres, L., and S. Mitra (2013), "Near-Coincident" Indicators of Systemic Stress", IMF Working Paper WP/13/115.

Battiston, S., Gatti, D., Gallegati M., Greenwald, B., and J. E. Stiglitz (2011), "Default Cascades: When Does Risk Diversification Increase Stability?" ETH Risk Centre – Working Paper Series, ETH-RC-11-006

Blancher, N., Mitra, S., Morsy, H., Otani, A., Severo, T., and L. Valderrama (2013), "Systemic Risk Monitoring ("SysMo") Toolkit—A User Guide", IMF Working Paper No. 13/168.

Čihák, M., Muñoz, S., and R. Scuzzarella (2011), "The Bright and the Dark Side of Cross-Border Banking Linkages," IMF Working Paper No. 11/186.

Coates, D., Everett, M., McNeill, J. and A. Moloney (2015), "Interpreting data for Ireland in international banking statistics", Central Bank of Ireland Economic Letter Vol. 2015, No. 1.

ESRB (2013), "The Structure and Resilience of the European Interbank Market", ESRB Occasional Paper Series No. 3/September 2013.

Furfine, C. (1999), "Interbank Exposures: Quantifying the Risk of Contagion", *Working Paper*, No 70, Bank for International Settlements, June.

Gaffney, E. (2016), "Interbank lending and fragmentation during the financial crisis", Central Bank of Ireland, *forthcoming*.

Gai, P. and S. Kapadia (2010), "Contagion in financial networks", *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Science*, 466, 2401–2423.

Gauthier, C., Lehar, A. and Souissi, M. (2010), "Macroprudential Regulation and Systemic Capital Requirements", Bank of Canada Working Paper 2010-4.

Godfrey, B. and B. Golden (2012), "Measuring Shadow Banking in Ireland using Granular Data", Central Bank of Ireland Quarterly Bulletin 04 / October 2012.

Godfrey, B., Killeen, N., and K. Moloney (2015), "Data Gaps and Shadow Banking: Profiling Special Purpose Vehicles' Activities in Ireland", Central Bank of Ireland Quarterly Bulletin 03 / July 2015.

Kenny, O., Killeen, N., and K. Moloney (2015), "Network analysis using EMIR credit default swap data: Micro-level evidence from Irish domiciled special purpose vehicles (SPVs)", IFC Workshop on "Combining micro and macro statistical data for financial stability analysis", December 2015.

Langfield, S., Liu, Z., and O. Tomohiro (2014), "Mapping the UK interbank system", Bank of England Working Paper no. 516.

Minoiu, C. and J. Reyes (2013), "A network analysis of global banking: 1978 – 2010", Journal of Financial Stability 9 (2013) 168 – 184.

Newman, M.E.J. (2010), "Networks: An Introduction", Oxford University Press.

Sachs, A. (2010), "Completeness, interconnectedness and distribution of interbank exposures: A parameterized analysis of the stability of financial networks", Deutsche Bundesbank Discussion Paper No. 08/2010.