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Abstract

Globally, there is evidence that vulnerabilities in real-estate markets have been the trigger for many financial crises. In this *Note*, we assess the concentration in real-estate exposures of the Irish banking system in a historic and European context. Despite a substantial reduction in overall lending balances since the Irish financial crisis, we find that the overall level of concentration in real-estate lending has remained relatively stable. We also find that the Irish banking system is more concentrated in real-estate lending than its European peers. We show that the composition of concentration has changed, with the share of residential mortgages increasing and the share of commercial real estate decreasing. This high degree of concentration of the Irish banking system in real-estate exposures underlines the importance of prudent underwriting by the banking system. The Central Bank's mortgage market measures help in this regard, by protecting banks and borrowers against a marked loosening of such underwriting. In doing this, the measures serve to strengthen the resilience of a concentrated system.

1 Introduction

Real-estate exposures have been central to many financial crises, including Ireland's own financial crisis experience (2008-2013). Credit-constrained borrowers using real estate as collateral can have an amplifying effect on credit cycles. Small shocks in the economy can result in large, persistent fluctuations in asset prices and economic output (Kiyotaki and Moore, 1997). For system-wide financial stability, it is important to monitor the level of exposure to real-estate lending in the banking system.

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In this *FS Note*, we review the literature on real-estate lending concentration and systemic risk. Evidence suggests that system-wide exposure to real estate can be risky, with the potential for significant adverse effects on the real economy. This is especially relevant where a real-estate boom has been fueled by inappropriate loan origination standards given the underlying risks. A financial crisis, if preceded by a real-estate boom, such as the crisis experienced in Ireland between 2008 and 2013, can be more costly. In such a scenario, the household and non-financial sectors may face a contraction of credit supply combined with debt repayment problems.

Motivated by the literature, we examine the extent of exposure to real estate in Irish resident bank lending portfolios. We present an overview of real-estate lending pre- and post-crisis and show that the proportion of real-estate lending by the Irish banking system has remained relatively stable over time. However, the share of lending for commercial real estate has decreased significantly, resulting in a corresponding increase in the share of residential real-estate lending. Using a cross-country data set, we find that the lending portfolios in the Irish banking system are highly concentrated when compared to other European countries. Lastly, given the high level of co-movement between commercial and residential real-estate prices observed during the crisis, we estimate their correlation and find that lending across the two sectors provided little diversification.

The observed changes in portfolio composition have not taken place in a vacuum. The banking system has undergone significant structural changes since the financial crisis. These changes include the establishment of the Single Supervisory Mechanism (SSM) and the granting of new macroprudential powers to the Central Bank of Ireland. Banks now operate under a more intrusive regulatory regime. This entails greater supervision, focusing on, among other items, business-model sustainability. Banks now rely on more stable funding sources and have higher capital and liquidity ratios. Furthermore, macroprudential mortgage market rules introduced in 2015 have helped to ensure that new mortgage lending is more prudent, thereby increasing the resilience of both banks and borrowers.¹ These changes mean that the banking system has greater capacity to absorb shocks, despite being concentrated in real-estate exposures.

This *Note* proceeds as follows: Section 2 provides an overview of the literature on the risks associated with real-estate lending. Section 3 recalls the Irish financial crisis experience with real-estate lending. Section 4 discusses trends in the Irish banks' aggregate portfolio exposures over time and includes a cross-country comparison. Section 5 examines the co-movement of commercial and residential real-estate prices, while Section 6 concludes.

¹It should be noted that these rules apply to new mortgages originated since 2015 only, and not to the larger stock of outstanding mortgages originated before 2015.

2 Risks associated with real-estate lending: international evidence

We can think of systemic risk as having two dimensions, a time dimension (cyclical) and a cross-sectional (structural) dimension. The time dimension reflects the procyclicality of the financial system where there is a build-up of risk during boom times. This can lead to asset bubbles and excess credit growth. The increased risk in the system leaves banks more vulnerable to shocks. The cross-sectional dimension reflects how shocks are transmitted or amplified through interlinkages in the system. Interlinkages can be direct such as two banks being counterparties to a transaction or they can be indirect such as a high degree of common or highly correlated exposures (for example to real estate). A discussion of the related literature follows.

Real-estate exposure is increasingly cited as a common factor in banking crises. Lo Duca et al. (2017) compile a systemic crisis database for EU countries and Norway since 1970 and show that the second most frequent type of risk to materialise (after banking risk) is significant asset-price corrections, including real-estate corrections. However, because of the complex relationship between the banking system and financial markets the two risks often materialise simultaneously. In the same way, the Global Financial Crisis, beginning in 2007, was driven by the over exposure of large US banks to the US mortgage market in the face of deteriorating underwriting standards and a credit boom (Brunnermeier, 2009).

Real-estate price fluctuations can have an impact on both the economy and the banking system where there is significant exposure to real estate. Igan et al. (2011) show that house price cycles in most advanced economies often lead credit and business cycles. Because of this dynamic, house price volatility can be a source of shocks to the economy affecting consumption, investment and credit (Crowe et al., 2013). The close relationship between the banking system and real-estate markets means that banks with high exposure to real estate can be sensitive to price fluctuations. Risks can materialise when house prices deviate from fundamental values, for example in a real-estate bubble. As shown in Koetter and Poghosyan (2010), the further prices deviate from fundamentals the more it contributes to bank distress.

The literature also suggests that mortgage credit plays an important role in the build-up of financial fragility in the system. Schularick and Taylor (2012) show that credit growth is a powerful predictor of financial crises and that a crisis driven by a credit boom is likely to be more severe and to last longer. Since the beginning of the twentieth century, advanced economies have experienced sharp increases in their credit-to-GDP ratios and bank balance sheets have also gone through significant structural changes. Jordà et al. (2016) show that both of these are largely the result of rapid growth in mortgage lending to households. They also show that when assessing crisis probability, the type of credit matters. As banks have become more focused on real-estate lending since World War II, they find that mortgage credit growth plays an increasingly important role in financial crisis probability. Furthermore, when households are highly leveraged, a subsequent bust can result in debt over-

hang problems, which can negatively affect household consumption and spending (Dynan et al. (2012), Melzer (2017), McCarthy and McQuinn (2017)).

The finance literature suggests there are both costs and benefits to asset concentration (for example, concentration in real-estate lending) at the individual bank level.² Diversification benefits can be gained through exposure to several less than perfectly correlated sectors. This reduces risk, as assets should not all move together. More highly correlated assets provide less diversification benefits and during market downturns, correlations between assets often increase (Campbell et al. (2002), Billio et al. (2012)). Similar to the Irish case, the US experienced simultaneous declines in both commercial and residential real estate (Clayton et al., 2009). This suggests that there may be fewer diversification benefits if both real-estate sectors are likely to move closely together. The literature also suggests that these sectors may be more similar than previously thought as they are driven in most part by common fundamentals (Gyourko, 2009).

From a system-wide perspective, when many banks allocate into similar assets this can result in common exposures across the system, leaving them exposed to similar risks (Wagner et al., 2006). Risk taking in the build-up phase of the cycle often results in similar collective behaviour by banks, which can lead to the same correlated risky exposures (Freixas et al., 2015). This may have consequences for the system as a whole. While a bank's size is an important determinant of systemic importance, smaller banks may also pose systemic risks. Adrian et al. (2016) find that smaller banks can be “systemic as a herd” – taking correlated risks in, for example, real-estate bubbles. A group of banks that act identically can have an equally destabilising effect as one large systemically important bank. For example, Acharya and Yorulmazer (2008) show that, *ex-ante*, banks have an incentive to herd and increase correlation with other banks by lending to similar industries. This can have undesired outcomes, however. The authors suggest that the level of herding can be thought of as the *ex-ante* aspect of systemic risk. Recent research also suggests that portfolio concentration and common exposures across banks can be used to forecast systemic risk measures such as marginal expected shortfall (MES) and SRISK (Brunetti et al., 2018).

3 Irish experience with real-estate exposures

Ireland's 2008-2013 financial crisis highlights the risks attached to real-estate lending. A credit-driven real-estate bubble was followed by a sharp correction in real-estate prices between December 2007 and September 2013. Commercial and residential real-estate prices declined by 67 and 51 per cent respectively in this period (see Figure 1). Each of the main Irish banks experienced large losses, resulting in substantial government intervention. This ranged from partial nationalisation of some banks to the winding up of others.

²This topic is widely covered in the literature. See Markowitz (1952) and Diamond (1984) for discussion on diversification benefits. Düllmann and Masschelein (2006) for the economic capital cost of concentration. Stomper (2006) highlights the cost of monitoring a well-diversified portfolio. Wagner et al. (2006) and Acharya and Yorulmazer (2008) highlight the risks of common exposures.

A number of official reports find that Ireland’s financial crisis was amplified by concentration in real-estate lending. Regling and Watson (2010) described the origins of the Irish crisis as a “plain vanilla property bubble, compounded by exceptional concentrations of lending for purposes related to property – and notably commercial property”. The Nyberg Report (2011) referred to “a national speculative mania in Ireland during the Period, centred on the property market”. The Report also identified the “growing dependence on foreign funding and the concentration of bank lending in the property sector” as the two key emerging risks to the Irish banking system. The Committee of Inquiry into the Banking Crisis (Lynch et al., 2016) pointed to over-concentration in real-estate lending and found consensus among interviewees that “commercial property broke the banks”.

Residential real-estate lending has also proved risky for Irish banks. More than 12 per cent of primary-dwelling residential mortgages were in arrears in 2013. Significant progress has been made in resolving these loans since then: as of December 2018, the share of loans in arrears was 6 per cent.³ However, non-performing loans (NPLs) remain a legacy concern for Irish banks and borrowers.⁴ The presence of high levels of NPLs can distort credit allocation, curtail consumer spending, raise costs for both banks and borrowers and worsen market confidence leading to adverse consequences for the economy.

4 Concentration in lending to the real-estate sector

4.1 Concentration over time

Pre-crisis, the residential loan books of Irish banks were highly exposed to real-estate assets, which had been growing considerably from the early 2000’s. The proportion of real-estate assets as a percentage share of all loans grew over 20 percentage points from 2000 to 2005 while the proportion of commercial real-estate lending increased steadily from the early 1990’s. Pre-crisis, some banks chose to concentrate on residential real-estate lending while others focussed on commercial real estate and some lent to both sectors (Kearns and Woods, 2006). However, in the downturn this provided little diversification benefit as both markets experienced significant losses.

Since the financial crisis, the banking system (both globally and in Ireland) has experienced significant structural change (BIS, 2018). Figure 2 shows the evolution of Irish resident banks’ Irish exposures between 2003 and 2018. As of Q1 2018, Irish real-estate lending⁵ represented 68 per cent of total lending. The corresponding concentration level was 71 per cent in 2006. Figure 2 also shows that, despite changes in the composition between the two

³Central Bank of Ireland mortgage arrears statistics, 2018

⁴In particular, loans in long-term arrears (greater than 720 days) in Ireland represent the greatest share of overall arrears (see McCann (2017) for a detailed discussion).

⁵Real-estate lending is defined as loans to households for house purchase and loans to non-financial corporations for real-estate and construction activity. Real-estate and construction activities are defined using NACE codes L and F respectively.

sectors, the level of concentration in the combined residential and commercial real-estate lending sectors has remained stable at around 70 per cent over time.

The substantial deleveraging that has taken place since the financial crisis explains much of this compositional change. Irish resident banks have more than halved their Irish loan books between 2006 (€272 billion) and 2017 (€133 billion). A large share of this deleveraging relates to banks transferring their distressed commercial loans to the National Asset Management Agency (NAMA) at substantial discounts to par value as well as other loan sales. This dynamic is evident in Figure 3, which shows the sector balances from 2003 to 2018. The stock of loans to non-financial corporations (NFCs) for real-estate and construction activities has continued to decrease since the crisis while the stock of loans to households for house purchases has remained relatively steady since 2012. The increase in mortgage credit as a proportion of total credit is not unique to Ireland. ECB monetary financial institution (MFI) balance sheet statistics show that between 2008 and 2018, the proportion of mortgage credit has increased for the majority of European countries.

Commercial real estate is observably more risky than residential real estate (see ESRB (2018) for detailed discussion on risks in the commercial real-estate sector). As future returns and rents on commercial real estate are closely tied to the business cycle, commercial real-estate prices are highly sensitive to changes in economic variables. High sensitivity to economic variables can cause commercial prices to be more volatile than residential prices. In addition, commercial real estate in Ireland is even more volatile than in other countries (IMF, 2018).

The riskiness of commercial real estate versus residential real estate is evident from their respective NPL rates, for example. In Q3 2011, the NPL rate for commercial real estate was 59 per cent, compared with 11 per cent for residential real-estate loans.⁶ Although they have changed over time, commercial real-estate NPL rates remain higher than residential real-estate NPL rates.

While concentration in real-estate lending has risks, as discussed above, it is important to assess these risks in the context of the significant structural changes to the banking system since the crisis that have strengthened its resilience. First, the funding structure is different: banks now rely more on retail deposits as opposed to their reliance on wholesale funding in the build-up to the crisis. Second, macroprudential rules put in place in 2015 have helped to ensure that new mortgage lending is more prudent, limiting the excesses seen in the build up to the crisis. Third, the risk weights that form the basis for how much capital Irish banks need to set aside for the risk associated with Irish mortgage lending are higher than in the pre-crisis period.⁷ Finally, there is a more intrusive regulatory regime in place, entailing greater microprudential supervision and focusing on, among other items, business-model sustainability. This regime has resulted in increased scrutiny over the level and quality of banks' capital as well as bank funding models. This has ultimately led to much higher capital and liquidity ratios for the Irish banking system. Taken together, these changes

⁶Central Bank of Ireland QSFR (authors' calculations). Rates relate to loan balances.

⁷Ireland's high NPL ratio and loss experience on mortgages contribute to these higher risk weights.

mean that the banking system has greater capacity to absorb shocks, despite being concentrated in real-estate exposures.

4.2 Concentration levels in a European context

To examine Irish credit exposures in a European cross-country context we use data collected by the ECB as part of the Consolidated Banking Data (CBD), a data set of the European Union (EU) banking system compiled on a group consolidated basis.⁸ Using the CBD we examine all lending by domestic banking groups and standalone banks, excluding foreign owned subsidiaries, for a selected number of EU countries. This allows a comparison of bank credit to households and NFCs across the euro area. Figure 4 shows the aggregate exposures by country, broken down by sector, where sectors are defined as: lending for house purchases; NFC real estate and construction; other household lending and other NFC lending. It is clear from Figure 4 that, when compared with a sample of other euro area countries, the Irish banking system's aggregate lending portfolio is more concentrated in loans for house purchases. In contrast, the Irish banking system has one of the lowest concentrations in the NFC real-estate and construction sectors.

We construct a concentration index based on the four sectors defined previously; this provides a cross-country comparison of lending portfolio concentration. Figure 5 displays the Herfindahl-Hirschman Index (HHI) measure of concentration of the lending portfolios of the Irish banking system, compared to its European peers.⁹ In our measure, a fully diversified banking system would have equal exposure to each of the four sectors and a HHI of 0.25. In contrast, a more concentrated banking system would have a HHI closer to 1, with a HHI equal to 1 signifying a fully concentrated banking system.

Based on this measure, the Irish banking system is more concentrated in its lending than the banking systems of other euro area countries. This concentration is primarily in residential real estate. Using alternative European cross-country data sets (results not shown but available on request from authors), the Irish banking system consistently ranks among the most concentrated in real-estate exposures.

5 Synchronisation of residential and commercial real-estate cycles

The risks of a high degree of exposure to real-estate lending stem from the cyclical nature of real-estate markets, where sharp corrections in prices can manifest in large losses for the banking system. This is all the more relevant for the Irish banking system whose primary

⁸For robustness we have compared other data sources (ECB MFI Statistics and EBA stress test data) and found similar results for Ireland.

⁹The HHI is calculated as the sum of the squares of the relative exposures and is a commonly used measure of concentration. $HHI = S_1^2 + S_2^2 + S_3^2 + S_4^2$, where S is the sectoral share.

income generation is from mortgages (residential and commercial).

In general, there are three main ways banks generate income: by providing loans at a higher interest rate than what they borrow at; by charging fees and commissions; and by trading financial instruments (typically debt securities) in their investment portfolios. The first of these depends on credit demand. Credit demand for residential mortgages has increased in Ireland in recent years but has declined for loans to small and medium enterprises (SMEs).¹⁰ This limits the opportunities of banks to expand their lending portfolios via SME lending. Furthermore, the large multinational corporations in Ireland avail of external financing sources and this further limits opportunities for domestic bank lending to this sector. With regard to other income, Irish banks' business models are structured in such a way that fee and commission income is typically lower than that of peer European banks. Finally, the low yield environment has made it more challenging for all banks to generate additional income from trading in debt securities. As such, new and existing lending for mortgage loans is the primary income-generating source for Irish banks.

Even where diversification exists, it may not provide adequate risk mitigation. For example, diversification between commercial and residential real estate proved ineffective during the crisis, given the high degree of correlation between Irish residential and commercial real-estate prices. Figure 1 shows the evolution of prices since 1994, where common trends are evident in price levels and Figure 6 shows percentage price changes. We estimate the correlation between commercial and residential real-estate prices to gain further insight into their observable relationship. The scarcity of commercial real-estate data is well documented (see for example ESRB (2018)). For this reason, we select a small sample of countries with 10 years of quarterly data for an international comparison.

Table 1 provides the correlation, mean and standard deviation of quarterly price changes over a 10-year period (2008-2018). The correlation gives an indication of the level of association between the two price series and the standard deviation indicates the level of volatility. The correlation coefficient shows that, for all countries in the sample, residential and commercial real-estate prices have positive correlation. This means that the prices move together – if one price goes up the value of the other will also go up. Conversely, if there is a downturn both prices will fall. Ireland, UK, the Netherlands and Hong Kong all have highly significant correlation coefficients over 0.7.¹¹ This suggests that, for these countries, lending between commercial and residential real estate may provide little diversification. Given the strong correlation, periods of stress could cause increased volatility, leaving banks exposed to losses on both residential and commercial real estate.

The strong evidence of correlation shown above is of particular significance to Ireland. As a small, open economy, Irish real-estate prices exhibit greater volatility than those in other

¹⁰See Kinghan (2018) for details of new mortgage lending in Ireland. Information on SME credit demand is available in the [Central Bank of Ireland SME Market Report](#).

¹¹For robustness, and to ensure this is not simply a crisis effect, correlation between Irish commercial and residential real estate is re-estimated for the pre-crisis period and a longer sample of 1995-2018. Correlation for the full sample 1995-2018 is 0.74 and the pre-crisis period 1995-2007 is 0.57. Gyourko (2009) finds a correlation coefficient of 0.4 in the US for a longer period of 1974 to 2008.

countries (O'Brien et al., 2018). This suggests that a shock (external or other) to the Irish real-estate sector is likely to result in a significant fluctuation in prices. Furthermore, it suggests that both residential and commercial prices are likely to move together, as was the case in the Irish financial crisis.

6 Conclusions

In this *Note*, we provide a review of the international evidence of the risks associated with real-estate lending. We recall the role of real-estate lending in the Irish financial crisis experience. We then assess the level of exposure to real estate in Irish bank lending portfolios over time and in a European context. We find that the Irish banking system remains highly concentrated in real-estate lending. Irish banks have increased their share of residential mortgage lending while reducing their share of commercial mortgage lending. In a European context, the Irish banking system is among the most concentrated in terms of residential mortgage lending. This level of concentration of the Irish banking system in real-estate lending warrants close attention.

The high degree of concentration of the Irish banking system to real-estate exposures underlines the importance of prudent underwriting by the banking system. The Central Bank's mortgage market measures help in this regard, by protecting banks and borrowers against a marked loosening of such underwriting. In doing this, the measures serve to strengthen the resilience of a concentrated system. Furthermore, the banking system has increased resilience by virtue of having more stable funding sources and by having higher capital and liquidity ratios, which contribute to an increased capacity of the system to absorb shocks. This is despite the system itself being concentrated in real-estate exposures, as shown in this *Note*.

References

- Acharya, Viral V and Tanju Yorulmazer**, “Information contagion and bank herding,” *Journal of money, credit and Banking*, 2008, 40 (1), 215–231.
- Adrian, Tobias, Markus K Brunnermeier et al.**, “CoVaR,” *American Economic Review*, 2016, 106 (7), 1705–1741.
- Billio, Monica, Mila Getmansky, Andrew W Lo, and Loriana Pelizzon**, “Econometric measures of connectedness and systemic risk in the finance and insurance sectors,” *Journal of financial economics*, 2012, 104 (3), 535–559.
- BIS**, “Structural changes in banking after the crisis,” *CGFS papers, no.60*, 2018.
- Brunetti, Celso, Jeffrey H Harris, and Shawn Mankad**, “Bank Holdings and Systemic Risk,” *Finance and Economics Discussion Series 2018-063*. Washington: Board of Governors of the Federal Reserve System, 2018.
- Brunnermeier, Markus K**, “Deciphering the liquidity and credit crunch 2007-2008,” *Journal of Economic perspectives*, 2009, 23 (1), 77–100.
- Campbell, Rachel, Kees Koedijk, and Paul Kofman**, “Increased correlation in bear markets,” *Financial Analysts Journal*, 2002, 58 (1).
- Clayton, Jim, S Michael Giliberto, Jacques Gordon, Susan Hudson-Wilson, Frank J Fabozzi, and Youguo Liang**, “Real estate’s evolution as an asset class,” *Journal of Portfolio Management*, 2009, 35 (5), 10.
- Crowe, Christopher, Giovanni Dell Ariccia, Deniz Igan, and Pau Rabanal**, “How to deal with real estate booms: Lessons from country experiences,” *Journal of Financial Stability*, 2013, 9 (3), 300–319.
- Diamond, Douglas W**, “Financial intermediation and delegated monitoring,” *The review of economic studies*, 1984, 51 (3), 393–414.
- Duca, Marco Lo, Anne Koban, Marisa Basten, Elias Bengtsson, Benjamin Klaus, Piotr Kusmierczyk, Jan Hannes Lang, Carsten Detken, Tuomas Peltonen et al.**, “A new database for financial crises in European countries,” Technical Report, European Central Bank 2017.
- Düllmann, Klaus and Nancy Masschelein**, “Sector concentration in loan portfolios and economic capital,” 2006.
- Dynan, Karen, Atif Mian, and Karen M Pence**, “Is a household debt overhang holding back consumption?[with comments and discussion],” *Brookings Papers on Economic Activity*, 2012, pp. 299–362.
- ESRB**, “Report on vulnerabilities in the EU commercial real estate sector,” Technical Report, ESRB Report 2018.

- Freixas, Xavier, Luc Laeven, and José-Luis Peydró**, *Systemic risk, crises, and macroprudential regulation*, MIT Press, 2015.
- Gyourko, J.**, “Understanding commercial real estate: just how different from housing is it?,” *National Bureau of Economic Research*.(No. w14708)., 2009.
- Igan, Deniz, Alain Kabundi, Francisco Nadal De Simone, Marcelo Pinheiro, and Natalia Tamirisa**, “Housing, credit, and real activity cycles: characteristics and comovement,” *Journal of Housing Economics*, 2011, 20 (3), 210–231.
- IMF**, “The Irish Commercial Real Estate Market: Synchronization and the Role of External Factors,” Technical Report, Selected Issues Paper, Chapter III, International Monetary Fund 2018.
- Jordà, Òscar, Moritz Schularick, and Alan M Taylor**, “The great mortgaging: housing finance, crises and business cycles,” *Economic Policy*, 2016, 31 (85), 107–152.
- Kearns, Allan and Maria Woods**, “The concentration in property-related lending—a financial stability perspective,” *Financial stability report*, 2006, pp. 133–144.
- Kinghan, Christina**, “Macroprudential Measures and Irish Mortgage Lending: Insights from H1 2018,” *Financial Stability Note*, 2018.
- Kiyotaki, Nobuhiro and John Moore**, “Credit cycles,” *Journal of political economy*, 1997, 105 (2), 211–248.
- Koetter, Michael and Tigran Poghosyan**, “Real estate prices and bank stability,” *Journal of Banking & Finance*, 2010, 34 (6), 1129–1138.
- Lynch, Ciaran et al.**, “Report of the Joint Committee of Inquiry into the Banking Crisis,” Technical Report, Houses of the Oireachtas 2016.
- Markowitz, Harry**, “Portfolio selection,” *The journal of finance*, 1952, 7 (1), 77–91.
- McCann, Fergal**, “Resolving a Non-Performing Loan crisis: The ongoing case of the Irish mortgage market,” *Research Technical Paper*, 2017.
- McCarthy, Yvonne and Kieran McQuinn**, “Price expectations, distressed mortgage markets and the housing wealth effect,” *Real Estate Economics*, 2017, 45 (2), 478–513.
- Melzer, Brian T**, “Mortgage debt overhang: Reduced investment by homeowners at risk of default,” *The Journal of Finance*, 2017, 72 (2), 575–612.
- Nyberg, Peter**, “Misjudging risk: Causes of the systemic banking crisis in Ireland,” *Ministry of Finance, Dublin, March*, 2011, p. 42.
- O’Brien, Eoin, Martin O’Brien, Sofia Velasco et al.**, “Measuring and mitigating cyclical systemic risk in Ireland: The application of the countercyclical capital buffer,” *Economic Letter*, 2018.

Regling, Klaus and Maxwell Watson, *A preliminary report on the sources of Ireland's banking crisis*, Government Publications Office Dublin, OH, 2010.

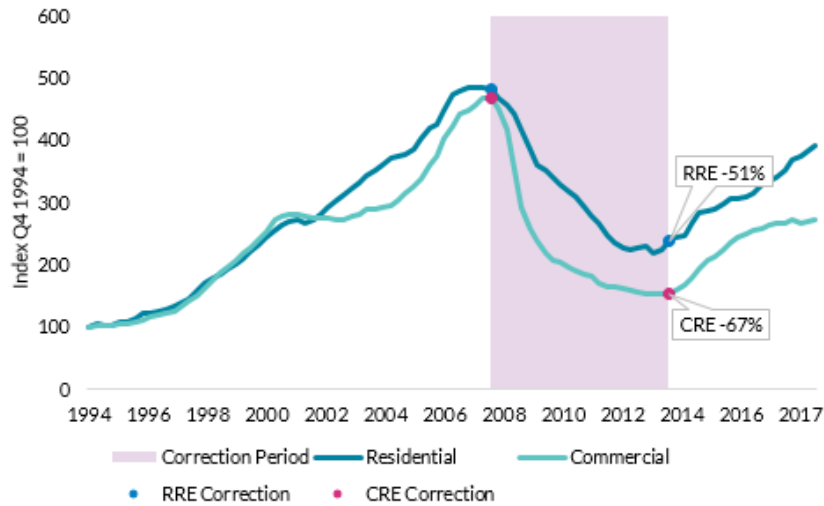
Schularick, Moritz and Alan M Taylor, "Credit booms gone bust: Monetary policy, leverage cycles, and financial crises, 1870-2008," *American Economic Review*, 2012, 102 (2), 1029–61.

Stomper, Alex, "A theory of banks' industry expertise, market power, and credit risk," *Management science*, 2006, 52 (10), 1618–1633.

Wagner, Wolf et al., *Diversification at financial institutions and systemic crises*, Tilburg University, 2006.

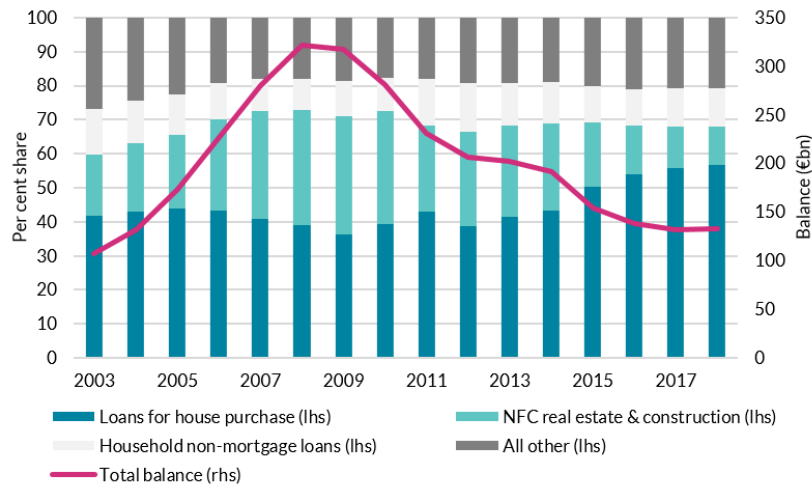
Figures

Figure 1: Ireland residential and commercial real-estate prices



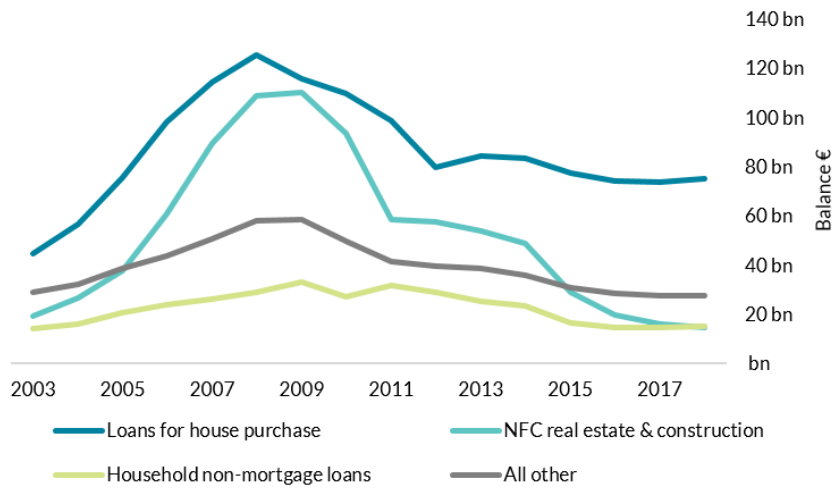
Source: MSCI IPD Index. All Property Types, Capital Growth Index. CSO Residential index.

Figure 2: Irish resident bank lending by sector (shares) and total balance



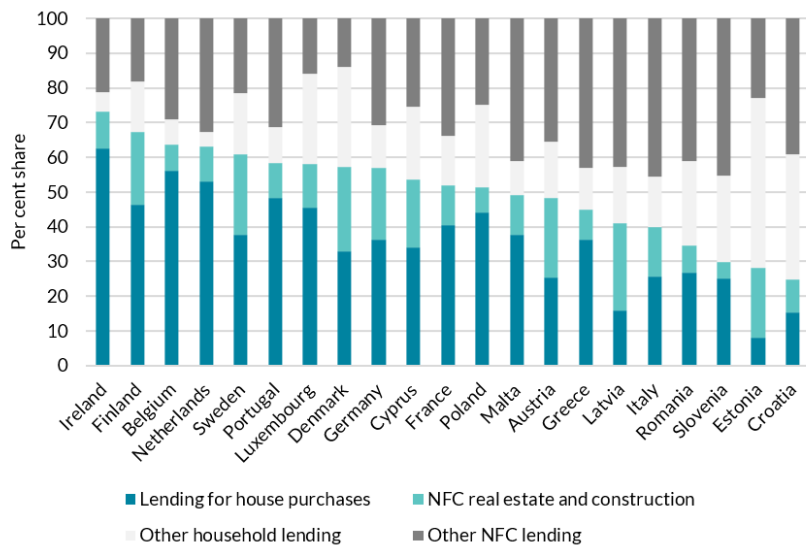
Source: Authors' calculations using Central Bank of Ireland credit and banking statistics. Includes all banks resident in Ireland. Irish exposures only.

Figure 3: Irish resident bank lending by sector (balances)



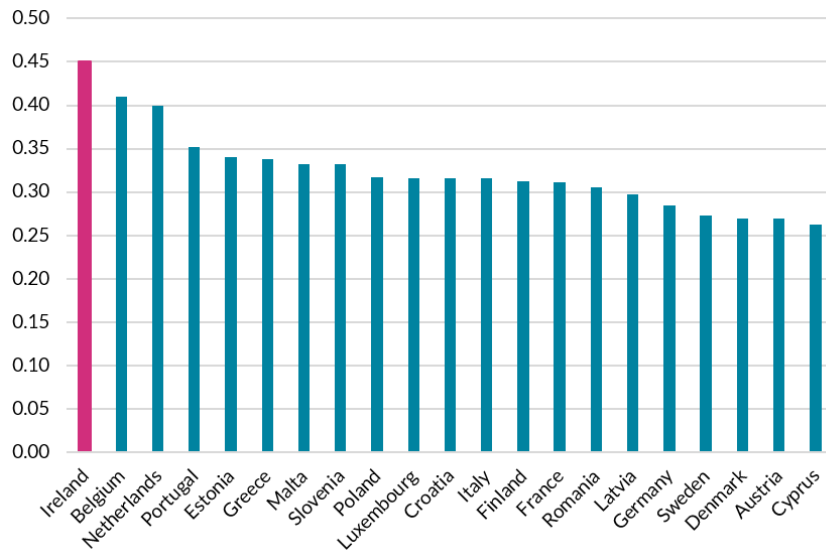
Source: Authors' calculations using Central Bank of Ireland credit and banking statistics. Includes all banks resident in Ireland. Irish exposures only.

Figure 4: Credit exposures per country



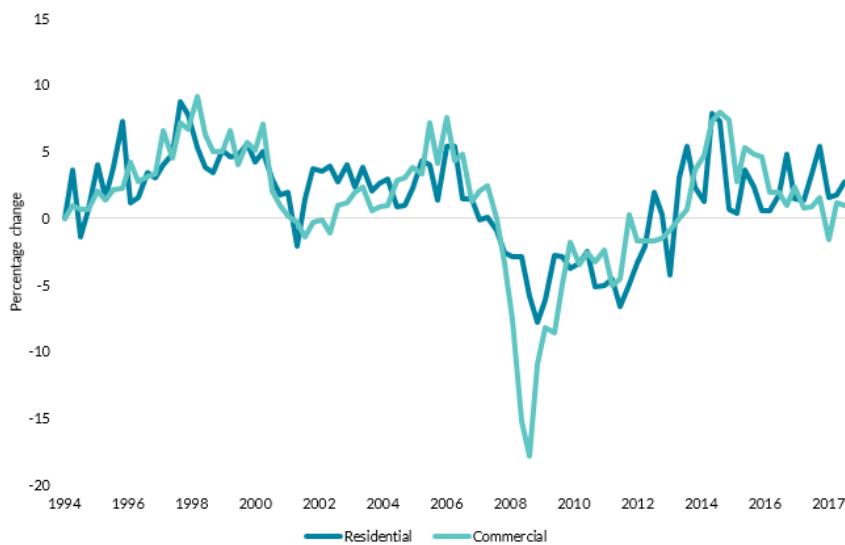
Source: Authors' calculations and ECB consolidated banking data. Domestic banking groups and standalone banks ex. foreign subsidiaries. Countries ranked by combined real-estate share. Data at end-2017. Data composition is different to that of earlier figures.

Figure 5: Herfindahl-Hirschman index of concentration



Source: Authors' calculations using ECB consolidated banking data. Data at end-2017. Data composition is different to that of earlier figures.

Figure 6: Irish residential and commercial real-estate index – quarterly percentage change



Source: MSCI IPD Commercial Property Price Index, CSO Residential index.

Tables

Table 1: Correlation and standard deviation between residential and commercial real-estate markets. Quarterly series percent change 2008-2018.

	Ireland	UK	Germany	Netherlands	US	Hong Kong
Correlation	0.78***	0.88***	0.28*	0.76***	0.45***	0.74***
Mean residential	-0.5	0.5	0.8	0.0	0.4	3.0
Std. dev. residential	3.6	1.9	0.9	1.5	1.5	4.3
Mean commercial	-1.2	0.1	0.6	0.0	0.1	1.9
Std. dev. commercial	5.6	3.7	1.6	1.5	3.0	5.9

Source: OECD residential property prices, MSCI IPD Commercial Property Price Indices, BIS commercial property prices and Hong Kong rating and valuation department.
Correlation significance ***, **, * significant at 0.01, 0.05 and 0.1 levels respectively.

