Financial system interconnectedness

José Alonso and Patricia Stupariu (*)

(*) José Alonso and Patricia Stupariu belong to the Directorate General for Financial Stability, Regulation and Resolution of the Banco de España.

Abstract

Interconnectedness between financial institutions – banks and other financial agents – is an inherent characteristic of developed financial systems that adds flexibility to investment and to the financing of the economy. However, at times of crisis, it may also contribute to propagating stress through the system. This article presents an overview of interconnectedness in the Spanish financial system, with emphasis on (i) the direct linkages between the different resident financial sectors and with non-resident financial sectors, and (ii) the indirect interconnectedness between resident sectors. The changes in recent years in two measures of interconnectedness are also examined: the degree of portfolio overlap between banks, investment funds, insurance companies and pension funds, and a measure of portfolio similarity based on the correlation coefficient of each sector's holdings. The analysis shows significant cross-border interconnectedness, a growing presence of the non-bank sector in the Spanish financial system overall and significant similarity between certain sectors' portfolios.

1 Introduction

In most developed economies the financial sector is made up of a network of entities with different corporate structures and subject to different regulatory regimes but which in some cases pursue similar activities. Within the financial sector, banks tend to be the most relevant agents. Yet other agents also pursue key activities and, in some cases, provide other economic agents with financing similarly to the way banks do.

Non-bank financing is an alternative to bank financing that fosters competition and broadens sources of funding. The existence of alternative financing sources offers economic agents greater flexibility for securing funds for investment or consumption and can further diversify the risks assumed by the financial system.

However, as the non-bank sector expands worldwide and becomes increasingly involved in activities traditionally belonging to the banking sector (liquidity or maturity transformation, imperfect transfer of credit risk, or leveraging), it may become a source of risk, either directly or as the result of its interconnectedness with the banking sector. Moreover, the increase in banking regulation has prompted doubts as to the extent to which growing regulatory pressure may be driving activity towards less regulated environments. Questions about this possible regulatory

arbitrage have arisen, even though most of the non-bank sector is subject to regulatory frameworks designed to address some of the most relevant risks they are exposed to. From this starting point, in recent years work has been undertaken at the international level in order to get a more accurate mapping of the financial sector and analyse potential risk propagation channels. Analysis of the interconnectedness of the financial sector has been central to this work.

Interconnectedness is a natural development in any mature financial system. It allows financing to flow from areas where savings build up to others that seek funding, thus ensuring credit supply to the real economy. It also provides for diversification and risk-sharing between agents. Yet as was observed in the last great financial crisis, imbalances or shocks in one sector (or specific group of entities within one sector) can pass through to the rest of the financial system. The longer and more complex the credit intermediation chains, the greater this risk of contagion may be, since it is more difficult to take measures if there is little information available regarding these links. The interlinkages embedded in the financial system architecture could turn even relatively small subsectors into sources of systemic risk.

After the outbreak of the crisis, various international bodies began working on improving monitoring and analysis of these risks and also the regulatory framework associated with their assessment and containment. Since 2011 the Financial Stability Board (FSB) has been publishing annual reports – the *Global Monitoring Report on Non-Bank Financial Intermediation* (previously, the *Global Shadow Banking Monitoring Report)* – that include a section on interconnectedness among financial sectors, a relevant indicator of potential contagion risk. The report also has thematic sections that have analysed specific aspects of interconnectedness in certain jurisdictions in greater depth.[1]

At the European level, since 2016 the European Systemic Risk Board (ESRB) has published an annual report – the *EU Non-bank Financial Intermediation Risk Monitor* (previously, the *EU Shadow Banking Monitor)* – that also analyses interconnectedness and the risk of contagion across financial sectors. This report has likewise included specific analysis of interconnectedness within the non-bank sector.[2] In addition, the European Central Bank (ECB) has included analysis of interconnectedness in the financial sector in its *Financial Stability Review.*[3]

---

1 See, for example, the box on interconnectedness in Brazil (p. 41 of the 2017 report, published in March 2018), or the box on indirect interconnectedness in the euro area (p. 36 of the 2018 report, published in February 2019).

2 See, for example, Box 2 in the 2018 report (published in September 2018) on Irish non-securitisation special purpose entities, or Box 2 in the 2017 report (published in May 2017) on EU banks' exposures to shadow banking entities.

3 See, for example, section 3.2 of the ECB's *Financial Stability Review* of November 2018, especially Chart 3.24 and related paragraphs.

Moreover, some sections of the regulatory reforms of recent years have addressed the risks generated through interconnectedness: from the measures introduced to strengthen the regulatory frameworks for money market funds or securitisations to the steps taken to mitigate risks in the securities lending markets, or the sections of Basel III that limit certain types of exposures.

For the more in-depth analysis carried out in this article we will use the standard classifications developed by the previously mentioned work on interconnectedness, which tends to distinguish between two types:

— Direct interconnectedness, where two entities are direct counterparties through debt instruments, shares or other contractual relationships. In general, analysis of these interlinkages focuses on cross-holdings: instruments issued by one financial institution and held by another financial institution belonging to the same or a different financial sector.

— Indirect interconnectedness, where financial institutions hold common exposures to certain sectors, markets or instruments, form part of the same collateral chains, belong to the same corporate groups, or are exposed to reputational risk owing to financial support provided to subsidiaries or similar entities aside of contractual relationships (step-in-risk).

2 Developments in the resident financial system

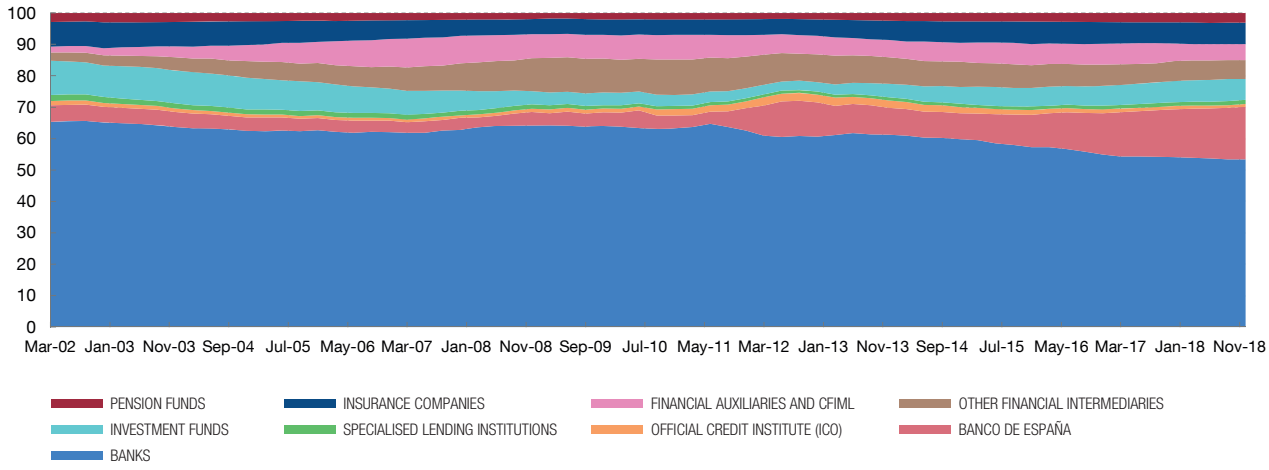
In Spain, the financial system's total financial assets amounted to €4.5 trillion in December 2018. According to FSB published data, at December 2017 the Spanish financial system accounted for 6% of the euro area's financial system. In Spain, the banking sector is the main component of the financial system, with a larger share than in other developed economies. As Chart 1 shows, at December 2018 the banking sector held 53% of the financial assets of the financial system.[4] Within the non-bank sector (which holds 29% of financial assets), the largest subsectors in Spain are insurance companies (7%), investment funds (6%) and Other Financial Intermediaries (6%).[5]

4 According to the FSB's "Global Monitoring Report on Non-Bank Financial Intermediation 2018", at December 2017 the share of the banking sector in Spain (55%) was much higher than in other developed economies such as Luxembourg (5%), Ireland (11%), the Netherlands (21%), the United States (24%), Switzerland (37%), the United Kingdom (48%), Italy (49%) or Japan (49%) and was similar to that in others such as Germany (53%) or France (55%).

5 The Other Financial Intermediaries category comprises securities dealers, asset securitisation special purpose vehicles (SPVs), venture capital companies, bank asset funds, central counterparties and asset management companies (sector S.125 in National Financial Accounts nomenclature).

Chart 1

COMPOSITION OF THE SPANISH FINANCIAL SYSTEM (% OF FINANCIAL ASSETS)



SOURCE: *Financial Accounts of the Spanish Economy* (July 2019) - Banco de España.
NOTE: Captive financial institutions and money lenders (CFIML) is sector S.127 of the Financial Accounts. It comprises holding companies holding shares of financial and non-financial corporations controlled by non-residents and residents (if they have decision-making autonomy), special purpose entities (SPEs) and companies issuing preference debt instruments and the like.

Chart 1 also shows how the weight of banks in the financial sector has declined since 2011 (when it stood at 65%). This is due to the decrease in banks' assets (chiefly owing to the decline in credit), but also to other factors such as the effects of the accommodative monetary policy that has given a significant boost to financial assets held by the Banco de España (17% at end-2018 compared with 4% in 2011).

While in the global financial system the non-bank sector has grown continuously since 2011,[6] in Spain its share has remained steady around 30%. Yet its composition has changed: investment funds have grown (after losing relevance during the crisis) and also insurance companies, albeit to a lesser extent, while Other Financial Intermediaries, which in 2011 accounted for 11% of the financial system, have declined (owing, for example, to the decline in securitisation SPVs).

Following on from the work started by the Banco de España in its Spring 2019 *Financial Stability Report,* this article seeks to analyse interconnectedness in the Spanish financial sector in greater depth. The analysis will draw on National Financial Accounts data to describe direct interconnectedness. It will also draw on Securities Holdings Statistics by Sector (SHSS)[7] data to obtain a greater

6 According to the FSB's Global Monitoring Report on Non-Bank Financial Intermediation 2018, the share of non-bank intermediaries in the financial sector in the 29 jurisdictions that participated in the exercise rose from 45% in December 2011 to 49% in December 2017.

7 This database contains granular data on the portfolio composition of the different euro area financial sectors. It is managed by the ECB, which centralises data received from the national competent authorities (NCAs). For more information, see section 3.3.

breakdown of these direct linkages and explore the indirect interconnectedness resulting from portfolio overlap.

3 Direct interconnectedness

3.1 Direct interconnectedness between resident financial sectors

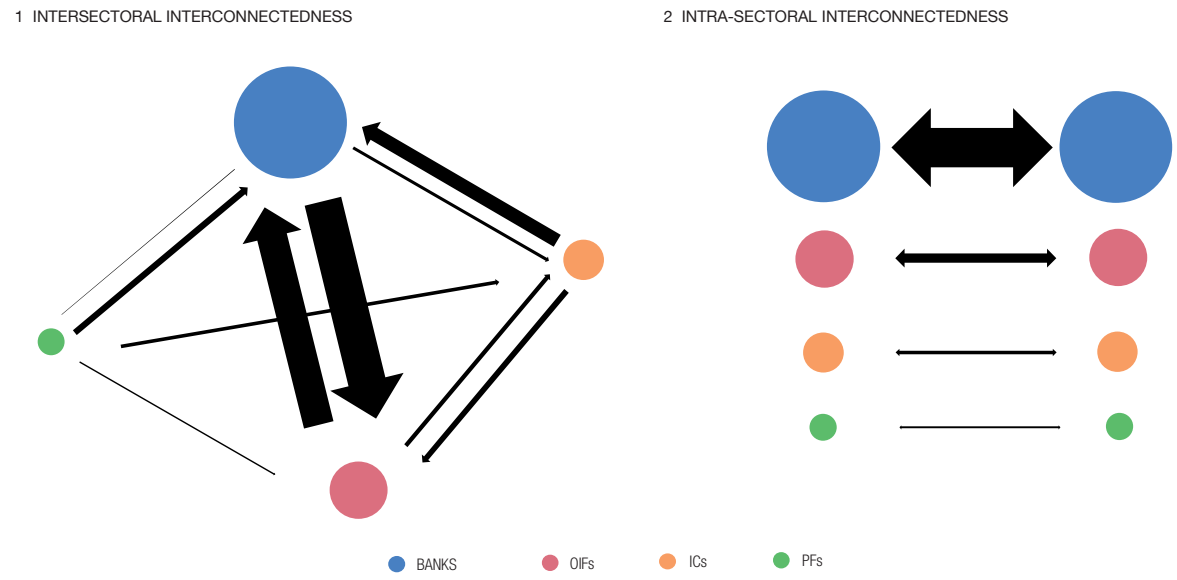
In Spain, banks play a central role in the activities of the resident financial system. The main interconnectedness between sectors by volume is between banks and Other Financial Institutions (OFIs)[8] (see Figure 1, where the size of the circles is proportional to the size of each sector and the thickness of the arrows to the scale of the interconnectedness (the volume of exposures that each sector holds with the others). Figure 1.1 depicts the direct interconnectedness between the different sectors of the financial system. For instance, banks' exposures to OFIs, which are the largest by volume, amount to approximately €97 billion, while banks' exposures to insurance companies (the smallest by volume) are around €8 billion. Figure 1.2 depicts the intra-sectoral direct interconnectedness (the volume of exposures that entities in each sector hold with others in the same sector). For instance, interconnectedness amounts to €108 billion between resident banks and to €24 billion between resident OFIs.

As the figure shows, the smallest sector – pension funds – is also the least connected sector. Intra-sectoral direct interconnectedness (between different agents in the same sector) is highest between banks (4.3% of their total financial assets), followed by OFIs (3.9%), pension funds (3.5%) and insurance companies (3.1%).

Banks' direct interconnectedness with each of the other sectors accounts for a relatively small share– in no case more than 5% – of banks' financial assets (see Chart 2). This interconnectedness has evolved rather differently from the pattern observed at the global level described in the FSB's reports (growth in interconnectedness in the pre-crisis years followed by decline since 2009). In Spain the level of interconnectedness, for example between banks and OFIs, has remained relatively steady around 5% (for liabilities to OFIs) and 3%-4% (for assets) of bank's financial assets. Just two significant changes are observed: growth in banks' liabilities to OFIs in 2005, which is associated with the entry into force of Circular 4/2004 which placed stricter conditions on derecognition by banks of securitisation-related assets (which increased the volume of loans on banks' balance sheets and, consequently, liabilities to OFIs);

8 Not to be confused with the Other Financial Intermediaries category in the Financial Accounts which, as explained in the note to Figure 1, is just a part of the Other Financial Institutions sector.

Figure 1
DIRECT INTERCONNECTEDNESS IN 2018 Q4



SOURCE: *Financial Accounts of the Spanish Economy* (July 2019) - Banco de España.
NOTE: The abbreviations OFIs, ICs and PFs denote Other Financial Institutions, insurance companies and pension funds, respectively. The OFI category comprises several sectors in the Financial Accounts: Other Financial Intermediaries, specialised lending institutions, investment funds (money market and non-money market funds), financial auxiliaries, and captive financial institutions and money lenders. The 2018 Q4 data on interconnectedness and the change in those data differ somewhat from the figures published in the Spring 2019 *Financial Stability Report* owing to a review of the methodology used.

and growth in 2012 in banks' assets with OFIs, which is associated with the decline in the consolidation of some securitisation SPVs and the creation of Sareb[9] (banks hold a significant amount of debt issued by Sareb).

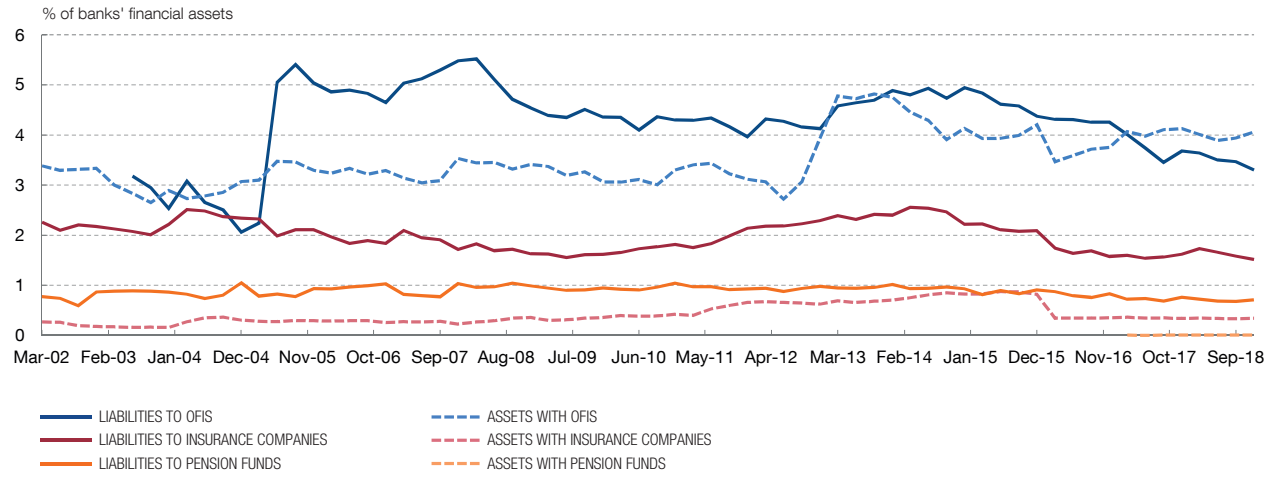
Although the volume of direct interconnectedness appears to be contained at the aggregate level, it may be significant for certain entities. For that reason a more granular analysis is needed that will provide insights on the degree of concentration and the specific characteristics of these linkages.

In a stressed environment, for instance, financing difficulties might arise for banks if other financial sector entities that had acquired bank debt were to experience difficulties and were unable to refinance the debt upon maturity. There could also be problems if the financing granted by banks was concentrated on a specific group of financial or other sector entities, which could trigger a chain of defaults in the event of sector-specific problems. Conversely, in the event of stress in the banking sector, entities reliant on bank lending could lose their access to financing. The consequences of this would be more marked if they were highly interconnected entities, or entities playing a key role in the supply of financing to the real economy.

9 The Spanish asset management company for assets arising from bank restructuring, which belongs to the Other Financial Intermediaries category (S.125 in Financial Accounts nomenclature).

Chart 2

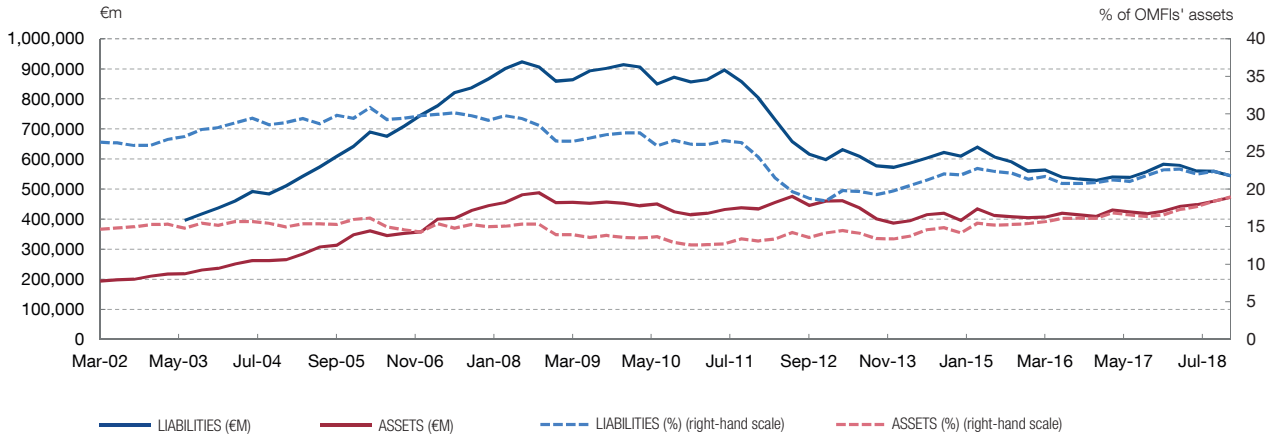
BANKS' INTERCONNECTEDNESS WITH OTHER FINANCIAL SECTORS (% OF BANKS' FINANCIAL ASSETS)



SOURCE: *Financial Accounts of the Spanish Economy* (July 2019) - Banco de España.
NOTE: Data on banks' assets with pension funds available only from 2017.

Chart 3

OMFIs' INTERCONNECTEDNESS WITH THE REST OF THE WORLD



SOURCE: *Financial Accounts of the Spanish Economy* (July 2019) - Banco de España.

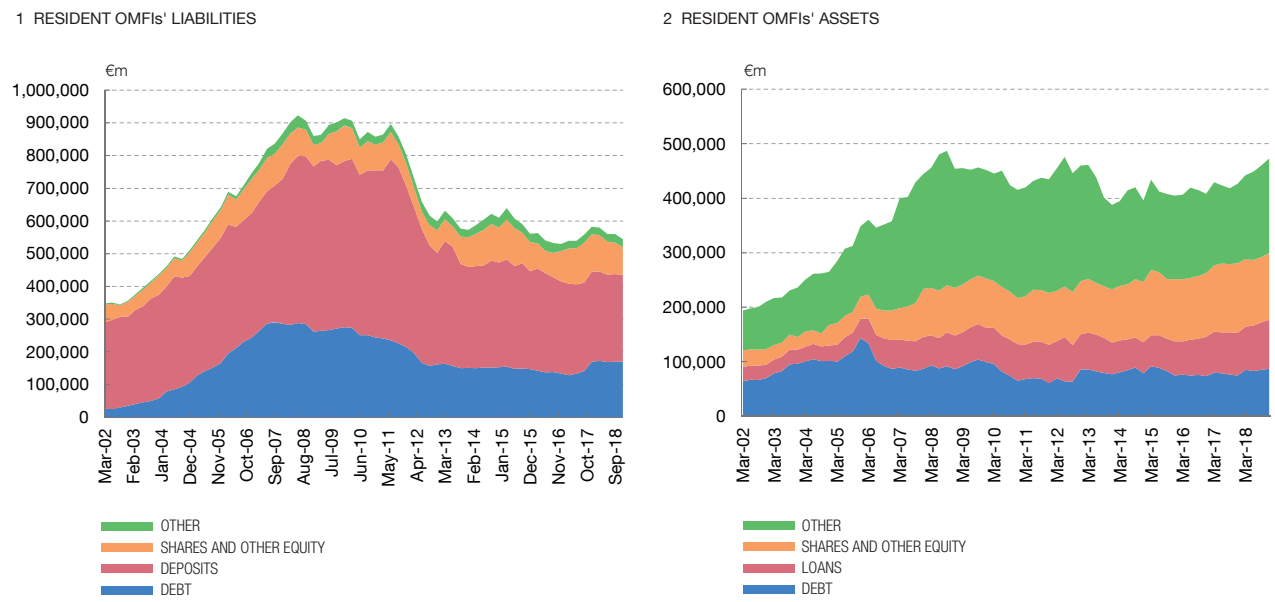
3.2 Exposures to the Rest of the World

Chart 3 depicts the interconnectedness of Other Monetary Financial Institutions (OMFIs)[10] with the rest of the world: claims on and liabilities to financial and non-financial agents of other countries. The lack of more granular data in the Financial Accounts for this broad category and the absence of information on the sector to

10 OMFIs include banks, specialised lending institutions, the Spanish Official Credit Institute (ICO) and money market investment funds.

Chart 4

RESIDENT OMFIs, LIABILITIES TO AND ASSETS WITH THE REST OF THE WORLD, BREAKDOWN BY INSTRUMENT



SOURCE: *Financial Accounts of the Spanish Economy* (July 2019) - Banco de España.

which the counterparties belong make it impossible to distinguish the non-resident sectors with which these linkages are established.

The chart shows how the interconnections between resident OMFIs and agents domiciled in other countries evolved between December 2002 and December 2018. The blue lines depict the change in liabilities by volume (left-hand axis, dark blue line) and as a percentage of their total financial assets (right-hand axis, light blue line). The red lines depict the change in financial assets by volume (left-hand axis, dark red line) and as a percentage of their total financial assets (right-hand axis, light red line).

As the chart shows, while assets with the rest of the world have recorded a more stable trend, liabilities have declined in value since the crisis. Currently, liabilities to the rest of the world account for 22% of OMFIs' total financial assets, while claims on the rest of the world account for 19%. A slight decline is observed in resident OMFIs' liabilities to the rest of the world in the last year and an increase in claims compared with December 2017.

Chart 4 depicts these changes by type of instrument. In this respect, on the liabilities side, deposits from the Rest of the World (49%) stand out, and on the assets side, the Other category (37%) which are mainly Spanish banks' deposits at non-resident entities. These are also the two instrument categories that define the changes observed both in liabilities (a decline in deposits since the crisis) and claims (in this case, also shaped by the growth in shares and investment fund units).

3.3 Available data sources

Direct interconnectedness between resident financial sectors seems relatively limited, but it could entail vulnerability according to the degree of concentration and typology. However, the lack of granularity of the data held in the Financial Accounts impedes more in-depth analysis.

Moreover, the rest of the world data do not permit identification of the foreign financial sectors interconnected with the resident financial sectors. The fact that neither the entities responsible for this interconnectedness nor their nationality can be identified makes it impossible to assess their significance for financial stability or determine which are the relevant transmission channels. These problems are in keeping with those identified by:

1 The FSB, which in its *Assessment of Shadow Banking Activities* prepared for the G20 (July 2017) set out recommendations for addressing data gaps and improving supervision of the non-bank sector. One of the main recommendations was to improve the granularity of the data on cross-border interconnectedness.

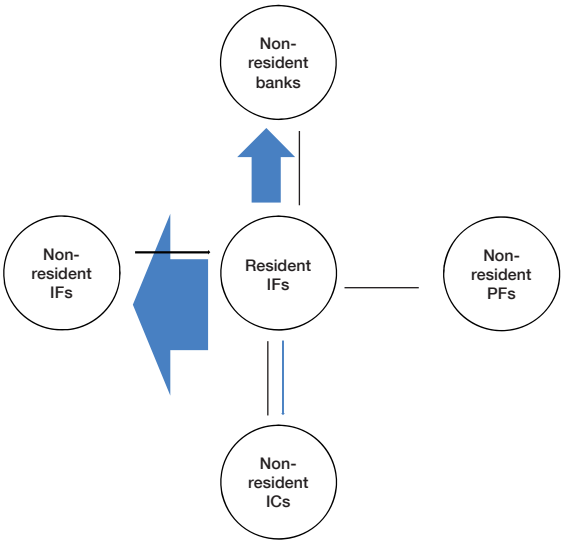
2 The ESRB, which in its annual *EU Non-bank Financial Intermediation Risk Monitor* identifies four key risks or vulnerabilities (see July 2019 report). One of these is always interconnectedness and the risk of contagion across sectors (both at the domestic and the cross-border level). Another is data gaps, with specific mention of the gaps that need to be addressed to better understand interconnectedness and contagion risk.

To solve these problems, other data sources in addition to the Financial Accounts are needed. For this purpose we have explored the SHSS database, which has additional information on types of interconnectedness (instruments) and counterparties (including foreign counterparties). Moreover, as will be seen in the next section, these data permit analysis of indirect interconnectedness. This complements the work on direct interconnectedness, helping to better understand the possible contagion risks and vulnerabilities in the financial sector.

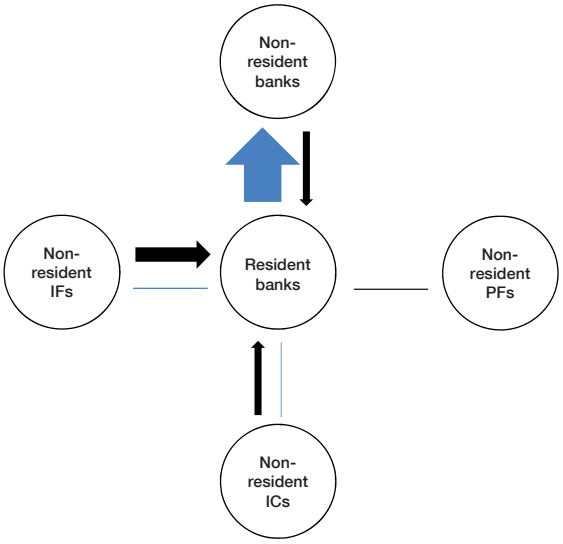
The SHSS database contains granular data, on a security-by-security basis, on euro area financial agents' holdings of securities. It permits identification of almost all holdings at the sectoral level and provides data on a series of key variables associated with each holding (such as instrument type, maturity, country and sector of issuer and holder and market or issue value on each date). The database does not have information on loans granted or deposits held by financial sectors and does not include unlisted equity instruments.

Figure 2
EXPOSURES TO NON-RESIDENT FINANCIAL SECTORS

1 EXPOSURES, RESIDENT INVESTMENT FUNDS



2 EXPOSURES, RESIDENT BANKS



SOURCE: SHSS.
NOTE: The abbreviations IFs, ICs and PFs denote investment funds (money market and non-money market funds), insurance companies and pension funds.

The data provide, among other things, more information on direct interconnectedness, as they include domestic financial sectors' holdings of securities issued by both domestic and foreign financial sectors. Accordingly, they complement the information provided by the Financial Accounts, especially on interconnectedness with Rest of the World financial sectors.

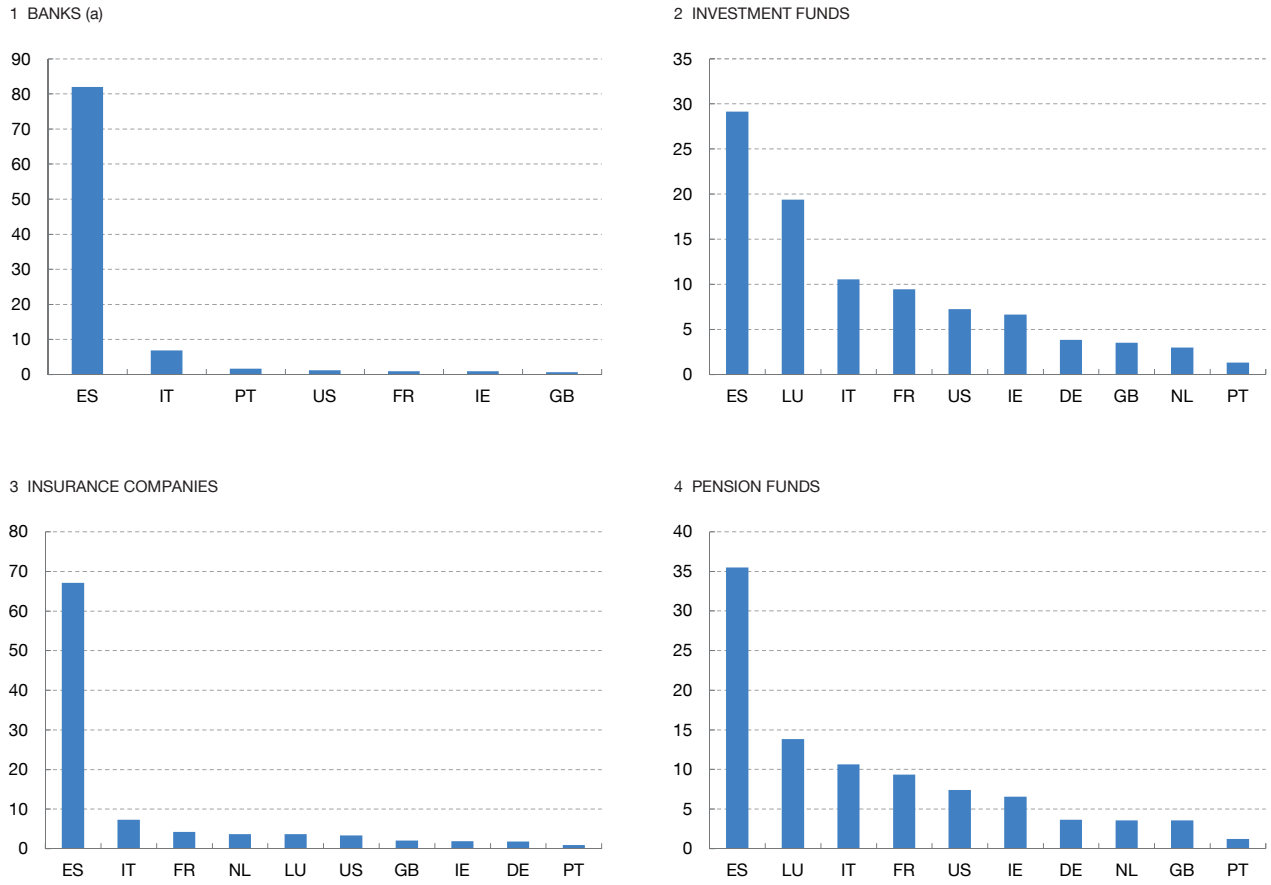
By way of illustration, Figure 2 shows: (i) instruments issued by investment funds and banks domiciled in Spain (their liabilities) and held by foreign financial institutions (black arrows); and (ii) resident funds' and banks' holdings (assets) of instruments issued by non-resident sectors (blue arrows), in both cases at December 2018. The value of the holdings is market value; the thickness of the arrows is proportional to the scale of the interconnectedness (the volume of exposures that each sector holds to the others).

Figure 2.1 depicts the direct interconnectedness between investment funds domiciled in Spain and other sectors of the non-resident financial system. The largest direct cross-border linkages by volume – amounting to €70 billion – are through instruments held by resident investment funds and issued by non-resident investment funds.

Figure 2.2 depicts the direct interconnectedness between banks domiciled in Spain and other sectors of the non-resident financial system. In the case of resident banks,

Chart 5

MAIN ISSUERS OF RESIDENT FINANCIAL SECTORS' HOLDINGS (% OF TOTAL PORTFOLIO)



SOURCE: SHSS.

a Includes own shares (with the information available in the database it is not possible to distinguish issues retained by banks).

the largest linkages in terms of volume – €29 billion – are through their holdings of instruments issued by non-resident banks.

Both figures show that the main direct cross-border linkages are through resident entities' holdings of instruments issued by non-resident entities. However, some significant linkages are also observed in the opposite direction, such as instruments issued by banks domiciled in Spain held by non-resident investment funds.

The SHSS data permit identification of the specific securities in the different sector portfolios, including both the sector and the nationality of each agent. In this respect, Chart 5 shows some of the most significant issuing countries in the portfolios of the four resident financial sectors analysed (banks, investment funds, insurance companies and pension funds), calculated as a percentage of the total portfolios of each of these resident sectors.

As the chart shows, the main issuers of all four sectors' holdings are Spanish. This is especially so in the case of banks (more than 80% of their holdings) and insurance companies (almost 70%). Investment funds are the most diversified sector by issuer country, with issuers from six countries (Spain, Luxembourg, Italy, France, the United States and Ireland) accounting on aggregate for more than 5% of the portfolios. These issuers also have certain features in common by sector: the general government sector is generally a major issuer in Spain or Italy, while investment funds are the main issuers in Luxembourg or Ireland.

4 Indirect interconnectedness

As indicated at the beginning, there may be different types of indirect interconnectedness between financial sectors. For example, they may hold exposures to the same issuers or group of issuers (portfolio overlap), the distribution of securities in their portfolios may be very similar (portfolio correlation), or they may form part of the same collateral chains, belong to the same corporate groups or be exposed to reputational risk owing to financial backing provided aside of contractual relationships. Here we will cover the first two aspects.

4.1 Portfolio overlap

Different financial sectors hold similar securities (issued by financial or non-financial sectors) in their portfolios. These are the common holdings that give rise to what is known as portfolio overlap, which may become a contagion mechanism.[11] For example, in the event of a shock in the investment fund sector, investment funds may need to sell assets that are also held by banks or insurance companies. These fire sales may drive down the prices of these assets, prompting valuation losses for other sectors, with the corresponding implications for financial stability.

Figure 3.1 shows, at December 2018, the common securities holdings for four sectors of the Spanish financial system (banks, insurance companies, investment funds and pension funds). The size of the circles is proportional to the size of each sector's portfolio. The figure shows, for each sector, the volume of holdings they have in their securities portfolio that are also held by each of the other three sectors (the analysis reflects the overlap on a security-by-security basis).[12] Each arrow denotes, for the sector from which it starts, the volume of common holdings

11 For more details, see reference in footnote 3.

12 For example, if a bank and an investment fund hold in portfolio the same debt security issued by a non-financial company (identified through its ISIN, a unique code assigned to each issue), the amounts of that issue held by the bank and the investment fund are counted to measure portfolio overlap.

with the sector to which it points. As each sector holds a different amount of the overlapping exposures, the arrows are not symmetrical. The figure also shows these volumes as a percentage of the total sector portfolios; the thickness of the lines denotes the scale of the holdings. For instance, of the common holdings (identical securities issued by the same issuer) between banks and investment funds, banks hold some €284 billion (blue arrow), which is 47% of their total portfolio, while investment funds hold €114 billion (green arrow), which is 47% of their total portfolio. In both cases, based on the market value of the holdings reported by the entities (or, where appropriate, their fair value).

As the figure shows, the banking sector has the largest portfolio (the largest circle).[13] In consequence, it is also the sector that has most common holdings with the other sectors by volume. The most significant linkages are with investment funds (€284 billion), insurance companies (€276 billion) and pension funds (€274 billion), which account for 47%, 45% and 45%, respectively, of the banking sector portfolio.

The insurance company sector has the second largest number of common holdings with the other sectors (€510 billion, mainly with banks and pension funds). In addition, these common holdings are significant in relative terms for the insurance company sector portfolio, since by volume the securities that insurance companies share with banks, pension funds and investment funds amount to 69%, 76% and 59%, respectively, of the portfolio.

In relative terms, these holdings are also particularly significant for pension funds, since the securities they share with banks, insurance companies and investment funds amount to 56% 78% and 85%, respectively, of the pension fund sector portfolio. However, since this is the smallest of the four sectors analysed, these are the smallest common holdings by volume (€244 billion).

Figure 3.2 shows the same information as at March 2014.[14] At that date, for instance, of the common holdings (identical securities issued by the same issuer) between banks and investment funds, banks held some €452 billion (blue arrow), which was 55% of their total portfolio, while investment funds held €104 billion (green arrow), which was 68% of their total portfolio.

Comparing Figures 3.1 and 3.2 shows that while the banking sector's portfolio has decreased in size (by 26% between the two dates), the other sectors' portfolios have grown (especially those of investment funds and insurance companies, by 59% and 57%, respectively).

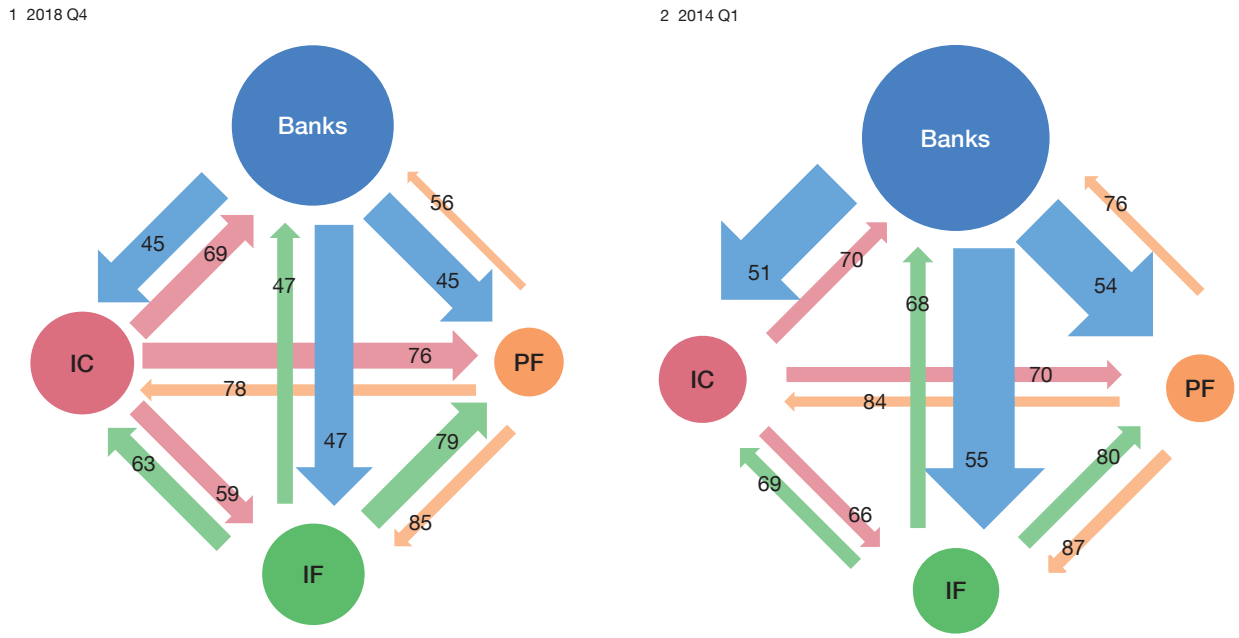
---

13 As indicated earlier, the bank portfolio includes retained issues (such as securitisations) that cannot be excluded using SHSS data.

14 Data compilation for creation of the database became compulsory in 2013 Q4.

Figure 3

FINANCIAL ENTITIES' PORTFOLIO OVERLAP (a)



SOURCE: SHSS.

a Sectors: banks, insurance companies (IC), investment funds (IF) and pension funds (PF).

These changes also shape the changes in the volume of common holdings. Thus, while the banks' common holdings with each of the other sectors have decreased, the opposite is true for the other sectors (except in the case of pension funds' common holdings with banks which have fallen by 13%). This growth is especially significant in the case of insurance companies, whose total common holdings with the other sectors increased by 56%.

The change in the share of these common holdings as a proportion of each sector's total portfolio may also be analysed. In relative terms, this analysis shows a widespread decrease (save in the case of insurance companies' common holdings with pension funds, which rise from 70% to 76%). The common holdings of investment funds and pension funds with banks reflect the most pronounced declines in share, from 68% to 47% of investment funds' portfolio and from 76% to 56% of pension funds' portfolio.

To conclude, these data suggest that as the banking sector's portfolio has shrunk, so have its common holdings with the other sectors (a decline of 36%). The opposite is true for the other sectors, whose portfolio size and common holdings have increased. However, the relative share of these common holdings in portfolio has declined in all sectors. Insurance companies are the sector least affected by this decline: the volume of securities they hold in common with banks and investment funds has fallen only

slightly, from 70% to 69% and from 66% to 59%, respectively, while the share of their common holdings with pension funds has increased.[15]

Portfolio overlap on a security-by-security basis offers an incomplete picture of indirect interconnectedness. This exercise does not include exposures to the same issuer through holdings of different securities (for example, debt securities or equity instruments). Calculated for the total holdings of securities issued by each issuer, portfolio overlap would be larger.

4.2 Portfolio correlation

Data on securities holdings may also be used to calculate other measures of similarity between portfolios and how they evolve. For instance, by calculating the correlation coefficient of the holdings of each sector pair on each date it is possible to estimate the extent of similarity of the distribution of the securities in their portfolios.[16] This measure does not depend on portfolio size and, therefore, is not affected by the differences in total volume of each sector's holdings.

A positive correlation between two sectors would suggest, for example, that holdings whose volume is above the average of the portfolio total in one sector would generally also have a higher than average value in the portfolio of the other sector. Conversely, a negative correlation would suggest that holdings whose volume is below the portfolio average in one sector would have a higher than average value in the other sector. In addition, the smaller the dispersion of the value of the holdings in each portfolio around their average value, the greater the correlation between the portfolios.

Chart 6 shows the change in the correlation coefficients between 2013 Q4 and end-2018. The highest correlation observed, throughout the period analysed, is between the portfolios of investment funds and pension funds. Moreover, while for all other pairings the correlation has decreased, between investment funds' and pension funds' portfolios it has remained steady around 60%.[17]

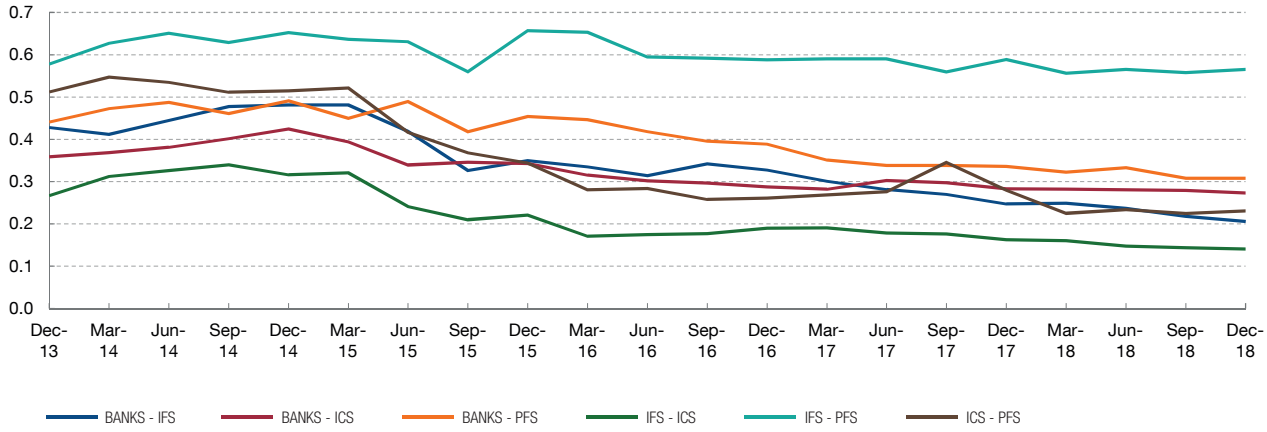
---

15 See Annex 2 for the changes over time in these common holdings, both by volume and as a proportion of each sector's portfolios.

16 The Pearson correlation coefficient is calculated between each sector pair on each date, using the market value of the holdings of each individual security (expressed in euro) in the portfolio of the financial sectors. The correlation coefficient is defined as the ratio of the covariance of the holdings of each sector pair to the product of the variances of those holdings on each date.

17 As when measuring portfolio overlap, if the correlation is calculated at the level of issuers (grouping together all securities issued by a single issuer), the correlation coefficients between the different sectors' portfolios could be higher.

Chart 6
CORRELATION COEFFICIENTS BETWEEN SECTOR PORTFOLIOS (2014-2018)



SOURCE: SHSS.

5 Future work

In recent years much work has been focused on analysing the different components of the financial system. But a more granular analysis is needed, to identify the specific areas where risk may be higher. To date, the lack of more granular databases precludes this type of analysis. For instance, it was impossible to identify specific entities in the interconnectedness network, or the instruments that defined the linkages, or the non-resident sectors linked to resident entities.

The emergence of new databases, such as the SHSS database, makes it possible to begin to explore these issues and to perform more effective analyses, so as to comprehend transmission channels within the financial sector. The granularity of these data allows counterparties to be identified, along with their nationality and the interconnecting instruments. It also facilitates analysis of the indirect linkages that arise as a result of portfolio composition, thus enriching the analysis of the financial system.

This growing data availability facilitates deeper analysis and comprehension of the financial system. To benefit from these possibilities, systematic combination of databases is needed. In addition, the globalisation of the financial system demands greater cooperation and exchange of information between supervisors, to allow the identification of risk and risk transmission channels.

However, despite the growing volume of data available, there are still data gaps that must be addressed. For example, the data used do not provide information on portfolios at the highest level of consolidation, but only data on holdings of resident entities, thus making it impossible to exclude intragroup interconnections. They

need to be combined with information from other databases, which requires sufficient data consistency and granularity.

In addition to addressing these data gaps, deeper analysis of the information available is also needed. For instance, future work should be concentrated on areas such as:

— Identifying and analysing the main issuers of securities that make up common holdings. This would also permit more in-depth analysis of the most important countries and sectors for resident sectors and entities.

— Identifying and analysing the main securities that give rise to interconnections for entities domiciled in Spain.

— Linking these data to data from other sources, to obtain a more complete picture of the interconnectedness of the financial system. This would allow other relevant variables relating to securities holdings to be taken into account, such as the credit rating of the issue or issuer or the sector of activity of the issuers according to the statistical classification of economic activities in the European Union (CNAE). This would help complete the analysis of interconnectedness and would allow bank lending to corporates to be included in the calculation of measures of portfolio similarity.

— Developing models that describe possible contagion dynamics and that may help detect possible financial system vulnerabilities.

6 Conclusions

Analysis of the interconnectedness between the various agents in the financial system is essential to understand the relations between them and the possible transmission channels for the risks generated in each sector. A first step is to comprehend the direct relationships between these agents. In Spain, the importance and size of the banking sector afford it a central role in the financial system. The National Financial Accounts data used to date showed that, at an aggregate level, the volume of interconnectedness was contained and relatively stable.

For a more in-depth analysis and a higher level of detail, additional data sources, such as the SHSS database, may be used. As seen, these data provide complementary information, for example:

— The scale of cross-border interconnectedness is significant and deserves the same level of attention as domestic interconnectedness. At the cross-

border level, Spanish entities' main connections are through resident entities' holdings of instruments issued by non-resident entities. In addition, although the banking sector continues to play a key role at the cross-border level, investment funds also play a significant part in channelling funds and, therefore, they too should be monitored.

— Indirect interconnectedness shows that, despite the banking sector's central role in the Spanish financial system, the share of the other sectors has grown in recent years (the banking sector's common holdings have decreased as the size of its portfolio has shrunk, while the opposite is true for the other sectors). It also suggests that the share of common holdings is significant for the portfolios of some sectors, such as pension funds, and that the correlation between portfolios, calculated on a security-by-security basis, has decreased in recent years.

Analysis of this kind is key from a financial stability standpoint, since once the interconnections have been identified, headway can be made to analyse potential risks and develop measures to address them. For example, the conclusions presented above suggest that non-bank sectors are gaining importance in the Spanish financial system. This makes it essential to progress in the development of macroprudential tools for non-bank sectors, as suggested by various voices within the European Union.[18] There is a pressing need for headway to be made, not only to address possible financial stability risks in these sectors, but also to prevent any decline in the efficiency of the banking sector framework (for example, as a result of regulatory arbitrage).

The scale of cross-border flows also indicates the importance of cooperation and exchange of information between authorities and jurisdictions. In this respect, the work led by the FSB has been key in fomenting analytical work and regulatory developments in the fields of interconnectedness and the non-bank sector. Given the global nature of the financial system, risk analysis and the development of regulatory frameworks also require this global consistency.

18 See the work of the ESRB, the speech given by Philip R. Lane (ex-Governor of the Central Bank of Ireland), "The Management of Systemic Risks: Current Priorities" (27 September 2018), the address given by Mario Draghi (ex-President of the ECB and Chair of the ESRB), "Welcome remarks at the third annual conference of the ESRB"(27 September 2018), or the speech given by Luis de Guindos (Vice-President of the ECB), "Coming to the forefront: the rising role of the investment fund sector for financial stability in the euro area" (12 November 2018).